BWP SW 26 - APPLICATION FOR AUTHORIZATION TO CONSTRUCT PHASE 9 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY BOURNE, MASSACHUSETTS

SITEC Environmental, Inc.
769 Plain Street, Unit C
Marshfield, Massachusetts 02050

December 6, 2022

BWP SW 26 - APPLICATION FOR AUTHORIZATION
TO CONSTRUCT
PHASE 9 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY
BOURNE, MASSACHUSETTS

Prepared For:

TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT
24 Perry Avenue
Bourne, Massachusetts 02532

Prepared By

SITEC Environmental, Inc.
769 Plain Street, Unit C
Marshfield, Massachusetts 02050

COMMONWEALTH OF MASSACHUSETTS
A. RAYMOND
QUINN
SANITARY
No. 32861
REGISTERED
PROFESSIONAL ENGINEER

A. Raymond Quinn

December 6, 2022

BWP SW 26 - APPLICATION FOR AUTHORIZATION TO CONSTRUCT PHASE 9 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY BOURNE, MASSACHUSETTS

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PART A

PERMIT APPLICATION FORMS

BWP SW 26 - APPLICATION FOR AUTHORIZATION TO CONSTRUCT PHASE 9 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY BOURNE, MASSACHUSETTS

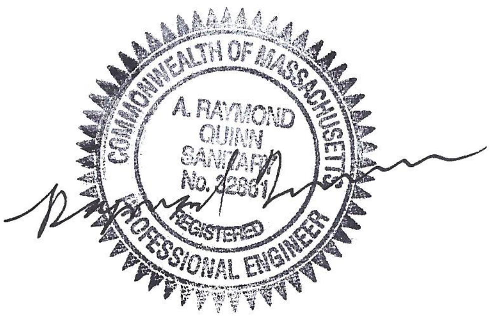
PART A PERMIT APPLICATION FORMS

Prepared For:

TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT
24 Perry Avenue
Bourne, Massachusetts 02532

Prepared By

SITEC Environmental, Inc.
769 Plain Street, Unit C
Marshfield, Massachusetts 02050



December 6, 2022

Enter your transmittal number →

Transmittal Number

Your unique Transmittal Number can be accessed online: http://mass.gov/dep/service/online/trasmfrm.shtml or call MassDEP's InfoLine at 617-338-2255 or 800-462-0444 (from 508, 781, and 978 area codes).

Massachusetts Department of Environmental Protection

Transmittal Form for Permit Application and Payment

1. Please type or print. A separate Transmittal Form must be completed for each permit application.

2. Make your check payable to the Commonwealth of Massachusetts and mail it with a copy of this form to: DEP, P.O. Box 4062, Boston, MA 02211.

3. Three copies of this form will be needed.

Copy 1 - the original must accompany your permit application. **Copy 2** must accompany your fee payment. **Copy 3** should be retained for your records

4. Both fee-paying and exempt applicants must mail a copy of this transmittal form to:

MassDEP
P.O. Box 4062
Boston, MA
02211

*** Note:**
For BWSC Permits, enter the LSP.

A. Permit Information

BWP SW 26
1. Permit Code: 7 or 8 character code from permit instructions

New Large Landfill or Major Expansion
2. Name of Permit Category

Application for Phase 9 Landfill Expansion Approval
3. Type of Project or Activity

B. Applicant Information – Firm or Individual

Town of Bourne - Department of Integrated Solid Waste Management
1. Name of Firm - Or, if party needing this approval is an individual enter name below:

2. **Last Name** of Individual | 3. **First Name** of Individual | 4. MI

24 Perry Avenue
5. Street Address

Buzzards Bay	MA	02532	508-759-0600	4240
6. City/Town	7. State	8. Zip Code	9. Telephone #	10. Ext. #

Daniel T. Barrett
11. Contact Person

dbarrett@townofbourne.com
12. e-mail address (optional)

C. Facility, Site or Individual Requiring Approval

Town of Bourne Integrated Solid Waste Management Facility
1. Name of Facility, Site Or Individual

201 MacArthur Boulevard
2. Street Address

Bourne	MA	02532	508-759-0600	4240
3. City/Town	4. State	5. Zip Code	6. Telephone #	7. Ext. #

172356		
8. DEP Facility Number (if Known)	9. Federal I.D. Number (if Known)	10. BWSC Tracking # (if Known)

D. Application Prepared by (if different from Section B)*

SITEC Environmental, Inc.
1. Name of Firm Or Individual

769 Plain Street, Unit C
2. Address

Marshfield	MA	02050	781-319-0100	12
3. City/Town	4. State	5. Zip Code	6. Telephone #	7. Ext. #

A. Raymond Quinn, PE
8. Contact Person

9. LSP Number (BWSC Permits only)

E. Permit - Project Coordination

1. Is this project subject to MEPA review? ☒ yes ☐ no
If yes, enter the project's EOEA file number - assigned when an Environmental Notification Form is submitted to the MEPA unit:

11333
EOEA File Number

F. Amount Due

DEP Use Only

Permit No:

Rec'd Date:

Reviewer:

Special Provisions:

1. ☒ **Fee** Exempt (city, town or municipal housing authority)(state agency if fee is $100 or less).
There are no fee exemptions for BWSC permits, regardless of applicant status.
2. ☐ Hardship Request - payment extensions according to 310 CMR 4.04(3)(c).
3. ☐ Alternative Schedule Project (according to 310 CMR 4.05 and 4.10).
4. ☐ Homeowner (according to 310 CMR 4.02).

Check Number	Dollar Amount	Date

Massachusetts Department of Environmental Protection
Bureau of Waste Prevention – Solid Waste Management

BWP SW 05 Large Handling Facilities
BWP SW 08 Landfills – Phase Approval
BWP SW 15 New or Expanded Combustion Facility
BWP SW 19 Small Handling Facilities
BWP SW 26 New Large Landfill or Major Expansion
BWP SW 27 New Medium Landfill or Medium Expansion
BWP SW 28 New Small Landfill or Small Expansion
BWP SW 29 New or Expanded Woodwaste Landfill

Transmittal Number

172356
Facility ID# (if known)

Application for New or Expanded Solid Waste Management Facility: Authorization to Construct

A. Facility Information

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

Directions: Specify the plan/report and page numbers in which the following information is located.

For **BWP SW 08**, complete sections I & II. For all others, complete sections II - V.

Enter N/A if information requested is not applicable.

Important Note: Engineering Plans must be stamped by a Registered Professional Engineer (PE). Property Line Location must be stamped by a Registered Land Surveyor (RLS).

1. Which permit category are you applying for?

☐ BWP SW 05 ☐ BWP SW 08 ☐ BWP SW 15 ☐ BWP SW 19
☒ BWP SW 26 ☐ BWP SW 27 ☐ BWP SW 28 ☐ BWP SW 29

	Plan/Report #	Page #	DEP Use Only
I. Authorization to Construct (ATC) a new phase in an existing permitted landfill (BWP SW 08 only):			
A. Copy of approved facility permit	B	B-4, App B-1	
B. Identify the phase for which the ATC is being requested	B	B-4	
C. Design complies with 310 CMR 19.000	B	B-4	
II. Authorization to Construct – Other Permits/Approvals (19.041(3))			
A. Surface Water Discharge Permit (314 CMR 3.00)	B	B-4	
B. Ground Water Discharge Permit (314 CMR 5.00)	B	B-5	
C. Storm Water Discharge permit	B	B-5	
D. Sewer Connection Permit (314 CMR 7.00)	B	B-5	
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F. Other local, state, federal etc.	B	B-5	
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B. Facility Plan (310 CMR 19.030(2)(d))			
1. Site Plan (310 CMR 19.030(2)(d)(1))	B & G	B-6	

A. Facility Information (cont.)

	Plan/Report #	Page #	DEP Use Only
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3. Operation and Maintenance Plan (310 CMR 19.030(2)(d)(4)	B & D	B-6 & D-6	
4. Closure/Post Closure Plan (310 CMR 19.030(2)(d)(5)	B & C	B-6 & C-12	
5. Hydrogeological Study (310 CMR 19.104(3)) required for Landfills	B	B-7	
IV. Documentation			
A. Public Health Report (310 CMR 19.030(2)(e))	NA		
B. Site Assignment Documentation (310 CMR 19.030(2)(f))	B	B-7, App B-2	
C. MEPA Status (310 CMR 19.030(2)(g))	B	B-7, App-B-3	
D. Wetlands Order of Conditions	NA		
E. Waste Disposal Contract (Transfer Stations)	NA		
F. Financial Assurance Estimate (310 CMR 19.051(5))	B & C	B-8 & C-18	
V. Permit Criteria (310 CMR 19.038)			
A. MEPA Compliance	B	B-7, App B-3	
B. Site Assignment Limits	B	B-7, App B-2	
C. Compliance with Facility Specific Regulations	B	B-9	
D. Public health, safety or environmental considerations	B	B-12	
E. Compliance with Other Applicable Laws and Regulations	B	B-12	

Transmittal Number

172356
Facility ID# (if known)

A. Facility Information (cont.)

	Plan/Report #	Page #	DEP Use Only
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I. Structural Support	B	B-13	
J. Wildlife Endangerment	B	B-13	
K. Capacity Utilization	B	B-13	
L. Waste Diversion & Processing	B	B-14	
M. Integrated Solid Waste Management Effects	B	B-14	
N. Location Restrictions			
1. Combustion Facilities and Handling Facilities			
a. Zone II	NA		
b. IWPA	NA		
c. Unmonitorable Area	NA		
d. Waste Handling Setbacks	NA		
2. Landfills			
a. Zone II	B	B-14	
b. Public Water Supply	B	B-14	
c. IWPA	B	B-14	

Massachusetts Department of Environmental Protection
Bureau of Waste Prevention – Solid Waste Management

BWP SW 05 Large Handling Facilities
BWP SW 08 Landfills – Phase Approval
BWP SW 15 New or Expanded Combustion Facility
BWP SW 19 Small Handling Facilities
BWP SW 26 New Large Landfill or Major Expansion
BWP SW 27 New Medium Landfill or Medium Expansion
BWP SW 28 New Small Landfill or Small Expansion
BWP SW 29 New or Expanded Woodwaste Landfill

Transmittal Number

172356
Facility ID# (if known)

Application for New or Expanded Solid Waste Management Facility: Authorization to Construct

A. Facility Information (cont.)

		Plan/Report #	Page #	DEP Use Only
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f.	Gas Control	B	B-15	
g.	Leachate Containment Structures	B	B-15	
h.	Waste Deposition Setbacks	B	B-15	
i.	Seismic Impact Zone	B	B-15	
j.	Unstable Area	B	B-16	

B. Certification & Engineer's Supervision: 310 CMR 19.011

Engineer's Supervision:

All papers pertaining to design, operation, or engineering of this site or facility shall be completed under the supervision of a Massachusetts registered professional engineer knowledgeable in solid waste facility design, construction and operation, and shall bear the seal, signature and discipline of said engineer. The soils, geology, air monitoring and groundwater sections of the application or monitoring report shall be completed by competent professionals experienced in the fields of soil science and soil engineering, geology, air monitoring and groundwater, respectively, under the supervision of a Massachusetts registered professional engineer. All mapping and surveying shall be completed by a registered surveyor.

A. Raymond Quinn, PE
Print Name

Raymond Quinn
Authorized Signature

Senior Project Manager
Position/Title

SITEC Environmental, Inc.
Company

32861
P.E. #

12/05/2022
Date (MM/DD/YYYY)

Massachusetts Department of Environmental Protection
Bureau of Waste Prevention – Solid Waste Management

BWP SW 05 Large Handling Facilities
BWP SW 08 Landfills – Phase Approval
BWP SW 15 New or Expanded Combustion Facility
BWP SW 19 Small Handling Facilities
BWP SW 26 New Large Landfill or Major Expansion
BWP SW 27 New Medium Landfill or Medium Expansion
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Transmittal Number

172356
Facility ID# (if known)

Application for New or Expanded Solid Waste Management Facility: Authorization to Construct

B. Certification & Engineer's Supervision: 310 CMR 19.011 (cont.)

Responsible Official Certification

I attest under the pains and penalties of perjury that:

a) I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this certification statement;
b) Based on my inquiry of those persons responsible for obtaining the information, the information contained in this submittal is, to the best of my knowledge, true, accurate and complete;
c) I am fully authorized to bind the entity required to submit these documents and to make this attestation on behalf of such entity; and
d) I am aware that there are significant penalties including, but not limited to, administrative and civil penalties for submitting false, inaccurate or incomplete information, and possible fines and imprisonment for knowingly submitting false, inaccurate or incomplete information.

Daniel T. Barrett
Print Name

Dal T. Barrett
Authorized Signature

General Manager
Position/Title

11/25/2022
Date (MM/DD/YYYY)

PART B

SUPPLEMENTAL PERMIT INFORMATION
BWP SW 26

BWP SW 26 - APPLICATION FOR AUTHORIZATION TO CONSTRUCT PHASE 9 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY BOURNE, MASSACHUSETTS

PART B SUPPLEMENTAL PERMIT INFORMATION

Prepared For:

TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT
24 Perry Avenue
Bourne, Massachusetts 02532

Prepared By:

SITEC Environmental, Inc.
769 Plain Street, Unit C
Marshfield, Massachusetts 02050

December 6, 2022

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PART B
SUPPLEMENTAL PERMIT APPLICATION INFORMATION

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PHASE 9 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY
BOURNE, MASSACHUSETTS

PART B
SUPPLEMENTAL PERMIT APPLICATION INFORMATION

BWP SW 26 - APPLICATION FOR AUTHORIZATION TO CONSTRUCT PHASE 9 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY BOURNE, MASSACHUSETTS

1.0 INTRODUCTION

1.1 Purpose

This Application for Authorization to Construct (ATC) addresses the construction, operations, monitoring and closure for the proposed Phase 9 Landfill Expansion at the Bourne Landfill located in Bourne, Massachusetts. The proposed expansion is located within the central portion of the original Landfill property. The total footprint of the area to be filled will encompass approximately 28 acres, which completely overlays previously lined and landfilled areas. Phase 9 will be a vertical expansion over portions of the Phase 2, Phase 3, Phase 4, Phase 5 and Phase 6, or in other words all lined landfill phases. Consequently, there will be no liner construction conducted as part of the Phase 9 Landfill Expansion. The gross available volume for Phase 9 will be approximately 1,255,000 cubic yards.

This report and the accompanying drawings and attachments have been developed in accordance with the provisions of 310 CMR 19.000 "Massachusetts Department of Environmental Protection (DEP), Solid Waste Management Facility Regulations" by SITEC Environmental, Inc. for the Town of Bourne's Department of Integrated Solid Waste Management (ISWM).

1.2 Project Description

The subject of this document is the proposed Phase 9 Landfill Expansion. The Phase 9 area will overlay the 28-acres of currently lined landfill area. The development of the Phase 9 Landfill Expansion will not include the construction of any new landfill liner.

ISWM assumes that it will continue to accept MSW combustor ash from SEMASS at a rate of about 86% of its average daily capacity of 600 tons per day (maximum of 700 tons per day). While ISWM is not proposing to limit the waste type going into Phase 9 to just ash, it is assuming that the vast majority (86%) of the Phase 9 capacity will be used for ash. Ash generally has an in-place density of approximately 2,000 pounds per cubic yard (1.0 ton per cubic yard) and MSW has an in-place density of about 1,500 pounds per cubic yard (0.75 tons per cubic yard), which prorates to a net density of about 1,900 pounds per cubic yard (0.95 tons per cubic yard). At 1,255,000 cubic yards the Phase 9 Expansion will have a maximum disposal capacity of approximately 1,192,000 tons. Currently, the Facility is accepting ash for disposal and daily cover, at a rate of approximately 230,000 tons per year. At that rate the life expectancy of the Phase 9 Landfill will be about five years, two months.

1.3 Authorization To Construct (ATC) Application

This Supplemental Permit Information report is the second of seven parts that comprise an Application for Authorization to Construct (ATC) the Phase 9 Landfill Expansion of the Bourne Integrated Solid Waste Management Facility. The seven parts of the Application are listed below. Included in the parts are additional attachments and appendices, such as design drawings and reports that support this Application.

Part A	Permit Application Forms
Part B	Supplemental Permit Information
Part C	Design Plan
Part D	Operation and Maintenance Plan
Part E	Construction Quality Assurance Plan
Part F	Technical Construction Specifications
Part G	Drawings

2.0 SITE DESCRIPTION

The Bourne Integrated Solid Waste Management Facility (the Facility) is located on MacArthur Boulevard (Route 28) in Bourne, Massachusetts, approximately one mile south of the Bourne Rotary. Refer to Figure 1 – Site Locus Map in Part G, Drawings. It is abutted to the north by the Monument Beach Sportsmen's Club; to the south by a 25-acre parcel that is currently used by ISWM for solid waste handling/transfer operations and soil stockpiling and beyond that a 12-acre woodland parcel that was acquired by the Town of Bourne; to the east by primarily undeveloped land on the Joint Base Cape Cod (JBCC) facility; and to the west by Route 28 and commercial and residential properties on the opposite side of the highway.

Landfill operations began on the site in the late 1960s on the original 74.0-acre parcel. Landfilling originally covered approximately 31.4 acres. This area is known as Phase 1. The Existing Conditions Plan of the attached drawings (Part G) depicts approximate current conditions at the Facility and shows the phased landfill development areas.

To the south of the 74.0-acre site assigned area, ISWM maintains offices, parking, and various storage areas for equipment, parts, salt/sand, recyclables, etc. A maintenance garage is located along the eastern side line of the 74.0 site assigned parcel. Two truck scales and a scale house are located along the western sideline, near the entrance to the Facility, which also serves as access for the Sportsmen's Club to the north.

The Facility consists of approximately 99.0-acres of land that have been site assigned for landfilling. Landfill operations conducted to date have proceeded in the following order: Phase 1 Landfill, Phase 2 Landfill, Phase 3 Landfill, Phase 2A/3A, Phase 4 and Phase 5 Landfill areas are closed and inactive. Phase 6 is the currently active area, where landfilling is occurring. Refer to the Existing Conditions Plan in Part G, which shows the locations of the Landfill Phases.

The existing Phase 1-ABC Landfill final closure system originally consisted of approximately 20.7 acres of cap. There is approximately 5.1 acres of the Phase 1-ABC cap area that remains, with the rest of the Phase's area having been built over by the Phase 2A/3A, Phase 4 and Phase 5 liner systems. The Phase 1D Landfill, which was a non-contiguous part of Phase 1, was located within the west-central portion of the 74.0 acre site. This area has been reclaimed (mined) as part of the development of the Phase 4 Landfill Expansion, and no longer exists. The existing Phase 2 and Phase 3 Landfill final closure system area is a 12.05-acre portion of the 20.85-acre lined landfill that is located along the easterly and northerly boundaries of the site assigned area. The Phase 2A/3A Landfill, which overlays portions of these three areas, has been closed with a 17.2 acre final cap. Phase 4, Stage 1 and the sideslopes of Phase 4, Stage 2 and Phase 5 have also receive final cover for an additional 8.4-acres. The plateau areas of Phase 4, Stage 2 and Phase 5 have not been capped, in anticipation of the over lying Phase 9 Expansion. Those areas have approved interim cover.

The present earthen (not landfilled) topography of the site ranges from approximately 60-feet in elevation above mean sea level (NGVD) in the excavated area located to the south of the existing Phase 6 area to approximately 156-feet MSL, in the southwest corner of the 74-acre parcel. Maximum elevations on the existing landfill is about 185-feet along the top of the Phase 2A/3A Landfill, which was the approved maximum elevation. In March of 2022 the Bourne Board of Health modified the facility's Site Assignment to allow for a maximum elevation of 225-feet. The Phase 9 design is based on the 225-feet maximum elevation.

A series of swales and drainage structures direct surface water run off to the low spots on the site. Drainage from the northern and western portion of the Phases 1ABC area and the northern faces of the Phase 2 and Phase 2A/3A Landfills, the top and western sideslopes of Phase 4, Phase 5 and Phase 6 as well as the entrance and scale area is directed to a retention basin in the northwest corner of the Facility. The eastern portion of Phase 2, Phase 3 and Phase 6, as it is developing, flow to a swale running parallel to the eastern perimeter of the landfill. This drainage is collected and diverted by a drainage interceptor along the eastern edge of the Phase 6 and future Phase 7 and Phase 8 landfill areas to a sedimentation basin located in the southeast corner of the 25 acre parcel that is currently used for waste handling. All run off is contained to the site and no wetlands exist on the site.

The Landfill is situated primarily on the Buzzards Bay outwash deposit with a small area of ground moraine deposits in the southwest corner of the site. Bedrock is at a significant depth of about 250 to 300 feet below the surface in this area. Although lenses of clay and silt exist, the typical soils are highly permeable and well drained. Groundwater movement at the site is to the west-northwest, at a gradient of about 0.003 feet per foot. Maximum groundwater elevations beneath the site range from approximately 43 feet to 49 feet (MSL). Based upon over 45 years of monitoring groundwater elevations at USGS groundwater observation well # MA-BHW 215-0083, which is located on the ISWM site, it has been determined that the historical high groundwater elevations occurred during the July 1998 sampling event. It is the groundwater elevations measured for that period that have been used to determine maximum groundwater elevation contours.

3.0 FACILITY INFORMATION

The sections below provide the information requested on MassDEP permit application form *BWP SW 26 – New Large Landfills or Major Expansions* in the sequence presented on the form. The application forms are included in Part A of this Application. The sections which are applicable to the requested approval contain a response and an indication of sections which are not applicable is also made.

1. Application Permit Category:

BWP SW 26 – New Large Landfill or Major Expansion

I. Authorization to Construct (ATC) a new phase in an existing permitted landfill (BWP SW 08 Only)

The Phase 9 Landfill Expansion is to solely occupy area that is currently lined and landfilled. The entire, approximate 28.0-acres of the Phase 9 Landfill Expansion will overlay portions of the Phases 2, 3, 2A/3A, 4, 5 and 6 landfills. The design of the Phase 9 Landfill Expansion complies with 310 CMR 19.000 and current MassDEP guidelines for landfill construction. A copy of the current Phase 6 operating permit is included in Appendix B-1.

II. Authorization to Construct - Other Permits/Approvals (19.041(3))

A. Surface Water Discharge Permit (314 CMR 3.00)

A surface water discharge permit is not necessary for the Phase 9 ATC. The project does not include any point source discharges of wastewater or stormwater into the "waters of the Commonwealth of Massachusetts".

B. Ground Water Discharge Permit (314 CMR 7.00)

A groundwater discharge permit is not necessary for the Phase 9 ATC. The project does not include any discharges of wastewater into the groundwater. Leachate produced by Phase 9 will be captured in the existing leachate collection systems and will be pumped into either of the two existing leachate storage tanks and transported off-site to a licensed wastewater treatment facility.

C. Storm Water Discharge Permit

A storm water discharge permit is not necessary for the Phase 9 ATC. The project does not include any discharges of storm water into surface waters. Storm water run-off will be directed to on-site sedimentation basins where the waters will be retained and will infiltrate to the groundwater.

D. Sewer Connection Permit (314 CMR 7.00)

A sewer connection permit is not necessary for the Phase 9 ATC. Leachate produced by Phase 9 will be conveyed to either the existing leachate storage tanks and will be transported off-site to a licensed facility

E. Federal Water Pollution Control Act

The Federal Water Pollution Control Act is not applicable to the Phase 9 ATC. The project does not include any discharges governed by The Act.

F. Other local, state, federal etc.

There are no additional permits required for the Phase 9 ATC.

III. Plan Submissions

A. Waste Control Plans (310 CMR 19.017)

Part D of this Application contains a report titled "Operation and Maintenance Plan". This report provides a plan for compliance with the Waste Ban Compliance requirements at 310 CMR 19.017. These requirements specify materials that are banned from disposal within Massachusetts landfills. Operators of landfills are required to comply with the provisions of this regulation. ISWM will comply with the intent and spirit of this section, by screening incoming loads for the presence of these materials, rejecting loads that violate the regulations or removing banned materials, should they be encountered. The Operation and Maintenance Plan report provides the ISWM Waste Ban Compliance Plan to conform to the Waste Control requirements of the regulations, which are consistent with current operations.

B. Facility Plan (310 CMR 19.030(3)(c))

1. Site Plan (310 CMR 19.030(3)(c)1)

Drawings (Plans) showing plans, sections and details of the site, the landfill cell and appurtenances have been prepared. The Plans show the existing and proposed topography, leachate collection and storage facilities, operations sequencing, drainage improvements and other features of the Site. These plans are included as Part G of this Application.

2. Recycling/Composting Plan (310 CMR 19.030(3)(c)2)

The Operation and Maintenance Plan, included as Part D, fully describes the recycling operations to be conducted at this facility. These operations include the separation of various components within the waste stream as well as the enforcement of MassDEP Waste Bans as a means of promoting recycling by others. This plan also describes residential recycling activities and composting performed on-site.

3. Facility Design Plan (310 CMR 19.030(3)(c)3)

Part C of this application is a report titled "Design Plan, Phase 9 Landfill Expansion, Bourne Integrated Solid Waste Management Facility." This report provides the information necessary to demonstrate the negligible impact of the proposed Facility on public health, safety and the environment including the following; a detailed description of the type and size of the Facility; the nature and amount of refuse to be handled on a daily basis; a detailed description of the design; and a detailed description of the specific operational aspects of the Facility.

4. Operation and Maintenance (310 CMR 19.030(3)(c)4.)

Part D of this application contains a report titled "Operation and Maintenance Plan, Phase 9 Landfill Expansion, Bourne Integrated Solid Waste Management Facility." This report provides information applicable to the operation and maintenance of the Facility, sufficient to demonstrate that the Facility's procedures will ensure good solid waste management practices and will protect public health, safety and the environment.

5. Closure/Post-Closure Plan (310 CMR 19.030(3)(c)(5).

When the Phase 9 area is unable to accept or ceases to accept solid waste under the conditions of its permit, closure of the landfill must be conducted in accordance with MassDEP regulations, which are found at 310 CMR 19.000. The regulations stipulate activities that must accompany landfill closure, including site assessment, closure design, post-closure use determination and construction quality assurance programs. As part of this ATC a conceptual Closure/Post-Closure Plan is presented in the Design Plan, which is included in Part C.

6. Hydrogeologic Study (310 CMR 19.030(2) and 19.104(3)).

Hydrogeologic Assessments have been conducted for the Facility as part of the MEPA requirements for the expansion of landfill operations and the Comprehensive Site Assessment process, that is complete. This study work meets the requirements of 310 CMR 19.104(3) and is incorporated into this Application by reference.

IV. Documentation

A. Public Health Report

Not Applicable.

B. Site Assignment Documentation (310 CMR 19.030(3)(e))

The original 74-acre site, which was comprised of six separate lots, was assigned after a public hearing, pursuant to M.G.L. Ch. 111 S. 150A, as a sanitary landfill site on June 6, 1972. The Site Assignment has been modified twice since then. The most recent modification was granted in March 2022, which expanded landfilling to the 25-acre parcel and to the maximum elevation of 225-feet. A copy of the Site Assignment is included as Appendix B-2.

C. MEPA Status (310 CMR 19.030(3)(f))

The Bourne Landfill and the associated solid waste handling facilities, were the subject of a Final Environmental Impact Report (FEIR) in 1999. The filing described a full build-out of the Landfill through Phase 6. A FEIR Certificate was issued on November 29, 1999 which acknowledged the conceptual development of the Landfill in phases and required the Town to submit Notices of Project Change (NPC) to the MEPA Office for updates to the project.

Notice of Project Change 1 in 2003 addressed accepting a broader range of materials to include municipal solid waste (MSW) and municipal combustor ash while not increasing the daily tonnage limits to the site. Notice of Project Change 2 was submitted in 2007 as an Emergency Action to allow a temporary increase in daily tonnage to accept MSW that was displaced by a fire at the SEMASS waste-to-energy facility in Rochester, MA. Notice of Project Change 3 addressed construction of a potential landfill gas to energy facility utilizing reciprocating engines/electric generator sets to create up to 4.3 megawatts (MW) of electricity. Notice of Project Change 4 was submitted in 2016 and provided a report on the Phase 1D Reclamation Project and a final development plan for the Phase 5 Landfill Expansion. In all cases, the preparation of an EIR was not warranted. Notice of Project Change 5, which was an Expanded Notice of Project change (ENPC) was submitted in 2017 and a subsequent Single Supplemental Environmental Impact Report (SSEIR) was submitted in 2018 for the Phase 6 Landfill Expansion, the legislatively authorized disposition of Article 97 land on the adjacent JBCC and outlined further site development into Phases 7, 8, 9 and the relocation of the LHF.

Similar to Phase 6, the preparation of an EIR for the development of the Phases 7, 8 and 9 landfill expansions and the relocation of the LHF, was warranted because of the potential to create more than ten acres of impervious surface. After consultation with the MEPA Office, it was determined the Town would file an Expanded Notice of Project Change (ENPC) (Notice of Project Change 6) that would act in effect as an Expanded Environmental Notification Form (EENF) in which the Town requested that the Secretary consider allowing the preparation of a Single Supplemental EIR (SSEIR) as part of the ENPC Certificate. The Secretary subsequently issued an ENPC Certificate on April 24, 2020 that required the preparation of a Single Supplemental Environmental Impact Report (SSEIR) with a limited Scope. In response to that certificate, ISWM submitted a SSEIR on November 13, 2020. The Secretary subsequently issued a final certificate to the SSEIR on December 30, 2020 which determined that the SSEIR "adequately and properly complies with MEPA and its implementing regulations" and that no further MEPA review was required for the project. This certificate is included in Appendix B-3.

D. Wetlands Order of Conditions

There are no wetlands in the vicinity of the Facility, consequently a Wetlands Order of Conditions is not applicable to the Phase 9 Landfill expansion project.

E. Waste Disposal Contract (Transfer Stations)

Not Applicable

F. Financial Assurance Estimate and Mechanism (310 CMR 19.051)

The Town of Bourne maintains a MassDEP approved Financial Assurance Mechanism (FAM) and adequately funds that mechanism so as to be able to construct landfill capping and conduct thirty years of post-closure monitoring and maintenance. The estimated capping costs for the Phase 9 expansion are presented in Part C, the Design Plan. While this estimated cost of approximately $7,040,000 will be incurred in phases as the closure proceeds by stages, the approximate value of the FAM that is to be reserved for this work will be available as the result of the release of funds that are currently in the FAM for the future and on-going capping of currently active areas of operations. That is to say that as current operations areas (Phase 6) is capped, the money that is reserved for that work in the FAM can be released to cover the capping of Phase 9. Post-Closure costs are estimated on the entire site and thus do not change as a result of the construction and operation of the Phase 9 area. The Town of Bourne regularly reviews the FAM requirements and budgets adjustments to the FAM, as required. A copy of the FAM in the form required to show adequate financial resources to comply with 310 CMR 19.051 will be submitted to MassDEP prior to issuance of the Final ATO for the Phase 9 Landfill Expansion.

V. Permit Criteria (310 CMR 19.038(2)(a))

A. MEPA Compliance

See IV.C., above.

B. Site Assignment Limits

See IV.B., above.

C. Compliance with Facility Specific Regulations

In addition to the general review criteria cited in 310 CMR 19.038(2)(a), the Facility is governed by the facility-specific criteria cited in 310 CMR 19.038:(2(c)), Landfills. The Facility's compliance with each of these criteria is demonstrated below.

Groundwater Supply
The Facility is not located in

- *a. Zone II of an existing or potential public water supply;*
- *b. Within 15,000 feet upgradient of an existing public water supply well unless a preliminary Zone II has been completed and the Facility is not in the Zone*

II;

- c. *In the Interim Wellhead Protection Area (IWPA) of an existing or potential public drinking water supply unless a preliminary Zone II has been completed and the Facility is not in the Zone II;*
- d. *In the recharge area of a sole source aquifer, unless:*
  - I. *there are no existing or potential public groundwater supplies downgradient of the site;*
  - ii. *.....the Applicant may have the option of providing an alternative public water supply to replace all the existing or potential downgradient private water supplies; and*
  - iii. *there is a sufficient existing or potential public water supply to meet the municipality's projected needs.*

Zone IIs have been delineated in Bourne and the Facility is not located in either a Zone II area or an IWPA of an existing/potential public or private water supply. The Facility is within a sole source aquifer and a Potentially Productive Aquifer (PPA), however there are no existing or potential downgradient public water supplies; the Bourne Water District has provided a public water supply to the area downgradient of the Facility; and there is an adequate water supply to meet the municipality's projected needs. See correspondence from the Bourne Water District in Appendix B-4.

Unmonitorable Area

A facility cannot be located on a site where appropriate environmental monitoring cannot feasiblely be performed. Furthermore, no leachate or surface run-off will be allowed to enter ground or surface waters.

A significant amount of hydrogeologic assessment has been conducted on the Facility. This assessment has included the installation of a network of groundwater and landfill gas monitoring wells, which provide adequate environmental monitoring of the site. The absence of fractured bedrock in the vicinity of the Facility assures that the site is monitorable.

Landfill Gas

The landfill does not represent a threat to public health, safety or the environment due to concentration or migration of explosive gases, excluding gas control or recovery system components, at the facility or beyond the facility property boundary.

The existing landfill facilities include an active gas collection and treatment (flare) system and a migration monitoring system. The active gas collection system will be extended to the Phase 9 area, which will mitigate any threat from the generation or migration of landfill gas from this area. The site has a network of on-site landfill gas monitoring wells to detect any gas migration beyond the property boundaries. Refer to Part C, Design Plan for a more detailed description of the gas collection and treatment system.

Wetlands Resource Area

The leachate containment structure of a landfill shall not be located within a resource area *protected by the Wetlands Protection Act (M.G.L. c.131, s.40), including the 100 year floodplain.*

All leachate containment structures are located outside resource areas protected by the Wetlands Protection Act and are not situated within the 100 year flood plain.

Waste Deposition Area

The outer most limits of the waste deposition area for new landfills or expansions of landfills shall not be within the following distances unless, as applicable, a waiver has been obtained under 310 CMR 16.00 or a variance has been obtained under 310 CMR 19.080.

a. 100 feet of the nearest edge of the property boundary,...

All proposed solid waste handling operations in the Phase 9 Landfill Expansion area will be conducted outside of the 100 foot property line setback

b. 500 feet of a private water supply well.

All portions of the waste deposition area are greater than 500 feet from any private water supply wells.

c. 500 feet from an occupied residential dwelling, prison, bedded health care facility, lower educational institution or children's pre-school excluding equipment storage or maintenance structures.

All portions of the waste deposition area are greater than 500 feet from an occupied residential dwelling, prison, bedded health care facility, lower educational institution or children's pre-school.

d. A resource area protected by the Wetlands Protection Act (M.G.L. c.131, s.40) and the regulations promulgated thereunder (310 CMR 10.00), including the 100 year floodplain.

All portions of the waste deposition area are outside of a resource area protected by the Wetlands Protection Act (M.G.L. c.131, s.40) and the regulations promulgated thereunder (310 CMR 10.00), including the 100 year floodplain.

e. 2,500 feet upgradient or 500 feet downgradient of a surface drinking water supply.

All portions of the waste deposition area are greater than 2,500 feet upgradient or 500 feet downgradient from a surface drinking water supply.

f. 250 feet upgradient of a perennial watercourse that drains to a surface drinking supply where the landfill is within one mile of the surface drinking water supply.

All portions of the waste deposition area are greater than 250 feet upgradient from a perennial watercourse that drains to a surface drinking supply where the landfill is within one mile of the surface drinking water supply.

g. 250 feet of a lake, pond or river (not including a stream) as defined in 310 CMR 10.00, other than a drinking water supply.

All portions of the waste deposition area are greater than 250 feet from a lake, pond or river.

Seismic Impact Zone

The landfill is not located in a seismic impact zone unless all containment structures are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

The Phase 9 Landfill area was mapped in 2008 by the USGS as not being in an area that meets the regulatory definition of a seismic impact zone. However, consistent with previous Bourne Landfill cell designs, the Phase 9 containment structures were assessed and designed to resist the previous design standard for horizontal acceleration in lithified earth material for the site. Refer to the *Bourne Landfill, Phase 9, Geotechnical Evaluation Report* (Geocomp Corp.) included in Appendix C-3 of Part C, Design Plan of this Application.

Unstable Areas

The landfill is not located in an unstable area unless......

The subgrade for the Phase 9 expansion area will be constructed of suitable bearing materials, subject to engineering specifications, capable of supporting the overlaying landfill and minimizing differential settlement. Refer to the *Bourne Landfill, Phase 9, Geotechnical Evaluation Report* (Geocomp Corp.) included in Appendix C-3 of Part C, Design Plan of this Application.

D. Health and Environmental Impact Assessment

In accordance with MassDEP's Interim Risk-Evaluation Guidance Document for Solid Waste Facility Site Assignment and Permitting in Support of 310CMR 16.00 & 19.000, a Quantitative Impact Evaluation was conducted for the entire facility, including full build out of the site. To accomplish this, Bourne hired Cambridge Environmental, Inc. to perform the health and environmental risk assessments. The Quantitative Impact Evaluation was submitted to MassDEP in May 2003 and was approved by the Department in a memorandum dated July 1, 2003. The Evaluation included the full build-out of the site, including all future phases of the Landfill and other handling and/or processing facilities on the 25 acre parcel to the south of the Landfill, which is now site assigned for landfilling and is operating as a solid waste handling facility. Additionally, the evaluation looked at a wide range of potential waste streams for the Landfill including: municipal solid waste; municipal waste combustion ash; and construction and demolition materials. During the most recent MEPA approval process, Sanborn Head reviewed the application and reconfirmed the conclusion of the original assessment. It should be noted that the lead engineer on the review is the same engineer that led the review in 2003. The Department's approval memorandums and letters are included in Appendix B-5.

As part of the most recent MEPA process, the site suitability criteria were addressed and the potential impact of the proposed expanded landfill including Phase 7, Phase 8 and Phase 9. The Facility was evaluated with respect to health and environmental impact. The Phase 9 Expansion will not adversely affect the public health or environment. The design of the expansion meets the design requirements of the Solid Waste Management Facility Regulations. The operation of the expansion will comply fully with the Solid Waste Management Facility Regulations. The expansion incorporates the existing double composite liner with leachate collection and leak detection systems designed in compliance with 310 CMR 19.110. The current MassDEP approved environmental monitoring program will continue to be conducted. The program may be modified in the future, which will require MassDEP approval.

E. Compliance with Other Applicable Laws and Regulations

The Facility must comply with all applicable state and federal rules, regulations and policies. The following approvals and permits must be obtained and ISWM must comply with their specific requirements.

a. Authorization to Construct (ATC) from the Department of Environmental Protection pursuant to the Massachusetts Solid Waste Management Facility Regulations (310 CMR 19.000).

b. Authorization to Operate from the MassDEP Solid Waste Management Section (The Permit to operate will be recorded at the Barnstable Country Registry of Deeds.)

F. Compliance with Waste Control

See Section III, Item A. above and the Operation and Maintenance Plan included as Part D of this Application.

G. Enforcement Status

There are no outstanding Enforcement Orders related to the Facility.

H. Bird Hazard

The operation of the Phase 9 Landfill expansion will not result in a bird hazard to aircraft. This has been demonstrated by the long-term operation of the Facility. While the Facility abuts the Joint Base Cape Cod, which includes Otis Air National Guard Base and Camp Edwards, the Facility is at least 4.5 miles from the closest runway area. No incidents involving bird hazards have been reported. Refer to the Gull Control Plan included in Part D, Operation and Maintenance Plan.

I. Structural Support

The subgrade for the Phase 9 expansion area will consist of the suitable bearing materials of the existing Landfill, subject to engineering specifications, capable of supporting the overlaying landfill and minimizing differential settlement. Refer to the *Bourne Landfill, Phase 9, Geotechnical Evaluation Report* (Geocomp Corp.) included in Appendix C-3 of Part C, Design Plan of this Application.

J. Wildlife Endangerment

The construction, operation, and maintenance of the Facility will not cause or contribute to the taking of any endangered or threatened species of plant, fish or wildlife as identified in 50 CFR, Part 17. The construction and operation of the site does not, and will continue not to affect any endangered or threatened species of plants, fish or wildlife. As part of the MEPA process correspondence was received from the National Heritage and Endangered Species Program confirming that all proposed landfilling areas are exempt from the Massachusetts Endangered Species Act (MESA). The responses from that office indicate that the project will not impact state-protected rare species. Since that time the Phase 9 area has remained unsuitable as a habitat area.

K. Capacity Utilization

The MassDEP issued its latest Solid Waste Master Plan in October 2021 (Master Plan). It continues to identify a shortfall and dwindling capacity for solid waste disposal in the state. This shortfall in capacity highlights the need for additional solid waste disposal capacity. The Phase 9 expansion helps to address this statewide situation by providing approximately 1,192,000 tons of solid waste and combustion ash disposal capacity.

L. Waste Diversion & Processing

The Facility is and will remain an important component of solid waste management in southeastern Massachusetts. The Facility has been conducting waste diversion and processing operations at the site since 1990 including yard waste and brush processing and composting, recyclables transfer operation, a Swap Shop and most recently a food waste collection and diversion program for off-site composting. The ISWM facility permitted and built a construction and demolition (C&D) debris transfer station, which collects and transports C&D materials to recyclers for waste diversion and processing. The facility in turn may accept certain residual materials of the recycling operations for disposal in the Landfill.

M. Integrated Solid Waste Management Effects

The Facility will maintain its existing residential drop-off operations for the residents of the Town. The existing drop-off facility is located on the southern 25-acre parcel. In the future, ISWM plans to relocate those facilities to the adjacent 12-acre parcel.

N. Location Restrictions

1. Combustion Facilities and Handling Facilities

This section of the Permit Application is not applicable to the proposed facility.

2. Landfills

a. Zone II

The Facility is not located within a Zone II of a public or private water supply.

b. Public Water Supply

The proposed Facility is not located within 2,500 feet of a public water supply.

c. IWPA

The proposed Facility is not located within an Interim Wellhead Protection Area of either a public or private water supply well.

d. Sole Source Aquifer

The Facility is within a sole source aquifer and a Potentially Productive Aquifer (PPA), however there are no existing or potential downgradient public water supplies. The Bourne Water District has provided a public water supply to the area downgradient of the Facility; and there is an adequate water supply to meet the municipality's needs. See correspondence from the Bourne Water District in Appendix B-4.

e. Unmonitorable Area

The Facility is located on property which is easily accessible from a state highway. Adequate environmental monitoring has been ongoing at the site for many years. The Site can not be considered unmonitorable based upon the current knowledge of the geologic and hydrologic conditions in the vicinity of the Site.

f. Gas Control

The existing landfill facilities include an active gas collection and treatment (flare) system and a landfill gas migration monitoring system. The active gas collection system will be extended to the Phase 9 area, which will mitigate any threat from the generation or migration of landfill gas from this area. Refer to Part C, Design Plan for a more detailed description of the gas collection and treatment system.

g. Leachate Containment Structures

The existing leachate containment structures include double composite liners with leachate collection and leak detection systems. The leachate generated in Phase 9 will infiltrate downward into the existing landfill cells and flow to their liner and leachate collection systems. It will then be pumped from the leachate collection and leak detection systems into the existing aboveground leachate storage tanks. The leachate storage system has adequate capacity for the Phase 9 Landfill area. This is due to both the significant capacity (207,000 gallons and 125,000 gallons) of the existing system and to an off-setting reduction in leachate generation that is expected to occur as portions of the active landfill areas are capped.

h. Waste Deposition Setbacks

The waste handling areas of the proposed facility will not be located within the following distances; 500 feet of a private water supply well; 500 feet of an occupied residential dwelling, prison, bedded health care facility, lower education institution or children's pre-school; within a wetland area or the 100 year floodplain; 2,500 feet upgradient or 500 feet downgradient of a surface drinking water supply; 250 feet upgradient of a perennial watercourse that drains to a surface drinking supply where the landfill is within one mile of the surface drinking water supply; 250 feet of a lake, pond or river; 200 feet of a fault that has had displacement in Holocene time; or 100 feet of a property line.

i. Seismic Impact Zone

The Phase 9 Landfill area was mapped in 2008 by the USGS as not being in an area that meets the regulatory definition of being in a seismic impact zone. However, consistent with previous Bourne Landfill cell designs, the Phase 9 containment structures were assessed and designed to resist the previous design standard for horizontal acceleration in lithified earth material for the site. Refer to the *Bourne Landfill, Phase 9, Geotechnical Evaluation Report* (Geocomp Corp.) included in Appendix C-3 of Part C, Design Plan of this Application.

j. Unstable Area

The subgrade for the Phase 9 expansion area will be the existing landfill structure which is constructed of suitable bearing materials, subject to engineering specifications, capable of supporting the overlaying landfill and minimizing differential settlement. Refer to the *Bourne Landfill, Phase 9, Geotechnical Evaluation Report* (Geocomp Corp.) included in Appendix C-3 of Part C, Design Plan of this Application.

APPENDIX B-1

AUTHORIZATION TO OPERATE PHASE 6 LINED LANDFILL EXPANSION

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen Theoharides
Secretary

Martin Suuberg
Commissioner

January 17, 2020

Mr. Daniel Barrett
Bourne Department of Integrated Solid Waste Management
24 Perry Avenue
Buzzards Bay, Massachusetts 02532

RE: PERMIT APPROVAL
Application for: BWP SW 10
AUTHORIZATION TO OPERATE
PHASE 6 LANDFILL EXPANSION (6.9 acres)
Application No. 19-SW10-000002-APP
Authorization No. SW10-0000008

AT: Bourne Integrated Solid Waste Management Facility
MacArthur Boulevard
Bourne, MA
Facility No. 39101 R.O.# 172356

Dear Mr. Barrett:

The Massachusetts Department of Environmental Protection, Solid Waste Management Section ("Department"), has completed its review of the permit application ("Application") listed above in regard to operation of Phase 6, of the Bourne Sanitary Landfill ("Landfill") and determined the Application is technically complete. Accordingly, the Application to Operate Phase 6 of the Landfill is **approved** with the conditions herein.

Application Summary

The initial Application was prepared and submitted by Sitec Environmental, Inc. ("Sitec"), Marshfield, Massachusetts, and submitted on September 24, 2019, on behalf of the Town of Bourne ("Town" or "Applicant"). The Application consisted of the following:

A. Authorization to Operate a Landfill Permit Application (BWP SW 10) received by MassDEP on September 25, 2019. The Application was divided into three parts:

- Part I Permit Application Forms
- Part II Operation and Maintenance Plan
- Part III Interim Construction Quality Assurance Report

B. Supplemental information prepared by Sitec, consisting of a response to MassDEP's October 2, 2019 comments, received by MassDEP on October 3, 2019 and October 8, 2019.

Based on its review of the above information, on October 10, 2019, MassDEP issued a partial approval to operate the Phase 6 Landfill Expansion for the placement of a buffer layer of select waste material and for the acceptance of leachate. At the time of the partial approval, construction of the Phase 6 double composite liner system was complete, with the exception of the connection to the existing Phase 4, Stage 2 liner and leachate collection systems.

Additional information was submitted on December 30, 2019, providing the information necessary for MassDEP to approve the full operation of Phase 6 of the Landfill for the acceptance of waste material. The additional information consisted of an updated version of the Construction Quality Assurance Report.

The initial Application and additional information was submitted electronically via the Massachusetts Executive Office of Energy and Environmental Affairs ePlace Portal at https://permitting.state.ma.us/CitizenAccess/ on September 25, 2019 and December 30, 2019, respectively.

The Application and Permit may be reviewed online at:
https://eeaonline.eea.state.ma.us/EEA/PublicApp/ using the "Site Name" Bourne Landfill and the "Search" tab. Under "Record Type", select the "Application" file with the September 25, 2019 "Application Date" and the "Authorization" file with the January 17, 2020 "Application Date".

APPLICATION REVIEW AND DECISION PROCESS:

The Application was submitted and reviewed pursuant to the provisions of 310 CMR 19.029(2): Applicable Permit Procedures and 310 CMR 19.033: *Permit Procedure for an Application for a Permit Modification or Other Approval.* According to these review procedures, MassDEP's decision regarding the proposed activities shall be either: a "Provisional Decision" pursuant to 310 CMR 19.033(4)(a); or a non-provisional decision pursuant to 310 CMR 19.033(4)(b). MassDEP has determined that non-provisional decision is appropriate for this Application.

MassDEP has reviewed the Application pursuant to 310 CMR 19.000: *Solid Waste Regulations* and MassDEP's *Landfill Technical Guidance Manual, May 1997* (the "Manual").

PROJECT BACKGROUND

The Landfill is located off MacArthur Boulevard (Route 28) in Bourne, Massachusetts on a 74-acre parcel of land that was Site Assigned by the Bourne Board of Health on June 16, 1972. The Landfill is owned and operated by the Town. Landfill operations conducted to date have proceeded in the following order: Phase 1 Landfill (sub-phases A, B, C and D), Phase 2 Landfill, Phase 3 Landfill, Phase 2A/3A Landfill, and the currently active Phase 4 Landfill and Phase 5 Landfill areas. MassDEP approved for construction of Phase 6 on July 16, 2018.

Other ongoing operations at the Landfill site include composting, recycling, and operation of a residential recycling and waste transfer area, and operation of a Construction and Demolition debris transfer station.

The Landfill is abutted to the north by the Monument Beach Sportsmen's Club; to the south by a 25-acre parcel that is used by ISWM for solid waste handling/transfer operations and soil stockpiling and beyond that woodland that has recently been acquired by the Town of Bourne; to the east by primarily undeveloped land on the Joint Base Cape Cod ("JBCC") facility; and to the west by Route 28 and commercial and residential properties on the opposite side of the highway.

MEPA REVIEW

Pursuant to the Massachusetts Environmental Policy Act ("MEPA") statute M.G.L. C. 30, S. 61-62H and regulations 301 CMR 11.00, a Final Environmental Impact Report ("FEIR") was prepared for the Landfill and a Certificate (EOEA #11333) of the Secretary of the Executive Office of Environmental Affairs ("EOEA") was issued on November 29, 1999, stating that the FEIR adequately and properly complied with MEPA. The FEIR was prepared for the partial build-out of the Landfill including the processing, recycling, composting, and disposal aspects of the project at the anticipated maximum daily tonnage rate of 825 tons per day ("tpd").

In June 2003, the Town of Bourne submitted a Notice of Project Change ("NPC") to MEPA that requested that the landfill be allowed to accept municipal solid waste ("MSW") and municipal combustor ash ("MCA") for disposal. On August 7, 2003, the Secretary issued a Certificate which stated that no further MEPA review was required for this change.

The Town of Bourne submitted a NPC to the EEA on November 8, 2017, providing an update of the planned development for the entire site. Alternative development plans were described, including the "Preferred Phase 6" with potential further development of Phase 7 and Phase 8 landfill and the "No Further Build Phase 6" alternatives. The Secretary issued a Certificate on January 12, 2018 which determined that a Single Supplemental Environmental Impact Report ("SSEIR") was required. An SEIR dated May 9, 2018 was submitted to EEA and published in the Monitor on May 23, 2018 (EEA No. 11333). On June 29, 2018, the Secretary issued a Certificate on the SEIR and determined that the SEIR adequately and properly complies with MEPA and its implementing regulations. The Town of Bourne will submit a future NPC to address development of Phase 7 and Phase 8 of the Landfill.

SITE ASSIGNMENT

On June 16, 1972, the Bourne Board of Health issued a site assignment for the entire 74-acre site including Phase 1, Phase 2, Phase 3, and Phase 4 pursuant to Massachusetts General Laws, Chapter 111, Section 150A.

Phase 6 Description

The Application details the design, construction, and operation of the Phase 6 Landfill. The design utilized some areas of the existing liner system and includes constructing a new primary composite liner and leachate collection system and a secondary composite liner with leak detection system in some areas. The Phase 6 area overlays approximately 4.9 acres of the southern sideslopes of the Phase 3, Stage 3 and Phase 4, Stage 2 Landfills as well as 6.9 acres of new land located to the south of the existing Landfill operations area.

The project also included the construction of a 125,000 gallon, glass coated steel, above ground tank and truck load out structure, located adjacent to and south of the southwest corner of Phase 6 and interconnected to the existing leachate storage tank and force main system.

The contract for construction of Phase 6 was awarded to David G. Roach and Sons, Inc. ("Roach") of South Barre, Massachusetts. Construction began in April 2019. Full time construction quality assurance oversight was conducted by Sitec. Roach retained the services of New England Liner Systems, Inc. for the procurement and installation of all geosynthetic liner system materials. Roach retained the services of GeoTesting Express for testing of geosynthetics and for soils conformance testing.

Within the current Application, Sitec certified that the Phase 6 double composite liner system was constructed in general conformance with the approved plans, technical specifications and Construction Quality Assurance Plan.

Phased Liner Construction

The Authorization to Construct application for Phase 6 detailed the design and construction of two alternatives for the Phase 6 Landfill, the "Preferred Phase 6" and the "No Further Build Phase 6". The "Preferred Phase 6" alternative is dependent on the development and approval of Phase 7 and Phase 8.

Phase 6 is divided into at least two separate liner construction stages (Stage 1 and Stage 2) by the construction of a temporary berm that allows for the phased construction of the Phase 6 liner. Stage 1 construction is complete and is the subject of this approval.

Stage 2 is contingent upon whether Phase 7 is approved and constructed. If Phase 7 is not built, also known as the "No Further Build Phase 6" alternative, the southern sideslope would be constructed up to the existing grade as Stage 2. If Phase 6 Stage 2 is constructed, MassDEP is requiring that a Construction Certification Report be submitted to MassDEP prior to disposal of waste. An Authorization to Operate would also be needed prior to disposal of waste in Phase 6 Stage 2.

If Phase 7 is built, also known as the "Preferred Phase 6" alternative, the southern sideslope of Phase 6 will be excavated and that area will be part of the Phase 7 liner.

Phase 6 Landfill Disposal Volume

Construction of the Phase 6 Landfill adds approximately 920,000 cubic yards of disposal volume (approximately 570 acre-feet). Pursuant to the March 30, 2017, Phase 5 Landfill Authorization to Operate permit (BWP SW 10, Transmittal No. X272125) the Landfill is permitted to operate seven days per week and accept an annual average of 600 tons per day of waste, with a maximum of 700 tons per day not to exceed 4,900 tons per week. Waste approved to be disposed at the Landfill includes municipal solid waste ("MSW"), residual C&D material, waste-to-energy incinerator ash, and other non-MSW material. The definition of non-MSW for the purpose of the landfill operating permit includes construction and demolition waste residuals from a C&D processing facility, bulky waste, difficult to manage waste, special wastes that may be accepted pursuant to 310 CMR 19.061, and special wastes that have received prior written approval from MassDEP and only in accordance with MassDEP policy.

The Landfill accepts combustion ash from the Covanta waste-to-energy facility located in Rochester, Massachusetts, which currently constitutes the majority of the waste material accepted at the Landfill. Assuming that all of the gross volume will be utilized by ash, which has an in-place density of approximately 2,000 pounds per cubic yard (1.0 ton per cubic yard), the Phase 6 Expansion will have a maximum disposal capacity of approximately 920,000 tons. Currently, the Facility is accepting ash for disposal and daily cover, at a rate of approximately 230,000 tons per year. At that rate, the life expectancy of the Phase 6 will be about four years. Should ash acceptance cease or decrease, the Landfill life will be dependent upon the rate of MSW acceptance.

Double Composite Liner System with Leak Detection

The liner system for Phase 6 consists of existing components from the surrounding Phase 4, Stage 2 and Phase 3, Stage 3 Landfills, as well as a new double composite liner system with leak detection capabilities designed in accordance with 310 CMR 19.110. The liner was designed with a minimum 4-foot separation from the historical maximum high groundwater elevation to the top of the prepared subgrade layer for the liner.

The Phase 4, Stage 2 Landfill is an existing active landfill area and the Phase 3, Stage 3 Landfill is an existing inactive landfill area with either final or intermediate cover. Both these landfill areas are lined with a double composite liner.

A new double composite liner system was constructed over 6.9 acres and includes, from bottom to top:

- A subgrade layer placed where needed to provide structural support to the overlying liner system. The subgrade layer preparation work included the excavation and grading of existing, in-situ soils, overlain by;
- A low permeability soil layer comprised of 12 inches of compacted low permeability soil having a maximum in-place, saturated hydraulic conductivity of 1×10^{-7} centimeters per second, overlain by;

- A secondary geosynthetic clay liner ("GCL") fabricated of a layer of granular sodium bentonite encapsulated between two sheets of needle-punched geotextile will be placed above the low permeability layer. On sideslopes greater than 4:1. (4 foot horizontal to 1 foot vertical), this layer will extend only to a height that is 5 feet vertically above areas with a slope of less than 4:1, overlain by;
- A secondary geomembrane made of 60-mil thick textured high-density polyethylene ("HDPE") placed on top of the secondary GCL or low permeable soil and extending over the entire liner area, overlain by;
- A bi-planar, geocomposite drainage layer, consisting of an HDPE geonet bonded on both sides with a non-woven geotextile, placed on the secondary geomembrane covering the entire liner area, overlain by;
- A primary GCL placed above the geocomposite drainage layer covering the entire liner area, overlain by;
- A primary geomembrane made of a 60-mil thick textured HDPE placed above the primary GCL covering the entire liner area, overlain by;
- A primary drainage/protection layer placed above the primary geomembrane consisting of an 18-inch thick layer of clean sand having a minimum hydraulic conductivity of 1×10^{-2} centimeters per second, covering the entire liner area.

The Phase 6 Landfill liner was connected to the existing Phase 3, Stage 3 and Phase 4, Stage 2 Landfill liner systems by exposing the existing base liner materials as necessary to connect each element of the new liner system to the corresponding element of the existing liner system. All connections of the HDPE geomembranes were completely welded along the entire length.

An electrical leak location survey was conducted on the Phase 6 primary liner system.

Primary Leachate Collection System

The Phase 6 Landfill primary leachate collection system is designed to drain the primary liner system so that no more than one foot of hydraulic head will develop on the liner. The primary leachate collection system consists of the sand drainage layer and a system of 8-inch and 6-inch diameter HDPE perforated and solid pipes installed within the sand drainage layer leading to the primary leachate collection sump located along the toe of the western sideslope. The drainage pipes are embedded in 3/4 to 1-1/2 inch crushed stone placed above a filter fabric and a geocomposite drainage layer to prevent damage to the primary geomembrane layer. During construction, the design engineer requested and was approved to substitute crushed stone with additional protective geosynthetic materials for washed/rounded stone after providing MassDEP with an evaluation and supporting calculations.

The Landfill liner system base was graded with shallow swales that radiate from the leachate collection sump, to promote leachate drainage in the sand layer to the collection piping. The primary leachate header piping was installed along the centerline of the swale areas at a 1.0% (0.01 ft/ft) minimum slope with cleanouts extending to the top of the side slopes. There are lateral collection pipes located across the liner base that connect to the header pipes. The lateral pipes were placed at a minimum slope of 0.5% and a maximum spacing of 60 feet. All leachate collected by the Phase 6 primary collection system is diverted to the Phase 6 primary leachate sump located along the toe of the Phase 6 western sideslope.

In addition, a 6-inch diameter HDPE solid pipe was installed to connect a Phase 4, Stage 2 leachate pipe located along the toe of the Phase 4, Stage 2 western sideslope to the Phase 6 primary leachate collection system. The connection to Phase 4, Stage 2 provides a hydraulic connection between Phase 4 and Phase 6 and will divert leachate from Phase 4 to Phase 6.

Due to accepting waste combustion ash as its primary waste stream, the Landfill has experienced plugging of the leachate collection piping. The Landfill's operators have determined that the chemical REDUX-300, is effective in keeping the leachate from coagulating and plugging the collection system. In response, the design for the Phase 6 liner system includes a chemical injection system in the primary sump as detailed below. A series of 1-inch diameter HDPE perforated pipe was installed along the first 100 feet of each collection header pipes and within the leachate sump area, which individually connect to solid wall pipes that run to the pump control panel area, where a chemical can be injected by a metering pump into each distribution line.

Secondary Leachate Collection System

The Phase 6 Landfill secondary leachate collection system, also known as the leak detection system, is designed to detect and collect any potential leakage through the primary liner and convey this leakage to the secondary leachate collection sump. The secondary leachate collection system consists of bi-planar geocomposite drainage material and 4-inch diameter HDPE perforated pipes embedded in 3/4 to 1-1/2 inch crushed stone with filter fabric wrapped around the stone to prevent damage to the secondary geomembrane layer. The collection pipes are located in the center of the troughs constructed approximately twenty feet wide and one foot deep with 12% side slopes. During construction, the design engineer requested and was approved to substitute crushed stone with additional protective geosynthetic materials for washed/rounded stone after providing MassDEP with an evaluation and supporting calculations.

Notification Leakage Rates and Action Leakage Rates were established for the current Landfill operation and are incorporated into this permit decision for the Phase 6 Landfill operation **(refer to condition #12).**

Leachate Sump

Leachate from both the primary and secondary leachate collection systems will flow to an internal sump located along the toe of the Phase 6 western sideslope, where submersible pumps will lift and transport leachate to either of the aboveground leachate storage tanks. The pump units are supplied with liquid level sensors and controls and recording flow monitors. Both the primary and the secondary leachate collection system flow rate will be recorded so that leachate generation volumes can be monitored and liner leachate leakage rates can be calculated.

Perforated 24-inch diameter HDPE piping was installed within the primary collection sump and the secondary sump. The 24-inch diameter pipes transition to 18-inch diameter solid wall riser pipes that extend up the side slope to the top of the perimeter waste containment berm. The submersible pump units, along with 3-inch diameter flexible discharge hose for the primary system and 2-inch diameter flexible hose for the secondary system, electrical and liquid level sensor leads were placed down the riser pipes and positioned within the sumps.

The primary collection system pump unit has a capacity of 130 gallons per minute ("gpm") or about 187,000 gallons per day ("gpd"), based on a peaking factor of 3 being applied to the calculated maximum daily leachate flow of approximately 62,245 gpd as determined by the HELP Model calculations. The secondary collection system pump unit has a capacity of 40 gpm or about 57,600 gpd based on a peaking factor of 3 being applied to an assumed maximum secondary leachate (leakage) flow rate of 1,000 gpd per acre of landfill liner (18,700 gallons per day).

The pump discharge lines were connected to the existing dual 4 inch force mains that are located along the western side line of the Landfill, which run to the existing leachate storage tank located to the east of the Phase 3, Stage 3 Landfill, and to a new 125,000 gallon above ground leachate storage tank, located south of the southwest corner of Phase 6. As of the date of this Approval, construction of the new leachate storage tank is not yet complete, and the Phase 6 sump will discharge to the existing storage tank. Upon completion and prior to operation of the new storage tank, MassDEP is requiring that the Applicant provide MassDEP with a written certification statement demonstrating the tank was constructed in accordance with MassDEP regulations, requirements, the Manual, and the approved design **(refer to condition #4).**

The Town has a contract with a third-party transporter to load and transport leachate from the leachate storage tank for disposal at the Covanta waste-to-energy facility or the Middleborough Water Pollution Control Facility via tanker trucks on an as-needed basis. The total quantity of landfill leachate generated will be recorded and the leachate quality will be monitored in accordance with the approved plan and the disposal agreements with Covanta, the Middleborough Water Pollution Control Facility, and any other leachate disposal location.

Stormwater Management System

Phase 6 landfilling operations will prevent stormwater run-off from areas outside the Phase 6 Landfill from draining into the Phase 6 Landfill area. This run-off will be diverted to the south to existing Stormwater Basin No. 2 located on the 25-acre parcel that is to the south of the Landfill parcel. Control of stormwater run-off along the western side of the Landfill area will be managed by existing facilities that discharge to Stormwater Basin No. 1, located in the northwest corner of the property. The design stormwater flow rates were analyzed for the stormwater retention basins utilizing HydroCAD Stormwater Modeling program, which utilizes the TR-20 method for run-off calculations.

The existing stormwater management system is designed to control run-off and run-on from the 25-year, 24-hour rainfall event during operations and after final closure.

Stormwater Basin No. 1 will provide about 585,400 cubic feet of storage, which exceeds the storage volume required to accommodate the run-off from a 25-year, 24-hour storm event (approximately 235,700 cubic feet) and is sufficient for managing the stormwater run-off from a 100-year storm event (approximately 379,800 cubic feet of storage) or from back-to back rainfall events.

Stormwater Basin No. 2 will provide about 777,400 cubic feet of storage, which exceeds the storage volume required to accommodate the run-off from a 25-year, 24-hour storm event (approximately 382,000 cubic feet) and is sufficient for managing the stormwater run-off from a 100-year storm event (approximately 551,700 cubic feet of storage) or from back-to-back rainfall events.

Landfill Gas Collection System

Landfill gas generated at the Landfill is collected, treated, and combusted on-site. The existing landfill gas collection system is comprised of vertical gas extraction wells connected to a main header system.

A conceptual design for the management of gas generated within the Phase 6 Landfill was submitted and includes the installation of 24 vertical landfill gas extraction wells with a 100 foot radius of influence, two temporary horizontal landfill gas collectors, gas condensate traps, and associated header pipes and control valves. The design also includes the installation of a new network of piping to collect generated landfill gases and convey them to a flare station for treatment. The existing flare station is located to the northeast of the Phase 2 Landfill area and prevents the occurrence of odors and the off-site migration of landfill gas.

The final details the landfill gas collection system will be submitted in a separate permit application prior to installation.

Financial Assurance Mechanism

The Town maintains a Financial Assurance Mechanism for closure and post closure costs. The Town has estimated a closure cost of $3,375,251.07 for Phase 6. The Town is funding the closure liability over a 4 year pay-in period. One payment totaling $843,812.77 has been made into the post closure fund. In accordance with 310 CMR 19.051 (12) (b) (2) the Town will review and adjust the Final Closure Cost Estimate and make subsequent payments to the Closure Account annually in March 2020, 2021, and 2022.

Deed Notice

A Notice of permit for Authorization to Construct the Phase 6 Landfill Expansion was recorded at the Barnstable County registry of Deeds on July 30, 2018.

Approval and Conditions

MassDEP has determined the ATO for Phase 6 (6.9 acres) application is satisfactory and in accordance with the authority granted pursuant to Massachusetts General Laws, Chapter 111, Section 150A, hereby approves the Phase 6 Construction Certification and authorizes solid waste disposal operations in Phase 6 of the Landfill subject to the following conditions:

1. Life of Permit: This Authorization to Operate permit shall be valid until Phase 6 reaches capacity or for a period of five (5) years, whichever comes first. This Authorization to Operate also supersedes Condition 1 of the October 15, 2014, Authorization to Operate Phase 4, Stage 2, in that Stage 2 may continue to operate in conjunction with Phase 6.

2. Reserve Capacity: Notwithstanding the capacity and waste-type restrictions in this permit, the Landfill may accept additional waste **upon request** to, and written approval by MassDEP. MassDEP may grant such approval if it determines that a capacity shortfall may occur, and that alternate disposal facilities are not able to handle the shortfall adequately.

3. Regulatory Compliance: The Town shall operate and maintain the Facility, including Phase 2A/3A, Stages 1 and 2, Phase 4, Phase 5, and Phase 6 in accordance with MassDEP regulations, requirements, the Manual, or as specified by this permit. This includes, but is not limited to, 310 CMR 19.043(5) *Standard Conditions*, 310 CMR 19.051 *Financial Assurance Requirements*, and 310 CMR 19.130 *Operation and Maintenance Requirements*. There shall be **no** deviation from the approved plan without prior written approval from MassDEP.

4. Leachate Storage Tank: Upon completion and prior to operation of the new storage tank, the Town shall submit a written certification statement from the supervising engineer demonstrating the tank was constructed in accordance with MassDEP regulations, requirements, the Manual, and the approved design. In addition, as part of this permit approval, the Town shall submit to MassDEP the final as-built layout drawing for the leachate storage tank. The submitted drawing shall depict the as-built leachate pump station, leachate storage tank, and all piping and appurtenances as shown in drawing titled "Leachate Storage Tank Site Plan" of the ATC Application for Phase 6.

5. Waste Types and Tonnage Limits: The Town may accept an average of 600 tons per day of waste with a maximum of 700 tons per day not to exceed 4,900 tons per week. The Town shall not accept more than 219,000 tons of waste for disposal per year. Waste approved to be disposed at the Landfill includes municipal solid waste (MSW), residual C&D material, ash and other non-MSW material. The definition of non-MSW for the purpose of this permit includes construction and demolition waste residuals from a C&D processing facility, bulky waste, difficult to manage waste, and other special wastes that have received prior written approval from MassDEP and only in accordance with Department policy.

The overall Facility tonnage, including recycling, composting, and disposal remains at a maximum materials acceptance rate of 825 tons per day as established during the EIR process.

6. Hours of Operation: The Town may operate the Facility seven days per week, fifty-two (52) weeks per year, Monday through Saturday 7:00 AM to 4:00 PM and Sunday from 7:00 AM to 12:00 PM.

6. Buffer Waste Layer: The Town shall use all appropriate care to protect the liner system when depositing the first lift of the waste into the cell.

7. Nuisance Conditions: The Town shall ensure that Facility operations do not create nuisance problems with vectors, odors, dust, noise, litter or other nuisance conditions. Measures shall be undertaken immediately to mitigate any potential impacts from nuisance conditions including temporarily ceasing operation on any given day. Operations shall be modified to prevent these conditions from reoccurring.

8. Landfill Gas Monitoring Consultant Services: The Town shall continue to engage the services of a third-party consultant, experienced in the optimization of the performance of landfill gas collections systems, to review the landfill gas collection system performance and advise the Town regarding necessary adjustments to the system vacuum and/or design based on temperature, methane, oxygen, and nitrogen levels. Performance data shall be collected at each landfill gas extraction well at least monthly, or more frequently as necessary. Adjustments to the landfill gas extraction rate shall be made as appropriate to maintain maximum efficiency, control landfill soil gas migration and emissions including odors. The results of each test and records of each adjustment to the landfill gas collection system shall be recorded and maintained on-site for MassDEP review upon request.

9. Waste Inspections: The Town shall conduct waste inspections for banned waste and other unacceptable materials in accordance with MassDEP's recycling rules, the approved Waste Ban Plan, or as required by this permit. Routine operations shall include supervised unloading and inspection of all waste for unacceptable materials including asbestos, hazardous materials, and waste ban materials. All unacceptable materials shall be managed in accordance with procedures contained in the operation and maintenance plan and as modified by this permit.

10. Asbestos Inspection Protocol: The Town shall adhere to the following protocol for testing and inspecting incoming waste material to prevent the acceptance and processing of Asbestos Containing Materials (ACM).

   a. A sign shall be posted at the entrance to the Facility identifying acceptable and unacceptable materials received at the Facility. The sign must clearly state that ACM is not accepted at the Facility.

b. An on-site asbestos inspector certified by the Massachusetts Department of Labor Standards Asbestos Program for landfill / transfer station type operations shall visually inspect all incoming loads of waste in order to determine the presence and/or likelihood of ACM. In addition to classroom certification, inspectors must have a minimum of forty (40) hours of on-the-job training and/or experience in identifying potential ACM and sampling protocols. A minimum of two employees shall maintain an asbestos inspector license. All other operations staff shall attend asbestos awareness class.

c. For each load where ACM is suspected the Town shall notify the MassDEP Southeast Regional Office, Solid Waste Management Section, by telephone (508) 946-2828 within two (2) hours after identifying the load as containing suspect ACM. The Town shall also submit a written report that identifies the source (name of hauler and vehicle license number), and, if known, the generator name and address, the type, quantity, handling procedures and disposition of the suspect ACM, to the MassDEP Southeast Regional Office, Solid Waste Management Section via facsimile (508-946-2865) within two (2) hours of observing the suspect ACM. If facsimile is not available, the Town shall notify the MassDEP Southeast Regional Office, Solid Waste Management Section via telephone within two (2) hours (508) 946-2828, and submit a written report via mail within twenty-four (24) hours, of observing the suspect ACM.

Pursuant to 310 CMR 19.061(2) certain asbestos-containing asphaltic roofing and siding materials may be disposed of in any landfill permitted by MassDEP to accept solid waste pursuant to 310 CMR 19.000. Provided the requirements of 310 CMR 7.15(10) "Requirements for the Removal of Asbestos-containing Asphaltic Roofing and Siding Materials" are followed and best management practices are used to prevent emissions at the Landfill, and if the Town determines that the only suspect ACM within a waste load is **intact** and **unbroken** vinyl asbestos tile and asphalt based asbestos-containing siding products and asphalt based asbestos-containing roofing materials, then the load may be disposed at the Landfill. The load does not require notification to MassDEP. The load should not be culled, compacted or otherwise handled in a manner that causes breakage of the suspect ACM material. Recyclable materials that are banned from disposal pursuant to 310 CMR 19.017, should be culled from the load prior to disposal, whenever this can be performed without causing a threat to worker safety and/or result in a discharge of asbestos to the environment. Recyclable materials that are likely to be contaminated by exposure to asbestos containing materials do not need to be culled and may be transferred for disposal.

11. Leachate Management: The Town shall operate and maintain the leachate collection and handling equipment at the Landfill in accordance with 310 CMR 19.130(30), the approved plan or as required by this permit. At a minimum, the Town shall conduct quarterly analysis of the leachate for the parameters listed at 310 CMR 19.132(2)(h) or as required to comply with the monitoring requirements and standards of all leachate disposal permits. The quantity of leachate generated shall be reported in the Facility Inspection reports required pursuant to Condition #16.

12. Leachate Monitoring: Upon commencement of operation of Phase 6, periodic Secondary Leachate Collection System (SLCS) flow rates shall be determined and submitted to

MassDEP bi-monthly, by the 15th calendar day of the subsequent month. SCLS flow rates shall be measured each week on a daily basis.

Notification Flow Rates (NTF) shall be one-hundred (100) gallons per acre per day (gpad) for any single day and an average of fifty (50) gpad, calculated on a 30-day running average basis.

Action Flow Rates (AFR) shall be two-hundred (200) gpad for any single day and an average one-hundred (100) gpad, calculated on a 30-day running average basis.

Unless otherwise approved by MassDEP, the Town shall, for each SLCS flow rate exceedance of either NFR, notify MassDEP by the next business day, evaluate the operations and maintenance at the Landfill, conduct an assessment to evaluate the appropriateness of the Notification Flow Rate, and take other actions as deemed appropriate by MassDEP.

If the SLCS exceeds either AFR, the Town shall notify MassDEP by the next business day, schedule a meeting with MassDEP, and submit an engineering evaluation report within thirty (30) days of the exceedance, unless an alternate schedule is approved by MassDEP.

MassDEP reserves the right to modify the NFR and the ALR and the frequency and/or method of SLCS measurements, and/or the required responses at any time.

13. Cover Requirements: The Town shall apply daily, intermediate, and final cover materials at the Landfill in accordance with 310 CMR 19.130(15), the approved plan, or as required by this permit.

14. Stormwater runoff: The Town shall control and collect all stormwater in contact with solid waste and/or daily cover within the Phase 6, leachate collection systems such that the contact water is not allowed to flow into unlined areas of the site.

15. Environmental Monitoring: At a minimum, the Town shall conduct quarterly environmental monitoring of all existing groundwater, surface water, and soil gas monitoring points at the Landfill in accordance with MassDEP regulations, as modified by MassDEP through review of monitoring data and the CSA. All sampling results including leachate sampling shall be submitted to MassDEP within 60-days after the scheduled sampling period or as required to notify MassDEP of any exceedances.

16. Facility Inspections: The Town shall provide for the Facility to be inspected on a bi-monthly basis by a Massachusetts Registered Professional Engineer, or other qualified professional approved by MassDEP. An inspection report shall be submitted to MassDEP no later than 14 days following the inspection. The report shall address all aspects of the Facility including the compost and recycling operations, the C&D transfer operations, all Landfill disposal operations, leachate volumes, leachate management, stormwater controls, and all other site features. The report shall indicate whether all

items are in compliance and propose remedies and establish a schedule for correcting any problems.

17. Records: The Town shall maintain daily logs at the Facility at all times to record the operational information required pursuant to 310 CMR 19.130(34) with copies periodically forwarded to the Board of Health. The Town shall retain copies of all personnel training records regarding operation and maintenance procedures, health and safety training, asbestos training, first aid, emergency procedures and any other training. All logs and records shall be available for Department review upon request.

18. Financial Assurance Mechanism: The Town shall continually maintain the approved financial assurance mechanism, revise the cost estimates, and submit the revised estimates in accordance with 310 CMR 19.051.

19. Annual Report: The Town shall submit an Annual Report to MassDEP by February 15th of each year which summarizes the facility operations for the previous calendar year on a form as provided by MassDEP.

20. Facility Modification(s): The Town shall submit a permit modification application to MassDEP for review and approval for any activities proposed to be conducted on the site assigned property including any construction or substantial changes or additions to site operations.

21. Local, State, Federal Requirements: The Town shall fully comply with all applicable local, state, and federal laws, regulations, and policies, by-laws, ordinances and agreements. Applicable federal regulations include, but are not limited to, 29 CFR Part 1910, OSHA standards governing employee health and safety in the workplace.

22. Permit Limitations: The issuance of this conditional approval is limited to the construction certification and operation of the Phase 6 (6.9 acres), lined disposal area and does not relieve the Town from the responsibility to comply with all other regulatory or permitting requirements. MassDEP reserves the right to require additional assessment or action, as deemed necessary to protect and maintain the environment free from objectionable nuisance conditions, dangers or threats to public health or the environment.

RIGHT TO APPEAL

Right to Appeal: This approval has been issued pursuant to M.G.L. Chapter 111, Section 150A, and 310 CMR 19.033: Permit Procedure for an Application for a Permit Modification or Other Approval, of the "*Solid Waste Management Regulations*". Pursuant to 310 CMR 19.033(5), any person aggrieved by the final permit decision, except as provided for under 310 CMR 19.033(4)(b), may file an appeal for judicial review of said decision in accordance with the provisions of M.G.L. Chapter 111, Section 150A and M.G.L. Chapter 30A no later than thirty days of issuance of the final permit decision to the Applicants. The standing of a person to file an appeal and the procedures for filing such an appeal shall be governed by the provisions of M.G.L. c. 30A. Unless the person requesting an appeal requests and is granted a stay of the terms and conditions of the permit by a court of competent jurisdiction, the permit decision shall be effective in accordance with the terms of 310 CMR 19.033(3).

Notice of Appeal: Any aggrieved person intending to appeal a final permit decision to the Superior Court shall first provide notice of intention to commence such action. Said notices of intention shall include MassDEP Authorization No. SW10-0000008 and shall identify with particularity the issues and reason why it is believed the final permit decision was not proper. Such notice shall be provided to the Office of General Counsel of MassDEP and the Regional Director for the regional office which processed the permit application, if applicable at least five days prior to filing of an appeal. The appropriate addresses to send such notices are:

Office of General Counsel
Department of Environmental Protection
One Winter Street
Boston, MA 02108

Regional Director
Department of Environmental Protection
20 Riverside Drive
Lakeville, MA 02347

No allegation shall be made in any judicial appeal of a final permit decision unless the matter complained of was raised at the appropriate point in the administrative review procedures established in 310 CMR 19.000, provided that a matter may be raised upon showing that it is material and that it was not reasonably possible with due diligence to have been raised during such procedures or that matter sought to be raised is of critical importance to the environmental impact of the permitted activity.

If you have any questions or comments regarding this approval letter, please contact me at (508) 946-2847 or Alison Cochrane (508) 946-2778 or at the letterhead address.

Very truly yours,

Mark Dakers, Chief
Bureau of Air and Waste
Solid Waste Management Section

D/AC
W:\BAW\Solid Waste\1 MUNICIPALITIES\Bourne\Landfill\Phase 6\ATO\Bourne Phase 6 ATO_SW10-0000008.doc

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DEP – SERO
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APPENDIX B-2

SITE ASSIGNMENT DOCUMENTS

COMMONWEALTH OF MASSACHUSETTS
TOWN OF BOURNE
BOARD OF HEALTH

In the Matter of: Town of Bourne Integrated Solid Waste Management Facility	)	Application for Major Modification of Site Assignment Application No. 21-SW38-001-APP

DECISION AND STATEMENT OF FINDINGS

I. INTRODUCTION

The Town of Bourne (the "Town") acting through the Department of Integrated Solid Waste Management (the "Applicant" or "ISWM") proposes to modify the existing Site Assignment for the 99-acre solid waste management facility on two parcels of land located at 201 MacArthur Boulevard, Bourne, Massachusetts (the "Facility" or the "Site" or the "Bourne Landfill"). The Applicant is seeking a Major Modification of an Existing Site Assignment ("Major Modification") to the Facility by way of vertical and horizontal expansion of the landfill cells to extend the life of the Bourne Landfill for several years.

The Applicant submitted an expanded Notice of Project Changes to the Massachusetts Environmental Policy Act Office (the "MEPA Office") of the Massachusetts Executive Office of Energy and Environmental Affairs ("EEA") in February 2020 to provide an updated site development plan to describe the proposed Bourne Landfill expansion. (Exhibit 3). On November 13, 2020, the Applicant submitted a Single Supplemental Environmental Impact Report ("SSEIR") to the MEPA Office. (Exhibit 3). On December 30, 2020, the Secretary issued a Certificate determining that the SSEIR adequately and properly complies with the Massachusetts Environmental Policy Act ("MEPA") and its implementing regulations. (Exhibit 3).

The Applicant submitted an Application for Site Suitability for a Major Modification of an Existing Site Assignment on March 29, 2021 to the Massachusetts Department of Environmental Protection ("MassDEP"). (Exhibit 3). MassDEP issued a Report on Suitability for Site Assignment (the "Report") on January 3, 2022 and determined the location suitable for the proposed use. (Exhibit 4). In accordance with 310 Code of Massachusetts Regulations ("CMR") 16.20, the Town of Bourne Board of Health (the "Board") provided public notice and conducted public hearings in regard to the Site Assignment Major Modification in February 2022. (Exhibit 5).

Upon review of the record, the Board has determined that the site is suitable for its proposed use and will not constitute a danger to the public health, safety or environment based on the siting criteria established in 310 CMR 16.40, and outlined in detail below.

II. STATEMENT OF FACTS

The Town owns and the Applicant operates the existing Facility on two parcels of land totaling 99 acres. A 74-acre parcel of land, recorded as Parcel ID No. 280-13-0 in the Assessor database of the Town, was initially site-assigned by the Bourne Board of Health in 1972, which allowed landfilling on this parcel. In 1989, the Town developed its residential recycling center and composting area adjacent to the Bourne Landfill. (Exhibit 1). In 2001, the Town acquired a 25-acre parcel to the immediate south of the 74-acre parcel. Based on the Assessor database of the Town, the 25-acre parcel of land is recorded under a Parcel ID No. 32.0-9-0. On January 28, 2005, the Applicant submitted to MassDEP an application for Major Modification relative to the proposed 25-acre expansion to allow for solid waste handling and processing. On April 19, 2005, MassDEP issued a BWP SW 38 Approval for Site Assignment Major Modification (Transmittal No. W057110) and a Site Suitability Report No. 036-001-B. Subsequently, on June 27, 2005, the Board site assigned the 25-acre parcel for solid waste handling and processing. (Exhibit 2).

The Bourne Landfill operations within the 74-acre parcel of land conducted to date have proceeded in the following order: Phase 1, Phase 2, Phase 3, Phase 2A/3A, Phase 4, Phase 5, and Phase 6. Phase 1 is an unlined and capped landfill area located in the northwest corner of the Facility. Phase 2 is an inactive and capped landfill area with a single composite liner. Phase 3, Phase 4, and Phase 5 are inactive double composite lined landfill areas. Phase 6 is an active double composite lined landfill area. The Applicant stated that Phase 6 is the final portion of the horizontal development of the existing Bourne Landfill on the 74-acre parcel and is anticipated to reach its approved final grades in late 2023. The existing Bourne Landfill has a footprint of approximately 56.86 acres. (Exhibit 3).

The Bourne Landfill is permitted by MassDEP to accept an average of 600 tons per day of waste with a maximum of 700 tons per day, not to exceed 4,900 tons per week, with a maximum annual disposal rate of 219,000 tons of waste per year. Waste approved to be disposed at the Bourne Landfill includes municipal solid waste ("MSW"), residual Construction and Demolition ("C&D") material, ash and other non-MSW material as defined in the Application. The Bourne Landfill accepts combustion ash from the Covanta waste-to-energy facility located in Rochester, Massachusetts ("SEMASS"), which currently constitutes the majority of the waste material accepted at the Bourne Landfill. The Town's contract with SEMASS requires the Bourne Landfill to accept and dispose of combustion ash at a rate of up to 189,000 tons per year. The Town utilizes the remaining 30,000 tons per year to dispose of biodegradable waste (i.e., MSW). (Exhibit 3).

Within the existing 25-acre site-assigned parcel, the Applicant operates a C&D transfer station, a single stream recyclable material transfer station, a residential recycling center (MSW, C&D, recyclables, organic wastes), an asphalt, brick and concrete ("ABC") stockpile and a brush and yard waste processing and composting operation. Offices and a salt shed are also on the parcel. The overall 99-acre Facility is permitted to accept up to 825 tons per day including recycling, composting, and a maximum of 700 tons per day of disposal. (Exhibit 2).

Under consideration for site assignment modifications at the Facility are the two separate parcels: 74-acre parcel and a 25-acre parcel. The first area under consideration is a proposed 17.34-acre horizontal expansion to the active and existing Bourne Landfill onto the 25-acre parcel that is currently site-assigned for solid waste handling. The modified site assignment would allow a landfill facility on approximately 17.34 acres of the 25-acre parcel. The proposed horizontal landfill expansion, designated as Phase 7 and Phase 8, consists of approximately 17.34 acres of new landfill cells. The Applicant submitted a Schematic Site Buildout Plan and a Proposed Site Assignment Modifications plan that depicts the limit of site assignment modifications for Phase 7 and Phase 8. Although the proposed area of waste deposition is not shown on the plans, all areas of waste deposition are limited to the limit of site assignment modifications for Phase 7 and Phase 8 as depicted. (Exhibit 3).

The second area under consideration for site assignment modifications is a proposed vertical expansion which would increase the maximum permitted height of the Bourne Landfill by 40 feet from elevation 185-ft mean sea level ("MSL") to elevation 225-ft MSL. The proposed vertical landfill expansion, designated as Phase 9, footprint is approximately 28.08 acres and lies entirely within the existing Bourne Landfill areas located on the 74-acre site-assigned parcel of land. The Applicant submitted a Schematic Site Buildout Plan that depicts the "Future Phase 9 Landfill Area" or the approximate area of waste deposition for Phase 9. (Exhibit 3).

Phase 7, Phase 8, and Phase 9 would provide approximately 5,175,000 cubic yards of disposal capacity and would extend the life of the Bourne Landfill for several years. The Bourne Landfill is currently permitted to receive an average of 600 tons per day, with a maximum on any given day of 700 tons, a weekly cap of 4,900 tons and a yearly cap of 219,000 tons. The overall Facility tonnage, including recycling, composting, and disposal remains at a maximum materials acceptance rate of 825 tons per day. The Applicant is not proposing any additional tonnage capacity in this Application. (Exhibit 3).

III. STATEMENT OF PROCEEDINGS

A. Other Regulatory Proceedings

Pursuant to the provisions of M.G.L. c. 30, §§ 61-62I and 310 CMR 11.00, the Applicant submitted an expanded Notice of Project Changes to the MEPA Office in February 2020 to provide an updated site development plan for the Bourne Landfill and describe the development of Phase 7, Phase 8 and Phase 9 of the Bourne Landfill expansion. The Applicant then submitted a SSEIR on November 13, 2020. (Exhibit 3). On December 30, 2020, the Secretary issued a Certificate determining that the SSEIR adequately and properly complies with MEPA and its implementing regulations. (Exhibit 3). The Application was submitted electronically to MassDEP on March 29,

2021. On May 12, 2021, MassDEP determined the Application was Administratively Complete. On May 25, 2021, MassDEP issued a letter of Request for Information ("RFI") to clarify the Application. On August 3, 2021, the Applicant submitted a Response to the RFI. (Exhibit 3).

During the MEPA review process, MassDEP provided clarification of the site assignment process as it pertains to the Phase 9 vertical expansion. The site assignment regulations at 310 CMR 16.22(2) state, in relevant part, that; "Modifications deemed to be 'Major Modifications' include" ... "vertical expansions beyond the limits of an approved plan". Therefore, MassDEP determined that the Phase 9 vertical expansion constitutes a Major Modification to the Site Assignment. 310 CMR 16.22(2) further provides that "A major modification shall require submittal of a new site assignment application that addresses all criteria affected by the modification, as determined by MassDEP in writing, and shall be reviewed in accordance with the requirements established at 310 CMR 16.08 through 16.20." Within MassDEP's comments on the Expanded Notice of Project Change, MassDEP determined, in writing, that the following criteria should be addressed for Phase 9: 16.40(4)(b) Traffic and Access to the Site; 16.40(4)(f) Potential Air Quality Impacts; 16.40(4)(g) Potential for the Creation of Nuisances; 16.40(4)(h) Size of Facility; 16.40(4)(i) Areas Previously Used for Solid Waste Disposal; 16.40(4)(k) Consideration of Other Sources of Contamination or Pollution; and 16.40(5) Promotion of Integrated Solid Waste Management. (Exhibit 3).

MassDEP previously determined that the site assignment application for the vertical expansion did not require addressing the Facility Specific criteria at 310 CMR 16.40(3)(a). Regarding Phase 7 and Phase 8, the horizontal expansion constitutes "Expand a Site" and requires a Modification to the Site Assignment pursuant to 310 CMR 16.22(2). MassDEP determined that the application for the Major Modification for Phase 7 and Phase 8 shall address all the site suitability criteria contained within 310 CMR 16.40(3)(a) Criteria for Landfill Facilities and 16.40(4) General Site Suitability Criteria. (Exhibit 3).

Accordingly, pursuant to the requirements of 310 CMR 16.00, Site Assignment Regulations for Solid Waste Facilities (hereinafter the "Regulations"), an Application for Site Suitability for a Major Modification of an Existing Site Assignment was submitted by SITEC Environmental, Inc. on behalf of the Applicant on March 29, 2021. (Exhibit 3). MassDEP assigned Report Number 036-001-C to this permit application. The Applicant submitted revised plans and figures on April 20, 2021 in accordance with the comments MassDEP provided during a verbal discussion on April 16, 2021. In response to MassDEP's Request for Additional Information issued on May 12, 2021, supplemental application information was submitted on August 4, 2021. (Exhibit 3).

At the time the project completed MEPA review in December 2020 and when the Applicant submitted a site suitability application (BWP SW 38) to MassDEP on March 29, 2021, there was no mapped Environmental Justice ("EJ") Population within one (1) mile of the proposed site assignment modifications or within the Town of Bourne. In accordance with Massachusetts Executive Office of Energy and Environmental Affairs, EJ Policy, there are additional requirements (e.g., enhanced public participation, enhanced analysis) during MEPA review for a project that triggers a MEPA threshold and is located within one mile of an EJ Population. However, since there was no EJ Population within one (1) mile when the Bourne Landfill expansion project underwent MEPA review, enhanced public participation and/or enhanced analysis did not apply. (Exhibit 4).

However, in June 2021, EJ maps were updated using the 2019 American Community Survey data and the new EJ population definitions in the EEA EJ policy that MassDEP is required to implement. Based on the update, there is a mapped EJ population with the criteria "Income" immediately abutting the Site. The mapped area is Joint Base Cape Cod and is identified as Block Group 1, Census Tract 141, Barnstable County, Massachusetts. The EJ block group has a total area of roughly 17 square miles and a population of 949. Although MassDEP could not identify any residents of the EJ population within one (1) mile of the proposed site assignment modifications and despite that there is no regulatory/statutory requirement to do so, to meet the intent of EEA 's EJ Policy, MassDEP encouraged the Town to consider voluntarily performing the enhanced public outreach that would have been required had the EJ population definition been available at the time the project completed MEPA review. (Exhibit 4).

In accordance with EEA's EJ Policy, MassDEP has obligations as an agency to establish a public involvement plan ("PIP") that focuses agency resources on outreach activities that enhance public participation opportunities for agency activities that potentially affect EJ populations. Since the Facility directly abuts an EJ Population and there are three additional mapped EJ Populations within the Town of Bourne, MassDEP prepared a PIP and conducted outreach activities to encourage EJ community engagement. In response, the Applicant contacted potentially affected EJ populations, specifically at Joint Base Cape Cod. The Applicant provided information in accordance with MassDEP's recommendations to the United States Coast Guard and the separate commands at the base, as well as other local groups for distribution. (Exhibit 4).

B. Publication of Notice and Opportunity for Comment

In accordance with M.G.L c. 111, §§ 150A and 150A½ and the corresponding regulations under 310 CMR 16.00, on September 24, 2021, MassDEP received documentation that public notice was published in the Bourne Courier on July 14, 2021 and the Bourne Enterprise on July 9, 2021. (Exhibit 3). On October 12, 2021, MassDEP received documentation that public notice was sent via Certified Mail to the parties listed at 310 CMR 16.08(2). Accordingly, MassDEP accepted public comments for twenty-one (21) days, between October 13, 2021 and November 3, 2021. MassDEP received correspondence from interested parties including organizations and private citizens.

On November 10, 2021 MassDEP issued correspondence to the Applicant requiring a formal response to public comments. On November 22, 2021, the Applicant submitted responses to public comments. (Exhibit 3).

Pursuant to the Regulations, the MassDEP determined that the location is suitable for the proposed use, and issued Report #036-001-C on January 3, 2022. (Exhibit 4). In accordance with 310 CMR 16.20, a public hearing notice of the proposed site assignment major modification was published in the Cape Cod Times on January 10, 2022 and mailed certified notices to required parties under the Regulations. (Exhibit 5). Notice was also posted under the open meeting law and on the Town's website. On February 1, 2022, a Participant registered in accordance with the Regulations. (Exhibit 5).

C. Selection of the Hearing Officer

In accordance with 310 CMR 16.20(11), the Board selected John F. Shea, Esq. of Macke Shea Durning, PC to serve as the Hearing Officer. Attorney Shea conducted pre-hearing conferences with counsel to the Applicant, Michelle N. O'Brien, Esq., and counsel to the Board, Steven Torres, Esq., and issued a Prehearing Order and Report (Revised January 18, 2022). (Exhibit 6). Among other things, the Hearing Officer ordered the Applicant to submit its pre-filed written direct testimony by January 26, 2022. (Exhibit 6).

D. Public Hearing

The Board received two public comments prior to the commencement of the hearing. On January 17, 2022, the Board received an email message from Richard Jordan of Avon, Massachusetts and Barnstable, Massachusetts. (Exhibit 9). On January 26, 2022, the Conservation Law Foundation ("CLF") submitted a letter to the Board regarding Initial Comments to Proposed Site Assignment Major Modification with a copy of a comment letter dated November 3, 2021 previously submitted to MassDEP. (Exhibit 8). The Applicant submitted a response to the CLF comments on January 31, 2022. (Exhibit 14). On February 1, 2022, Steven MacNally of Bourne submitted to the Board a registration statement to be included as a Participant in the site assignment hearing, as defined in 310 CMR 16.20(9)(d). (Exhibit 16). Mr. MacNally stated that he lives downgradient of the Site and may be impacted by the future vertical and horizontal expansion of the facility. (Exhibit 16).

In accordance with the thirty (30) day requirement, the public hearing was opened February 2, 2022 and continued to February 16, 2022[1]. During this time, the Applicant presented witness testimony from two witnesses, A. Raymond Quinn, P.E. and Daniel T. Barrett, and a Ten Citizens Group sought Party status under the regulations. (Exhibits 7; 10-11). The Ten Citizens Group (the "Group") was granted Party status, with the CLF as the Group's Authorized Representative, at the February 2, 2022 hearing, upon resubmission of its original Registration. (Exhibit 20). The Group submitted curative pleadings to the Board on February 4, 2022. (Exhibits 22-24). At the February 2, 2022 hearing, the Hearing Officer ordered the Group to file pre-filed testimony in accordance with the regulations by February 9, 2022 for review by the Board.

On February 9, 2022 the Group filed a "Prefiled Presentation Summary" for two witnesses, Lisa Cote and Laura Orlando. (Exhibits 30-31). The Board's engineer, David Murphy, P.E. from Tighe

[1] A stenographer recorded the hearings, and a local cable access channel video recorded the hearings as well.

& Bond, also filed his pre-filed testimony on February 9, 2022. (Exhibit 28). In addition, the Applicant submitted additional pre-filed testimony. (Exhibit 26). The pre-filed testimony of David Murphy, P.E. as well as the Applicant's witnesses were accepted into the record.

On February 11, 2022, the Applicant submitted a Motion to Strike the Group's "Pre-filed Presentation Summar[ies]" on the grounds that they did not comply with the Site Assignment Regulations or the Hearing Officer's procedural orders. (Exhibits 32-33). This Board's counsel submitted a memorandum in agreement of this motion on February 14, 2022. (Exhibit 34). The Hearing Officer heard arguments by the Applicant and the Group regarding the motion on February 14, 2022, and on February 15, 2022, ruled that the pre-filed testimony submitted by the Group was insufficient and granted the motion. (Exhibit 35). Due to the Hearing Officer's ruling, the pre-filed testimony submitted by the Group was not accepted into the record.

The continued public hearing was conducted February 16, 2022 at which time the Applicant testified in accordance with the submitted supplementary pre-filed testimony. The Applicant's witnesses were cross-examined by the Group. The registered Participant waived his right to testify under the regulations. The Board's Engineer, Tighe & Bond, acting through David Murphy, P.E. testified consistently with his pre-filed testimony. The Hearing Officer closed the presentation of evidence into the record, instructed the Applicant and the Group (hereinafter, the "Parties") to file Recommendations for Determination by February 23, 2022. The Hearing Officer admitted 35 exhibits into the official record. The hearing was called to a close by the Board.

In accordance with 310 CMR 16.20, the Board had forty-five (45) days from the initial date of the public hearing to issue its decision. As required by the regulations, "every final decision shall be in writing and shall be signed by a majority of those officials of the board who rendered the decision. Every final decision shall contain a statement of the reasons therefore, including a determination of fact pertaining to each of the site suitability criteria listed in 310 CMR 16.40 or law necessary to the decision." 310 CMR 16.20(10)(k)(4).

I. STANDARD OF DECISION

MassDEP issued the Report on November 3, 2021, with findings that the Site meets the site suitability criteria set forth in the Site Assignment Regulations. (Exhibit 3). In accordance with 310 CMR 16.15(2), the Board was required, after receipt of the Report, to hold a public hearing pursuant to 310 CMR 16.20 "for the purpose of deciding whether to grant or refuse to grant a site assignment for the parcel for which is the subject of the [Report]."

As codified in 310 CMR 16.20(10)(k)(2), this Board "shall determine that a site is suitable for assignment as a site for a new or expanded solid waste facility unless it makes a finding, supported by the record of the hearing, that the siting thereof would constitute a danger to the public health, safety or environment, based on the siting criteria set forth and established under 310 CMR 16.40."

II. <u>STATEMENT OF FINDINGS AND CONFORMANCE WITH SITE SUITABILITY CRITERIA</u>

Upon review of the Record, the Board finds that the Site is suitable for the proposed Major Modification. Pursuant to 310 CMR 16.22(2), "A major modification shall require submittal of a new site assignment application that addresses all criteria affected by the modification, as determined by MassDEP in writing, and shall be reviewed in accordance with the requirements established at 310 CMR 16.08 through 16.20."

For the vertical expansion, designated as Phase 9, MassDEP previously determined the site assignment application for the vertical expansion should **not** address the Facility Specific Criteria at 310 CMR 16.40(3)(a). For the horizontal expansion, designated as Phase 7 and Phase 8, the Applicant has addressed all the Facility Specific Criteria.

For Phase 9, MassDEP has determined that the site assignment application for the vertical expansion should address the following General Facility Criteria: 16.40(4)(b) Traffic and Access to the Site; 16.40(4)(f) Potential Air Quality Impacts; 16.40(4)(g) Potential for the Creation of Nuisances; 16.40(4)(h) Size of Facility; 16.40(4)(i) Areas Previously Used for Solid Waste Disposal; 16.40(4)(k) Consideration of Other Sources of Contamination or Pollution; and 16.40(5) Promotion of Integrated Solid Waste Management. For Phase 7 and Phase 8, the Applicant has addressed all the General Facility Criteria at 310 CMR 16.40(4).

The Board has determined the following Facility Specific Criteria have been met:

A. Facility Specific Site Suitability Criteria, 310 CMR 16.40(3)(a)

No site assignment shall be determined to be suitable or be site assigned as a landfill facility where:

1. *<u>any area of waste deposition would be within a Zone II area of an existing public water supply well;</u>*

Upon review of the Report, Tighe & Bond Engineer's Report on Site Suitability ("Engineer's Report"), and the Record, the Board confirmed that the proposed waste deposition area of Phase 7 and Phase 8 is not within the Zone II area of an existing public water supply well.

Accordingly, the Board finds that the Site **MEETS** this criterion.

2. *<u>any area of waste deposition would be within the Interim Wellhead Protection Area (IWPA) of an existing public water supply provided that the proponent may conduct a preliminary Zone II study, approved of by the Department, to determine if the facility would be beyond the Zone II of the public water supply well in question;</u>*

The Applicant stated that the Facility is not within the Interim Wellhead Protection Area ("IWPA") of an existing public water supply. Furthermore, the Board determined that according to the Applicant's submitted Water Resources Plan, the proposed waste deposition area is not within the IWPA of an existing public water supply and that the nearest IWPA is located approximately 2 miles to the north - northwest.

Accordingly, the Board finds that the Site **MEETS** this criterion.

3. *any area of waste deposition would be within a Zone II or Interim Wellhead Protection Area (IWPA) of a proposed drinking water source area, provided that the documentation necessary to obtain a source approval has been submitted prior to the earlier of either the site assignment application, or if the MEPA process does apply, the Secretary's Certificate on the Environmental Notification Form or Notice of Project Change, or where applicable, the Secretary's Certificate on the EIR or Final EIR;*

The Applicant submitted a letter from the Board acknowledging Section 5.3 of the local Health Regulations that prohibit the installation of any public or private water supply wells downgradient of the Site. 310 CMR 16.02 defines a "Proposed Drinking Water Source Area" as the preliminary Zone II or the preliminary IWPA for a proposed water supply well that has received a site exam approval by the Department and is actively pursuing source approval as a public water supply. Currently, there are no applications pending for a proposed drinking water source area within a three-mile radius of the proposed waste deposition areas for Phase 7 and Phase 8.

Upon review of the Report, Engineer's Report, the Record, and the Town's June 6, 2020 letter, the Board finds that the waste deposition areas proposed in the Application for Phase 7 and Phase 8 will not be located within a Zone II or IWPA of a proposed drinking water source area.

Accordingly, the Board finds that the Site **MEETS** this criterion.

4. *any area of waste deposition would be within 15,000 feet upgradient of the existing public water source well or proposed drinking water source area for which a Zone II has not been calculated; the proponent may conduct a preliminary Zone II study, approved of by the Department, to determine if the facility would be beyond the Zone II of the public water supply well or proposed drinking water source area in question;*

The Board has confirmed upon review of the Record and the Report, that the nearest public water source (ID #4036000-08G) is located approximately 0.5 miles south and cross-gradient (not downgradient) of the proposed waste deposition areas of Phase 7 and Phase 8. The Board has further confirmed that the proposed waste deposition areas are not located upgradient of any existing public water supply wells; and that there are no existing public water supply wells located west/northwest of the Bourne Landfill between the Bourne Landfill and Buzzards Bay.

Accordingly, the Board finds that the Site **MEETS** this criterion.

5. *it is determined by the Department that a discharge from the facility would pose a danger to an existing or proposed drinking water source area;*

The Applicant stated that the nearest public drinking water supply is approximately 0.83 miles south and not downgradient to the proposed waste deposition area. The Applicant submitted a letter from the Bourne Water District dated May 26, 2020 stating that the "Bourne Water District does not have a wellfield downgradient from the Bourne Sanitary Landfill." In addition, the letter stated that all areas downgradient of the Bourne Landfill are connected to the town's public water system.

The Applicant stated that the groundwater protection system for proposed Phase 7 and Phase 8 will be a double composite liner and monitoring that will meet MassDEP's requirements. The Applicant further stated that the groundwater protection system will intercept and collect leachate that passes through the waste, protecting groundwater quality within the area of the Bourne Landfill.

The Board has confirmed that Zone II is approximately 0.5 miles from the proposed waste deposition area and that there is no IWPA within the one-half mile radius from the proposed waste deposition area. The Site is not located upgradient of any existing public water supply well; there are no existing public water supply wells located west/northwest of the Bourne Landfill between the Bourne Landfill and Buzzards Bay.

Accordingly, the Board finds that the Site **MEETS** this criterion.

6. *any area of waste deposition would be over the recharge area of a Sole Source Aquifer, unless all of the following criteria are met:*
   a. *there are no existing public water supplies or proposed drinking water source areas downgradient of the site;*
   b. *there are no existing or potential private water supplies downgradient of the site; however, the applicant may have the option of providing an alternative public water supply to replace all the existing or potential downgradient private groundwater supplies; and*
   c. *there exists a sufficient existing public water supply or proposed drinking water source area to meet the municipality's projected needs;*

The Board has concluded that the Site is located over the Cape Cod Sole Source Aquifer, as designated by the Environmental Protection Agency ("EPA"). Accordingly, the Site must meet each criterion stated above.

The Applicant submitted a Water Resources Plan encompassing a ½ mile radius from the Site and indicated that there are no public or private water supply wells within the mapped area. The nearest public water source (ID #4036000-08G) is a Zone II area located approximately 0.5 miles south and cross-gradient (not downgradient) from the proposed waste deposition areas of Phase 7 and Phase 8. In its Report, MassDEP determined that the Site is not located upgradient of any existing public water supply well; there are no existing public water supply wells located west/northwest of the Bourne Landfill between the Bourne Landfill and Buzzards Bay.

The land upgradient of Phase 7 and Phase 8 is vacant land owned by Joint Base Cape Cod ("JBCC") and has been determined that there are no residents located within 1,000 feet upgradient of Phase 7 and Phase 8. The land cross-gradient of Phase 7 and Phase 8 is vacant land to the south and the existing Bourne Landfill to the north and MassDEP determined that there are no residents within 1,000 feet cross-gradient of Phase 7 and Phase 8. Additionally, all areas downgradient of the Bourne Landfill are connected to the Town's public water system.

The Applicant stated that the water supply for the Town is provided by the Bourne Water District ("BWD"), which is supplied by ten different sources. In addition, the Town was connected by a metering station at Connery Avenue to the other wells of the Upper Cape Regional Water Supply Cooperative (the "Cooperative") which have a total permitted yield of three million gallons per day ("MGD"). The Applicant states that the Cooperative allows BWD to obtain water along with other cooperative members (Sandwich Water District, Falmouth, Mashpee and JBCC) to withdraw any needed supplemental water from the legislatively established Upper Cape Water Supply Reserve.

The Applicant has demonstrated there are no existing or potential private water supplies downgradient of the Site, nor are there any applications pending for proposed drinking water sources within a three-mile radius of the proposed waste deposition area of Phase 7 and Phase 8. Furthermore, the Applicant demonstrated there exists a sufficient existing public water supply or proposed drinking water source area to meet the municipality's projected needs.

Accordingly, the Board finds that the Site **MEETS** this criterion.

7. *any area of waste deposition is within the zone of contribution of an existing public water supply or proposed drinking water source area, or the recharge area of a surface drinking water supply, pursuant to a municipal ordinance or by-law enacted in accordance with M.G.L. c. 40A, § 9;*

Upon review of the Report, Engineer's Report, the Record, and Section 5.3 of the Board's regulations prohibiting drinking water supplies downgradient of the site, the Board confirmed that the nearest public water source (ID #4036000-08G) is a Zone II area located approximately 0.5 miles south and cross-gradient (not downgradient) from the proposed waste deposition areas of Phase 7 and Phase 8. According to the Report, MassDEP has reviewed its file and confirmed that there are no applications pending for a proposed drinking water source area within a three-mile radius of the proposed Site.

The Applicant submitted a Water Resources Districts and Zone II Map depicting that the proposed Site is not within an area designated as a Bourne Water Resource District, a Buzzards Bay Water Resource District, or a North Sagamore Water Resource District.

Accordingly, the Board finds that the Site **MEETS** this criterion.

8. *any area of waste deposition would be within the Zone A or Zone B of a surface drinking water supply;*

Upon review of the Report, Engineer's Report, and the Record, the Board has confirmed that the nearest mapped Zone A or Zone B Surface Drinking Water Supply Protection Zones (for the Long Pond Reservoir) is located approximately 9 miles south of the proposed waste deposition area.

Accordingly, the Board finds that the Site **MEETS** this criterion.

9. *any area of waste deposition would be less than 400 feet upgradient, as defined by groundwater flow or surface water drainage, of a perennial water course that drains to a surface drinking water supply which is within one mile of the waste deposition area;*

Upon review of the Report, Engineer's Report, and the Record, the Board determined that the nearest surface water drinking supply (the Long Pond Reservoir) is located approximately 9 miles south of the proposed waste deposition area. Therefore, the Board has determined that the proposed waste deposition areas will not be located less than 400 feet upgradient of a perennial water course that drains to a surface drinking water supply which is within one mile of the waste deposition area.

Accordingly, the Board finds that the Site **MEETS** this criterion.

10. *any area of waste deposition would be within a Potentially Productive Aquifer unless:*
    a. *the proponent demonstrates to the Department's satisfaction, based on hydrogeological studies, that the designation of the area as a potentially productive aquifer is incorrect;*
    b. *the proponent demonstrates to the Department's satisfaction, based on hydrogeological studies, that the aquifer cannot now, nor in the reasonably foreseeable future, be used as a public water supply due to existing contamination of the aquifer; or*
    c. *the area has been excluded as a "Non-Potential Drinking Water Source Area" pursuant to 310 CMR 40.0932, or as otherwise defined at 310 CMR 40.0006: The Massachusetts Contingency Plan.*

The Applicant has identified contamination sources downgradient of the Site, in particular Phases 7 and 8, as two closed and unlined landfills in the Town of Bourne (Brookside Development Corp. Landfill and Nightingale Stump Landfill). The Brookside Development Corp. Landfill is approximately 0.5 miles southwest of the proposed modifications and was closed in 1968 and capped in 1996. Additionally, the Nightingale Stump Landfill is approximately 0.5 miles west and was closed in 1989. The Applicant in its Application stated that portions of the aquifer beneath the highway corridor associated with MacArthur Boulevard, and some areas west of MacArthur Boulevard have been classified as "Non-Potential Drinking Water Source Areas" in accordance with the Massachusetts Contingency Plan ("MCP").

MassDEP approved the permit application for a BWP SW23 Comprehensive Site Assessment ("CSA") to the Town of Bourne - Department of Integrated Solid Waste Management on June 5, 2017. The CSA identified the primary sources of contaminants detected in groundwater samples collected from the environmental monitoring network are the unlined landfill, former septage lagoons and Department of Public Work ("DPW") facility. Leachate from the unlined landfill has degraded water quality downgradient of the Bourne Landfill. The unlined landfill has been capped and closed in accordance with solid waste regulations to reduce leachate generation. The former wastewater lagoons were located at the northeastern of the comer of the property, which dumping of septage ceased in 1991 and the lagoons have been decommissioned by removing the accumulated sludge and underlying soils. All underground storage tanks (USTs), which were part of the DPW facility, have been removed from the site and five floor drains in the DPW garage were connected to an underground tight tank with oil water separator.

The Applicant stated that the Town of Bourne has put in place institutional controls (i.e., Board of Health Regulation) to prevent future installation of private and public wells from being located downgradient of the Bourne Landfill and that drinking water from the Bourne Water District distribution system is available in all areas hydraulically downgradient of the Bourne Landfill.

Upon review of the Report, Engineer's Report, and the Record, the Board determined that the Site is located within a Potentially Productive Aquifer. The Board also reviewed the CSA, MassDEP's approval of the CSA, and Section 5.3 of the Board of Health's regulations prohibiting drinking water supplies downgradient of the Site. In its review, the Board determined that based on hydrogeological studies, the aquifer cannot now, nor in the reasonably foreseeable future, be used as a public water supply due to existing contamination of the aquifer.

Accordingly, the Board finds that the Site **MEETS** this criterion.

11. *any area of waste deposition would be within 1,000 feet upgradient, and where not upgradient, within 500 feet, of a private water supply well existing or established as a potential supply at the time of submittal of the application; provided, however, the applicant may show a valid option to purchase the restricted area, including the well and a guarantee not to use the well as a drinking supply, the exercise of which shall be a condition of any site assignment;*

Upon review of the Report, Engineer's Report, and the Record, the Board has determined that the proposed waste deposition area for Phase 7 and Phase 8 will not be within 1,000 feet in any direction of an existing or potential private water supply well. During the assessment process, the Applicant conducted private well surveys to identify all private wells in the vicinity of the Bourne Landfill, including downgradient, upgradient and cross-gradient. All private wells that were identified in the landfill plume, adjacent to the plume, and/or in close proximity to the Bourne Landfill were connected to the public water supply system. The land upgradient of Phase 7 and Phase 8 is vacant land owned by Joint Base Cape Cod and it has been determined that there are no residents located within 1,000 feet upgradient of Phase 7 and Phase 8. The land cross-gradient of Phase 7 and Phase 8 is vacant land to the south and the existing Bourne Landfill to the north and it has been determined that there are no residents within 1,000 feet cross-gradient of Phase 7 and Phase 8.

Accordingly, the Board finds that the Site **MEETS** this criterion.

12. *the maximum high groundwater table is within four feet of the ground surface in areas where waste deposition is to occur or, where a liner is designed to the satisfaction of the Department, within four feet of the bottom of the lower-most liner;*

Pursuant to 310 CMR 16.40(1)(c), site suitability applications shall be evaluated with the presumption that the proposed facility shall be designed and constructed to meet all relevant state and federal statutory, regulatory and policy requirements. The review of an application does not consider detailed facility design or operations except where:

a. the Department determines that specific design or operation plans or data are necessary to determine whether potential discharges or emissions from the proposed facility could render the site not suitable and requires the applicant to submit such relevant and detailed information; or
b. the applicant intends to alter the site or design the facility to meet specific site suitability criteria and submits such plans or other information as the Department deems necessary to determine if the criteria are satisfied.

The Applicant stated that the lowest point of elevation where the Phase 7 liner joins to the Phase 6 will be at 52 feet MSL. The groundwater elevation at this area is at 46.5 feet MSL. The lowest point of elevation for Phase 8 will be in the leachate sump area at 51.5 feet MSL. The groundwater elevation at this area is 47.4 feet MSL. The Applicant submitted the Groundwater Contour Plan that shows the estimated maximum groundwater elevations for the Bourne Landfill area, based on historical maximum groundwater elevations in groundwater monitoring wells located around the perimeter of the Bourne Landfill, including the area for the proposed modifications. Based on the data presented, the Applicant has demonstrated that there will be a four-foot separation of the base of the liner above the maximum calculated groundwater surface.

The Board reviewed the application inclusive of the proposed double composite liner design, the Groundwater Contour Plan and the information provided by Geoscience on July 1, 2021. Upon review of the Report, Engineer's Report, the Record, and the Application, the Board determined that there will be a minimum four-foot separation from maximum high groundwater to the base of the liner in Phases 7 and 8.

Accordingly, the Board finds that the Site **MEETS** this criterion.

13. *the outermost limits of waste deposition or leachate containment structures would be within a resource area protected by the Wetlands Protection Act, M.G.L. c. 131, § 40, including the 100 year floodplain;*

Upon review of the Report, Engineer's Report, and the Record, the Board determined that the outermost limits of waste deposition or leachate containment structures are not within a resource area protected by the Wetlands Protection Act, M.G.L c. 131, § 40, including the 100-year floodplain.

Accordingly, the Board finds that the Site **MEETS** this criterion.

14. *any area of waste deposition or the leachate containment structures would be less than 400 feet to a lake, or 200 feet to a Riverfront Area as defined in 310 CMR 10.00, that is not a drinking water supply;*

Upon review of the Report, Engineer's Report, and the Record, the Board determined that the Site is not located within 400 feet of a lake or within 200 feet of a riverfront area.

Accordingly, the Board finds that the Site **MEETS** this criterion.

15. *any area of waste deposition would be within 1,000 feet of an occupied residential dwelling, health care facility, prison, elementary school, middle school or high school or children's pre-school, licensed day care center, senior center or youth center, excluding equipment storage or maintenance structures; provided, however, that the applicant may show a valid option to purchase the restricted area, the exercise of which shall be a condition of any site assignment;*

The Applicant stated that a Global Positioning Survey ("GPS") survey was conducted to locate the closest occupied residential dwelling, which has been identified to be within the Bay View Campground. Pursuant to the definitions under the Town's Zoning Laws, the facilities within the campgrounds are intended for temporary overnight facilities and not for human habitation or occupied residential dwelling.

Additionally, the Applicant submitted a Land Use Plan in the Application encompassing a ½ mile radius from the Site. The Land Use Plan shows the location of the closest occupied residential dwelling just outside the 1,000-foot offset line from the waste deposition area for Phase 7 and Phase 8. The Land Use Map shows a healthcare facility at 146 MacArthur Boulevard, approximately 3,500 feet north of the waste deposition area for Phase 7 and Phase 8. The Land

Use Plan does not show any prisons, elementary schools, middle schools, high schools, children's preschools, licensed day care centers, or senior or youth centers within the mapped area.

Upon review of the Report, Engineer's Report, and the Record, the Board determined that the proposed waste deposition area for Phase 7 and Phase 8 will not be within 1,000 feet of an occupied residential dwelling, health care facility, prison, elementary school, middle school or high school or children's pre-school, licensed day care center, senior center or youth center, excluding equipment storage or maintenance structure.

Accordingly, the Board finds that the Site **MEETS** this criterion.

16. *waste deposition on the site would result in a threat of an adverse impact to groundwater through the discharge of leachate, unless it is demonstrated to the satisfaction of the Department that a groundwater protection system will be incorporated to prevent such threat.*

The Application stated that a groundwater protection system (double composite liner system with interstitial leak detection) in compliance with current MassDEP regulations will be incorporated into the design of Phase 7 and Phase 8. There are no wells, private or public, allowed to be constructed, for human consumption, if its placement is hydraulically downgradient of the Bourne Landfill. Furthermore, the Board does not permit the construction of potable wells downgradient from the Bourne Landfill and these areas are connected to the public water system.

In the Application, the Applicant stated that the Facility has been monitoring groundwater quality in its vicinity and downgradient of the Bourne Landfill, in accordance with the MassDEP's approved quarterly groundwater monitoring program, since 1997. The Applicant stated that the monitoring record shows monitored groundwater quality has improved, which the Applicant indicated presumably because of the abandonment and removal of the former septage pits that were located in the northeast corner of the Site, the closing and capping of the unlined Phase 1-A, B, C landfills and the mining and removal of the former unlined Phase 1-D landfill. The Applicant stated that beginning with the construction of the Phase 3, Stage 1 landfill in 2000, and all other cells since then, liners have been constructed with double composite liners with interstitial leak detection. In addition, an 18-inch screened sand drainage and protection layer is constructed above the liner system.

The Board's review of the Site Assignment application notes that the Applicant has proposed a double composite liner with monitoring for Phases 7 and 8 that will meet MassDEP's liner requirements. The Applicant has further stated that the groundwater protection system will intercept and collect leachate that passes through the waste, protecting groundwater quality within the area of the Bourne Landfill. Based on the Report, Engineer's Report, and the Record, the Board determined that the proposed double composite liner design, the proposed Facility modifications will not result in a threat of an adverse impact to groundwater through the discharge of leachate.

Accordingly, the Board finds that the Site **MEETS** this criterion.

B. General Site Suitability Criteria, 310 CMR 16.40(4)

The Board has determined the following General Facility Criteria have been met:

1. *Agricultural Lands. No site shall be determined to be suitable or be assigned as a solid waste management facility where:*
    a. *the land is classified as Prime, Unique, or of State and Local Importance by the United States Department of Agriculture, Natural Resources Conservation Service; or*
    b. *the land is deemed Land Actively Devoted to Agricultural or Horticultural Uses, except where the facility is an agricultural composting facility; and*
    c. *a 100-foot buffer would not be present between the facility and those lands classified at 310 CMR 16.40(4)(a)1. or 2.*

The Applicant submitted a site-specific soil survey report for the 25-acre parcel dated August 29, 2018. A soil profile was performed for twenty (20) test pits. The soil survey report concluded that the majority of the 25-acre parcel consists of soil and non-soil material disturbed by human activity, related to the operation of the Bourne Landfill, that was redefined as Urban Land and Udipsamments which are not Prime, Important or Unique Farmland in Massachusetts.

A small strip of natural, undisturbed Barnstable sandy loam was surveyed and classified as farmland of statewide importance. In response, the Applicant submitted a Site Buildout Plan that indicated that the modifications for Phase 7 and 8 have a 100-foot buffer from the areas determined to be important farmland.

Based on the findings of the August 29, 2018 LEC Site Specific Soil Survey, the Site will not be located on land on which the existing conditions meet the requirements for classification as Prime, Unique, or of State and Local Importance by the United States Department of Agriculture, Natural Resources Conservation Service; the land is not Land Actively Devoted to Agricultural or Horticultural Uses, and a 100-foot buffer will be present between the Site and those lands.

Accordingly, the Board finds that the Site **MEETS** this criterion.

2. *Traffic and Access to the Site. No site shall be determined to be suitable or be assigned as a solid waste management facility where traffic impacts from the facility operation would constitute a danger to the public health, safety, or the environment taking into consideration the following factors:*
    a. *traffic congestion;*
    b. *pedestrian and vehicular safety;*
    c. *road configurations;*
    d. *alternate routes; and*

e. vehicle emissions

Traffic Congestion: Upon review of the August 3, 2021 report prepared by TEPP LLC, the SSEIR and notes that the proposed operations will remain under the existing cap of 825 tons per day, the Board agrees with the TEPP LLC report's conclusions that operations of the site will not negatively impact the traffic operations on MacArthur Boulevard. The proposed Bourne Landfill expansion does not change the site access or permitted tonnage to the Site therefore no change to the existing traffic volumes will impact the Site.

Pedestrian and Vehicular Safety: The facility is accessed via a deacceleration lane to a private driveway on Route 28 northbound. The Applicant stated that pedestrians are prohibited along Route 28 therefore potential conflicts with pedestrians will not arise. The Applicant evaluated the crash rates at the study area intersections and determined that the crash rate at each intersection was below both the statewide and Massachusetts Department of Transportation ("MassDOT") District 5 average crash rates.

Road Configuration: The only access to the Site is via Route 28 northbound. These lanes are dedicated solely to access to the Site. Route 28 is the main thoroughfare in the area and is capable of handling facility traffic without impact.

Alternative Routes: There are no alternative routes.

Vehicular Emissions: The total approved tonnage will not change therefore the traffic volume will not change. The emission rates will stay the same.

Upon receipt of the Board's Site Assignment approval, MassDEP requires the Applicant to submit an Authorization to Construct application to MassDEP and traffic impacts will be evaluated again. According to the Report, MassDEP is prepared to require that the Applicant monitor and record daily traffic volumes. If the actual traffic volumes are not consistent with what was evaluated in the TIAS (e.g., 289 trucks per day), MassDEP may require a new traffic impact study.

The Board will Condition the Site Assignment on preventative queuing measures being contained in the hauler's contracts, but otherwise, does not have any concerns related to traffic. Therefore, the Applicant will not be required to monitor traffic levels and perform a post-development traffic impact study as a condition of any Site Assignment approval or require a pre-submittal of the study protocol for review and approval by the Board and MassDEP.

Accordingly, the Board finds that the Site **MEETS** this criterion.

3. *Wildlife and Wildlife Habitat. No site shall be determined to be suitable or be assigned as a solid waste management facility where such siting would:*

a. *<u>have an adverse impact on Endangered, Threatened, or Special Concern species listed by the Natural Heritage and Endangered Species Program of the Division of Fisheries and Wildlife in its database;</u>*
b. *<u>have an adverse impact on an Ecologically Significant Natural Community as documented by the Natural Heritage and Endangered Species Program in its database; or</u>*
c. *<u>have an adverse impact on the wildlife habitat of any state Wildlife Management Area.</u>*

Portions of the 25-acre parcel proposed for Phase 7 and Phase 8 are mapped as Priority Habitat for the Eastern Box Turtle, a species state-listed as Special Concern. The Applicant stated that the Town has committed to maintaining a buffer, such as boulders, fencing, or earthen berms. Upon review of the Report, Engineer's Report, and the Record, including that correspondence to and from Natural Heritage and Endangered Species ("NHESP"), the Board finds that the Eastern Box Turtle will not be directly impacted so long as a buffer is maintained, and all work associated with Phase 7 through 9 occurs within previously disturbed areas and no areas mapped as Priority Habitat for the Eastern Box Turtle are disturbed.

Accordingly, the Board finds that the Site **MEETS** this criterion.

4. *<u>Areas of Critical Environmental Concern. No site shall be determined to be suitable or be assigned as a solid waste management facility where such siting:</u>*
   a. *<u>would be located within an Area of Critical Environmental Concern (ACEC), as designated by the Secretary of the Executive Office of Environmental Affairs; or</u>*
   b. *<u>would fail to protect the outstanding resources of an ACEC as identified in the Secretary's designation if the solid waste management facility is to be located outside, but adjacent to the ACEC.</u>*

Upon review of the Record, Engineer's Report, and Report, the Board has determined that the site is not located within an Area of Critical Environmental Concern (ACEC), as designated by the Secretary of the Executive Office of Environmental Affairs or located immediately adjacent to an ACEC. The Applicant submitted a Land Use encompassing a ½ mile radius from the site showing the nearest ACEC located along the western edge of Route 28, across the highway and within 500 feet of the site.

Accordingly, the Board finds that the Site **MEETS** this criterion.

5. *<u>Protection of Open Space. No site shall be determined to be suitable or be assigned as a solid waste management facility where such siting would have an adverse impact on the physical environment of, or on the use and enjoyment of:</u>*
   a. *<u>state forests;</u>*

b. *state or municipal parklands or conservation land, or other open space held for natural resource purposes in accordance with Article 97 of the Massachusetts Constitution;*
c. *MDC reservations;*
d. *lands with conservation. preservation, agricultural, or watershed protection restrictions approved by the Secretary of the Executive Office of Environmental Affairs; or*
e. *conservation land owned by private non-profit land conservation organizations and open to the public.*

Based on the ISWM's coordinating effort with JBCC and the ISWM's implementation of best management practices, the Board has determined that operation of the Site will not have an adverse impact on the physical environment of, or on the use and enjoyment of open space.

Accordingly, the Board finds that the Site **MEETS** this criterion.

6. *Potential Air Quality Impacts. No site shall be determined to be suitable or be assigned as a solid waste management facility where the anticipated emissions from the facility would not meet required state and federal air quality standards or criteria or would otherwise constitute a danger to the public health, safety or the environment, taking into consideration:*
   a. *the concentration and dispersion of emissions;*
   b. *the number and proximity of sensitive receptors; and*
   c. *the attainment status of the area.*

The Applicant submitted a document titled "Interim Risk Evaluation and Cumulative Impact Assessment ("CIA") of the Proposed Phased Landfill Development of the Town of Bourne Integrated Solid Waste Management Facility" dated May 2003 (Record No. 12) and presented an updated landfill gas emissions impact analysis on sensitive receptors, dated July 20, 2021. The current waste acceptance at the Facility constitutes approximately 86 percent of its annual tonnage of 219,000 in the form of municipal combustor ash ("MCA") from SEMASS waste-to-energy facility. The Applicant stated they intended to extend the contract, which is to continue accepting up to 189,000 tons per year ("TPY") of MCA and 30,000 TPY of biodegradable municipal solid waste ("MSW") from Bourne and Falmouth.

In addition to landfill gas composed of mostly methane and carbon dioxide as well as trace levels of a variety of volatile organic compounds and reduced sulfur compounds such as H2S, the CIA includes evaluation of criteria pollutants of National Ambient Air Quality Standards ("NAAQS"). The 2003 CIA identified the key pollutant as hydrogen sulfide ("H2S"). In 2009, Cambridge Environmental conducted an expanded evaluation of H2S (Record No. 35), which resulted in the determination that there were no unacceptable health risks due to fugitive emissions of landfill gas from the ISWM facility.

The 2021 landfill gas collection rate, as metered at the flare, has been 660 standard cubic feet per minute ("scfm"). The Applicant states its assumptions for the analysis are based on over 90% landfill gas collection rate and approximately 98% destruction rate of H2S by the flare, taking into consideration the operation of the horizontal collection wells in active areas of the Bourne Landfill, the installation of vertical collection wells once landfill areas reached closure grade, and the placement of ash residue cover over small quantities of potential degradable MSW. The current monitoring result showed that the Facility's emission in 2021 of 54.2 parts per million ("ppm") is below the MassDEP's permit for the Facility's emission of landfill gas combusted at the flare of no more than 200 ppm.

The Bourne Landfill is subject to the reporting requirement for the Design Capacity Modifications and uncontrolled non-methane organic compounds ("NMOC") emissions under Subpart XXX of 40 CFR 60. Under Subpart XXX, specifically 40 CFR 60.767(b)(l)(ii), allows the Bourne Landfill to elect submitting the NMOC emission report once every 5 years if the reported emission is less than 34 mg for five consecutive years. The Applicant has notified the United States Environmental Protection Agency ("USEPA") and MassDEP in a letter dated April 19, 2019 regarding their intention to elect submitting the NMOC emission report once every 5 years.

The Applicant also provided an evaluation of potential emission increases for six primary pollutants under the National Ambient Air Quality Standards ("NAAQS"). The result showed that the emissions from the proposed modifications under the maximum landfill gas generation scenario are below the NAAQS standards.

The Board has reviewed the "Interim Risk Evaluation and Cumulative Impact Assessment ("CIA") of the Proposed Phased Bourne Landfill Development of the Town of Bourne Integrated Solid Waste Management Facility" dated May 2003, the updated landfill gas emissions impact analysis on sensitive receptors, dated July 20, 2021, prepared by Sanborn Head Associates, Inc., the Air Quality Plan Approval #SE-12-011 and the 2009 Cambridge Environmental expanded evaluation of H2S gas emissions. Based on our review of the Record, including the documents noted above, the Board agrees with MassDEP's and Tighe & Bond's findings and makes its own, separate finding consistent with the DEP and its Engineer's factual conclusions.

Accordingly, the Board finds that the Site **MEETS** this criterion.

7. *Potential for the Creation of Nuisances. No site shall be determined to be suitable or be assigned as a solid waste management facility where the establishment or operation of the facility would result in nuisance conditions which would constitute a danger to the public health, safety or the environment taking into consideration the following factors:*
    a. *noise;*
    b. *litter;*
    c. *vermin such as rodents and insects;*
    d. *odors;*
    e. *bird hazards to air traffic; and*

f. other nuisance problems.

Noise: The Facility is well buffered by distance, traffic noise from Route 28 and vegetation, mitigating any potential impacts.

Litter: The Applicant will continue to use operational controls to handle any windblown litter associated with the Facility.

Vermin: The Applicant proposes to mitigate any potential vermin using the following measures:

1. Contracting with a vector control management firm;
2. Proper compaction techniques and placing cover material at the end of daily operations;
3. Mixing some waste loads with soil materials; and,
4. Limiting storage and quick removal of putrescible materials.

Odors: The Applicant stated proper compaction and covering methods (daily and intermediate cover) helps minimize odors at the operating face of the Bourne Landfill. The Applicant stated that the Bourne Landfill operators are instructed to take immediate action on any odor nuisance as it arises including the placement of daily cover and the placement of dry lime. The Applicant stated that expansion and proper maintenance of the existing, active landfill gas collection and flare system will serve as another mitigation measure.

Bird Hazards: The Applicant stated that the operation of the proposed modifications will not result in a bird hazard to aircraft.

Other Nuisance Problems: The Applicant stated that the landfilling and handling operations could potentially generate dust during dry periods of the year, and will continue with current control measures to mitigate any dust.

Accordingly, the Board finds that the Site **MEETS** this criterion.

8. *Size of Facility. No site shall be determined to be suitable or be assigned as a solid waste management facility if the size of the proposed site is insufficient to properly operate and maintain the proposed facility. The minimum distance between the waste handling area or deposition area and the property boundary shall be 100 feet, provided that a shorter distance may be suitable for that portion of the waste handling or deposition area which borders a separate solid waste management facility.*

The Board has reviewed the Application including the proposed facility designs for Phases 7, 8, and 9 and note and that the proposed Phase 7 and Phase 8 waste deposition area will not be within 100 feet of the southern, eastern, or western property line of the 25-acre parcel. MassDEP notes that since Phase 7 and Phase 8 will be an expansion of the existing Bourne Landfill, there is no requirement for a 100-foot setback from the northern property line. Additionally, Phase 9 is fully within the limits approved in the current Site Assignment. Based on our review of the Record, including the facility design considerations for leachate control structures, the Report and the Engineer's Report, the Board agrees with MassDEP and Tighe & Bond's findings that Phase 7 and 8 as well as Phase 9 complies with the requirements under the Regulations.

Accordingly, the Board finds that the Site **MEETS** this criterion.

9. *Areas Previously Used for Solid Waste Disposal. Where an area adjacent to the site of a proposed facility has been previously used for solid waste disposal the following factors shall be considered by the Department in determining whether a site is suitable and by the board of health in determining whether to assign a site:*
   a. *the nature and extent to which the prior solid waste activities on the adjacent site currently adversely impact or threaten to adversely impact the proposed site;*
   b. *the nature and extent to which the proposed site may impact the site previously used for solid waste disposal; and*
   c. *the nature and extent to which the combined impacts of the proposed site and the previously used adjacent site adversely impact on the public health, safety and the environment; taking into consideration:*
      i. *whether the proposed site is an expansion of or constitutes beneficial integration of the solid waste activities with the adjacent site;*
      ii. *whether the proposed facility is related to the closure and/or remedial activities at the adjacent site; and*
      iii. *the extent to which the design and operation of the proposed facility will mitigate existing or potential impacts from the adjacent site.*

The Board has reviewed the "Interim Risk Evaluation and Cumulative Impact Assessment ("CIA") of the Proposed Phased Bourne Landfill Development of the Town of Bourne Integrated Solid Waste Management Facility" dated May 2003, the updated landfill gas emissions impact analysis on sensitive receptors dated July 20, 2021 and prepared by Sanborn Head Associates, Inc., the 2009 Cambridge Environmental expanded evaluation of H2S, the Comprehensive Site Assessment ("CSA"), the MassDEP's approval of the CSA dated June 15, 2017, the Single Supplemental Environmental Impact Report ("SSEIR") and the SSEIR Certificate dated December 30, 2020.

Based on the review of analysis presented in the Application, CSA, SSEIR and the CIA, the combined impacts of the existing Bourne Landfill and the proposed modifications in Phase 7 and 8 will not adversely impact on the public health, safety and the environment. However, MassDEP stated that the proposed Phase 9 vertical expansion will disturb areas previously used for waste disposal (Phase 2, Phase 2A/3A, Phase 3 and Phase 4, Stage 1). However, pursuant to 310 CMR 16.40(1)(c)l, MassDEP evaluated the Application with the assumption that the proposed facility would be designed and constructed to meet all relevant state and federal statutory, regulatory and policy requirements should the Board grant a site assignment for the proposed facility.

Based on our review of the Record, including the documents noted above, the Report and the Engineer's Report, the Board agrees with MassDEP and Tighe & Bond's findings. MassDEP will require the Applicant to provide additional information and design analysis during the Authorization to Construct permit application for Phase 9 vertical expansion that addresses the disturbance of landfill areas cited herein.

Accordingly, the Board finds that the Site **MEETS** this criterion.

10. *Existing Facilities. In evaluating proposed sites for new solid waste management facilities the Department and the board of health shall give preferential consideration to sites located in municipalities in which no existing landfill or solid waste combustion facilities are located. This preference shall be applied only to new facilities which will not be for the exclusive use of the municipality in which the site is located. The Department and the board of health shall weigh such preference against the following considerations when the proposed site is located in a community with an existing disposal facility:*
    a. *the extent to which the municipality's or region's solid waste needs will be met by the proposed facility; and*
    b. *the extent to which the proposed facility incorporates recycling, composting or waste diversion activities.*

The Board has determined that the proposed Bourne Landfill expansion is not a new solid waste management facility and according to 310 CMR 16.40(4)(j) and the proposed Bourne Landfill expansion **should not be given preferential consideration for this criterion.**

11. *Consideration of Other Sources of Contamination or Pollution. The determination of whether a site is suitable and should be assigned as a solid waste management facility shall consider whether the projected impacts of the proposed facility pose a threat to public health, safety or the environment, taking into consideration the impacts of existing sources of pollution or contamination as defined by the Department, and whether the proposed facility will mitigate or reduce those sources of pollution or contamination.*

The Board has reviewed the "Interim Risk Evaluation and Cumulative Impact Assessment ("CIA") of the Proposed Phased Bourne Landfill Development of the Town of Bourne Integrated Solid Waste Management Facility" dated May 2003, the Comprehensive Site Assessment ("CSA"), the MassDEP's approval of the CSA dated June 15, 2017, the Single Supplemental Environmental Impact Report ("SSEIR"), the SSEIR Certificate dated December 30, 2020, and the proposed double composite liner design. Based on the information provided in the Application, concluded that the groundwater protection system proposed in the Application for Phase 7, Phase 8, and Phase 9 complies with current regulatory requirements for such systems and will contain features and elements designed to prevent the discharge of leachate into groundwater.

Based on our review of the Record, including the documents noted above, the Report and the Engineer's Report, the Board agrees with MassDEP and Tighe & Bond's findings.

Accordingly, the Board finds that the Site **MEETS** this criterion.

12. *Regional Participation. The Department and the board of health shall give preferential consideration to sites located in municipalities not already participating in a regional disposal facility. The Department and the board of health shall weigh such preference against the following considerations when the proposed site is located in a community participating in a regional disposal facility:*
    a. *the extent to which the proposed facility meets the municipality's and the region's solid waste management needs; and*
    b. *the extent to which the proposed facility incorporates recycling, composting, or waste diversion activities.*

The Town hosts the Bourne Integrated Solid Waste Management Facility landfill, which is a regional disposal facility and incorporates recycling efforts. In accordance with the Regional Participation Criterion, the Board **need not give preferential consideration to the proposed project for this criterion.**

C. Promotion of Integrated Solid Waste Management, 310 CMR 16.40(5)

1. *In determining whether a site is suitable for a combustion facility or a landfill, the Department shall consider the following factors:*
    a. *The potential yearly and lifetime capacity created by the proposed site use(s) in relation to the reasonably anticipated disposal capacity requirements and reduction/diversion goals of the Commonwealth and the geographic area(s) which the site will serve.*
    b. *The extent to which the proposed site use(s), alone or in conjunction with other sites, provides or affords feasible means to maximize diversion or processing of each component of the anticipated waste stream in order to reduce potential adverse impacts from disposal and utilize reusable materials and only thereafter extract energy from the remaining solid waste prior to final disposal.*
    c. *The extent to which the proposed use(s) of the site, alone or in conjunction with other sites, will contribute to the establishment and maintenance of a statewide integrated solid waste management system which will protect the public health and conserve the natural resources of the Commonwealth.*
2. *In determining whether a site is suitable for a combustion facility or a landfill, the Department and the board of health shall consider the extent to which the proposed use of the site directly incorporates recycling and composting techniques or is otherwise integrated into recycling and composting activities for the geographic area(s) which the site will serve.*
3. *A site proposed for a combustion facility or a landfill shall be reviewed to determine if the site is also suitable for a recycling or composting facility either in conjunction with or instead of the proposed facility.*
4. *Site assignment applications which incorporate significant recycling or composting uses, in accordance with the goals of the statewide plan, shall receive preferred consideration.*

The Board acknowledges that expanded Bourne Landfill will be a regional landfill, not for the exclusive use of the Town will address disposal capacity requirements and reduction/diversion goals in the region and in the Commonwealth. The Board therefore agrees that the facility **should be given preferential consideration under this criterion.**

III. CONDITIONS IMPOSED BY THE BOARD

Under 310 CMR 16.20(12), "The board may include in any decision to grant a site assignment such limitations with respect to the extent, character and nature of the facility or expansion thereof, as may be necessary to ensure that the facility or expansion thereof will not present a threat to the public health, safety or the environment."

The Board finds that the Site is suitable for expansion as described in the Application, provided the Applicant, its successors and assigns comply with the Conditions set forth below. Therefore, the Board approves this Major Modification of the Site Assignment for the Site, and grants the Site Assignment, subject to the following conditions:

1. The additional areas herein assigned for the Bourne Landfill expansions shall include the designated areas on the 99-acre Site on land owned by the Town of Bourne, located at 201 MacArthur Boulevard, Bourne, Massachusetts, as described in the Application, including horizontal bounds and vertical elevation of 225 feet MSL, as shown on Figure 4 (dated December 9, 2021) and Figure 15 (dated December 9, 2021).
2. ISWM shall include in all contracts with haulers a requirement that their vehicles not queue beyond the capacity of the left turn lane at any U-turn on Route 28 southbound or northbound, and vehicles should utilize the next available U-turn or rotary for reversing direction.
3. ISWM shall implement Best Management Practices to control litter, dust, stormwater and air emissions from equipment, vehicles and operations.
4. The maximum daily solid waste tonnage accepted at the combined 99-acre site assigned area shall not exceed 825 tons per day.
5. The hours of operation at the Site for landfilling, handling and transfer operations shall be limited to 7:00 a.m. to 5:00 p.m., seven days a week, with the exception of municipal combustor ash delivered to the Site beginning no earlier than 6:00 a.m. Hours may be adjusted due to emergencies upon prior notification to the Chair of the Board of Health and the Board of Health Agent. No equipment that shall constitute an audible public nuisance shall be used prior to 6:00 a.m.
6. ISWM shall construct and operate the improvements and activities on the Site in conformity with the Application and the material submitted therein. The construction details of the proposed expansion shall be determined by the MassDEP in accordance with review and approval of any Authorization to Construct and Authorization to Operate that may be issued under 310 CMR 19.000.

7. The area described in the Application shall be utilized for landfilling and continued use of the area for solid waste handling and processing, including but not limited to transfer operations, processing and handling, composting and recycling. Any solid waste activity other than landfilling, handling, or processing shall not be conducted at the Site except in accordance with a new or modified Site Assignment. No combustion of solid waste will be permitted on the Site.
8. This Site Assignment shall take effect when recorded at the Registry of Deeds and after a certified copy of the same from the Registry of Deeds is provided to the Board of Health, with all recording fees and charges paid by ISWM.
9. This Site Assignment may be modified, suspended or rescinded by the Board, for good cause, after notice to the owner and operator and a public hearing, in accordance with M.G.L. c. 111, § 150A.
10. ISWM shall have sole operational responsibility for the entire 99-acre Site. The operational responsibility for the Site shall not be assigned or transferred, in whole or in part, to another party, including an assignment or transfer for another department or board of the Town, unless approved by a vote of the majority of the Board at a public hearing. Assignment or transfer shall include, but not be limited to, a lease, license, or other agreement related to the operation of the Site.
11. Prior conditions, permissions, allowances and restrictions not modified expressly by this Site Assignment shall remain in full force and effect.
12. To ensure that all public and/or private wells in the areas described in or referred to in the Site Assignment Decision (as being connected to public water supply) are no longer used for potable water, ISWM shall maintain an annually updated list of such wells and well owners, and shall provide, for the Board of Health to transmit, an annual notice to all applicable, current property owners that the listed wells are not available for use as potable water. ISWM shall bear the cost of such notification.
13. ISWM shall report annually to the Board, at a public meeting, on the state of operations at the Facility including, without limitation, information on emissions, waste diversion efforts, including food waste, addressing Contaminants of Emerging Concern, pilot projects, and any other information pertinent to operations at the Site.
14. ISWM shall contribute an amount of $1.00 (one dollar) per ton of all waste and cover materials whether landfilled or transferred to the Facility to the Town of Bourne's Climate Resiliency and Infrastructure Stabilization Fund (the "Fund"), which shall be deposited into the Fund no later than November 30th of the next fiscal year.
15. ISWM shall take affirmative steps to ensure that all public and/or private wells in the areas described in or referred to in the Site Assignment Decision (as being connected to public water supply), are properly labeled (via permanent plaquing) as "not available for use as potable water," and ISWM shall bear the cost of such notification and labeling. To the extent permitted by law, ISWM shall cause an annotation to be recorded at the Registry of Deed for each well included in this Condition.
16. In the event any condition herein is determined to be invalid or unenforceable by a court of appropriate jurisdiction, that condition shall be severed and the remaining conditions shall remain in full force and effect.

IV. CONCLUSION

The Board has reviewed the Bourne Site Assignment Application along with associated submittals and supporting information as contained in the Record. Accordingly, the Board finds that the proposed Facility Site Major Modifications adequately satisfies and complies with the site suitability criteria established in 310 CMR 16.40(3), Facility Specific Site Suitability Criteria, and (4), General Site Suitability Criteria. Furthermore, the Board has determined that the proposed Major Modifications, including the Phase 7, 8 and 9 expansions, do not pose a threat to public health, safety or the environment in accordance with 310 CMR 16.20(10)(k)(2).

Dated this 14th day of March, 2022

BOURNE BOARD OF HEALTH

Stanley Andrews, Chair

William Meier

Barbara Princiotta

Donald C. Uitti

BARNSTABLE REGISTRY OF DEEDS
John F. Meade, Register

APPENDIX B-3

MEPA CERTIFICATES

The Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
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GOVERNOR

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December 30, 2020

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS ON THE SINGLE SUPPLEMENTAL ENVIRONMENTAL IMPACT REPORT

PROJECT NAME	: Bourne Integrated Solid Waste Management Facility
PROJECT MUNICIPALITY	: Bourne
PROJECT WATERSHED	: Cape Cod
EOEA NUMBER	: 11333
PROJECT PROPONENT	: Town of Bourne
DATE NOTICED IN MONITOR	: November 23, 2020

Pursuant to the Massachusetts Environmental Policy Act (MEPA; M.G. L. c. 30, ss. 61-62I) and Section 11.08 of the MEPA regulations (301 CMR 11.00), I have reviewed the Single Supplemental Environmental Impact Report (Single Supplemental EIR) and hereby determine that it **adequately and properly complies** with MEPA and its implementing regulations.

Project Description

As described in the Single Supplemental EIR, the project consists of the phased expansion (Phases 7, 8 and 9) of the Bourne Integrated Solid Waste Management Facility (ISWMF) project. Specifically, the Town of Bourne is proposing a vertical and horizontal landfill expansion and the relocation of the solid waste handling facility and other offices and facilities on the property. The three phase 25.0-acre expansion will provide a total of 5,175,000 cubic yards (cy) of disposal capacity which will extend the life of the landfill through 2040.

The horizontal expansion of the landfill (Phase 7 and 8) will require the development of new lined landfill cells in an area located south of Phase 6. These new cells will incorporate leachate collection and landfill gas management infrastructure. Phases 7 and 8 will provide approximately 3,920,000 cy of disposal capacity. The horizontal expansion will be located within a 25-acre parcel that is currently site assigned for solid waste handling and contains a residential recycling area, transfer station, office building, and other appurtenant structures. The development of Phases 7 and 8 will require the relocation of the transfer station and other structures to an adjacent 12-acre parcel which was acquired by the Town in 2016 and abuts the residential recycling center at the southern boundary of the site. The vertical expansion (Phase 9) is proposed over uncapped areas of the landfill and areas that have been capped with a final cover system. Phase 9 will increase the maximum height of the landfill by 40 feet (from 185 ft to 225 ft) and will provide approximately 1,255,000 cy of disposal capacity which could extend the life of the landfill up to four and a half years.

The Certificate on the Final Environmental Impact Report (FEIR), issued November 29, 1999, acknowledged that certain aspects of the landfill project, including future phases, were conceptual and required that the Town submit Notice of Project Changes (NPCs) to the MEPA Office to address development of subsequent phases. The Town submitted an Expanded NPC in February 2020 that provided an updated site development plan for the landfill and described the development of Phase 7, Phase 8 and Phase 9 of the landfill expansion. The Town was allowed to submit a Single Supplemental EIR in lieu of the usual two-stage Draft and Final EIR process.

Procedural History

The full procedural history for this project was reviewed in the Certificate on the Expanded NPC. Review of the Bourne ISWMF project was initiated with the submission of an Environmental Notification Form (ENF) in 1997. Several Notices of Project Change (NPC) were filed thereafter, including the Expanded NPC on this project change filed in February 2020. All prior phases through Phase 6 were previously reviewed, and the most recent Certificate on Phase 6 was issued on June 26, 2018.

Project Site

The Bourne ISWMF, located at 201 MacArthur Boulevard (Route 28), is comprised of a 74-acre site-assigned parcel which contains the landfill operations and facilities. In 2001, a 25-acre parcel immediately abutting the landfill to the south was purchased and has been used for recycling and transfer operations. The landfill contains lined and unlined waste disposal areas. Phases 1A, 1B, 1C, and 1D are unlined cells that comprise the oldest portion of the landfill. Phases 1A, 1B, and 1C are closed and capped. Phase 1D was part of a pilot landfill reclamation project with the Massachusetts Department of Environmental Protection (MassDEP) that removed the solid waste in this area in order to create additional landfill space. Phases 2 and Phase 3 are both lined and are closed and capped with leachate collection systems. Phase 4, an active landfill cell, is located in the area previously occupied by Phase 1D. Phase 5 consists of a vertical expansion proposed over Phases 1A, 1B, and 1C. MassDEP issued an Authorization to Construct (ATC) and ATO Permit in 2019 for Phase 6 which is currently under construction.

Permits and Jurisdiction

The development of Phases 7, 8 and 9 is undergoing MEPA review and requires an NPC because it consists of a material change to the project prior to the taking of all Agency Actions. The project change exceeds the mandatory EIR threshold at 301 CMR 11.03 (1)(a)(2) because it will result in the creation of ten or more acres of impervious area. The project change also exceeds the Solid Waste ENF threshold at 301 CMR 11.03(9)(b)(1) because it will result in new capacity or expansion in capacity for combustion or disposal of any quantity of solid waste, or storage, treatment or processing of 50 or more tpd of solid waste. Because it requires an EIR, the project change is subject to review in accordance with the MEPA Greenhouse Gas (GHG) Emissions Policy and Protocol ("GHG Policy").

The proposed landfill expansion will require the following Permits from MassDEP: Site Suitability Report for a Major Modification of an Existing Site Assignment (BWP SW 38), Authorization to Construct (ATC) a Large Landfill Expansion (BWP SW 26), and Authorization to Operate (ATO) (BWP SW 10). Relocation of the transfer station to the 12-acre parcel will require the following Permits from MassDEP: Site Suitability Report for a New Site Assignment (BWP SW 01), ATC a Large Handling Facility (BWP SW 05), and ATO a Large Handling Facility (BWP SW 06). The project will likely require a Conservation Management Permit (CMP) from the Division of Fisheries and Wildlife's (DFW) Natural Heritage and Endangered Species Program (NHESP).

The project will require a Development of Regional Impact (DRI) Modification from the Cape Cod Commission (CCC), Site Assignment Approval from the Bourne Board of Health, and a National Pollutant Discharge Elimination System (NPDES) Construction General Permit from the U.S. Environmental protection Agency (EPA).

Because the project is not seeking Financial Assistance from the Commonwealth, MEPA jurisdiction extends to those aspects of the project that are within the subject matter of required, or potentially required, State Agency Actions and that may cause Damage to the Environment as defined in the MEPA regulations. The subject matter of the Site Assignment regulations is sufficiently broad to confer the equivalent of broad scope jurisdiction over the potential environmental impacts of the project. Therefore, MEPA jurisdiction is broad in scope and extends to all aspects of a project that are likely, directly or indirectly, to cause Damage to the Environment, as defined in the MEPA regulations.

Environmental Impacts and Mitigation

Potential environmental impacts of the project change will include alteration of 38 acres of land (112 total acres) and creation of 16.23 acres of impervious area. Measures to avoid, minimize, and mitigate project impacts include: construction period Best Management Practices (BMPs), permanent protection of rare species habitat, dust control measures, erosion and sedimentation controls, leachate management, and measures to maximize LFG (landfill gas) collection efficiency.

Review of Single Supplemental EIR

The Single Supplemental EIR was generally responsive to the Scope provided in the Certificate on the Expanded NPC. It described the project, identified existing conditions, and described potential environmental impacts and mitigation measures. It provided a brief description of applicable statutory and regulatory standards and requirements, and described how the project will meet those standards. The Single Supplemental EIR provided a list of required local, state, and federal permits and provided an update on the status of each of these actions. It also contained a response to comments received on the Expanded NPC and draft section 61 findings.

The primary emphasis of the Single Supplemental EIR was to demonstrate that the project's design and operational measures will comply with solid waste regulations and applicable policies and provide sufficient information for MassDEP to use in making its permitting decisions and associated Section 61 Findings. Comments from MassDEP indicate that the Single Supplemental EIR has provided information to support subsequent permitting where compliance with solid waste regulations and applicable policies will be determined. In addition, MassDEP's comments indicate that the Draft Section 61 Findings are in general compliance with solid waste compliance requirements.

The Single Supplemental EIR includes an update on the Cape Cod Commission (CCC) review process and a discussion of the project's compliance with the pertinent goals and objectives from the Cape Cod Regional Policy Plan.

I have received a comment from the Conservation Law Foundation (CLF) on behalf of Beyond Plastics, Clean Water Action, Community Action Works, the Global Alliance for Incinerator Alternatives, Massachusetts Rivers Alliance, MASSPIRG, Saugus Action Volunteers for the Environment, the Saugus River Watershed Council, Sierra Club, and Sustainable Practices. The comment letter is in opposition to the Town's Phase 7, 8, and 9 Integrated Solid Waste Management Facility expansion as proposed in the Single Supplemental EIR. CLF's comment indicates that the expansion would be a threat to public health and the environment and would continue to undermine the need to responsibly manage waste through source reduction, recycling, and composting.

CLF's comment letter also states that meaningful opportunities for public review of the expansion's potential environmental impacts have not been provided, because it is not possible for the public to access the majority of the historical project documents. As noted above, however, the FEIR Certificate issued in 1999 acknowledged that certain aspects of the landfill project, including future phases, were conceptual and required that the Town submit future NPC filings to disclose the impacts associated with those components. The Expanded NPC filed in February 2020 therefore was the operative document that contained all relevant details (*not* available in historic project filings) related to the phases at issue here, and members of the public have had full access to information and materials associated with this NPC filing. I am also aware that this Office responded to a public records request filed by CLF, and provided the historic files that were sought.

I note that the project will require extensive permitting after the conclusion of MEPA review, and such permitting procedures will include opportunities for public review. The proposed expansion will require the following solid waste permits:

a. For the proposed landfill expansion:
- Site Suitability Report for a Major Modification of an Existing Site Assignment (BWP SW 38).
- Authorization to Construct a Large Landfill Expansion (BMP SW 26), and
- Authorization to Operate (BWP SW 10).

b. For the proposed solid waste transfer station:
- Site Suitability Report for a New Site Assignment (BWP SW 01).
- Authorization to Construct a Large Handling Facility (BWP SW 05); and
- Authorization to Operate a Large Handling Facility (BWP SW 06).

Prior the submission of a BWP SW 38 or BWP SW 01 application, MassDEP requires a preapplication meeting to discuss comments received from the public on the Supplemental Single EIR and to ensure the facility design and operational measures will comply with solid waste regulations and applicable policies with an emphasis on odor, noise, and traffic mitigation. In addition, the following permit applications have public comment periods or public hearing requirements:

a. BWP SW 01 applications: There is a 21-day public comment period.
b. BWP SW 38 applications: There is a 21-day public comment period.
c. Board of Health Site Assignment Decisions: The Board of Health must hold a public hearing in accordance with 310 CMR 16.20.
d. BWP SW 05 applications: There is a minimum 30-day public comment period.
e. BWP SW 26 applications: There is a minimum 30-day public comment period.
f. BWP SW 06 or BWP SW 10 applications: Public comments are not required prior to issuing a decision, but MassDEP comments indicate MassDEP may issue provisional approval with a deferred effective date to allow for 21-day public notice/comment period.

MEPA review is not a permitting process, nor does it serve as an appeal for local decisions. It does not pass judgment on whether a project is or is not beneficial, or whether a project can or should receive a particular permit. Rather, the MEPA process requires public disclosure of a project's environmental impacts as well as the measures that the proponent will undertake to avoid, minimize and mitigate these impacts. MEPA review occurs before public agencies act to issue permits and approvals for a proposed project to ensure that those agencies are fully cognizant of the environmental consequences of their actions. I have examined the record before me, including but not limited to the Scope issued on the Expanded NPC; the Supplemental Single EIR filed in response; and the numerous comments entered into the record. Given the long history of review of this project as detailed in the Certificate on the Expanded NPC, and the comprehensive information provided in response to the Scope and additional prefiling consultations with Agencies, I do not find that further review is warranted on this project change.

Solid Waste

The project will be regulated under MassDEP's Site Assignment Regulations for Solid Waste Facilities and Solid Waste Regulations. The Town will be required to modify its Site Assignment with the Board of Health prior to development of Phases 7, 8 or 9. The Single Supplemental EIR included a narrative that addressed the project's consistency with the applicable regulatory approval criteria.

Leachate and Landfill Gas Collection

As required by the Scope, the Single Supplemental EIR provided information on the existing monitoring wells and leachate and landfill gas collection systems. It also provided plans and described how leachate and landfill gas will be collected and managed within Phase 7-9. The existing landfill operations include leachate collection and storage facilities, landfill gas collection and treatment systems and an environmental monitoring system that is sampled and evaluated for impacts to groundwater and soil gas conditions in the vicinity of the landfill. These systems will be expanded and maintained for the proposed expansions to the facilities. The leachate collection and storage systems include double composite liner system with primary and secondary leachate collection and monitoring capacity. The double composite liner system consists of 12 inches of low permeable soil, upon which multiple layers of geosynthetic liner materials are installed. MassDEP comments indicate that the double composite liner system is consistent with systems used for hazardous waste sites.[1] As described in the Single Supplemental Certificate, the layers include primary and secondary geosynthetic clay liners (GCL) and geomembranes, with a leak detection/drainage layer material that drains to a secondary sump and allows for the measurement of leachate that might leak through the primary liner system. On top of the primary geomembrane is a leachate collection system consisting of a network of pipes and 18-inches of drainage sand which allows for the collection and discharge of leachate to the primary leachate sump. There are pumps installed in both the primary and secondary leachate sumps, which pump the collected leachate through a force main to one of two leachate storage tanks. The stored leachate is transferred to tanker trucks and hauled to licensed wastewater treatment plants for treatment and disposal. The leachate collection system will be expanded to Phase 7 by extending the existing Phase 6 leachate collection system. It is anticipated that Phase 8 will be designed and constructed with its own collection system and leachate sump. Phase 9 will be developed by removing any final or intermediate cover systems onto which it will be built, so that leachate will flow vertically into the existing landfill phases and collection system.

Phase 9 will be a vertical expansion of landfilling over existing double composite lined landfill phases. Some of the phase areas have final cap installations that will require the removal of those cap components, including geomembrane barriers. Other areas upon which Phase 9 will be developed (Phase 4, Stage 2 and Phase 5) are currently not capped, because they have just recently stopped operating, having reached their current approved final subgrades. The other portion of the Phase 9 overfill area will be constructed over the future plateau area of the active Phase 6 Landfill, when those approved grades are achieved. The Town plans to develop Phase 9 in stages. The first stage will be to fill the area that is over the Phase 5 Landfill. This will allow the final closure of the northwest corner of the landfill, which includes the currently uncapped Phase 5 sideslopes. The second stage would be to fill over the currently uncapped Phase 4, Stage 2 plateau and the completed Phase 6 plateau. This sequence will allow the postponement of removal of the existing final cap over the remainder of the Phase 9 footprint and will allow for the progressive modification to the existing gas collection system that underlays the Phase 9 Landfill. The completion of the Phase 9 overfill will require sequentially removing stages of the existing final caps of the Phase 2, Phase 2A/3A, Phase 3 and Phase 4, Stage 1 landfills. The sequential cap removal work will be done to minimize the area of open landfill surface at any one time. The Single Sup. EIR contained a Figure 4 in Attachment 3 that shows the anticipated sequential development of the Phase 9 Landfill. There will be areas that remain uncovered for several years before the Phase 9 filling occurs on them. In order to mitigate any impacts from occurring because of this, there will be an intermediate cover layer installed over these areas upon achieving the currently approved subgrades. The intermediate cover will be an application of soil materials meeting the requirements of 310 CMR 19.130(15)(d) Intermediate Cover. Because of the possible long-term exposure of the intermediate cover material until Phase 9 is constructed, the cover soils material will be applied across the subgrade surface, so as to form an intermediate cover that is at least twelve inches (12") thick.

MassDEP comments indicate that the Single Supplemental EIR addressed MassDEP's prior comments regarding the use of a long-term intermediate cover system. MassDEP will evaluate the plan for the long-term intermediate cover at solid waste permitting. MassDEP's decision on the use of long-term intermediate cover and the proposed capping schedule will depend on the waste stream (i.e. mainly ash in the "preferred alternative" or MSW only). If the Proponent decides to accept only MSW, the plan for a long-term intermediate cover system may not feasible according to MassDEP. Comments from

[1] Supplemental information provided by MassDEP on December 29, 2020.

MassDEP make clear that MassDEP may require the Proponent to revise the proposed schedule for capping if there are issues with leachate management, nuisance conditions, or as necessary to ensure compliance with 310 CMR 19.000.

The current landfill facilities include an existing gas collection and treatment system. The system for the management of gas generated within the landfill includes vertical extraction wells and horizontal gas collectors. There is also a network of piping to collect generated landfill gases and convey them to a flare station for treatment. The existing flare station is located to the northeast of the Phase 2 landfill area and prevents the occurrence of odors and the off-site migration of landfill gas. The landfill gas collection system will be expanded by modifying the existing header system, by relocating portions of it to the perimeter sideslopes to prevent them from being buried by the Phase 9 vertical expansion. Existing gas extraction wells located within the proposed footprint of Phase 9 will be modified by converting the wells to having remote wellheads, also along the perimeter sideslopes. The Phase 7 and 8, as well as the Phase 9 overfill waste will have new extraction wells installed and operated in the same manner as the existing extraction wells.

Potential impact from the landfill to the environment has been monitored for several decades by a groundwater and soil gas monitoring program. The monitoring program has consisted of quarterly sampling that began in the 1990s. This program has contributed to the development and approval of a Comprehensive Site Assessment (CSA) for the site. The scope of the current monitoring program was established in MassDEP's approval of the CSA in 2017. According to the Single Supplemental EIR, the facility anticipates that MassDEP approvals for Phases 7 and 8 will include the placement of additional groundwater and gas monitoring wells along their perimeter.

Traffic Assessment

The Single Supplemental EIR included a traffic assessment memorandum (dated July 16. 2020) which indicated that traffic generation has decreased since 2015 when municipal combustor ash, delivered in large trailers, became the primary waste stream. The Single Supplemental EIR also described that if the MSW (municipal solid waste) Alternative were to occur and the facility were to operate at daily capacity, more truck traffic would be needed to deliver such waste to the facility. The Single Supplemental EIR concludes that even if the MSW alternative were adopted, the maximum level of traffic would be the same level that existed as of 2015. However, this is the operational scenario that existed at the facility prior to accepting ash even if the facility returned to receiving MSW waste (which is not the Preferred Alternative). Therefore, the Single EIR concludes that even if MSW alternative were adopted, the maximum traffic would be the same level that existed as of 2015. The Single Supplemental EIR indicated that the project does not otherwise require an increase to the permitted tonnage the site can accept and therefore will not generate new traffic or impact traffic patterns due to an increase in permitted tonnage limits. The traffic assessment memorandum concluded that if the facility runs at daily capacity through its life, the landfill will operate until approximately September 2041 under the Preferred Alternative of accepting ash, while the MSW Alternative will only operate until approximately January 2036. The Single Supplemental EIR also included crash data from the Massachusetts Department of Transportation (MassDOT) from January 1, 2013 to June 4, 2020 for locations near the facility. Analysis of the data confirms that traffic operations of the facility will not constitute a danger to public safety.

Land Use and Water Resources

As required by the Scope, the Single Supplemental EIR presented the Preferred Alternative with both a Land Use Plan and a Water Resources Plan in accordance with the Site Assignment. The Single Supplemental EIR also included plans that show the limits of site assignment and waste handling, the conceptual site plans for the proposed landfill expansion and relocation of the large handling facility as requested by MassDEP during the review of the Expanded NPC. The Single Supplemental EIR included a groundwater contour map which delineates where the nearest public drinking water supply is located.

The Single Supplemental EIR presented a detailed assessment of compliance with site suitability criteria for both the landfill and waste handling facility components of the project. The filing did not indicate that the Proponent would seek a waiver of any site suitability criteria by MassDEP. The Bourne Landfill is located over the Cape Cod Sole Source Aquifer, as designated by the EPA. However, the Single Supplemental EIR has established that there are no existing or potential public or private drinking water supplies downgradient from the Landfill. The Single EIR includes a letter from the Bourne Board of Health confirming that all previously identified downgradient water supply wells have been replaced with connections to the public water supply system. The Proponent also indicates that the project will comply with the 310 CMR 16.40(4)(a) related to agricultural lands. MassDEP indicates United States Department of Agriculture (USDA) mapping shows the presence of soil types associated with Prime, Unique, or State and Local Importance farmland designations on the property. The Single EIR included a site specific soil survey as attachment 12 which included test pits and an evaluation by a certified soil scientist to determine whether the USDA mapping is correct. MassDEP allows site specific soil surveys since the USDA soil surveys are based on soil examinations at 100-150 foot intervals. The site specific soil survey in the Single EIR did find some areas of agricultural lands, however as proposed all waste handling areas meet the agricultural land setback requirements of 310 CMR 16.40(4)(a). Therefore, MassDEP concludes that no waiver is required. [2] Compliance with site suitability criteria will be determined in subsequent permitting by the local board of health and MassDEP.

Emergency Authorization

According to the Single Supplemental EIR, the landfill is anticipated to play a leading role in responding to future emergency conditions on Cape Cod in order to ensure that the public health and the environment are protected. The Single Supplemental EIR included a request that MEPA review be waived for such emergencies such that deference is afforded to MassDEP for any technical oversight. Specifically, the Single Supplemental EIR requests presumptive approval to operate any or all of its facilities 24 hours per day, with a total inbound tonnage not to exceed 1,500 tons in any 24 hour period, for a minimum of five consecutive days, or 120 hours. The Single Supplemental EIR did not describe the anticipated future emergency conditions nor provide additional details on what may trigger the need for implementation of this scenario. I note the MEPA regulations already include provisions that address review of emergency actions necessary to avoid or eliminate an imminent threat to environmental resources or quality or public health or safety (301 CMR 11.13), though these provisions would be premised on the need for Agency Action by MassDEP.

Land Alteration/Stormwater

[2] Supplemental information provided by MassDEP dated December 29, 2020.

The new liner areas and area required for new structures and associated pavement will create 15.86 total acres of impervious area. The Single Supplemental EIR included both a graphic and narrative description of the impervious areas. The expansion of new impervious area on the 25-acre parcel will be for the landfill expansion and will be the portion of that parcel that is not currently paved or covered by a building. This area consists of approximately 10.28 acres. The expansion of new impervious area on the 12-acre parcel, which is currently undeveloped, will be for pavement, buildings and infrastructure to support the Large Handling Facility (LHF). The conceptual design of new impervious area is approximately 5.58 acres.

According to the Single Supplemental EIR, stormwater will be managed onsite through the use of diversion berms, swales, culverts, retention basins, and infiltration basins. The landfill has an established Stormwater Management Plan (SMP), which has evolved as the site has been developed. The current stormwater management facilities consist of a series of engineered runoff water quality diversion berms, let-down channels, perimeter swales, culverts and sedimentation/retention basins. The site is divided into three drainage basins. Generally, the northern two thirds of the western side of the site, which includes the site's access road and the northern and western sides of the landfill, drain to Stormwater Basin # 1 as tributary flows to a drainage swale along the western side of the landfill. The eastern side of the landfill and southern third of the site drains to Stormwater Basin #2. The interceptor is designed to collect flow at critical phase points at the toe of the eastern sideslope for Phases 6, 7 and 8 landfills. The Town is permitted to accept both fly ash and bottom ash for disposal, however the majority of ash they accept is bottom ash. All stormwater that comes into contact with solid waste including fly ash and bottom ash and/or daily cover is collected and controlled as leachate.[3] According to the Single Supplemental EIR, all site runoff from developed areas of the site drains to either of these two basins. Each basin completely discharges to groundwater. The Single Supplemental EIR contains a SMP that takes into account the proposed full site buildout and provides details on stormwater management during the construction period.

Rare Species

According to the Single Supplemental EIR, portions of the project site are located within mapped habitat of the Eastern Box Turtle *(Terrapene carolina),* which is state-listed as a species of Special Concern. This species and its habitat are protected pursuant to the Massachusetts Endangered Species Act (MESA; MGL c.131A) and its implementing regulations (321 CMR 10.00). Comments from NHESP indicate that the project is anticipated to result in a Take and, therefore, will require a CMP pursuant to 321 CMR 10.23. Projects resulting in a Take of state-listed species may be permitted only if they meet the performance standards for a CMP. In order for a project to qualify for a CMP, the Town must demonstrate that the project has avoided, minimized and mitigated impacts to state-listed species consistent with the following performance standards: (a) adequately assess alternatives to both temporary and permanent impacts to the state-listed species, (b) demonstrate that an insignificant portion of the local population will be impacted, and (c) develop and agree to carry out a conservation and management plan that provides a long-term net benefit to the conservation of the state-listed species. The Single Supplemental EIR indicated the Town intends to meet these performance standards by permanently protecting off-site land in the vicinity of the site as open space and state-listed species habitat. NHESP anticipates that the project will provide a suitable long-term net benefit and meet the

[3] Supplemental information provided by MassDEP dated December 29, 2020

performance standards for issuance of a CMP.

The Single Supplemental EIR provided an update on consultation with the NHESP and included additional details on how the project will provide a suitable long-term net benefit and meet the performance standards for issuance of a CMP. The Town has researched parcels in the nearby area that would provide suitable mitigation and could be placed under permanent protection. This research has yielded a candidate parcel. The Town is preparing an assessment of the parcels for NHESP review to ensure that they are suitable. Comments from NHESP indicate that the Town intends to meet the performance standards of a CMP by permanently protecting off-site land as open space and state-listed species habitat through fee conveyance to the Town of Bourne Conservation Commission. According to NHESP the Town has identified a candidate parcel in the vicinity of the property which should provide an acceptable option to address the required long-term net benefit for Eastern Box Turtle associated with the project. The Town may also propose to permanently protect portions of the property, as shown on the "Conceptual Site Buildout Plan" included in the Single Supplemental EIR. Although the exact details of the long-term net benefit required under a CMP have not yet been finalized, NHESP anticipates that a suitable long-term net benefit can be achieved through the protection of high quality off- and on-site habitat and that the project should be able to meet the performance standards of a CMP.

Climate Change and GHG Emissions

Adaptation and Resiliency

The Town is a participant in the Commonwealth's Municipal Vulnerability Preparedness (MVP) program. The MVP program is a community-driven process to define natural and climate-related hazards, identify existing and future vulnerabilities and strengths of infrastructure, environmental resources and vulnerable populations, and develop, prioritize and implement specific actions the Town can take to reduce risk and build resilience.

To aid in this assessment, the Town consulted resilientMA.org which contains a report entitled, Massachusetts Climate Change Projections - Statewide and for Major Drainage Basins Temperature, Precipitation, and Sea Level Rise Projections, prepared by the Northeast Climate Adaptation Science Center at the University of Massachusetts Amherst. The Single Supplemental EIR indicated that the Town has reviewed the prediction for sea level change noted in the report. The "Extreme", or maximum physically plausible case, sea level rise scenario for as far into the future as the year 2100, predicts a maximum rise of 10.3 feet above current (or mean) sea level. Phase 9 will increase the maximum height of the Landfill from elevation 185 feet mean sea level (MSL) to elevation 225 feet MSL over previously lined and filled areas of the landfill including Phases 2, 2A/3A, 3, 4, 5 and 6. The Single Supplemental EIR concluded that the designs for the expansion of the Bourne Landfill and associated waste management and handling facilities would not be directly affected by this change because the facility is located on one of the highest points on Cape Cod and has elevations ranging from approximately 144 feet MSL to 90 feet MSL along the perimeter of the facility. The maximum predicted sea level rise of 10.3 feet MSL is well below this level as contained Massachusetts Climate Change Projections.

In addition to sea level rise, the Town considered predictive modeling regarding increases in precipitation during the design of its stormwater management systems. The model shows for the Buzzards Bay basin that by the end of the century in the 2090s, the maximum increase in annual precipitation is predicted to be between 0.3 and 6.8 inches from the observed baseline amount of 47.8 inches per year. The model also shows predictions in the 2090s for the Cape Cod Basin, which is to the north of the facility, ranging from a decrease of 0.8 inches to an increase of 5.5 inches from the observed baseline amount of 44.9 inches per year. The Single Supplemental EIR states that the SMS systems at the ISWM facility are capable of handling this projected increase with available capacity and proposed drainage basins above the current 100-year storm event.

Greenhouse Gas Emissions (GHG)

This project is subject to review under the May 5, 2010 MEPA GHG Policy. The Policy requires Proponents to quantify carbon dioxide (CO_2) emissions and identify measures to avoid, minimize or mitigate such emissions. As previously disclosed in the Expanded NPC, a major reduction in the production of GHGs has been achieved by shifting the waste the Town accepts. As required by the Scope, the Town provided an update on its contract with SEMASS and an analysis of alternative scenarios, should this contract be suspended and the landfill returned to acceptance of MSW waste. Approximately 86 percent of its annual tonnage is in the form of municipal combustor ash (MCA) which does not produce gases. The Town's 10-year contract to accept MCA from SEMASS will terminate at the end of 2021. The Town intends to extend the contract and to continue accepting up to 189,000 tpy of MCA and 30,000 tpy of biodegradable MSW from Bourne and Falmouth (Scenario 1). However, if the contract is not extended, the Town will return to accepting up to 219,000 tpy of biodegradable municipal solid waste (MSW) (Scenario 2). The Single Supplemental EIR reiterated from the Expanded NPC that Scenario 2 would generate a total of 815,844 tons of GHG emissions over this period. The Town's preferred scenario (Scenario 1), representing continued acceptance of MCA, would decrease GHG emissions by 425,138 total tons over the 40 year period (2021 through 2041) compared to Scenario 2. This represents an approximate 52 percent reduction in GHG emissions compared to Scenario 2.

The Single EIR included a commitment to explore various options to utilize landfill gas as an energy source and identified the possibility of the installation of a solar photovoltaic array on the Landfill under both Scenario 1 and Scenario 2. Comments from MassDEP indicate any of the landfill gas use options that are described in the Single Supplemental EIR will require air permitting by MassDEP. The Single Supplemental EIR did not identify any additional measures which will be implemented to reduce GHG emissions should Scenario 2 occur if the SEMASS contract were not renewed. However, the Proponent indicates that the existing landfill gas collection is designed to capture and reuse 95% of gas emissions, and this rate will be maintained in either scenario. The Proponent reiterates that several other measures will continue to be explored to further GHG emissions, including, in particular: recovering thermal energy; operation of an animal crematory that would use the LFG as a fuel; vertical axis wind turbines; use of compressed natural gas for trucks; and, regional composting.

Construction Period

The Single Supplemental EIR identified construction period impacts including increases in construction related truck traffic, dust, noise, stormwater runoff, and construction waste. Mitigation measures identified in the Single Supplemental EIR include implementation of a traffic control and construction management plan, dust suppression measures, and construction waste management and recycling.

All construction and demolition activities will be managed in accordance with applicable MassDEP's regulations regarding Air Pollution Control (310 CMR 7.01, 7.09-7.10), and Solid Waste Facilities (310 CMR 16.00 and 310 CMR 19.00, including the waste ban provision at 310 CMR 19.017). The project will include measures to reduce construction period impacts (e.g., noise, dust, odor, solid waste management) and emissions of air pollutants from equipment, including anti-idling measures in accordance with the Air Quality regulations (310 CMR 7.11). The Town plans to require that its contractors use construction equipment with engines manufactured to Tier 4 federal emission standards, or select project contractors that have installed retrofit emissions control devices or vehicles that use alternative fuels to reduce emissions of volatile organic compounds (VOCs), carbon monoxide (CO) and particulate matter (PM) from diesel-powered equipment. If oil and/or hazardous materials are found during construction, the Town will notify MassDEP in accordance with the Massachusetts Contingency Plan (310 CMR 40.00). All construction activities should be undertaken in compliance with the conditions of all State and local permits.

Mitigation and Draft Section 61 Findings

The Single Supplemental EIR contained a separate chapter on mitigation measures and draft Section 61 Findings for each Agency taking action on the project. It described mitigation measures and contained a table demonstrating the responsible party for implementing mitigation, monetary amounts where applicable, and a schedule for implementation. The draft Section 61 Findings will serve as the primary template for State Agency Permit conditions, and should be revised or updated as appropriate based on comments received and further consultation with Agencies after issuance of this Certificate. As described in the Single Supplemental EIR and prior MEPA documents, the Proponent has committed to implement the following measures to avoid, minimize, and mitigate environmental impacts:

MITIGATION MEASURE	IMPLEMENTATION SCHEDULE	COST ESTIMATE
Phased construction of Phase 7 & 8 double composite liner and leachate collection systems.	Starting in 2027	$8,000,000
Continue on-going environmental monitoring of groundwater quality and landfill gas migration.	Until 30 years after the close of the landfill.	$80,000/yr
Phased construction of final closure caps, including gas collections system extension, starting with Phase 9 and continuing as areas reach final subgrades.	Starting in 2022	$12,000,000
Construct stormwater management facilities, as part of the construction of the Large Handling Facility (LHF).	Starting in 2024	$800,000

Mitigate GHG by continuing to operate gas collection & treatment system, install solar photovoltaic arrays and evaluate other GHG mitigation measures. As heavy equipment is replaced purchase EPA air quality compliant equipment.	Ongoing operations with solar arrays added following area closure completions.	$ 1,000,000
Enforce noise mitigation measures during construction and operations.	For the life of the Facility	$1,000/yr
Enforce dust mitigation measures during construction and operations, including road sweeping and water applications.	For the life of the Facility	$10,000/yr
Enforce odor mitigation measures during construction and operations, including continued operation of gas collection and treatment system, as included above.	For the life of the Facility	$50,000/yr
Enforce vermin mitigation measures during construction and operations, including proper cover placement and maintaining exterminator services.	For the life of the Facility	$30,000/yr
Enforce litter mitigation measures during operations, including maintenance of fencing, cover application and litter patrols.	For the life of the Facility	$70,000/yr

For Rare Species:

MITIGATION MEASURE	IMPLEMENTATION SCHEDULE	COST ESTIMATE
Prepare and negotiate a Conservation Management Plan with NHESP.	Starting in 2020	$75,000
Purchase proposed compensatory, mitigation properties.	2021	$250,000

For Construction Period:

The measures that will be undertaken include:

- compliance with MassDEP regulations regarding air pollution control;
- designating areas for storage of equipment and supplies;
- ensuring that contractors keep all work areas neat and free from unsecuredsupplies such as gasoline, diesel fuel and other petroleum products;
- dust control measures such as regular road sweeping and watering as needed;

- requirement of a site-specific Health and Safety Plan by all contractors;
- installation of stormwater control structures to manage all stormwater on-site;
- requirement of a site-specific Erosion Control Plan by all contractors;
- requirement to follow anti-idling requirements;
- use of ultra-low sulfur diesel fuel (ULSD);
- use of and purchase of equipment with current low-emission engine types or other control mechanisms, including Tier 4 standards for engines (file maintained on-site); and
- coordination of on-site disposal and diversion of waste with the Town management to comply with waste bans and encourage recycling and diversion.

The Town will provide a GHG self-certification document to the MEPA Office that is signed by an appropriate professional (e.g., engineer, architect, transportation planner, general contractor) and indicates that all of the required mitigation measures, or their equivalents, have been completed.

Conclusion

Based on a review of the Single Supplemental EIR, comment letters, and consultation with State Agencies, I find that the Single Supplemental EIR adequately and properly complies with MEPA and its implementing regulations. State Agencies shall forward their final Section 61 Findings for publication in the Environmental Monitor.

K. Theoharides

December 30, 2020
Date

Kathleen A. Theoharides

Comments received:

12/17/2020	Natural Heritage & Endangered Species Program (NHESP), Massachusetts Division of Fisheries & Wildlife
12/23/2020	Conservation Law Foundation (CLF) in behalf of Beyond Plastics, Clean Water Action, Community Action Works, the Global Alliance for Incinerator Alternatives, Massachusetts Rivers Alliance, MASSPIRG, Saugus Action Volunteers for the Environment, the Saugus River Watershed Council, Sierra Club, and Sustainable Practices
12/23/2020	Cape Cod Commission (CCC)
12/23/2020	Massachusetts Department of Environmental Protection (MassDEP) – Southeast Regional Office (SERO)

KAT/ACC/acc

APPENDIX B-4

BOURNE WATER DISTRICT CORRESPONDENCE

TOWN OF BOURNE
BOARD OF HEALTH

24 Perry Avenue
Buzzards Bay, MA 02532

Terri A. Guarino
Health Agent

June 6, 2020

C/O Mr. Phil Goddard
Manager of Facility Compliance & Technology Development
Town of Bourne Dept. of Integrated Solid Waste Management
201 MacArthur Blvd.
Bourne, MA 02532

Dear Mr. Goddard:

Section 5.3 of the existing local Health Regulations indicates that "No well, private or public, will be allowed to be constructed, for human consumption, if its placement is hydraulically down-gradient of the Bourne Integrated Solid Waste Management Facility consisting of approximately 103 acres located at 201 MacArthur Boulevard, Bourne, as delineated on the Town of Bourne Assessor's maps as map 28, parcel 13 and map 32, parcel 9. Said down-gradient area shall be delineated by the particle tracking maps created by the United States Geological Survey (USGS) on file with the Board of Health office."

The Bourne Health Department does not permit the construction of potable wells downgradient from the Bourne Landfill and these areas are connected to the public water system. If you have any concerns please feel free to contact me at 508-759-0600 ext. 1513.

Sincerely,

Terri Guarino

Terri Guarino, RS, CHO
Health Agent

C.C. Board of Health

BOURNE WATER DISTRICT

211 Barlow's Landing Road. P.O. Box 1447
Pocasset, Massachusetts 02559
508-563-2294 FAX Number 508-564-4661

26 May, 2020

To: Phil Goddard
Manager of Facility Compliance and Technology Development
Town of Bourne, ISWM Department
24 Perry Avenue
Buzzards Bay, MA 02532
p. 508-759-0600, ext. 4241

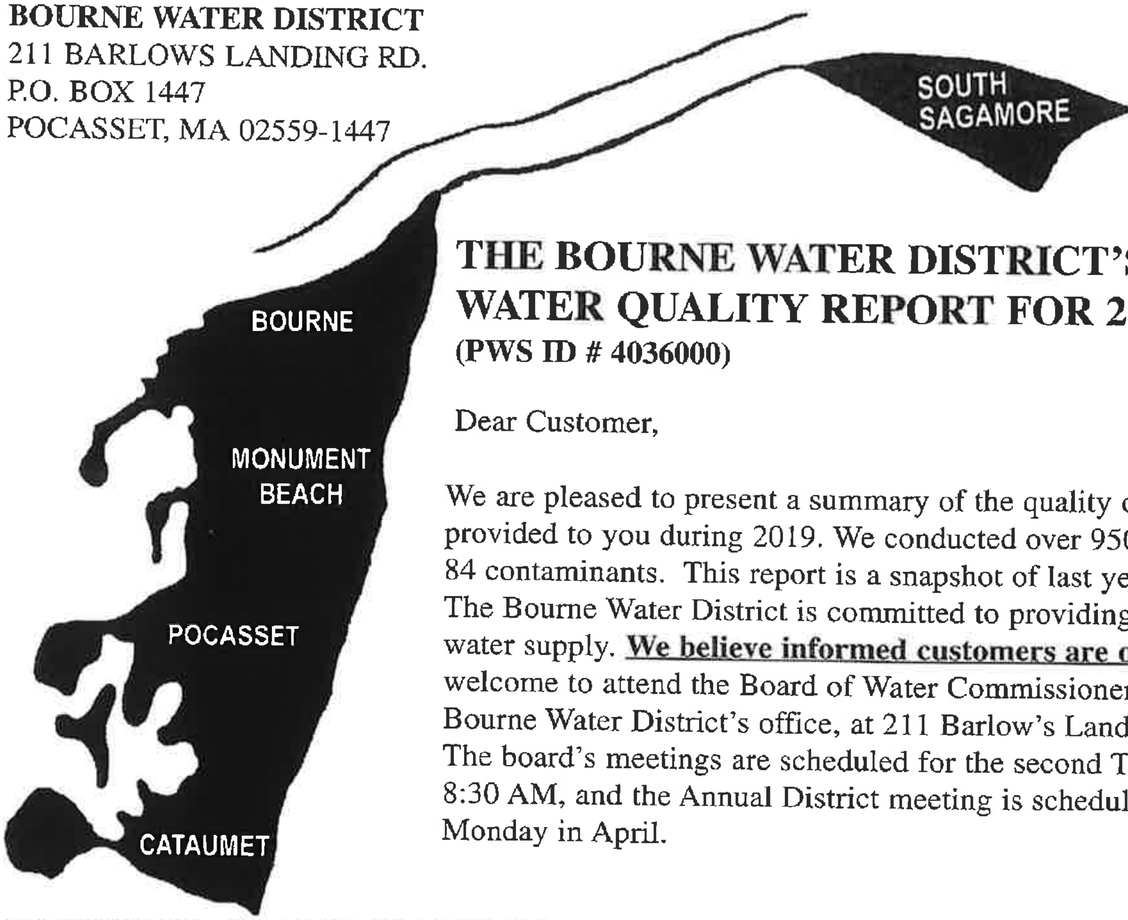
Re: Bourne Landfill build-out

Gentlemen:

Bourne Water District does not have a wellfield downgradient from the Bourne Sanitary Landfill. Bourne Water District would not be permitted by Mass Department of Environmental Protection to put a new production well downgradient of a Landfill. Bourne Water District has no objection to the build – out proposed by the I.S.W.M. Dept... If you have any questions or concerns please feel free to contact me at 508-563-2294.

Sincerely,
Robert Prophett, Superintendent
Bourne Water District

BOURNE WATER DISTRICT
211 BARLOWS LANDING RD.
P.O. BOX 1447
POCASSET, MA 02559-1447



THE BOURNE WATER DISTRICT'S WATER QUALITY REPORT FOR 2019

(PWS ID # 4036000)

Dear Customer,

We are pleased to present a summary of the quality of the drinking water provided to you during 2019. We conducted over 950 tests for more than 84 contaminants. This report is a snapshot of last year's water quality. The Bourne Water District is committed to providing you with a reliable water supply. **We believe informed customers are our best allies.** You are welcome to attend the Board of Water Commissioners meetings held at the Bourne Water District's office, at 211 Barlow's Landing Road in Pocasset. The board's meetings are scheduled for the second Tuesday of the month at 8:30 AM, and the Annual District meeting is scheduled on the fourth Monday in April.

WATER SOURCES AND TREATMENT

The Bourne Water District is supplied by 10 different sources, 7 of our own gravel packed well sites and 3 gravel packed well sites from the Upper Cape Regional Water Supply Cooperative. Four of our well sites are in the Monument Beach area of the Town Forest. The other two wells are in the Cataumet area of the Town of Bourne. One well is on Joint Base Cape Cod and we have one transfer station on Connery Ave. The Bourne Water District treats all supplies with lime slurry for corrosion control. The lime slurry is used to raise the pH of the water. This makes the water less aggressive to the copper pipe and lead joints in your homes to prevent exposure to lead and copper.

WHAT DOES THE FOLLOWING TABLE MEAN?

Action Level (AL) The concentration of a contaminant which if exceeded triggers treatment or other requirements.
Maximum Contaminant Level (MCL) The highest level of a contaminant that is allowed in the drinking water. The MCL is set as close to the MCLG as feasible using the best available treatment technology.
Maximum Contaminant Level Goal (MCLG) The level of a contaminant in the drinking water below which there is no known or expected risk to health. The MCLG allow for a margin of safety.
90th Percentile Out of every 10 houses sampled, 9 were below this level.

KEY TO TABLE

AL = Action Level
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
MFL = million fibers per liter
Mrem/year = millirems per year (a measure of radiation absorbed by the body)
NTU = Nephelometric Turbidity Units
pci/l = picocuries per liter (a measurement of radioactivity)
ppm = parts per million, or milligrams per liter (mg/l)
ppb = parts per billion, or micrograms per liter (ug/l)
ppt = parts per trillion, or nanograms per liter
ppq = parts per quadrillion, or picograms per liter
TT = Treatment Technique

APPENDIX B-5

CUMULATIVE IMPACT ASSESSMENT APPROVAL

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

MITT ROMNEY
Governor

KERRY HEALEY
Lieutenant Governor

ELLEN ROY HERZFELDER
Secretary

EDWARD P. KUNCE
Acting Commissioner

TO: Dan Connick, BWP, SERO

THROUGH: Carol Rowan West, Director, ORS CRW
Glenn Keith, Planning and Evaluation Division, BWP, Boston for Glenn Keith

FROM: Diane Manganaro, ORS
Steve Dennis, BWP SD

DATE: July 1, 2003

SUBJECT: Review of the Interim Risk Assessment and Cumulative Impact Assessment of the Proposed Phased Landfill Development of the Town of Bourne Integrated Solid Waste Management Facility

The Office of Research and Standards (ORS) and the Bureau of Waste Prevention (BWP) have reviewed the "Interim Risk Assessment and Cumulative Impact Assessment of the Proposed Phased Landfill Development of the Town of Bourne Integrated Solid Waste Management Facility" report dated May 2003. This report, prepared by Cambridge Environmental, Inc., was submitted in support of the Town of Bourne's request to build a phased development of the existing Bourne Integrated Solid Waste Management Facility (ISWMF). This facility is currently a non-municipal solid waste landfill that accepts construction and demolition debris (C&D), bulky items and various other waste streams but not municipal solid waste (MSW) or household trash. The ISWMF provides recycling, composting, waste processing and landfilling capacities. The facility-based impact evaluation submitted by the applicants examines a number of scenarios, involving the disposal of additional non-MSW waste (including municipal waste combustor (MWC) ash), the relocation to a lined area of some MSW that was historically placed in an unlined section of the landfill, and the potential future disposal of MSW considering both current and increased waste acceptance rates.

In accordance with the Massachusetts Department of Environmental Protection (MADEP's) "Interim Risk-Evaluation Guidance Document for Solid Waste Facility Site Assignment and Permitting in Support of 310 CMR 16.00 & 19.000" (hereafter referenced as the Interim Guidance Document), this report includes a Level 2 impact evaluation to address the proposed expansion request. Our review addresses the consistency of this report with the requirements of the Interim Guidance Document. Our conclusions and recommendations are presented below:

Conclusions

The modeling analysis contained in the cumulative impact assessment provides a reasonable estimate of concentrations of air contaminants of concern emitted from the subject landfill. The general risk assessment approach used by the consultants is also consistent with MADEP guidance. The report indicates that for scenarios in which the landfill only accepts MSW, estimated risks are below *de minimis* risks for both non-cancer and cancer endpoints. However, for scenarios in which the landfill accepts non-MSW waste, non-cancer risks exceed MADEP risk limits, mainly attributed to H_2S that is generated from C&D waste. In addition for the non-MSW scenarios, a comparison of predicted 30-year ambient concentrations of H_2S to maximally exposed receptors also indicates that these levels exceed the MADEP allowable ambient limit (AAL) for H_2S.

The exceedance of MADEP risk limits is determined based on site-specific landfill gas testing results taken in October and December 2002, from an existing portion of the landfill that accepted non-MSW. Additional testing, conducted in May 2003, resulted in concentration estimates of H_2S that were of half the magnitude of the previous testing rounds. There is a question as to the comparability of the more recent data to the older data since two different analytical methods were used and the differences in the precision and accuracy of these methods is unknown. An analysis of the May 2003 landfill gas testing data results in non-cancer risk estimates that meet MADEP risk limits although predicted ambient concentrations are still predicted to exceed the MADEP AAL for non-MSW scenarios.

These data indicate that continued disposal of non-MSW in the manner that has been used in the past poses an unacceptable health risk to receptors in the area of the ISWMF. This is in contrast to a scenario in which the landfill only accepts MSW, which results in minimal risks to receptors. ORS believes that a comprehensive waste acceptance and processing strategy that integrates acceptance of MSW and processed non-MSW waste can be developed which may limit emissions of H_2S to levels that meet MADEP risk limits. We recommend that the Town of Bourne work with SERO regional staff to develop such an approach.

Finally, the evaluation of groundwater resources required to be submitted as part of this evaluation indicates an exceedance of two compounds in off-site monitoring wells. The report indicates a general improvement in groundwater quality over time, attributed by SERO staff to the fact that the older, unlined portions of the landfill that were the source of groundwater contamination, have been mined and capped.

SERO staff has completed its review of the Comprehensive Risk Assessment (CSA) (December 1999) and will be issuing a technical review letter in the near future. They will determine whether additional remedial actions will be required and will finalize the environmental monitoring plan for the entire site.

We therefore recommend that this Facility-Based Impact evaluation be approved with the caveats discussed above and detailed below.

Modeling Issues

See attached memo dated June 26, 2003from Steve Dennis entitled "Review of the Cumulative Impact Analysis for the Proposed Phased Landfill Development of the Town of Bourne Integrated Solid Waste Management Facility, dated May 2003".

Risk Assessment Issues

1.) The consultants conducted the risk assessment using site-specific information (collected in October and December, 2002) at the Bourne ISWMF Phase 2. Phase 2 of the landfill has accepted only non-MSW since it opened in May 1999 and has been capped and equipped with a landfill gas collection system. The applicants used site-specific information for this facility since gas produced by non-MSW can differ significantly from gas produces by MSW, particularly in the amount of hydrogen sulfide (H_2S) generated from such materials as gypsum wallboard, a large component of C&D waste. The consultants took two samples of landfill gas in both October and December 2002. They used site-specific data for detected chemicals that are on the default AP-42 list, a value of ND for compounds that were not detected on either sampling date, and a value of one-half the method detection limit for compounds not detected in one sample that were detected in at least another sample. In addition, AP-42 COCs that were not analyzed in the site-specific data (i.e., mercury and t-1,2-dichloroethylene) were assumed to be present at the default AP-42 levels.

The Interim Guidance Document specifies that AP-42 default values should be used although site-specific data may be used at the discretion of the regional office. Given that these data were taken from an area which contains no MSW, ORS agrees that use of the site-specific data is appropriate. MADEP's policy in the past has been that when site-specific data are used, the higher of either the AP-42 value or the site-specific value should be used as the default. Although the consultants did not take this approach, ORS agrees that site-specific landfill gas results are much more representative of actual gas emissions than are AP-42 values. AP-42 values were developed to apply to MSW facilities while the site-specific data are representative of non-MSW waste. For non-cancer risks, given the fact that exposures and resulting risks to these gases are clearly driven by H_2S by a number of orders of magnitude, use of the higher value as described above would be both irrelevant and of minimal impact to final risk estimates for this facility. However, to account for possible additional cancer risk from MSW, it is suggested that at least the higher of the AP-42 or site-specific values for carcinogenic chemicals be included in this evaluation to estimate Excess Lifetime Cancer Risk (ELCR) or alternatively that an uncertainty analysis be done to compare ELCR from site-specific, or non-MSW emissions versus AP-42 , or MSW emissions at this facility to demonstrate any differences.

2.) The consultants assume a landfill gas capture efficiency of 75% in active landfill cells and 90% post-closure. They provide correspondence from the Waste Industry Air Coalition and SCS Engineers addressing the efficiency of landfill gas collection systems as documentation for their assumed collection efficiency of 90% for a post-closure landfill. While we acknowledge that landfill gas collection efficiencies are likely to have improved over time, MADEP maintains its position that this estimate should not be used unless additional, more quantitative documentation is submitted that demonstrates that the 90% value is representative for this facility. In the absence of this information, we request that the 75% value also be used for the post-closure scenario. The sensitivity analysis presented in Tables 3.51-3.54, which incorporates the 75% post-closure scenario, adequately addresses this issue. ORS will consider the risks incorporating a 75% post-closure assumption in its evaluation of this report. In terms of landfill gas collection efficiency for the active cell, MADEP is proposing in its revision of the Interim Guidance Document to recommend a 0% efficiency for landfill cells that are still operating. The proponent should work with SERO staff to identify the landfill gas collection efficiency for active cells that is appropriate for this facility.

3.) Final risk estimates calculated using the 75%/75% pre- and post-closure assumption and the data from the October and December 2002 site-specific landfill gas monitoring results indicate that chronic Hazard Indices (HI) exceed MADEP risk limits for non-cancer risk for scenarios A and C at both current and increased waste acceptance rates for all residential and all but one commercial receptor. This exceedance is clearly driven by the concentration of H_2S at this facility.

Additional sampling results were submitted to us by the consultants in a memo dated June 17, 2003 with an attached memo from SITEC Environmental (dated June 3, 2003) containing the data. Two landfill gas samples were taken on two days (i.e., May 23rd and May 30th 2003) using a Drager tube fitted with a pump apparatus. The submitted results included the quantified values along with pictures of the exposed Drager tubes.

The method used to collect the May 2003 data is very different from the method used in the October and December 2003 sampling rounds. The first two sampling rounds were collected and analyzed using published EPA methods including analysis by gas chromatography/mass spectrometry GC/MS. There was no information on the precision and accuracy of the Drager tube method. It is difficult to assess from the information submitted whether the difference in results can be attributed to actual changes in the data or if this difference may be reflect differences in the accuracy of the two methods.

We recommend that additional samples be taken be conducted using EPA-recommended methodologies as approved by MADEP to allow for direct comparison to the original October/December 2003 data.

4.) A comparison of the risk assessment baseline values of COC_{air} ($\mu g/m^3$) estimated in the consultants' May 2003 report for a 30-year exposure indicates that the calculated values exceed the ORS chronic allowable ambient limit (AAL) for H_2S in air of 1 $\mu g/m^3$ for a number of residential and commercial receptors in scenarios A and C, the non-MSW scenarios. These values range from about 1-4 $\mu g/m^3$ in the May 2003 report. Assuming, as the information from the June 3, 2003 SITEC memo indicates, that a more recent estimate of these values is one-half of the values in May 2003 report, then these values would fall into the range of 0.5-2 $\mu g/m^3$. The estimated values for the A and C scenarios for the commercial/industrial receptor would still exceed the H_2S AAL.

5.) As part of the uncertainty and sensitivity analysis section at the end of this report, the consultants cite information that seemingly lessens the perceived hazard of H_2S. Most of the information cited addresses animal and human studies in which subjects were exposed to very high concentrations. While it is true that H_2S can be extremely acutely toxic as an asphyxiant and an irritant at high concentrations, this compound is reported to be toxic at low concentrations as well. Effects from H_2S exposure are reported to occur at levels as low as 0.13-2.8 mg/m^3. Reported effects are on the respiratory system, the nervous system and the heart. Symptoms include eye and throat irritation, headache and nausea. The proposed mechanism of toxicity, as with cyanide, is inhibition of cellular oxidative metabolism. Direct inhibition of cellular enzymes, in particular cytochrome oxidase, an enzyme involved in cellular oxidative process and energy production has been implicated. Nervous and cardiac tissues, which have the highest oxygen demand, are especially sensitive to the disruption of oxidative metabolism by H_2S (MADEP, 2001).

6.) Table 3.30 which lists the toxicity data used in DEP risk calculations (and referenced as the DEP Risk Assessment Spreadsheet in Support of the Interim Guidance Document) excluded the subchronic and chronic Reference Concentrations (RfCs) for ethane based on the consultants' opinion that use of the hexane value overestimates risk for ethane. In the absence of a quantitative toxicity value for ethane, the ORS Risk Assessment Spreadsheet designates the toxicity value for hexane as a surrogate for ethane. As the consultants state in their discussion of uncertainty in Section 3.7 of their report, in their opinion the use of the hexane value to account for ethane toxicity results in an overestimate of the risk. As a result of the consultants' omission, risks from estimated ethane emissions were not included in the evaluation for this facility. Due to the fact that H2S clearly drives the non-cancer risk estimates for this facility, the risk contribution from ethane for this facility is not expected to significantly impact the final non-cancer risk estimate.

Groundwater Issues

ORS defers to the MADEP southeast regional office (SERO) hydrogeology staff for issues pertaining to water resources evaluation. The adequacy of this evaluation to characterize the extent of contamination at this site is subject to the opinion of SERO hydrogeology staff. SERO staff is reviewing the status of the CSA for this facility. SERO will determine whether additional remedial actions will be required and will finalize the environmental monitoring plan for the entire site.

7.) Upon consultation with the SERO hydrogeology staff, ORS is considering the groundwater in the vicinity of the Bourne ISWMF to be classified as GW-1. As such, there were two exceedances seen in deep, off-site wells in this area, including one exceedance of the GW-1 standard for lead and one exceedance of the GW-1 standard for 1,2-dichlorethane. Upon review of the Hydrogeologic Investigation for Bourne Integrated Solid Waste Management Facility compiled by Mahoney and Douglas for the consultants (hereafter referred to the hydrogeologic report) and consultation with the SERO hydrogeology staff, ORS concurs that monitored levels to date have appeared to decrease over time. This decrease has been attributed by SERO staff to the fact that the older, unlined portions of the landfill that were the source of groundwater contamination, have been mined and capped. The progress of this contamination should continue to be monitored on a periodic basis.

8.) In section 4.2 of the hydrogeologic report, the proponents note that a number of private drinking water wells not originally covered by the original USGS particle tracking map, are vacant lots. This section does not address any measures or safeguards that the Town of Bourne will take to ensure that private wells will not be installed at these vacant lots once these lots are developed. This issue should be addressed by the proponents.

Best Management Practices

9.) The applicant has committed to ongoing use of Best Management Practices (BMPs). However, the section on diesel emissions only commits to a pilot project to test two technologies on two pieces of equipment. MADEP does not require such testing of technologies. The applicant should consult with MADEP/SERO to establish a clear commitment for retrofitting specific pieces of frequently used equipment.

References

ATSDR (Agency for Toxic Substances and Disease Registry). July 1999. Toxicological Profile for Hydrogen Sulfide. U.S. Department of Health and Human Services. Public Health Service.

MADEP (Massachusetts Department of Environmental Protection). July 1995. Guidance for Disposal Site Risk Characterization in Support of the Massachusetts Contingency Plan. Office of Research and Standards.

MADEP (Massachusetts Department of Environmental Protection). December 5, 2001. Hydrogen Sulfide: Proposed Chronic, Subchronic and Acute Inhalation Exposure Guidelines – Draft Document. Office of Research and Standards.

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

MITT ROMNEY
Governor

KERRY HEALEY
Lieutenant Governor

ELLEN ROY HERZFELDER
Secretary

EDWARD P. KUNCE
Acting Commissioner

MEMORANDUM

TO: Glenn Keith

FROM: Steve Dennis

DATE: July 1, 2003

SUBJECT: Review of the Cumulative Impact Analysis for the Proposed Phased Landfill Development of the Town of Bourne Integrated Solid Waste Management Facility, dated May 2003

The modeling analysis contained in the Cumulative Impact Analysis for the subject landfill facility provides a reasonable estimate of maximum air quality impacts of contaminants of concern (COC) emitted from the proposed landfill phases. The ICS3 model was used with EPA regulatory default options to estimate maximum air quality impacts at nearby residential and commercial receptor points of concern. Five years of surface meteorological data (Green airport in Rhode Island) and five years of upper air data (Chatham, Massachusetts) were employed for the analysis. Following are my comments.

1. Site-specific landfill gas data was used to determine concentrations for a number of COCs. According to the 2001 Interim Solid Waste Guidance, use of site-specific data needs to be approved by the DEP before that data's incorporation into a risk assessment. Because the site-specific data was not pre-approved by DEP for use in the risk assessment, risks may have to be recalculated those chemicals having an AP-42 emission rate values higher than the site-specific landfill gas emission rate measurements.

2. The uncertainty analysis in Section 3.5 indicated that a 75%/75% collection efficiency (before and after closure) would result in Hazard Index (HI) values of up to 2 at residential receptors for scenarios using non-MWS materials (the DEP Hazard Index criteria is 1). The maximum Excess Cancer Lifetime Risk (ECLT) would be 2×10^{-7}, well below the DEP *de minimus* ECLT criteria of 1×10^{-6}.

3. The uncertainty analysis in Section 3.5 indicated that with a 75%/75% collection efficiency, all scenarios using MSW materials would never exceed the DEP *de minimus*

HI criteria of 0.1 or the DEP *de minimus* ECLT criteria of 1×10^{-6} at any residential receptor point of concern.

4. Maximum off-site air quality impacts occur at and near the northeast property line. Impacts there are 2-3 times the maximum predicted impacts calculated for residential receptor points. Presumably, no residences would ever be allowed in this area.

5. Landfill gases are collected and burned by a flare with an assumed destruction efficiency of 98%. The unburned COCs were distributed over the landfill as an area source emission, instead of being treated a discreet point source of emissions. Previous analyses by Cambridge Environmental (reviewed and approved by DEP) indicated that modeling the flare emissions as an area source was a conservative and acceptable way of estimating air quality impacts from a landfill gas collection system.

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

MITT ROMNEY
Governor

KERRY HEALEY
Lieutenant Governor

ELLEN ROY HERZFELDER
Secretary

ROBERT W. GOLLEDGE, Jr.
Commissioner

January 26, 2004

Michael Ames, ScD.
Associate Engineer
Cambridge Environmental Inc.
58 Charles Street
Cambridge, Massachusetts 02141

Dear Mr. Ames:

Thank you for submitting your letter and enclosures, (dated December 10, 2003) to us containing updated information for the Town of Bourne Integrated Solid Waste Management Facility (ISWMF). With this letter you provide the results of the most recent analysis of landfill gas at this site, a recalculation of risks associated with these newer data, a summary of recent developments at the Town of Bourne Board of Health and information on the U.S. Environmental Protection Agency's (EPA's) revised toxicity value for hydrogen sulfide.

Your report indicates that revised risks calculated using the results of the recent landfill gas analysis and associated with scenario C-high (which the report predicts to be associated with the highest non-MSW risks) all meet the risk limits specified in the Massachusetts Department of Environmental Protection (MADEP)'s "Guidance for Conducting Facility-Based Impact Evaluation for Solid Waste Facility Site Assignment and Permitting in Support of 310 CMR 16.00 & 19.000" (hereafter referred to as the MADEP Guidance Document).

The recalculated risks considered a range of pre-closure and post-closure landfill gas collection efficiencies. MADEP risk limits were not exceeded at any of the collection efficiencies considered, including at the most conservative of these efficiencies (i.e., 75% pre- and post-closure as recommended in the MADEP Guidance Document). It is noted that a proposed change to the MADEP Guidance Document recommends use of a pre-collection efficiency of 0 and a post-collection efficiency of 75%. While this recommendation is still only a proposal at this stage, it is not clear that risk limits for the Bourne ISWMF would meet the MADEP criteria using this assumption. As the Bourne ISWMF was assessed based on existing guidance, this proposed change will not impact the status of this facility. However, the possibility is raised that future landfill risk assessments may be subject to this revised collection efficiency assumption.

Your letter notes that the U.S. EPA revised their inhalation Reference Concentration (RfC) for hydrogen sulfide on July 28, 2003 from 1 $\mu g/m^3$ to 2 $\mu g/m^3$ and presumes that since the MADEP Allowable Ambient Limit (AAL) for hydrogen sulfide is based directly on the U.S. EPA value, that MADEP AAL will also be revised to 2 $\mu g/m^3$ to be consistent with this value. To date, we have not taken any action to revise our hydrogen sulfide AAL and cannot comment on our intention to do so in the future. Unless and until such time as this value is revised, the existing value of 1 $\mu g/m^3$ should be used in conducting risk assessments in accordance with Guidance Document specifications.

MADEP is currently working to address the issue of hydrogen sulfide emissions from non-MSW landfills, especially facilities that take in construction and demolition material. As part of this policy, MADEP will be issuing updated toxicity values and a risk management approach for addressing problem hydrogen sulfide emissions from solid waste facilities. These components will be integrated into a guidance policy for assessing and mitigating the impacts of hydrogen sulfide emissions from these facilities.

Sincerely,

Diane M. Manganaro

Diane Manganaro
Environmental Analyst

cc: Carol Rowan-West, DEP/ORS, Boston
Barbara Kwetz, DEP/BWP, Boston
Dan Connick, DEP/BWP, SERO

PART C

DESIGN PLAN FOR THE
PHASE 9 LANDFILL EXPANSION
BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY

BWP SW 26 - APPLICATION FOR AUTHORIZATION
TO CONSTRUCT
PHASE 6 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY
BOURNE, MASSACHUSETTS

PART C
DESIGN PLAN

Prepared For:

TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT
24 Perry Avenue
Bourne, Massachusetts 02532

Prepared By:

SITEC Environmental, Inc.
769 Plain Street, Unit C
Marshfield, Massachusetts 02050

December 6, 2022

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PHASE 9 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY
BOURNE, MASSACHUSETTS

1.0 INTRODUCTION

1.1 General

This Application for Authorization to Construct (ATC) addresses the construction, operations, monitoring and closure for the proposed Phase 9 Landfill Expansion at the Bourne Landfill located in Bourne, Massachusetts. The proposed expansion is located within the central portion of the original Landfill property. The total footprint of the area to be filled will encompass approximately 28-acres, which completely overlays previously lined and landfilled areas. Phase 9 will be a vertical expansion over portions of the Phase 2, Phase 3, Phase 2A/3A, Phase 4, Phase 5 and Phase 6, or in other words all lined landfill phases. Consequently there will be no liner construction conducted as part of the Phase 9 Landfill Expansion. The gross available volume for Phase 9 will be approximately 1,255,000 cubic yards.

The design of the expansion incorporates the existing liner systems of the underlying landfills as its double composite liner system. The liner system includes primary and secondary leachate collection systems, designed in accordance with the requirements of 310 CMR 19.000 and current MassDEP policy. The secondary leachate collection systems provide leak detection capabilities for the primary liner system. Leachate will be collected from the primary and the secondary liner systems and will flow to the respective leachate collection sumps. This leachate will be pumped to either the 207,000 gallon or to the 125,000 gallon above ground storage tanks. Leachate will be removed from the storage tanks on a regular basis and transported to an approved treatment facility.

The subject of this document is the proposed Phase 9 Landfill Expansion. The Phase 9 area will overlay approximately 28.0-aces of the plateaus of the above the listed landfills. The development of the Phase 9 Landfill Expansion will not include the construction of any new landfill liner systems.

The Phase 9 Expansion will have a maximum disposal capacity of approximately 1,192,000 tons. Currently, the Facility is accepting ash for disposal and daily cover, at a rate of approximately 230,000 tons per year. At that rate the life expectancy of the Phase 9 Landfill will be about five years, two months.

1.2 Purpose of this Report

The purpose of this report is to present the basis for the design of the various components of the Phase 9 Landfill Expansion. Conceptual designs for the final cover and landfill gas extraction systems have been included with this submission. This report includes the following:

- Leachate production estimates for Phase 9.
- Evaluation of Phase 9 leachate collection and removal system.
- Evaluation of the components that comprise the Phase 9 stormwater management system.
- Drainage capacity analyses of the Phase 9 final cover system.

1.3 Related Documents

This document is included as a component of the Application for Authorization to Construct the Phase 9 Landfill Expansion of the Bourne Integrated Solid Waste Management Facility. Documents that comprise the entire application are listed below:

Part A	Permit Application Forms
Part B	Supplemental Permit Information
Part C	Design Plan
Part D	Operation and Maintenance Plan
Part E	Construction Quality Assurance Plan
Part F	Technical Specifications for Liner Construction
Part G	Drawings

2.0 LANDFILL LINERS & LEACHATE COLLECTION SYSTEMS

2.1 General

Phase 9 will increase the maximum height of the Landfill from elevation 185' mean sea level (MSL) to elevation 225' MSL over previously lined and filled areas of the Landfill including Phases 2, 2A/3A, 3, 4, 5 and 6. By increasing the height of the Landfill over already constructed phases, in currently site-assigned areas and filling this area in conjunction with the active Phase 6, the Town can utilize the time that this capacity will provide to develop a detailed plan for how and when to relocate structures that will be replaced by the Phase 7 and Phase 8 landfill expansions, thereby maximizing the useful lifespan of the existing large handling facility assets which represent significant capital investments by the Town.

The Phase 9 vertical expansion will provide approximately 1,255,000 cubic yards of additional airspace which could extend the life of the landfill at least four and a half years. As noted earlier, by permitting and operating Phase 9 as the next area of landfill development after Phase 6, the Town will have additional time to create a schedule for the required permitting, financing and relocation of existing operations and site preparation for Phases 7 and 8. The combination of Phase 7, Phase 8 and Phase 9 will ensure that ISWM can continue to provide vitally needed landfill capacity to the region into the late 2030s or early 2040s.

There will be no new liner construction required for the Phase 9 Landfill Expansion. Phase 9 will be constructed completely above the existing liner components from the underlying landfills which meet and exceed the requirements of 310 CMR 19.110 and 19.111. The existing double composite liner systems were constructed over areas that had not at the time been previously landfilled or lined and are contiguous within the area of the Phase 9 Landfill Expansion.

Site preparation work for Phase 9 will include modifications to components of the existing landfill gas collection system that are within the Phase 9 overfill footprint. Additionally, Phase 9 will be constructed above portions of the Landfill's plateau area that have an approved, long-term intermediate cover system and portions that have a constructed "permanent" cover system. As stages of Phase 9 progress, the existing cover systems will have to be removed in order to provide a hydraulic connection for leachate generated in Phase 9 to flow through the existing landfills to their liner and leachate collection systems, or as supplemented by additional leachate collectors. With the completion of the Phase 4, Stage 2 and Phase 5 Closure Construction project, the east, north and west sideslopes have been permanently closed and capped. With an exception of an area on the southeast side of the Landfill, the sideslopes will not have to be disturbed. The south sideslope has approved intermediate cover and will subsequently be incorporated into the future Phase 7 Landfill Expansion project.

The current Landfill facilities include an existing, extensive gas collection and treatment system. These will be extended and modified as needed to expand the capacity for the collection of landfill gas. The system for the management of gas generated within the Landfill includes vertical extraction wells and horizontal gas collectors. There is an extensive network of piping to collect generated landfill gases and convey them to a flare station for treatment. The existing flare station is located to the northeast of the Phase 2 Landfill area and prevents the occurrence of odors and the off-site migration of landfill gas. The landfill gas collection system will be expanded by modifying the existing header system, by relocating portions of it to the perimeter sideslopes to prevent them from otherwise being buried by the Phase 9 vertical expansion. Existing gas extraction wells located within the proposed footprint of Phase 9 will be modified by converting the wells to having remote wellheads located along the perimeter sideslopes. The Phase 9 expansion will also have new extraction wells installed and operated in the same manner as the existing extraction wells, particularly in areas that do not currently have extraction wells. The existing flare treatment system was replaced and upgraded a few years ago and is adequately sized for future conditions.

Potential impacts from the Landfill to the environment have been monitored for several decades by a groundwater and soil gas monitoring program. The monitoring program has consisted of quarterly sampling that began in the 1990s. This program has contributed to the development and approval of a Comprehensive Site Assessment for the site. The scope of the current monitoring program was established in MassDEP's approval of the CSA in 2017. ISWM anticipates that there will not be a need to modify the existing environmental monitoring system, as a result of the Phase 9 Landfill Expansion since there is no increase in the Landfill's area.

Phase 9 will be a vertical expansion of landfilling over existing double composite lined landfill phases. Some of the phase areas have constructed final caps that will require the removal of those cap components, including geomembrane barriers. Other areas upon which Phase 9 will be developed (Phase 4, Stage 2 and Phase 5) are currently not capped, because they have just recently stopped operating, having reached their current approved final subgrades. The other portions of the Phase 9 overfill area will be constructed over the future plateau area of the active Phase 6 Landfill, when those approved grades are achieved. A slope stability analysis has been conducted, that determined the effects that Phase 9 will have on settlement of the underlying, existing landfill areas. Refer to the *Bourne Landfill, Phase 9, Geotechnical Evaluation Report* (Geocomp Corp.) included in Appendix C-3 of Part C - Design Plan of this Application.

ISWM plans to develop Phase 9 in stages. The first stage will be to fill the area that is over the Phase 5 Landfill. This will allow the final closure of the northwest corner of the Landfill. The second stage would be to fill over the completed Phase 6 plateau and then over the currently uncapped Phase 4, Stage 2 plateau.

This sequence will allow the postponement of removal of the existing final cap over the remainder of the Phase 9 footprint and will allow for the progressive modification to the existing gas collection system that underlays the Phase 9 Landfill. The completion of the Phase 9 overfill will require sequentially removing stages of the existing final caps of the Phase 2, Phase 2A/3A, Phase 3 and Phase 4, Stage 1 landfills. The sequential cap removal work will be done in a manner that will minimize the area of open landfill surface that exists at any one time. See the drawing titled *Existing Site Conditions and Proposed Phase 9 Staging Plan* in Part G- Drawings for a plan that shows the anticipated sequential development of the Phase 9 Landfill.

There are areas, as described above, that will not have a final cover for several years before the Phase 9 filling occurs on them, as approved by MassDEP. In order to mitigate any potential impacts from occurring because of this, in accordance with Phase 4, Stage 2 and Phase 5 BWP SW 25 CAD there has been an intermediate cover layer installed over these areas upon achieving the currently approved subgrades. The intermediate cover is an application of soil materials meeting the requirements of 310 CMR 19.130(15)(d) Intermediate Cover. Because of the possible long-term exposure of the intermediate cover material until Phase 9 is constructed, the cover soils material will be applied across the subgrade surface, so as to form an intermediate cover that is at least twelve inches (12") thick, when combined with existing daily cover will provide a total of eighteen inches (18") of cover. Should the intermediate cover materials fail, whereby odors are produced or excessive leachate is generated and cover repairs do not prove to be adequate, a temporary, sacrificial, geosynthetic cap may be installed.

2.2 Phase 9 Stage Sequencing

The construction of the Phase 9 Landfill Expansion Project consists of seven Stages of development, operation and closure. Drawings 4 through 11 in Part G of the Application present the sequencing of the seven stages, as described below.

Drawing No. 4 - Phase 6 Interim and Phase 9, Stage 1 Grading Site Plan
This drawing shows interim subgrades for the currently active Phase 6 Landfill. These interim grades provide better support for the vertical expansion of this area and shows a supplemental leachate collection line that will be connected to a leachate cleanout that is connected to the Phase 6 primary leachate sump. During this period, three existing gas extraction wells (EW-49, EW-50 and EW-51) along with two of their remote well heads may have to be abandoned. During the Phase 6 operating period, these wells have been vertically extended and will continued to be extended for as long as practical or a horizontal collection system may have to be installed as an interim measure. This drawing also shows the Phase 9, Stage 1 final subgrades over he existing Phase 5 Landfill.

Drawing No. 5 - Phase 9, Stage 2 Preparation Grading Site Plan
This drawing shows interim Stage 2 site preparation grades. This includes the construction of a berm around the Stage 2 area that will contain leachate to the area over the supplemental leachate collection line.

Drawing No. 6 - Phase 9, Stage 2 Filling and Stage 3 Preparation Grading Site Plan
This drawing shows final Stage 2 grades, with the expansion of the gas collection system in this area, including ten and eight inch gas header extensions and the installation of eight gas extraction wells. Gas system extensions are also shown over the Stage 1 area for future connections. Site preparations for Stage 3 include the removal of the existing cap and the berm construction for containment of this area. A supplemental leachate collection pipe will be extended into Stage 3 from a leachate interceptor line on the west side of the Landfill. The leachate line will be valved to allow the bleeding of leachate collected in the Stage 3 area following storms, into the leachate system. There will be a significant amount of modifications done to the existing gas collection system within this area. Generally these modifications will be to convert the existing direct mounted wellhead systems to remote wellheads. A typical modification is shown on the Landfill Gas System Details Plan in Part G - Drawings. Drawing No. 6 also shows the limits of final cap and the stormwater management facilities that are to be constructed on the Stage 1 and Stage 2 areas.

Drawing No. 7 - Phase 9, Stage 3 Filling and Stage 4 Preparation Grading Site Plan
This drawing shows final Stage 3 subgrades and the site preparation work for Stage 4. The Stage 4 preparation work includes removing the existing cap and grading to berm the area, as well as adding a leachate collection line connected to the leachate line that was extended into Stage 3 and the modification of existing gas wells in this area to being remote wellheads.

Drawing No. 8 - Phase 9, Stage 4 Filling and Stage 5 Preparation Grading Site Plan
This drawing shows final Stage 4 grades, along with the expansion of the gas collection system to add a ten inch gas header extension and two horizontal gas collection systems. This drawing also shows the limits of final cap and stormwater management facilities that are to be constructed on the Stage 3 and Stage 4 areas. Stage 5 preparation work includes berming the area for containment, gas well modifications to remote wellheads and the extension of a leachate line from the Phase 3, Stage 3 primary leachate sump.

Drawing No. 9 - Phase 9, Stage 5 Filling and Stage 6 Preparation Grading Site Plan
This drawing shows final Stage 5 subgrades and the site preparation work for Stage 6. The Stage 6 preparation work includes removing the existing cap and grading to berm the area, as well as adding a leachate collection line connected to the line that was extended into Stage 5 and the modification of existing gas wells to being remote wellheads.

Drawing No. 10 - Phase 9, Stage 6 Filling and Stage 7 Preparation Grading Site Plan
This drawing shows final Stage 6 grades, along with the expansion of the gas collection system to add a ten inch gas header extension and one horizontal gas collection system. This drawing also shows the limits of final cap and stormwater management facilities that are to be constructed on the Stage 5 and Stage 6 areas. Stage 7 preparation work includes berming, gas well modifications to remote wellheads and adding a leachate collection line connected to the line that was extended into

Stage 5.

Drawing No. 11 - Phase 9, Stage 7 Filling and Final Grading Site Plan
This drawing shows final Stage 7 grades, with the expansion of the gas collection system in this area, including ten and eight inch gas header extensions and the installation of ten gas extraction wells. This drawing also shows the limits of final cap and stormwater management facilities that are to be constructed on the Stage 7 area, which completes the Phase 9 Vertical Expansion.

2.3 Leachate Production

The Hydrologic Evaluation of Landfill Performance (HELP) modeling program (version 4.0), developed by the U.S. Army Waterways Experiment Station for the USEPA was utilized in the design and performance evaluation of the proposed landfill expansion. The HELP program is used to predict the performance of the proposed groundwater protection systems, leachate collection and removal systems, and final cover configurations by performing a water balance analysis of a landfill at varying stages of operations.

The HELP program models landfill performance utilizing user-entered or program generated climatological data, soil characteristics, design data and some operational features that simulate conditions expected at the project site. Climatological data requirements include precipitation, temperature and solar radiation. The soil characteristics include porosity, field capacity, wilting point, initial water content and hydraulic conductivity for each layer of the landfill profile. The landfill configuration information required to use the HELP program include soil and waste layer thickness, liner and cover materials, surface area, drainage layer slopes (both leachate collection and final cover), drainage lengths (flow path between collection pipes), and the condition of the Landfill surface, including vegetation.

To perform the analyses for the expansion, default climatological data generated by the HELP program were used. The characteristics for the various horizons of the Landfill cross section were, for the most part, selected from a list of default materials that generally reflect the types of soils, geosynthetic materials, and waste that will form the Landfill. The HELP Model input/output data are provided in Appendix C-1.

3.0 STORMWATER MANAGEMENT SYSTEM

3.1 General

The Phase 9 Landfill Expansion is proposed for construction over the existing landfilled area. Consequently, the construction of Phase 9 will not significantly alter existing drainage patterns, surface conditions or runoff characteristics than what has previously been evaluated in the site's permitting process, most recently in the Phase 6 ATC. In that analysis site conditions were assumed to extend the build out of Phase 6 to the limit of the 74-acre parcel and not extend into Phases 7 and 8 onto the 25-acre parcel. With the 25-acre parcel now being site assigned for landfilling, it is more likely that Phase 7 and Phase 8 will occur. During the interim period, when Phase 9 is operational, the footprint of the Landfill will be limited to the existing Landfill's area. Under these temporary conditions the area to the south of Phase 6, below existing perimeter grades, will continue to drain to the excavated low area and will not discharge to either of the stormwater retention basins. Consequently, this area to the south of the Phase 6 footprint will be excluded from the stormwater calculations.

The following sections describe the proposed stormwater management controls including the two stormwater retention basins implemented in the stormwater management plan. The Drainage Areas sketch in Appendix C-2 presents the drainage areas that will contribute to each of the retention basins, as well as the excluded area to the south of the Landfill's footprint. The design stormwater flow rates have been analyzed for the stormwater retention basins utilizing HydroCAD Stormwater Modeling program. The program utilizes the TR-20 method for run-off calculations. Storm rainfall, run-off curve numbers and other site characteristics are input into the program. Results of calculations are output into tables and graphs for each drainage area and control structure. The complete calculations are presented in a Stormwater Performance Standards Report that is included as Appendix C-2.

3.2 Stormwater Basin No. 1

Stormwater Basin No. 1 is an existing retention/infiltration pond located in the northwest corner of the property. This basin currently receives stormwater runoff from the westerly sideslopes and the plateau areas of the Phase 1ABC, Phase 2A/3A, Phase 4, Phase 5 and Phase 6 Landfills and the northerly sideslopes of the Phase 2 and Phase 2A/3A Landfills. Stormwater run-off from the site's access road areas also drain into Stormwater Basin No. 1. A Drainage Areas sketch showing the contributing area that discharges to this retention pond is attached to this report and can be found in Appendix C-2. The final construction of the Phase 6 Landfill will increase the contributory area and consequently the volume of stormwater discharging into Stormwater Basin No. 1. This increase in contributory area generally corresponds to the area that will be diverted from the area to the south of Phase 6, as it reaches its final grades. Stormwater Basin No. 1 was enlarged as part of the Phase 4 Landfill construction project, taking into account the flows that will be diverted by the final grading of Phase 6 and consequently Phase 9. A perimeter drainage channel, or swale, was constructed along the western toe of the Phase 4 sideslope and most of the Phase 6 area, as part of the Phase 4 and Phase 6 site construction work. The drainage channel conveys, along with a series of diversion berms and let-down channels, stormwater run-off from the tributary areas to the expanded Stormwater Basin No. 1.

Stormwater Basin No. 1 has been designed to accommodate the run-off from the 25 year-24 hour rainfall event. Stormwater run-off discharging to this basin will infiltrate to groundwater. Existing soils throughout this site area are comprised of highly permeable sands and gravels. The design capacity of the stormwater basins is based on an infiltration rate of 8.27 inches per hour which is an average rate for Hydrologic Group A soils, which are the soil types that occur throughout the Landfill area, according to the Massachusetts Stormwater Handbook (Volume 3, Table 2.3.3). Basin No. 1 provides approximately 585,400 cubic feet of storage capacity, between elevations 70 and 94. This available storage volume exceeds the storage volume required for the 25 year-24 hour storm, which is approximately 182,300 cubic feet, with the build out of the Phase 9 Landfill. This basin will also accommodate the run-off from greater magnitude storms (a 100-year storm will require approximately 307,700 cubic feet of storage) or from back-to-back rainfall events.

3.3 Stormwater Basin No. 2

Stormwater Basin No. 2 is an existing retention basin located at the southwestern corner of the site assigned 25-acre parcel. Currently, drainage from that 25 acre area, including the C&D Transfer Station, the Residential Recycling Center, the Single Stream Recycling facility and the surrounding materials storage and staging areas, flow into Stormwater Basin No. 2. Runoff from the eastern sides and plateau areas of Phase 2, Phase 3, Phase 2A/3A and Phase 6 is diverted to Stormwater Basin No. 2 by the drainage interceptor line that runs along the eastern toe of the landfill area.

As it is currently configured, Stormwater Basin No. 2 has adequate volume and surface area to accommodate design condition storm events based on an infiltration rate of 8.27 inches per hour which is an average rate for Hydrologic Group A soils, which are the soil types that occur throughout the Landfill area, according to the Massachusetts Stormwater Handbook (Volume 3, Table 2.3.3). The design will provide about 777,400 cubic feet of storage capacity from the bottom of the basin at elevation 80 to the top of the basin, which is at elevation 100. The available capacity within the basin greatly exceeds the storage volume required to accommodate the run-off from a 25 year-24 hour storm event, which has been calculated to be approximately 349,500 cubic feet. This excess capacity will be sufficient for managing the stormwater run-off from a greater magnitude event (a 100-year storm will require approximately 503,500 cubic feet of storage) or from back-to-back rainfall events and for the containment of run-off during winter weather and frost conditions.

4.0 CONCEPTUAL FINAL CLOSURE PLAN

4.1 Final Cover System

The purpose of final cover is to divert precipitation from completed landfill areas, facilitate the management of landfill gases and to isolate landfill materials from the environment and vectors. The final cover system will accomplish each of these objectives by incorporating an extensive network of run-off/run-on controls, an active gas management system and a cover system comprised of geomembrane and earthen materials that will effectively encapsulate the final landfill area.

The final cover system will be comprised of the components described below:

- A suitably prepared landfill surface beneath the final cover system.
- A geomembrane subgrade/gas venting layer consisting of 6 inches of a soil.
- A low permeability layer consisting of a 40 mil HDPE textured geomembrane cap.
- A drainage layer consisting of twelve inches (12") of a soil with a minimum saturated hydraulic conductivity of 1×10^{-2} centimeters per second.
- A vegetative support layer consisting of at least nine inches (9") of soil capable of supporting a healthy vegetative growth on the final cover.

The drainage layer and the vegetative support layer, together, will form a protection layer of earthen materials above the low-permeability layer.

In addition to the components listed above, the final cover system will have several stormwater run-off/run-on control features designed to maintain the integrity of the final cover and prevent ponding of water on the areas furnished with final cover. The stormwater control system will consist of:

- Earthen diversion berms are built on the final cover above the vegetative layer to divert run-off to side slope let-down channels. These berms reduce the distance that overland run-off has to travel, thereby, reducing the volume of overland flow and erosion of the final cover.
- Side slope stone-lined let-down channels are used to convey slope run-off from the diversion berms to perimeter drainage swales and interceptor piping at the toe of the slopes.
- Rip-rap lined perimeter swales are constructed along portions of the toe of the landfill slopes. The swales will take run-off from the let-down channels and convey it to the existing stormwater retention basins or the drainage interceptor piping.
- Drainage interceptor piping has been constructed along the eastern toe of the landfill slope, beginning within the Phase 3, Stage 3 Landfill area and flowing south, past Phase 6 to Sedimentaion Basin No. 2, located at the southeast corner of the 25-acre parcel.
- Stormwater basins will capture sediment and be the means of discharge through infiltration.
- Sub-drains constructed of perforated pipe will be installed above the geomembrane cap at maximum intervals on the side slopes and across the plateau areas. Sub-drains will divert drainage water that has percolated through the topsoil layer to the let-down channels and the perimeter swales, and will minimize the build-up of water within the drainage layer that could destabilize the sand drainage and vegetative support layer soils.
- The locations of each of these stormwater management features, along with details and typical section views are presented in Part G - Drawings of this application.

The proposed final cover drainage layer was evaluated to make sure it has enough capacity to manage all the water that enters the drainage layer and to assure that it complies with regulatory design standards. The evaluation was performed using the USEPA HELP Model to determine the spacing of sub-drains within the drainage layer.

The following data was used in the design:

- The final cover drainage layer is to be 12" thick and comprised of permeable sand having a minimum hydraulic conductivity of 1×10^{-2} cm/sec.
- The vegetative support layer is to be comprised of a minimum of 9" of an organic soil having a hydraulic conductivity of approximately 1.0×10^{-4} cm/sec.
- Sub-drains are to be installed on the landfill side slopes and across the top area plateau of the landfill to minimize pore pressure in the drainage layer.

The HELP Model analysis of the final cover indicates that the drainage layer has sufficient capacity to manage all infiltration, provided sub-drains are installed above the geomembrane barrier at a maximum spacing of 75 feet on the 3:1 sideslopes and the 5% slope plateaus. Results of the HELP Model analysis are provided in Appendix C-1.

4.2 Landfill Gas Management System

The conceptual design for the management of gas generated within the Phase 9 Landfill includes the installation of new vertical extraction wells and horizontal gas collectors and the modification of portions of the existing collection system within the Phase 9 footprint. The design also includes the installation of a new network of piping to collect generated landfill gases and convey them to a flare station for treatment. The existing flare station is located to the northeast of the Phase 2 Landfill area and prevents the occurrence of odors and the off-site migration of landfill gas. The layout of the conceptual landfill gas system and installation details are presented on the drawings included in Part G - Drawings of this Application. The components of the conceptual gas system are described in the following sections.

Gas Extraction Wells

The radius of influence exerted by a vertical gas extraction well is the lateral distance from which the gas generated will be drawn into the well as a result of pressure exerted by the gas within the Landfill and the vacuum exerted on the well by the flare station. To efficiently and effectively collect gases generated within the Landfill several extraction wells, appropriately located in areas that do not currently have extraction wells, shall be installed. An average radius of influence of 100 horizontal feet was utilized for the conceptual design of the gas collection system. The radii of influence for the gas extraction wells overlap to provide the capability of inducing a negative pressure gradient for points vertically through and horizontally over the landfill area. Conceptually, eighteen (18) new gas extraction wells are proposed for the collection and management of gas from within the full build out area of the Phase 9 Landfill that does not currently have collection wells.

The gas extraction wells have been designed to have a constructed well diameter of at least two feet. To construct each extraction well, a minimum two-foot diameter boring will be drilled into the waste to the designed well depth, by using a bucket auger-drilling rig. Once the well boring has been completed, the gas extraction well will be installed. Each extraction well will consist of the following:

- An eight-inch diameter perforated SCH.80 CPVC well screen, provided with a bottom end cap, joined to a six-inch solid SCH.80 CPVC riser pipe via a slip coupling connection.
- One to one and one half-inch (1" - 1 ½") washed stone placed around the well screen to a minimum of one-foot above the top of the well screen.
- A well washer to provide a separation between the wash stone gravel pack and the next layer.
- A two-foot thick bentonite plug consisting of medium bentonite chips or pellets placed above the stone and hydrated with water.
- Well-graded soil backfill placed above the bentonite plug to the Landfill's subgrade surface.

All of the vertical wells will be drilled to a maximum depth of ten feet above the sand drainage layer elevations of the primary underlying liner systems. Individual well depth information will be developed as part of the final closure plan based on actual surveyed elevations of the landfill surface.

The top of the six-inch diameter solid SCH. 80 CPVC riser will extend approximately six feet above the intermediate cover landfill surface to allow for the final cover thickness. Accu-Flo™ (or equal) wellhead assemblies will be attached to the well riser and will extend the well to approximately eight feet above the Landfill's subgrade elevation, prior to final cover.

Wellhead Assemblies
Accu-Flo™ (or equal) wellhead assemblies will be installed on each well, as indicated in the design drawings. Wellhead assemblies include the following:

- A two-inch by six-inch adapter bushing connecting the well riser or collector with the two-inch wellhead tube assembly.
- Quick connect instrument ports compatible with landfill gas monitoring instruments for measuring gas flows and gas quality.
- A two-inch valve used to regulate the gas extraction rate from the well. A two-inch dust cap will be installed on the top of the tee covering the instrument reading ports and temperature indicator to protect them from dust or debris.
- A two-inch flexible hose will be attached from the valve to the four-inch HDPE riser piping via a two-inch by four-inch adapter bushing.

Gas Extraction Header and Lateral Piping
The conceptual header and lateral piping layout is shown on the sequential Phase 9 staged construction plans included in Part G - Drawings. The proposed piping location and alignment of the piping may be adjusted during construction to allow for conditions not evident on design plans or to solve unforeseeable layout problems. The pipes will be installed with a minimum slope of five percent (5%) toward condensate collection points. The pipes associated with this design are sized to accommodate gas flow from these areas under full build conditions.

Underground piping and fittings will be constructed of SDR-17 HDPE. This material has high resistance to corrosion by landfill gas and condensate. HDPE piping is also durable and flexible and can withstand stresses imposed by differential settlement within the Landfill. The piping will be joined by heat fusion wherever practical, which will produce a joint stronger than the pipe itself. Flange connections will be made at valves and other fittings, as required for proper installation. Materials resistant to corrosion will be used for the flange connections. The piping will be pressure tested to document the integrity of the installation.

Gas Condensate Traps
When landfill gas is extracted from a landfill, a change in temperature and pressure occurs that results in the precipitation of moisture within the gas and the production of condensate within the gas extraction system piping. Solid pipes sloping toward condensate collection locations is required to drain the condensate and prevent blockages and surging in the system.

The design of the Phase 9 Landfill gas extraction system will incorporate the condensate traps along the eastern and western perimeters of the Phase 9 Landfill, each connected to the 10" gas header pipes located on each side of the Landfill. The condensate will travel downgradient through the gas collection lines in Phase 9 and surrounding areas and discharge into the condensate traps. Gas will be conveyed to the north toward the flare station located at the northeast corner of the site, near the Phase 2 Landfill. Traps allow the gravity drainage of condensate, while providing a separation from the vacuum being applied throughout the well field by the blower of the flare unit. Condensate collected by the condensate traps will flow into the leachate collection system and to the primary leachate collection sump. When the mixed condensate and leachate level rises to a specific depth, the primary leachate collection sump pump will turn on and will discharge the liquid through the existing force main to either the 207,000 or 125,000 gallon leachate collection tanks. Each condensate trap will be equipped with a four-inch valve to temporarily shut off flow for maintenance purposes. Refer to the details presented Landfill Gas System Details Plan in Part G - Drawings.

Horizontal Gas Collection System

Operational experience has indicated that temporary landfill gas control measures may be necessary to avoid the creation of nuisance odors being generated before the permanent cap and gas collection system of extraction wells can be constructed. In addition, Phase 9 will consiste of new fill of about forty feet (40') over areas that are currently capped and have existing vertical gas collection wells. In these areas, modifications are proposed where the existing wells will be maintained and be modified to be remote wellhead systems. With those modifications, it is proposed that gas extraction with a series horizontal gas extraction systems be provided within the 40' vertical expansion volume. Actual layout and elevations of horizontal collector systems will be determined by the field conditions of the landfill operations at the time of the collector construction. The horizontal collector systems will be constructed just below and connected to the geomembrane subgrade/gas venting sand layer as shown on the sequential Phase 9 staged construction plans included in Part G - Drawings.

Three proposed horizontal gas collection systems will be constructed, consistent with the details shown on the drawing titled *Gas Collection System Details - 2*, which is included in Part G - Drawings, of this application. The systems are intended to be permanent but may become temporary if new or replacement vertical gas extraction wells are installed. The work to be conducted includes the following components:

- Modification and connection to the existing or proposed gas headers will be made at either existing flanged or valved connection points or connection points will be fabricated by installing tee fittings by either cutting into or fusing onto existing collection lines.

- Installation of HDPE horizontal gas collection piping and appurtenances are shown on the drawings included in Part G - Drawings of this Application. The network of landfill gas collection piping will collect landfill gas within the Phase 9 Landfill area and convey it to the existing flare station located in the northeastern corner of the property, where it will be combusted. The described work will not have any effect on the operations, capacity or operating life of the Landfill.

- The horizontal landfill gas collection system will consist of 6" HDPE solid header piping and 6" HDPE corrugated slotted lateral piping. Landfill gas flow within the systems will be independently controlled using butterfly valves or wellhead assemblies to be installed in each header pipe section. Sampling ports will be installed adjacent to the valves so that gas quality can be monitored and vacuum pressures controlled.

5.0 LANDFILL STABILITY

5.1 General

The Phase 9 Landfill includes filling operations over existing lined landfill areas and the construction of a multi-layered final cover system. The filling will impose addition loads not originally considered in the design of the under lying liners or the cover system and caps. The proposed cap will employ a variety of natural and geosynthetic materials to act as barrier and drainage layers to impede or eliminate the movement of water into the closed landfill areas. This section summarizes the design basis for the suitability of the landfill structure and final cover system components; establishes the minimum acceptable properties for these components; and presents the results of the seismic and static stability analysis performed to determine these required properties.

5.2 Seismic and Static Stability

A seismic and static stability analysis was performed for the Phase 9 Landfill Expansion design by Geocomp, Corp. (Geocomp). This analysis was performed to evaluate the conformance of the design with the criteria of MassDEP Regulations 310 CMR 19.038 (c).5.h. through 19.038 (c).7.c. See Appendix C-3 for the Geocomp report.

Geocomp completed an assessment of the static and seismic stability of the proposed Phase 9 Expansion for the Bourne Landfill, which indicated the following:

- Sufficient information exists to complete a seismic evaluation of the geotechnical aspects of the proposed Phase 9 Landfill Vertical Expansion.

- The section of the regulations related to Fault Areas does not impact the project, since no known recent faults exist within 200 feet of the project.

- The section of the regulations related to Seismic Impact Zones does not apply to the project because the updated USGS mapping indicates a maximum horizontal acceleration at bedrock of 0.099g. However, to be consistent with previous expansion designs, Geocomp performed a seismic assessment using the most recent USGS 2016 seismic hazard maps.

- Geocomp's analyses indicated that the current design is adequate to withstand the maximum horizontal acceleration at bedrock of 0.099g.

- The Report conclusions are predicated on the liner and cover materials and the interfaces between these materials having at least the minimum strengths given in Tables 1 and 2 of the Geocomp Report included in Appendix C-3. Design documents will include requirements for the contractor to demonstrate that the materials and methods will meet or exceed these minimum requirements.

- Settlement of the Phase 5 liner system that is placed on top of Phase 1-A,B,C will result from ongoing consolidation of the existing waste under its own weight, as well as consolidation of the existing waste from the additional weight of the proposed Phase 9 Expansion. Geocomp analysis shows that the grades on the Phase 5 liner will be reduced but will still exceed the minimum MDPE guidelines for slopes on leachate collections systems and liners.

Geocomp's assessment of the impact of the Massachusetts Regulations for Seismic Stability for the Bourne Landfill, Phase 9 Expansion indicated that the current design meets these requirements, subject to the following provisions:

- The expansion does not include any new liners separating it from the existing waste fills.

- The as-placed cap (including soil, geosynthetics and the interface between soil and geosynthetics) must have strengths that equal or exceed the specified minimum requirements in Table 2 of the Geocomp Report included in Appendix C-3. Provisions will be made in the contract documents to have the Contractor demonstrate with test data that this requirement is met for the actual materials that will be used.

- All waste material placed in the Landfill is assumed to be any combination of MSW, Fly Ash or Boiler Aggregate, and that it is compacted to average densities not exceeding the values shown in Table 1 of the Geocomp Report included in Appendix C-3. Significantly, higher densities may lower the stability and increase the predicted displacements caused by earthquake shaking.

The contract documents will require that the contractor demonstrate that the materials he proposes to use in the Phase 9 construction will meet the specified requirements. The specified strength requirements shall be demonstrated via laboratory tests on the actual materials to be used in the construction of the liner system. The tests shall be performed using moisture and drainage conditions similar to those expected in the installed materials. Part E of this Application describes the Construction Quality Assurance (CQA) Plan and Part F the Technical Specifications that will be required for the construction.

6.0 PHASE 9 FINAL CLOSURE COSTS

A final closure construction cost estimate has been prepared for the Phase 9 Landfill area. This estimate assumes that closure construction will be performed through three separate contracts, staged over the estimated five year life of the facility, with the capping area of each contract being about ten acres (actual cap area is +/- 28.0-acres). The final closure costs listed on Table 6-1 include all materials, labor and incidentals required for the completion of this capping in accordance with the Solid Waste Regulations, as described within this Design Report and indicated on the Drawings included in Part G of this Application. This work includes the expansion and modification of the existing landfill gas extraction system into the Phase 9 cell for the control of odors and to prevent gas migration. The pricing presented on this table has been developed from recent competitive bids received by the Town of Bourne, ISWM for the final closure and gas system expansion of the Phase 4, Stage 2 and Phase 5 Landfill sideslopes.

BOURNE LANDFILL - PHASE 9 CONCEPTUAL CLOSURE COSTS

Approximate Area = 1,220,000 Square Feet

August 10, 2022

Item No.	Description	Unit	Qty.	Unit Price	Total
1	Contractor Mob/Demob & General Site Preparation	Contract	3	$ 125,000.00	$ 375,000.00
2	Gas Extraction Wells	Vertical Feet	2,400	$ 360.00	$ 864,000.00
3	Extraction Wellhead Assembly	Units	24	$ 2,000.00	$ 48,000.00
4a	4" HDPE Gas Piping & Appurtenances	Linear Feet	200	$ 45.00	$ 9,000.00
4b	6" HDPE Gas Piping & Appurtenances (Laterals)	Linear Feet	1,850	$ 70.00	$ 129,500.00
4c	6" HDPE Gas Piping & Appurtenances (Horizontal Collectors)	Linear Feet	1,500	$ 60.00	$ 90,000.00
4d	6" Corrigated HDPE Horz. Collector Gas Piping & Appurtenances	Linear Feet	3,000	$ 50.00	$ 150,000.00
4e	8" HDPE Gas Piping & Appurtenances	Linear Feet	600	$ 70.00	$ 42,000.00
4f	10" HDPE Gas Piping & Appurtenances	Linear Feet	2,400	$ 80.00	$ 192,000.00
5	HDPE Gas Cond. Traps & Appurtenances	Units	2	$ 10,000.00	$ 20,000.00
6	6" Sand Gas Venting Layer	Cubic Yard	22,593	$ 25.00	$ 564,814.81
7	40 Mil HDPE Geomembrane Liner	Square Foot	1,220,000	$ 0.80	$ 976,000.00
8	12" Sand Draiange Layer	Cubic Yard	45,185	$ 25.00	$ 1,129,629.63
9	Rip Rap Protected Let-Down Channels	Square Yard	700	$ 65.00	$ 45,500.00
10a	Grassed Diversion Berms With Subdrains	Linear Foot	3,000	$ 40.00	$ 120,000.00
10b	Subdrains and Toedrains	Linear Foot	4,500	$ 20.00	$ 90,000.00
11	9" Vegetative Support Layer	Cubic Yard	33,889	$ 20.00	$ 677,777.78
12	Hydroseeding	Square Yard	135,556	$ 0.80	$ 108,444.44
13	Landfill Cap Spring Maintenance	Lump Sum	3	$ 15,000.00	$ 45,000.00
14	Overexcavation & Backfill	Cubic Yard	1,000	$ 30.00	$ 30,000.00
SUBTOTAL ESTIMATE					$ 5,706,666.67

CONSTRUCTION SUBTOTAL ESTIMATE BASED ON COMPULATED UNIT PRICING FROM CLOSURE CONTRACT BID IN MAY 2021.
INFLATION ADJUSTMENT FROM ESTIMATE BASED ON MAY 2021 USING ENR CONSTRUCTION COST INDEX (CCI)
AND THE CONSUMER PRICE INDEX (CPI)

ENR CONSTRUCTION COST INDEX - MAY 2021	11,989.91	
ENR CONSTRUCTION COST INDEX - JULY 2022	13,167.00	
INFLATION FACTOR AND ADJUSTED COST	1.0982	$6,266,909.43

CONTINGENCY - 10%	$626,690.94

APPENDIX C-1

LEACHATE PRODUCTION CALCULATION

(HELP MODEL ANALYSIS)

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Bourne - Phase 9 - Plateau **Simulated On:** 11/3/2022 15:25

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
FSL - Fine Sandy Loam
Material Texture Number 7

Thickness	=	9	inches
Porosity	=	0.473	vol/vol
Field Capacity	=	0.222	vol/vol
Wilting Point	=	0.104	vol/vol
Initial Soil Water Content	=	0.225	vol/vol
Effective Sat. Hyd. Conductivity	=	5.20E-04	cm/sec

Layer 2
Type 2 - Lateral Drainage Layer
CoS - Coarse Sand
Material Texture Number 1

Thickness	=	12	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.0779	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02	cm/sec
Slope	=	5	%
Drainage Length	=	75	ft

Layer 3
Type 4 - Flexible Membrane Liner
HDPE Membrane
Material Texture Number 35

Thickness	=	0.04	inches
Effective Sat. Hyd. Conductivity	=	2.00E-13	cm/sec

FML Pinhole Density	=	1 Holes/Acre
FML Installation Defects	=	2 Holes/Acre
FML Placement Quality	=	2 Excellent

Layer 4

Type 1 - Vertical Percolation Layer

CoS - Coarse Sand

Material Texture Number 1

Thickness	=	6 inches
Porosity	=	0.417 vol/vol
Field Capacity	=	0.045 vol/vol
Wilting Point	=	0.018 vol/vol
Initial Soil Water Content	=	0.0932 vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02 cm/sec

Layer 5

Type 1 - Vertical Percolation Layer

FSL - Fine Sandy Loam

Material Texture Number 7

Thickness	=	6 inches
Porosity	=	0.473 vol/vol
Field Capacity	=	0.222 vol/vol
Wilting Point	=	0.104 vol/vol
Initial Soil Water Content	=	0.242 vol/vol
Effective Sat. Hyd. Conductivity	=	5.20E-04 cm/sec

Layer 6

Type 1 - Vertical Percolation Layer (Waste)

Municipal Solid Waste (MSW) (900 pcy)

Material Texture Number 18

Thickness	=	1920 inches
Porosity	=	0.671 vol/vol
Field Capacity	=	0.292 vol/vol
Wilting Point	=	0.077 vol/vol
Initial Soil Water Content	=	0.292 vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03 cm/sec

Layer 7

Type 2 - Lateral Drainage Layer
CoS - Coarse Sand
Material Texture Number 1

Thickness	=	18 inches
Porosity	=	0.417 vol/vol
Field Capacity	=	0.045 vol/vol
Wilting Point	=	0.018 vol/vol
Initial Soil Water Content	=	0.0525 vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02 cm/sec
Slope	=	2 %
Drainage Length	=	60 ft

Layer 8
Type 4 - Flexible Membrane Liner
HDPE Membrane
Material Texture Number 35

Thickness	=	0.06 inches
Effective Sat. Hyd. Conductivity	=	2.00E-13 cm/sec
FML Pinhole Density	=	2 Holes/Acre
FML Installation Defects	=	2 Holes/Acre
FML Placement Quality	=	2 Excellent

Layer 9
Type 3 - Barrier Soil Liner
Bentonite (High)
Material Texture Number 17

Thickness	=	0.24 inches
Porosity	=	0.75 vol/vol
Field Capacity	=	0.747 vol/vol
Wilting Point	=	0.4 vol/vol
Initial Soil Water Content	=	0.75 vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09 cm/sec

Layer 10
Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.5 inches

Porosity	=	0.85 vol/vol
Field Capacity	=	0.01 vol/vol
Wilting Point	=	0.005 vol/vol
Initial Soil Water Content	=	0.01 vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01 cm/sec
Slope	=	2 %
Drainage Length	=	60 ft

Layer 11

Type 4 - Flexible Membrane Liner

HDPE Membrane

Material Texture Number 35

Thickness	=	0.06 inches
Effective Sat. Hyd. Conductivity	=	2.00E-13 cm/sec
FML Pinhole Density	=	2 Holes/Acre
FML Installation Defects	=	2 Holes/Acre
FML Placement Quality	=	2 Excellent

Layer 12

Type 3 - Barrier Soil Liner

Bentonite (High)

Material Texture Number 17

Thickness	=	0.24 inches
Porosity	=	0.75 vol/vol
Field Capacity	=	0.747 vol/vol
Wilting Point	=	0.4 vol/vol
Initial Soil Water Content	=	0.75 vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09 cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	69.9
Fraction of Area Allowing Runoff	=	100 %
Area projected on a horizontal plane	=	28 acres
Evaporative Zone Depth	=	1 inches

Initial Water in Evaporative Zone	=	0.158	inches
Upper Limit of Evaporative Storage	=	0.473	inches
Lower Limit of Evaporative Storage	=	0.104	inches
Initial Snow Water	=	0.625843	inches
Initial Water in Layer Materials	=	566.92	inches
Total Initial Water	=	567.546	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was User-Specified.

Evapotranspiration and Weather Data

Station Latitude	=	41.75	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	121	days
End of Growing Season (Julian Date)	=	290	days
Average Wind Speed	=	11	mph
Average 1st Quarter Relative Humidity	=	76	%
Average 2nd Quarter Relative Humidity	=	72	%
Average 3rd Quarter Relative Humidity	=	80	%
Average 4th Quarter Relative Humidity	=	73	%

Note: Evapotranspiration data was obtained for Bourne, Massachusetts

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
4.17626	2.845436	4.754163	4.157978	3.258227	3.473881
2.762774	4.7014	4.603623	3.749151	3.913575	5.147298

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.75/-70.6

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
37.1	35.1	40.8	52.1	62	69.4
71.6	70.2	62.6	53	45.3	38.7

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.75/-70.6
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.75/-70.6

Average Annual Totals Summary

Title: Bourne - Phase 9 - Plateau
Simulated on: 11/3/2022 15:26

	Average Annual Totals for Years 1 - 5*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	46.14	[4.94]	4,689,279.3	100.00
Runoff	6.153	[2.763]	625,392.6	13.34
Evapotranspiration	13.769	[0.968]	1,399,512.2	29.84
Subprofile1				
Lateral drainage collected from Layer 2	23.9086	[3.1201]	2,430,073.6	51.82
Percolation/leakage through Layer 3	1.540215	[0.157063]	156,547.4	3.34
Average Head on Top of Layer 3	1.7367	[0.2281]	---	---
Subprofile2				
Lateral drainage collected from Layer 7	1.5305	[0.0892]	155,564.8	3.32
Percolation/leakage through Layer 9	0.000010	[0.000001]	1.0456	0.00
Average Head on Top of Layer 8	0.2219	[0.0131]	---	---
Subprofile3				
Lateral drainage collected from Layer 10	0.0000	[0]	0.9998	0.00
Percolation/leakage through Layer 12	0.000000	[0]	0.0457	0.00
Average Head on Top of Layer 11	0.0000	[0]	---	---
Water storage				
Change in water storage	0.7746	[2.1957]	78,735.1	1.68

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Bourne - Phase 9 - Plateau
Simulated on: 11/3/2022 15:26

	Peak Values for Years 1 - 5*	
	(inches)	(cubic feet)
Precipitation	3.52	357,593.7
Runoff	2.576	261,794.0
Subprofile1		
Drainage collected from Layer 2	0.3171	32,230.3
Percolation/leakage through Layer 3	0.015619	1,587.5
Average head on Layer 3	8.4111	---
Maximum head on Layer 3	11.5166	---
Location of maximum head in Layer 2	23.53	(feet from drain)
Subprofile2		
Drainage collected from Layer 7	0.0076	769.6
Percolation/leakage through Layer 9	0.000000	0.0052
Average head on Layer 8	0.4008	---
Maximum head on Layer 8	0.7077	---
Location of maximum head in Layer 7	7.01	(feet from drain)
Subprofile3		
Drainage collected from Layer 10	0.0000	0.0051
Percolation/leakage through Layer 12	0.000000	0.0005
Average head on Layer 11	0.0000	---
Maximum head on Layer 11	0.0000	---
Location of maximum head in Layer 10	0.00	(feet from drain)
Other Parameters		
Snow water	3.0613	311,155.5
Maximum vegetation soil water	0.4730	(vol/vol)
Minimum vegetation soil water	0.1040	(vol/vol)

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Bourne - Phase 9 - Plateau
Simulated on: 11/3/2022 15:26
Simulation period: 5 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.6915	0.2991
2	3.4557	0.2880
3	0.0000	0.0000
4	0.6328	0.1055
5	1.4497	0.2416
6	560.6400	0.2920
7	0.9213	0.0512
8	0.0000	0.0000
9	0.1800	0.7500
10	0.0050	0.0100
11	0.0000	0.0000
12	0.1800	0.7500
Snow water	1.2636	---

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Bourne - Phase 9 - Sideslope **Simulated On:** 11/3/2022 14:33

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
FSL - Fine Sandy Loam
Material Texture Number 7

Thickness	=	9 inches
Porosity	=	0.473 vol/vol
Field Capacity	=	0.222 vol/vol
Wilting Point	=	0.104 vol/vol
Initial Soil Water Content	=	0.225 vol/vol
Effective Sat. Hyd. Conductivity	=	5.20E-04 cm/sec

Layer 2
Type 2 - Lateral Drainage Layer
CoS - Coarse Sand
Material Texture Number 1

Thickness	=	12 inches
Porosity	=	0.417 vol/vol
Field Capacity	=	0.045 vol/vol
Wilting Point	=	0.018 vol/vol
Initial Soil Water Content	=	0.0465 vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02 cm/sec
Slope	=	30 %
Drainage Length	=	75 ft

Layer 3
Type 4 - Flexible Membrane Liner
HDPE Membrane
Material Texture Number 35

Thickness	=	0.04 inches
Effective Sat. Hyd. Conductivity	=	2.00E-13 cm/sec

FML Pinhole Density	=	1	Holes/Acre
FML Installation Defects	=	2	Holes/Acre
FML Placement Quality	=	2	Excellent

Layer 4

Type 1 - Vertical Percolation Layer

CoS - Coarse Sand

Material Texture Number 1

Thickness	=	6	inches
Porosity	=	0.417	vol/vol
Field Capacity	=	0.045	vol/vol
Wilting Point	=	0.018	vol/vol
Initial Soil Water Content	=	0.0787	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02	cm/sec

Layer 5

Type 1 - Vertical Percolation Layer

FSL - Fine Sandy Loam

Material Texture Number 7

Thickness	=	6	inches
Porosity	=	0.473	vol/vol
Field Capacity	=	0.222	vol/vol
Wilting Point	=	0.104	vol/vol
Initial Soil Water Content	=	0.222	vol/vol
Effective Sat. Hyd. Conductivity	=	5.20E-04	cm/sec

Layer 6

Type 1 - Vertical Percolation Layer (Waste)

Municipal Solid Waste (MSW) (900 pcy)

Material Texture Number 18

Thickness	=	1920	inches
Porosity	=	0.671	vol/vol
Field Capacity	=	0.292	vol/vol
Wilting Point	=	0.077	vol/vol
Initial Soil Water Content	=	0.292	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-03	cm/sec

Layer 7

Type 2 - Lateral Drainage Layer
CoS - Coarse Sand
Material Texture Number 1

Thickness	=	18 inches
Porosity	=	0.417 vol/vol
Field Capacity	=	0.045 vol/vol
Wilting Point	=	0.018 vol/vol
Initial Soil Water Content	=	0.0471 vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-02 cm/sec
Slope	=	2 %
Drainage Length	=	60 ft

Layer 8
Type 4 - Flexible Membrane Liner
HDPE Membrane
Material Texture Number 35

Thickness	=	0.06 inches
Effective Sat. Hyd. Conductivity	=	2.00E-13 cm/sec
FML Pinhole Density	=	2 Holes/Acre
FML Installation Defects	=	2 Holes/Acre
FML Placement Quality	=	2 Excellent

Layer 9
Type 3 - Barrier Soil Liner
Bentonite (High)
Material Texture Number 17

Thickness	=	0.24 inches
Porosity	=	0.75 vol/vol
Field Capacity	=	0.747 vol/vol
Wilting Point	=	0.4 vol/vol
Initial Soil Water Content	=	0.75 vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09 cm/sec

Layer 10
Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.5 inches

Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.01	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	2	%
Drainage Length	=	60	ft

Layer 11

Type 4 - Flexible Membrane Liner

HDPE Membrane

Material Texture Number 35

Thickness	=	0.06	inches
Effective Sat. Hyd. Conductivity	=	2.00E-13	cm/sec
FML Pinhole Density	=	2	Holes/Acre
FML Installation Defects	=	2	Holes/Acre
FML Placement Quality	=	2	Excellent

Layer 12

Type 3 - Barrier Soil Liner

Bentonite (High)

Material Texture Number 17

Thickness	=	0.24	inches
Porosity	=	0.75	vol/vol
Field Capacity	=	0.747	vol/vol
Wilting Point	=	0.4	vol/vol
Initial Soil Water Content	=	0.75	vol/vol
Effective Sat. Hyd. Conductivity	=	3.00E-09	cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	69.9	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	28	acres
Evaporative Zone Depth	=	1	inches

Initial Water in Evaporative Zone	=	0.158	inches
Upper Limit of Evaporative Storage	=	0.473	inches
Lower Limit of Evaporative Storage	=	0.104	inches
Initial Snow Water	=	0.625843	inches
Initial Water in Layer Materials	=	566.24	inches
Total Initial Water	=	566.866	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was User-Specified.

Evapotranspiration and Weather Data

Station Latitude	=	41.75	Degrees
Maximum Leaf Area Index	=	0	
Start of Growing Season (Julian Date)	=	121	days
End of Growing Season (Julian Date)	=	290	days
Average Wind Speed	=	11	mph
Average 1st Quarter Relative Humidity	=	76	%
Average 2nd Quarter Relative Humidity	=	72	%
Average 3rd Quarter Relative Humidity	=	80	%
Average 4th Quarter Relative Humidity	=	73	%

Note: Evapotranspiration data was obtained for Bourne, Massachusetts

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
4.17626	2.845436	4.754163	4.157978	3.258227	3.473881
2.762774	4.7014	4.603623	3.749151	3.913575	5.147298

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.75/-70.6

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
37.1	35.1	40.8	52.1	62	69.4
71.6	70.2	62.6	53	45.3	38.7

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.75/-70.6
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 41.75/-70.6

Average Annual Totals Summary

Title: Bourne - Phase 9 - Sideslope
Simulated on: 11/3/2022 14:34

	Average Annual Totals for Years 1 - 5*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	46.14	[4.94]	4,689,279.3	100.00
Runoff	6.153	[2.763]	625,392.6	13.34
Evapotranspiration	13.769	[0.968]	1,399,512.2	29.84
Subprofile1				
Lateral drainage collected from Layer 2	25.4372	[3.9563]	2,585,432.7	55.13
Percolation/leakage through Layer 3	0.399843	[0.044616]	40,640.0	0.87
Average Head on Top of Layer 3	0.3348	[0.0523]	---	---
Subprofile2				
Lateral drainage collected from Layer 7	0.3930	[0.0213]	39,945.7	0.85
Percolation/leakage through Layer 9	0.000003	[0]	0.3023	0.00
Average Head on Top of Layer 8	0.0570	[0.0031]	---	---
Subprofile3				
Lateral drainage collected from Layer 10	0.0000	[0]	0.2608	0.00
Percolation/leakage through Layer 12	0.000000	[0]	0.0415	0.00
Average Head on Top of Layer 11	0.0000	[0]	---	---
Water storage				
Change in water storage	0.3837	[1.4554]	38,995.8	0.83

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Bourne - Phase 9 - Sideslope
Simulated on: 11/3/2022 14:35

	Peak Values for Years 1 - 5*	
	(inches)	(cubic feet)
Precipitation	3.52	357,593.7
Runoff	2.576	261,794.0
Subprofile1		
Drainage collected from Layer 2	1.1081	112,623.7
Percolation/leakage through Layer 3	0.010687	1,086.2
Average head on Layer 3	5.3261	---
Maximum head on Layer 3	9.6682	---
Location of maximum head in Layer 2	0.80	(feet from drain)
Subprofile2		
Drainage collected from Layer 7	0.0019	198.0
Percolation/leakage through Layer 9	0.000000	0.0013
Average head on Layer 8	0.1031	---
Maximum head on Layer 8	0.1965	---
Location of maximum head in Layer 7	2.82	(feet from drain)
Subprofile3		
Drainage collected from Layer 10	0.0000	0.0012
Percolation/leakage through Layer 12	0.000000	0.0006
Average head on Layer 11	0.0000	---
Maximum head on Layer 11	0.0000	---
Location of maximum head in Layer 10	0.00	(feet from drain)
Other Parameters		
Snow water	3.0613	311,155.5
Maximum vegetation soil water	0.4730	(vol/vol)
Minimum vegetation soil water	0.1040	(vol/vol)

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Bourne - Phase 9 - Sideslope
Simulated on: 11/3/2022 14:35
Simulation period: 5 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.6915	0.2991
2	1.1372	0.0948
3	0.0000	0.0000
4	0.5199	0.0866
5	1.3320	0.2220
6	560.6400	0.2920
7	0.8348	0.0464
8	0.0000	0.0000
9	0.1800	0.7500
10	0.0050	0.0100
11	0.0000	0.0000
12	0.1800	0.7500
Snow water	1.2636	---

APPENDIX C-2

STORMWATER PERFORMANCE STANDARDS

STORMWATER PERFORMANCE STANDARDS

The DEP Stormwater Management Policy includes ten Stormwater Management Standards. The Standards were established to provide clear and consistent guidelines for stormwater management projects. The Standards address water quality (pollutants) and water quantity (flooding, low base flow and recharge) by establishing standards that require the implementation of a wide variety of stormwater management strategies. These strategies include environmentally sensitive site design and low impact development (LID) techniques to minimize impervious surface and land disturbance, source control and pollution prevention, structural BMPs, construction period erosion and sedimentation control, and the long-term operation and maintenance of stormwater management systems.

Each of the standards were evaluated for their applicability to the Bourne Landfill taking into consideration the proposed Phase 9 Expansion and the site-wide stormwater and sediment control facilities were designed to conform to these standards. Each of the ten Standards are addressed below.

1. **No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.**

   All stormwater discharges from the Bourne Landfill site shall be treated by the existing and proposed facilities. Storm flows from the Landfill area as well as the perimeter access roads and facilities are and will be collected by a system of drainage channels and swales which will direct the runoff to one of two stormwater basins. The stormwater basins have been sized to contain stomrwater runoff for all storm events and will infiltrate runoff to the groundwater table and not allow any off-site discharges to wetlands or surface waters.

2. **Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.**

   A comparison of pre-development to post-development peak discharge rates is not applicable because the the existing and proposed stormwater management systems direct runoff to one of two on site stormwater basins and there will be no discharge of flows to off-site surface waters. Consequently, no pre-development peak discharge rates were calculated. SITEC Environmental has prepared stormwater discharge calculations for post-development build out conditions resulting from the Phase 9 Landfill Expansion project after the final capping system has been constructed. These calculations have been performed for 25-year and 100-year, 24 hour storm events. These calculations demonstrate that the existing and proposed stormwater control facilities will be capable of handling the calculated storm conditions. The calculated peak discharge rates into the stormwater basins are summarized on the following table. Calculations are attached.

	PEAK STORMWATER DISCHARGE RATES INTO SEDIMENTATION BASINS (cfs)	
	25-Year, 24 Hour Storm Event (5.60")	100-Year, 24 Hour Storm Event (7.10")
Stormwater Basin No. 1	60.29	81.05
Stormwater Basin No. 2	143.07	189.60

3. **Loss of annual recharge to ground water should be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.**

Existing and proposed stormwater control facilities at the Bourne Landfill site will convey stormwater runoff to stormwater basins which will infiltrate, or recharge, runoff to the groundwater table. This is consistent with the pre-construction conditions at the Landfill, where the site's runoff recharges the groundwater. During the operations life of the Landfill, runoff from the active area will be contained on the site. Any stormwater that contacts waste or daily cover materials will be considered to be leachate and will infiltrate to the leachate collection system and not the groundwater. As intermediate and final cover is applied to the Landfill, runoff will be diverted to the stormwater collection and basin systems.

4. Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

(a) Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;

(b) Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and

(c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

The required water quality volume is calculated as:

- One inch of runoff times the total impervious area of the post-development project site for a discharge:
  1. from a land use with a higher potential pollutant load;
  2. within an area with a rapid infiltration rate (greater than 2.4 inches per hour);
  3. within a Zone II, or Interim Wellhead Protection Area;
  4. near or to a critical area including outstanding resource waters, special resource waters, bathing beaches, shellfish growing areas, and cold water fisheries.

- 0.5 inches of runoff times the total impervious area of the post-development project site for all other discharges.

Based on the rapid infiltration rate of the existing on-site soils, which consist of sand and gravel deposits, the volume of stormwater that is to be treated will be calculated as 1.0 inches of runoff times the total impervious area of the project site. The stormwater basins have been designed to contain all of the runoff from their respective tributary areas. No runoff will be discharged off-site or to any wetland resource areas.

BMPs that will be incorporated into the facilities include: water quality swales, sediment forebay & infiltration basin. MassDEP has developed a standard methodology for calculating TSS removal rates. This methodology has been applied to the existing and proposed stormwater management facilities that will be incorporated into the Phase 9 facilities, with a resultant calculated TSS removal rate of approximately 95.5 %. These calculations are presented on MassDEP'S "TSS Removal Calculation Worksheet", which is attached.

5. **For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.**

Areas where solid waste handling and disposal operations are conducted are considered to be "hot spots" and relevant BMPs should be used for source reduction and adequate treatment of stormwater runoff from these areas. Since all handling and disposal of solid waste is to be conducted within the lined landfill area and all runoff that contacts the solid waste is to be retained within the landfill and leachate collection systems, source reduction will effectively be implemented. Also, the BMPs that are to be incorporated into the project, as described above, are appropriate to the application of sites with higher potential pollutant loadings and as pretreatment to the existing infiltration basins, thus compliance with this Standard will be achieved. Additionally, the facility will be regularly inspected by an independent engineer, in accordance with MassDEP's Solid Waste Regulations. These BMPs, which are specific to solid waste facility operations, along with the existing structural BMPs that control the site's runoff and sediment, demonstrate that the Phase 9 Landfill Expansion will comply with this standard.

6. **Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is**

a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

Since all stormwater will recharge the groundwater and not discharge to surface waters, this standard is not applicable. If surface water were to discharge from the Bourne Landfill, they would not be toward an ORW area. This aside, the structural BMPs which are proposed for the site conform to the requirements of this standard.

7. **A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.**

The proposed construction and operation of the Phase 9 Landfill Expansion does not constitute a redevelopment project, thus this standard does not apply to this project.

8. **A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.**

"Construction phase" activities at the Phase 9 Landfill site will include site grading and construction of the Landfill. During the construction phase non-structural BMPs will be utilized to mitigate possible short term sedimentation. These temporary non-structural BMPs will include the use of haybales and silt fences around construction areas. These measures are intended to reduce sediment loadings to the structural BMPs. An Erosion Control Plan will be submitted to the Town of Bourne by the contractor for review and approval prior to the start of construction.

9. A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

A stormwater management system operation and maintenance plan is part of the Facility's overall Operation & Maintenance Plan, which is included as Part D of the Application for Authorization to Construct.

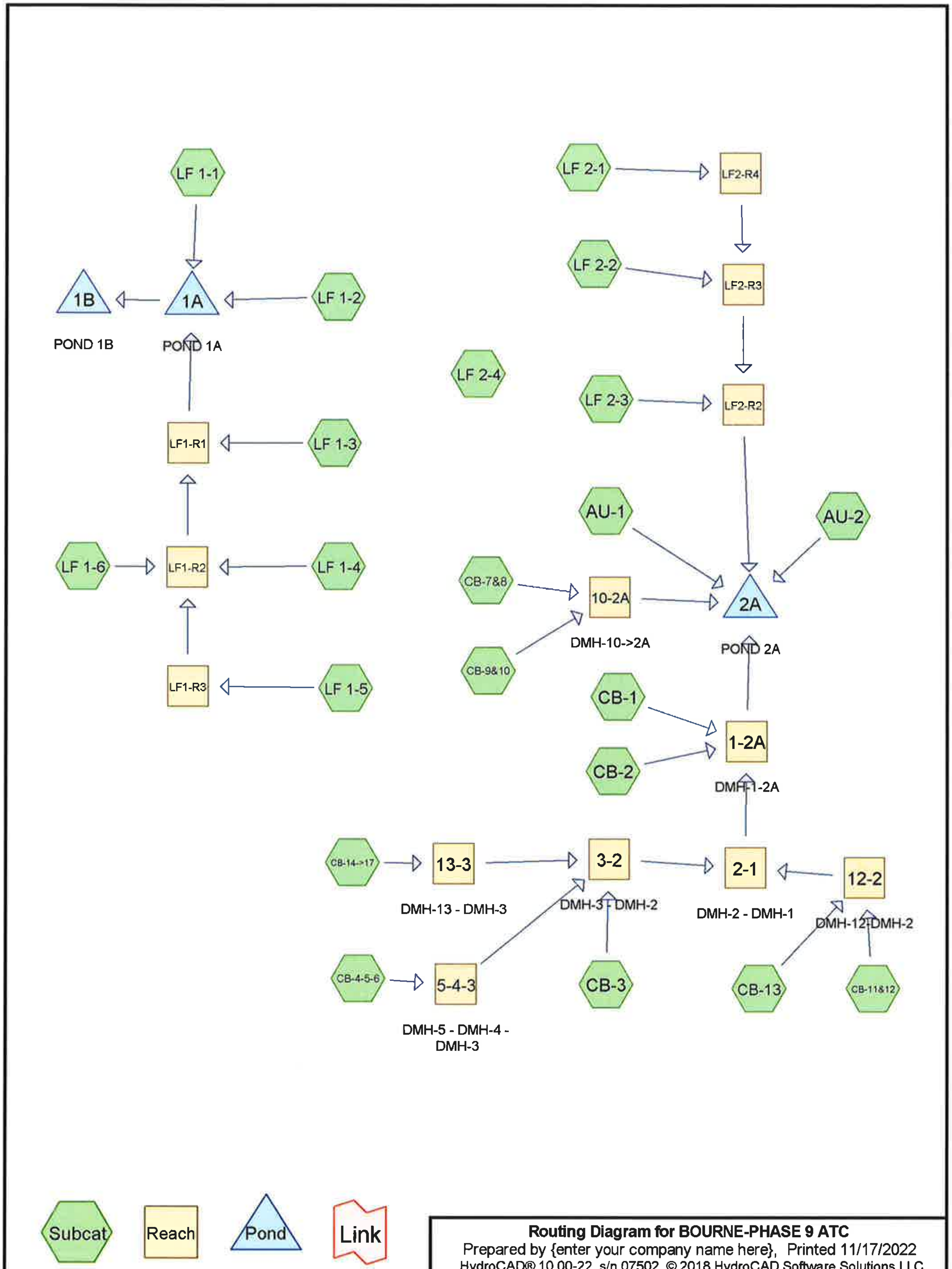
10. All illicit discharges to the stormwater management system are prohibited.

To the best of our professional knowledge and belief, no illicit discharges exist on or are proposed on the site.

STORMWATER CALCULATIONS

SITEC ENVIRONMENTAL Civil and Environmental Engineering Land Use Planning and Surveying Hazardous and Solid Waste Consultants PHONE (781) 319-0100	project: BOURNE LANDFILL PHASE 9 LANDFILL EXPANSION	scale: AS SHOWN date: NOV. 2 2022 drawn: TBD checked: ARG approved: ARG	No. | Date | Revision Description | Chkd. By | Appd. By
	client: TOWN OF BOURNE DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT		
	drawing title: PHASE 9 BUILDOUT DRINAGE ARAS	drawing number:	

25-YEAR STORM EVENT



Routing Diagram for BOURNE-PHASE 9 ATC
Prepared by {enter your company name here}, Printed 11/17/2022
HydroCAD® 10.00-22 s/n 07502 © 2018 HydroCAD Software Solutions LLC

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment AU-1: Runoff Area=100,600 sf 54.08% Impervious Runoff Depth>3.93"
Flow Length=250' Slope=0.0400 '/' Tc=1.0 min CN=85 Runoff=11.66 cfs 0.756 af

Subcatchment AU-2: Runoff Area=369,000 sf 71.27% Impervious Runoff Depth>4.46"
Flow Length=540' Slope=0.0200 '/' Tc=3.1 min CN=90 Runoff=45.80 cfs 3.145 af

Subcatchment CB-1: Runoff Area=55,240 sf 100.00% Impervious Runoff Depth>5.36"
Flow Length=252' Tc=1.7 min CN=98 Runoff=7.54 cfs 0.567 af

Subcatchment CB-11&12: Runoff Area=30,900 sf 100.00% Impervious Runoff Depth>5.36"
Flow Length=207' Tc=1.4 min CN=98 Runoff=4.26 cfs 0.317 af

Subcatchment CB-13: Runoff Area=66,870 sf 50.10% Impervious Runoff Depth>2.85"
Flow Length=1,275' Tc=3.7 min CN=74 Runoff=5.45 cfs 0.365 af

Subcatchment CB-14->17: Runoff Area=60,440 sf 100.00% Impervious Runoff Depth>5.36"
Flow Length=303' Tc=1.6 min CN=98 Runoff=8.26 cfs 0.620 af

Subcatchment CB-2: Runoff Area=34,850 sf 100.00% Impervious Runoff Depth>5.36"
Flow Length=514' Tc=2.9 min CN=98 Runoff=4.75 cfs 0.357 af

Subcatchment CB-3: Runoff Area=42,823 sf 100.00% Impervious Runoff Depth>5.36"
Flow Length=195' Tc=1.2 min CN=98 Runoff=5.96 cfs 0.439 af

Subcatchment CB-4-5-6: Runoff Area=74,800 sf 100.00% Impervious Runoff Depth>5.36"
Flow Length=397' Tc=1.9 min CN=98 Runoff=10.22 cfs 0.767 af

Subcatchment CB-7&8: Runoff Area=116,200 sf 83.82% Impervious Runoff Depth>4.23"
Flow Length=439' Tc=14.7 min CN=88 Runoff=9.81 cfs 0.941 af

Subcatchment CB-9&10: Runoff Area=44,240 sf 100.00% Impervious Runoff Depth>5.36"
Flow Length=798' Tc=2.8 min CN=98 Runoff=6.04 cfs 0.454 af

Subcatchment LF 1-1: Runoff Area=445,600 sf 0.00% Impervious Runoff Depth>2.40"
Flow Length=1,730' Tc=8.6 min CN=69 Runoff=25.43 cfs 2.046 af

Subcatchment LF 1-2: Runoff Area=290,700 sf 0.00% Impervious Runoff Depth>2.40"
Flow Length=915' Tc=6.7 min CN=69 Runoff=17.89 cfs 1.335 af

Subcatchment LF 1-3: Runoff Area=167,600 sf 0.00% Impervious Runoff Depth>2.40"
Flow Length=940' Tc=9.8 min CN=69 Runoff=9.29 cfs 0.769 af

Subcatchment LF 1-4: Runoff Area=329,400 sf 0.00% Impervious Runoff Depth>2.40"
Flow Length=950' Tc=7.5 min CN=69 Runoff=19.72 cfs 1.513 af

Subcatchment LF 1-5: Runoff Area=101,200 sf 0.00% Impervious Runoff Depth>2.40"
Flow Length=570' Tc=6.6 min CN=69 Runoff=6.25 cfs 0.465 af

Subcatchment LF 1-6: Runoff Area=478,000 sf 33.97% Impervious Runoff Depth>1.82"
Flow Length=1,300' Slope=0.0330 '/' Tc=6.3 min CN=62 Runoff=21.69 cfs 1.664 af

Subcatchment LF 2-1: Runoff Area=405,400 sf 0.00% Impervious Runoff Depth>2.49"
Flow Length=1,191' Tc=9.2 min CN=70 Runoff=23.71 cfs 1.929 af

Subcatchment LF 2-2: Runoff Area=435,000 sf 0.00% Impervious Runoff Depth>2.40"
Flow Length=1,305' Tc=7.9 min CN=69 Runoff=25.66 cfs 1.998 af

Subcatchment LF 2-3: Runoff Area=329,000 sf 0.00% Impervious Runoff Depth>2.40"
Flow Length=745' Tc=6.8 min CN=69 Runoff=20.18 cfs 1.511 af

Subcatchment LF 2-4: Runoff Area=364,500 sf 0.00% Impervious Runoff Depth>3.12"
Flow Length=1,155' Tc=15.6 min CN=77 Runoff=22.83 cfs 2.178 af

Reach 1-2A: DMH-1-2A Avg. Flow Depth=2.01' Max Vel=9.99 fps Inflow=42.62 cfs 3.430 af
30.0" Round Pipe n=0.013 L=290.0' S=0.0110 '/' Capacity=43.02 cfs Outflow=41.23 cfs 3.429 af

Reach 2-1: DMH-2 - DMH-1 Avg. Flow Depth=1.60' Max Vel=9.58 fps Inflow=31.82 cfs 2.507 af
30.0" Round Pipe n=0.013 L=309.0' S=0.0110 '/' Capacity=43.03 cfs Outflow=30.82 cfs 2.506 af

Reach 3-2: DMH-3 - DMH-2 Avg. Flow Depth=1.58' Max Vel=8.97 fps Inflow=23.88 cfs 1.826 af
24.0" Round Pipe n=0.013 L=91.0' S=0.0120 '/' Capacity=24.76 cfs Outflow=23.73 cfs 1.826 af

Reach 5-4-3: DMH-5 - DMH-4 - DMH-3 Avg. Flow Depth=0.94' Max Vel=10.32 fps Inflow=10.22 cfs 0.767 af
15.0" Round Pipe n=0.013 L=171.0' S=0.0300 '/' Capacity=11.19 cfs Outflow=10.10 cfs 0.767 af

Reach 10-2A: DMH-10->2A Avg. Flow Depth=1.02' Max Vel=7.64 fps Inflow=12.33 cfs 1.395 af
24.0" Round Pipe n=0.013 L=410.0' S=0.0111 '/' Capacity=23.83 cfs Outflow=12.24 cfs 1.394 af

Reach 12-2: DMH-12-DMH-2 Avg. Flow Depth=1.21' Max Vel=5.98 fps Inflow=9.39 cfs 0.682 af
18.0" Round Pipe n=0.013 L=410.0' S=0.0078 '/' Capacity=9.27 cfs Outflow=8.68 cfs 0.681 af

Reach 13-3: DMH-13 - DMH-3 Avg. Flow Depth=1.00' Max Vel=6.56 fps Inflow=8.26 cfs 0.620 af
18.0" Round Pipe n=0.013 L=158.0' S=0.0100 '/' Capacity=10.50 cfs Outflow=8.11 cfs 0.620 af

Reach LF1-R1: Avg. Flow Depth=1.86' Max Vel=3.52 fps Inflow=51.95 cfs 4.400 af
n=0.033 L=450.0' S=0.0050 '/' Capacity=257.98 cfs Outflow=49.57 cfs 4.389 af

Reach LF1-R2: Avg. Flow Depth=1.71' Max Vel=3.46 fps Inflow=45.57 cfs 3.640 af
n=0.033 L=400.0' S=0.0052 '/' Capacity=264.35 cfs Outflow=42.64 cfs 3.631 af

Reach LF1-R3: Avg. Flow Depth=0.32' Max Vel=3.89 fps Inflow=6.25 cfs 0.465 af
n=0.033 L=700.0' S=0.0420 '/' Capacity=747.69 cfs Outflow=5.80 cfs 0.463 af

Reach LF2-R2: Avg. Flow Depth=2.26' Max Vel=8.52 fps Inflow=63.17 cfs 5.431 af
48.0" Round Pipe n=0.010 L=630.0' S=0.0030 '/' Capacity=102.28 cfs Outflow=61.37 cfs 5.424 af

Reach LF2-R3: Avg. Flow Depth=2.09' Max Vel=7.97 fps Inflow=47.82 cfs 3.925 af
42.0" Round Pipe n=0.010 L=570.0' S=0.0030 '/' Capacity=71.64 cfs Outflow=46.02 cfs 3.920 af

Reach LF2-R4: Avg. Flow Depth=1.50' Max Vel=6.72 fps Inflow=23.71 cfs 1.929 af
36.0" Round Pipe n=0.010 L=270.0' S=0.0030 '/' Capacity=47.49 cfs Outflow=23.32 cfs 1.927 af

Pond 1A: POND 1A Peak Elev=90.87' Storage=59,753 cf Inflow=80.32 cfs 7.770 af
Outflow=60.16 cfs 7.215 af

Pond 1B: POND 1B Peak Elev=82.65' Storage=182,274 cf Inflow=60.16 cfs 7.215 af
Outflow=4.59 cfs 4.961 af

Pond 2A: POND 2A Peak Elev=93.07' Storage=349,504 cf Inflow=143.67 cfs 14.148 af
Outflow=8.71 cfs 9.659 af

Total Runoff Area = 99.687 ac Runoff Volume = 24.136 af Average Runoff Depth = 2.91"
78.03% Pervious = 77.786 ac 21.97% Impervious = 21.901 ac

Summary for Subcatchment AU-1:

Runoff = 11.66 cfs @ 12.01 hrs, Volume= 0.756 af, Depth> 3.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
46,200	69	50-75% Grass cover, Fair, HSG B
54,400	98	Paved parking & roofs
100,600	85	Weighted Average
46,200		45.92% Pervious Area
54,400		54.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	250	0.0400	4.06		**Shallow Concentrated Flow, PAVEMENT & ACROSS LAND** Paved Kv= 20.3 fps

Summary for Subcatchment AU-2:

Runoff = 45.80 cfs @ 12.05 hrs, Volume= 3.145 af, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
106,000	69	50-75% Grass cover, Fair, HSG B
263,000	98	Paved parking & roofs
369,000	90	Weighted Average
106,000		28.73% Pervious Area
263,000		71.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	540	0.0200	2.87		**Shallow Concentrated Flow, PAVEMENT** Paved Kv= 20.3 fps

Summary for Subcatchment CB-1:

Runoff = 7.54 cfs @ 12.03 hrs, Volume= 0.567 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
55,240	98	Paved parking & roofs
55,240		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	232	0.0140	2.40		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.1	20	0.0150	5.56	4.36	**Pipe Channel, CB-1 TO DMH-8** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
1.7	252	Total			

Summary for Subcatchment CB-11&12:

Runoff = 4.26 cfs @ 12.02 hrs, Volume= 0.317 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
30,900	98	Paved parking & roofs
30,900		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	193	0.0125	2.27		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.0	14	0.0150	5.56	4.36	**Pipe Channel, CB-11 TO DMH-11** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
1.4	207	Total			

Summary for Subcatchment CB-13:

Runoff = 5.45 cfs @ 12.06 hrs, Volume= 0.365 af, Depth> 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
33,500	98	Paved parking & roofs
33,370	49	50-75% Grass cover, Fair, HSG A
66,870	74	Weighted Average
33,370		49.90% Pervious Area
33,500		50.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	1,250	0.0210	5.72	38.62	**Trap/Vee/Rect Channel Flow, GRASSED SWALE** Bot.W=0.00' D=1.50' Z= 3.0 '/' Top.W=9.00' n= 0.030
0.1	25	0.0100	5.26	6.46	**Pipe Channel, CB-13 TO DMH-12** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'

		n= 0.013
3.7	1,275	Total

Summary for Subcatchment CB-14->17:

Runoff = 8.26 cfs @ 12.02 hrs, Volume= 0.620 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
60,440	98	Paved parking & roofs
60,440		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	235	0.0200	2.87		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.2	68	0.0120	5.77	7.08	**Pipe Channel, CB-16 TO DMH-13** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.6	303	Total			

Summary for Subcatchment CB-2:

Runoff = 4.75 cfs @ 12.05 hrs, Volume= 0.357 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
34,850	98	Paved parking & roofs
34,850		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	500	0.0200	2.87		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.0	14	0.0150	7.28	12.87	**Pipe Channel, CB-2 TO DMH-1** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
2.9	514	Total			

Summary for Subcatchment CB-3:

Runoff = 5.96 cfs @ 12.02 hrs, Volume= 0.439 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
42,823	98	Paved parking & roofs
42,823		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	178	0.0170	2.65		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.1	17	0.0100	5.26	6.46	**Pipe Channel, CB-3 TO DMH-3** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.2	195	Total			

Summary for Subcatchment CB-4-5-6:

Runoff = 10.22 cfs @ 12.03 hrs, Volume= 0.767 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
74,800	98	Paved parking & roofs
74,800		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	350	0.0260	3.27		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.1	47	0.0100	5.26	6.46	**Pipe Channel, CB-5 TO DMH-6** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.9	397	Total			

Summary for Subcatchment CB-7&8:

Runoff = 9.81 cfs @ 12.20 hrs, Volume= 0.941 af, Depth> 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
97,400	98	Paved parking & roofs
18,800	39	>75% Grass cover, Good, HSG A
116,200	88	Weighted Average
18,800		16.18% Pervious Area
97,400		83.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	170	0.0500	0.22		**Sheet Flow, GRASS AREA** Grass: Short n= 0.150 P2= 2.00"
1.5	247	0.0190	2.80		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.1	22	0.0100	5.26	6.46	**Pipe Channel, CB-8 TO DMH-10** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
14.7	439	Total			

Summary for Subcatchment CB-9&10:

Runoff = 6.04 cfs @ 12.04 hrs, Volume= 0.454 af, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
44,240	98	Paved parking & roofs
44,240		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	590	0.0460	4.35		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.5	208	0.0200	7.44	9.14	**Pipe Channel, CB-9 TO DMH-10** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
2.8	798	Total			

Summary for Subcatchment LF 1-1:

Runoff = 25.43 cfs @ 12.13 hrs, Volume= 2.046 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
399,700	69	50-75% Grass cover, Fair, HSG B
45,900	72	Dirt roads, HSG A
445,600	69	Weighted Average
445,600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
0.9	80	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
0.6	300	0.0500	8.35	56.80	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.033
0.2	350	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
2.0	950	0.0160	7.86	94.34	**Channel Flow, DRAINAGE SWALE** Area= 12.0 sf Perim= 10.0' r= 1.20' n= 0.027
8.6	1,730	Total			

Summary for Subcatchment LF 1-2:

Runoff = 17.89 cfs @ 12.10 hrs, Volume= 1.335 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
290,700	69	50-75% Grass cover, Fair, HSG B
290,700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
1.0	90	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
0.6	395	0.0500	10.21	69.42	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.2	380	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
6.7	915	Total			

Summary for Subcatchment LF 1-3:

Runoff = 9.29 cfs @ 12.15 hrs, Volume= 0.769 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
167,600	69	50-75% Grass cover, Fair, HSG B
167,600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
4.3	400	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
0.5	200	0.0200	6.46	43.91	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.1	290	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
9.8	940	Total			

Summary for Subcatchment LF 1-4:

Runoff = 19.72 cfs @ 12.11 hrs, Volume= 1.513 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
329,400	69	50-75% Grass cover, Fair, HSG B
329,400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
1.1	100	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
1.3	485	0.0200	6.46	43.91	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.2	315	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
7.5	950	Total			

Summary for Subcatchment LF 1-5:

Runoff = 6.25 cfs @ 12.10 hrs, Volume= 0.465 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
101,200	69	50-75% Grass cover, Fair, HSG B
101,200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW**
					Grass: Short n= 0.150 P2= 2.00"
1.2	110	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW**
					Short Grass Pasture Kv= 7.0 fps
0.4	165	0.0360	7.09	48.20	**Channel Flow, DIVERSION BERM**
					Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.033
0.1	245	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL**
					Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
6.6	570	Total			

Summary for Subcatchment LF 1-6:

Runoff = 21.69 cfs @ 12.10 hrs, Volume= 1.664 af, Depth> 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
162,400	98	Paved parking & roofs
315,600	43	Woods/grass comb., Fair, HSG A
478,000	62	Weighted Average
315,600		66.03% Pervious Area
162,400		33.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0330	1.16		**Sheet Flow, PAVEMENT SHEET FLOW**
					Smooth surfaces n= 0.011 P2= 2.00"
5.6	1,250	0.0330	3.69		**Shallow Concentrated Flow, PAVEMENT**
					Paved Kv= 20.3 fps
6.3	1,300	Total			

Summary for Subcatchment LF 2-1:

Runoff = 23.71 cfs @ 12.14 hrs, Volume= 1.929 af, Depth> 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
259,700	69	50-75% Grass cover, Fair, HSG B
145,700	72	Dirt roads, HSG A
405,400	70	Weighted Average
405,400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0200	0.12		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
0.6	125	0.2400	3.43		**Shallow Concentrated Flow, SIDESLOPE FLOW** Short Grass Pasture Kv= 7.0 fps
0.6	370	0.0434	9.51	64.68	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.1	136	0.2350	28.18	619.94	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
0.8	510	0.0078	10.11	485.32	**Channel Flow, DRAINAGE SWALE** Area= 48.0 sf Perim= 16.0' r= 3.00' n= 0.027
9.2	1,191	Total			

Summary for Subcatchment LF 2-2:

Runoff = 25.66 cfs @ 12.12 hrs, Volume= 1.998 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
379,200	69	50-75% Grass cover, Fair, HSG B
55,800	72	Dirt roads, HSG A
435,000	69	Weighted Average
435,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
1.4	130	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
1.2	400	0.0150	5.59	38.02	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.1	130	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
0.3	580	0.0720	30.72	1,474.50	**Channel Flow, DRAINAGE SWALE** Area= 48.0 sf Perim= 16.0' r= 3.00' n= 0.027
0.0	15	0.1750	32.33	57.13	**Pipe Channel, Lateral Culvert** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010
7.9	1,305	Total			

Summary for Subcatchment LF 2-3:

Runoff = 20.18 cfs @ 12.11 hrs, Volume= 1.511 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
319,500	69	50-75% Grass cover, Fair, HSG B
9,500	72	Dirt roads, HSG A
329,000	69	Weighted Average
329,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
1.3	120	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
0.5	270	0.0370	8.78	59.72	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.1	290	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
0.0	15	0.1000	24.44	43.18	**Pipe Channel, LATERAL CULVERT** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010
6.8	745	Total			

Summary for Subcatchment LF 2-4:

Runoff = 22.83 cfs @ 12.22 hrs, Volume= 2.178 af, Depth> 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.60"

Area (sf)	CN	Description
364,500	77	Newly graded area, HSG A
364,500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0115	0.23		**Sheet Flow, ACCESS ROAD AREA** Fallow n= 0.050 P2= 2.00"
7.3	470	0.0115	1.07		**Shallow Concentrated Flow, ACCESS ROAD AREA** Nearly Bare & Untilled Kv= 10.0 fps
4.6	635	0.0535	2.31		**Shallow Concentrated Flow, LOWER ACCESS ROAD** Nearly Bare & Untilled Kv= 10.0 fps
15.6	1,155	Total			

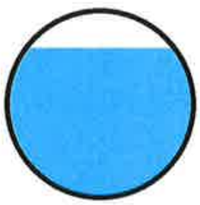
Summary for Reach 1-2A: DMH-1-2A

Inflow Area = 8.400 ac, 90.88% Impervious, Inflow Depth > 4.90" for 25 Year Storm event
Inflow = 42.62 cfs @ 12.05 hrs, Volume= 3.430 af
Outflow = 41.23 cfs @ 12.07 hrs, Volume= 3.429 af, Atten= 3%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.99 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 3.63 fps, Avg. Travel Time= 1.3 min

Peak Storage= 1,226 cf @ 12.06 hrs
Average Depth at Peak Storage= 2.01'
Bank-Full Depth= 2.50' Flow Area= 4.9 sf, Capacity= 43.02 cfs

30.0" Round Pipe
n= 0.013
Length= 290.0' Slope= 0.0110 '/'
Inlet Invert= 101.55', Outlet Invert= 98.36'



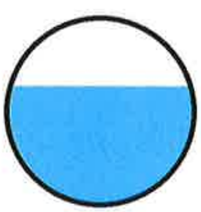
Summary for Reach 2-1: DMH-2 - DMH-1

Inflow Area =	6.332 ac, 87.90% Impervious, Inflow Depth > 4.75"	for 25 Year Storm event	
Inflow =	31.82 cfs @ 12.05 hrs, Volume=	2.507 af	
Outflow =	30.82 cfs @ 12.06 hrs, Volume=	2.506 af, Atten= 3%, Lag= 0.9 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.58 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 3.30 fps, Avg. Travel Time= 1.6 min

Peak Storage= 1,022 cf @ 12.05 hrs
Average Depth at Peak Storage= 1.60'
Bank-Full Depth= 2.50' Flow Area= 4.9 sf, Capacity= 43.03 cfs

30.0" Round Pipe
n= 0.013
Length= 309.0' Slope= 0.0110 '/'
Inlet Invert= 105.00', Outlet Invert= 101.60'



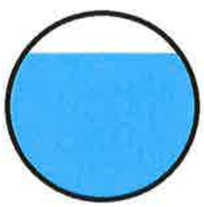
Summary for Reach 3-2: DMH-3 - DMH-2

Inflow Area = 4.088 ac,100.00% Impervious, Inflow Depth > 5.36" for 25 Year Storm event
Inflow = 23.88 cfs @ 12.03 hrs, Volume= 1.826 af
Outflow = 23.73 cfs @ 12.04 hrs, Volume= 1.826 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.97 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.20 fps, Avg. Travel Time= 0.5 min

Peak Storage= 242 cf @ 12.04 hrs
Average Depth at Peak Storage= 1.58'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 24.76 cfs

24.0" Round Pipe
n= 0.013
Length= 91.0' Slope= 0.0120 '/'
Inlet Invert= 109.09', Outlet Invert= 108.00'



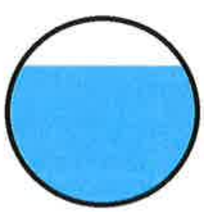
Summary for Reach 5-4-3: DMH-5 - DMH-4 - DMH-3

Inflow Area = 1.717 ac,100.00% Impervious, Inflow Depth > 5.36" for 25 Year Storm event
Inflow = 10.22 cfs @ 12.03 hrs, Volume= 0.767 af
Outflow = 10.10 cfs @ 12.04 hrs, Volume= 0.767 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.32 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.63 fps, Avg. Travel Time= 0.8 min

Peak Storage= 169 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.94'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 11.19 cfs

15.0" Round Pipe
n= 0.013
Length= 171.0' Slope= 0.0300 '/'
Inlet Invert= 117.85', Outlet Invert= 112.72'



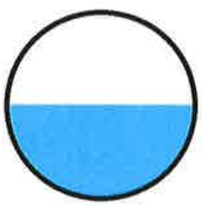
Summary for Reach 10-2A: DMH-10->2A

Inflow Area = 3.683 ac, 88.28% Impervious, Inflow Depth > 4.54" for 25 Year Storm event
Inflow = 12.33 cfs @ 12.18 hrs, Volume= 1.395 af
Outflow = 12.24 cfs @ 12.18 hrs, Volume= 1.394 af, Atten= 1%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.64 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 2.76 fps, Avg. Travel Time= 2.5 min

Peak Storage= 657 cf @ 12.20 hrs
Average Depth at Peak Storage= 1.02'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 23.83 cfs

24.0" Round Pipe
n= 0.013
Length= 410.0' Slope= 0.0111 '/'
Inlet Invert= 102.40', Outlet Invert= 97.85'



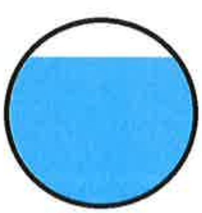
Summary for Reach 12-2: DMH-12-DMH-2

Inflow Area = 2.244 ac, 65.87% Impervious, Inflow Depth > 3.64" for 25 Year Storm event
Inflow = 9.39 cfs @ 12.04 hrs, Volume= 0.682 af
Outflow = 8.68 cfs @ 12.08 hrs, Volume= 0.681 af, Atten= 8%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.98 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 2.05 fps, Avg. Travel Time= 3.3 min

Peak Storage= 624 cf @ 12.06 hrs
Average Depth at Peak Storage= 1.21'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 9.27 cfs

18.0" Round Pipe
n= 0.013
Length= 410.0' Slope= 0.0078 '/'
Inlet Invert= 110.50', Outlet Invert= 107.31'



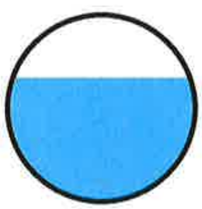
Summary for Reach 13-3: DMH-13 - DMH-3

Inflow Area = 1.388 ac,100.00% Impervious, Inflow Depth > 5.36" for 25 Year Storm event
Inflow = 8.26 cfs @ 12.02 hrs, Volume= 0.620 af
Outflow = 8.11 cfs @ 12.04 hrs, Volume= 0.620 af, Atten= 2%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.56 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.26 fps, Avg. Travel Time= 1.2 min

Peak Storage= 199 cf @ 12.03 hrs
Average Depth at Peak Storage= 1.00'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 10.50 cfs

18.0" Round Pipe
n= 0.013
Length= 158.0' Slope= 0.0100 '/'
Inlet Invert= 111.13', Outlet Invert= 109.55'



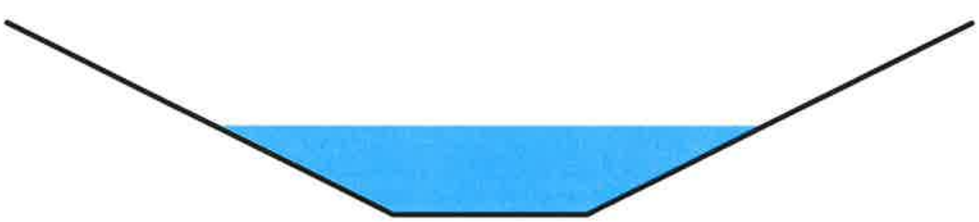
Summary for Reach LF1-R1:

Inflow Area = 24.706 ac, 15.09% Impervious, Inflow Depth > 2.14" for 25 Year Storm event
Inflow = 51.95 cfs @ 12.17 hrs, Volume= 4.400 af
Outflow = 49.57 cfs @ 12.24 hrs, Volume= 4.389 af, Atten= 5%, Lag= 4.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.52 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 5.5 min

Peak Storage= 6,454 cf @ 12.20 hrs
Average Depth at Peak Storage= 1.86'
Bank-Full Depth= 4.00' Flow Area= 48.0 sf, Capacity= 257.98 cfs

4.00' x 4.00' deep channel, n= 0.033
Side Slope Z-value= 2.0 '/' Top Width= 20.00'
Length= 450.0' Slope= 0.0050 '/'
Inlet Invert= 94.50', Outlet Invert= 92.25'



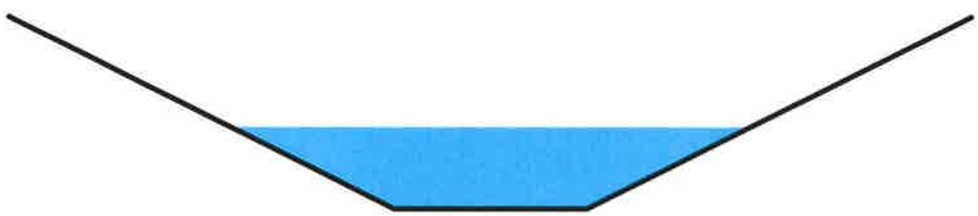
Summary for Reach LF1-R2:

Inflow Area =	20.859 ac,	17.87% Impervious,	Inflow Depth > 2.09"	for 25 Year Storm event	
Inflow =	45.57 cfs @	12.11 hrs,	Volume=	3.640 af	
Outflow =	42.64 cfs @	12.18 hrs,	Volume=	3.631 af,	Atten= 6%, Lag= 3.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.46 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.31 fps, Avg. Travel Time= 5.1 min

Peak Storage= 5,086 cf @ 12.14 hrs
Average Depth at Peak Storage= 1.71'
Bank-Full Depth= 4.00' Flow Area= 48.0 sf, Capacity= 264.35 cfs

4.00' x 4.00' deep channel, n= 0.033
Side Slope Z-value= 2.0 '/' Top Width= 20.00'
Length= 400.0' Slope= 0.0052 '/'
Inlet Invert= 96.60', Outlet Invert= 94.50'



Summary for Reach LF1-R3:

Inflow Area =	2.323 ac,	0.00% Impervious,	Inflow Depth > 2.40"	for 25 Year Storm event	
Inflow =	6.25 cfs @	12.10 hrs,	Volume=	0.465 af	
Outflow =	5.80 cfs @	12.19 hrs,	Volume=	0.463 af,	Atten= 7%, Lag= 5.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.89 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 1.33 fps, Avg. Travel Time= 8.8 min

Peak Storage= 1,042 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 4.00' Flow Area= 48.0 sf, Capacity= 747.69 cfs

4.00' x 4.00' deep channel, n= 0.033
Side Slope Z-value= 2.0 '/' Top Width= 20.00'
Length= 700.0' Slope= 0.0420 '/'
Inlet Invert= 126.00', Outlet Invert= 96.60'

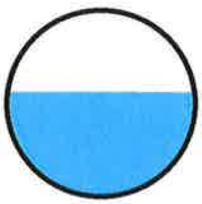
Summary for Reach LF2-R2:

Inflow Area = 26.846 ac, 0.00% Impervious, Inflow Depth > 2.43" for 25 Year Storm event
Inflow = 63.17 cfs @ 12.16 hrs, Volume= 5.431 af
Outflow = 61.37 cfs @ 12.20 hrs, Volume= 5.424 af, Atten= 3%, Lag= 2.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.52 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 3.48 fps, Avg. Travel Time= 3.0 min

Peak Storage= 4,623 cf @ 12.17 hrs
Average Depth at Peak Storage= 2.26'
Bank-Full Depth= 4.00' Flow Area= 12.6 sf, Capacity= 102.28 cfs

48.0" Round Pipe
n= 0.010
Length= 630.0' Slope= 0.0030 '/'
Inlet Invert= 95.01', Outlet Invert= 93.12'



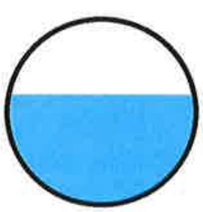
Summary for Reach LF2-R3:

Inflow Area = 19.293 ac, 0.00% Impervious, Inflow Depth > 2.44" for 25 Year Storm event
Inflow = 47.82 cfs @ 12.14 hrs, Volume= 3.925 af
Outflow = 46.02 cfs @ 12.18 hrs, Volume= 3.920 af, Atten= 4%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.97 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 3.21 fps, Avg. Travel Time= 3.0 min

Peak Storage= 3,408 cf @ 12.16 hrs
Average Depth at Peak Storage= 2.09'
Bank-Full Depth= 3.50' Flow Area= 9.6 sf, Capacity= 71.64 cfs

42.0" Round Pipe
n= 0.010
Length= 570.0' Slope= 0.0030 '/'
Inlet Invert= 97.22', Outlet Invert= 95.51'



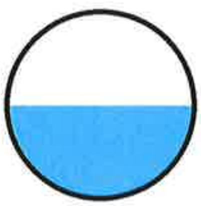
Summary for Reach LF2-R4:

Inflow Area = 9.307 ac, 0.00% Impervious, Inflow Depth > 2.49" for 25 Year Storm event
Inflow = 23.71 cfs @ 12.14 hrs, Volume= 1.929 af
Outflow = 23.32 cfs @ 12.16 hrs, Volume= 1.927 af, Atten= 2%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.72 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 2.65 fps, Avg. Travel Time= 1.7 min

Peak Storage= 955 cf @ 12.15 hrs
Average Depth at Peak Storage= 1.50'
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 47.49 cfs

36.0" Round Pipe
n= 0.010
Length= 270.0' Slope= 0.0030 '/'
Inlet Invert= 98.53', Outlet Invert= 97.72'



Summary for Pond 1A: POND 1A

Inflow Area = 41.609 ac, 8.96% Impervious, Inflow Depth > 2.24" for 25 Year Storm event
Inflow = 80.32 cfs @ 12.19 hrs, Volume= 7.770 af
Outflow = 60.16 cfs @ 12.35 hrs, Volume= 7.215 af, Atten= 25%, Lag= 9.4 min
Primary = 60.16 cfs @ 12.35 hrs, Volume= 7.215 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Starting Elev= 82.00' Surf.Area= 2,000 sf Storage= 3,000 cf
Peak Elev= 90.87' @ 12.35 hrs Surf.Area= 11,140 sf Storage= 59,753 cf (56,753 cf above start)
Flood Elev= 93.50' Surf.Area= 16,300 sf Storage= 94,325 cf (91,325 cf above start)

Plug-Flow detention time= 60.4 min calculated for 7.132 af (92% of inflow)
Center-of-Mass det. time= 18.5 min (872.0 - 853.4)

Volume	Invert	Avail.Storage	Storage Description
#1	80.00'	115,875 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.00	1,000	0	0
82.00	2,000	3,000	3,000
84.00	3,850	5,850	8,850
86.00	5,800	9,650	18,500
88.00	7,850	13,650	32,150
90.00	9,850	17,700	49,850
92.00	12,800	22,650	72,500
93.50	16,300	21,825	94,325
94.00	69,900	21,550	115,875

Device	Routing	Invert	Outlet Devices
#1	Primary	87.00'	**18.0" Round Culvert X 4.00** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 87.00' / 86.00' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Primary	93.50'	**170.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=60.15 cfs @ 12.35 hrs HW=90.87' (Free Discharge)
1=Culvert (Inlet Controls 60.15 cfs @ 8.51 fps)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 1B: POND 1B

Inflow Area =	41.609 ac,	8.96% Impervious, Inflow Depth > 2.08"	for 25 Year Storm event
Inflow =	60.16 cfs @	12.35 hrs, Volume=	7.215 af
Outflow =	4.59 cfs @	16.13 hrs, Volume=	4.961 af, Atten= 92%, Lag= 227.0 min
Primary =	4.59 cfs @	16.13 hrs, Volume=	4.961 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Starting Elev= 74.00' Surf.Area= 11,000 sf Storage= 32,400 cf
Peak Elev= 82.65' @ 16.13 hrs Surf.Area= 23,972 sf Storage= 182,274 cf (149,874 cf above start)
Flood Elev= 93.50' Surf.Area= 58,225 sf Storage= 559,525 cf (527,125 cf above start)

Plug-Flow detention time= 328.8 min calculated for 4.217 af (58% of inflow)
Center-of-Mass det. time= 71.5 min (943.4 - 872.0)

Volume	Invert	Avail.Storage	Storage Description
#1	70.00'	735,600 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
70.00	5,800	0	0
72.00	7,800	13,600	13,600
74.00	11,000	18,800	32,400
76.00	13,800	24,800	57,200
78.00	16,500	30,300	87,500
80.00	19,700	36,200	123,700
82.00	23,000	42,700	166,400
84.00	26,000	49,000	215,400
86.00	29,300	55,300	270,700
88.00	33,000	62,300	333,000
90.00	36,300	69,300	402,300
92.00	41,800	78,100	480,400
94.00	63,700	105,500	585,900
96.00	86,000	149,700	735,600

Device	Routing	Invert	Outlet Devices
#1	Primary	70.00'	**8.270 in/hr Exfiltration over Surface area**

Primary OutFlow Max=4.59 cfs @ 16.13 hrs HW=82.65' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 4.59 cfs)

Summary for Pond 2A: POND 2A

Inflow Area = 49.710 ac, 36.56% Impervious, Inflow Depth > 3.42" for 25 Year Storm event
Inflow = 143.67 cfs @ 12.07 hrs, Volume= 14.148 af
Outflow = 8.71 cfs @ 15.15 hrs, Volume= 9.659 af, Atten= 94%, Lag= 184.4 min
Primary = 8.71 cfs @ 15.15 hrs, Volume= 9.659 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Starting Elev= 82.00' Surf.Area= 14,400 sf Storage= 24,200 cf
Peak Elev= 93.07' @ 15.15 hrs Surf.Area= 45,519 sf Storage= 349,504 cf (325,304 cf above start)
Flood Elev= 100.00' Surf.Area= 79,400 sf Storage= 777,400 cf (753,200 cf above start)

Plug-Flow detention time= 306.0 min calculated for 9.085 af (64% of inflow)
Center-of-Mass det. time= 147.8 min (950.5 - 802.7)

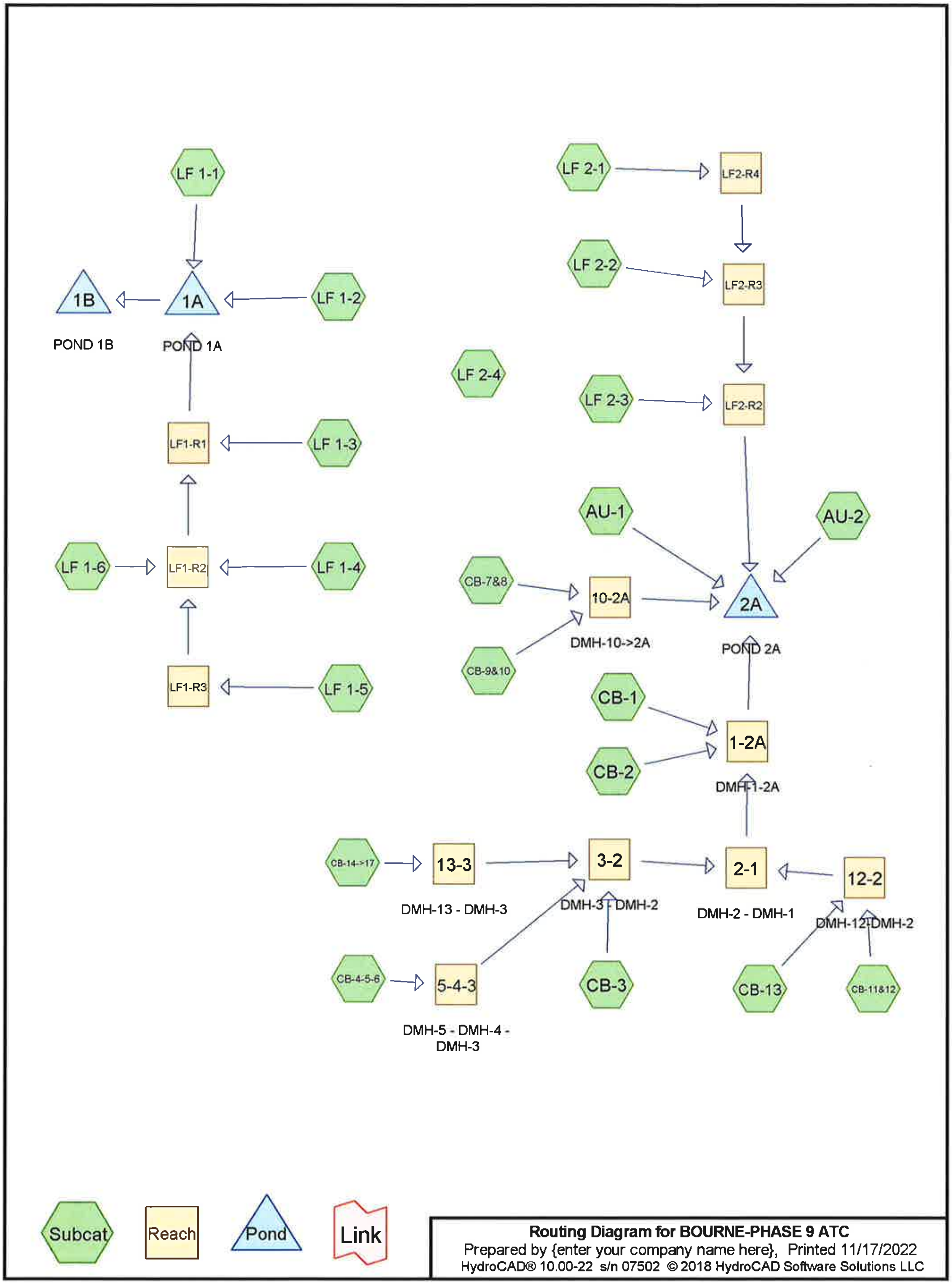
Volume	Invert	Avail.Storage	Storage Description
#1	80.00'	777,400 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.00	9,800	0	0
82.00	14,400	24,200	24,200
84.00	19,400	33,800	58,000
86.00	24,600	44,000	102,000
88.00	30,200	54,800	156,800
90.00	36,000	66,200	223,000
92.00	42,100	78,100	301,100
94.00	48,500	90,600	391,700
96.00	61,100	109,600	501,300
98.00	67,800	128,900	630,200
100.00	79,400	147,200	777,400

Device	Routing	Invert	Outlet Devices
#1	Primary	80.00'	**8.270 in/hr Exfiltration over Surface area**

Primary OutFlow Max=8.71 cfs @ 15.15 hrs HW=93.07' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 8.71 cfs)

100-YEAR STORM EVENT



Routing Diagram for BOURNE-PHASE 9 ATC
Prepared by {enter your company name here}, Printed 11/17/2022
HydroCAD® 10.00-22 s/n 07502 © 2018 HydroCAD Software Solutions LLC

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment AU-1: Runoff Area=100,600 sf 54.08% Impervious Runoff Depth>5.35"
Flow Length=250' Slope=0.0400 '/' Tc=1.0 min CN=85 Runoff=15.67 cfs 1.029 af

Subcatchment AU-2: Runoff Area=369,000 sf 71.27% Impervious Runoff Depth>5.92"
Flow Length=540' Slope=0.0200 '/' Tc=3.1 min CN=90 Runoff=59.85 cfs 4.179 af

Subcatchment CB-1: Runoff Area=55,240 sf 100.00% Impervious Runoff Depth>6.86"
Flow Length=252' Tc=1.7 min CN=98 Runoff=9.57 cfs 0.725 af

Subcatchment CB-11&12: Runoff Area=30,900 sf 100.00% Impervious Runoff Depth>6.86"
Flow Length=207' Tc=1.4 min CN=98 Runoff=5.41 cfs 0.406 af

Subcatchment CB-13: Runoff Area=66,870 sf 50.10% Impervious Runoff Depth>4.13"
Flow Length=1,275' Tc=3.7 min CN=74 Runoff=7.90 cfs 0.528 af

Subcatchment CB-14->17: Runoff Area=60,440 sf 100.00% Impervious Runoff Depth>6.86"
Flow Length=303' Tc=1.6 min CN=98 Runoff=10.50 cfs 0.793 af

Subcatchment CB-2: Runoff Area=34,850 sf 100.00% Impervious Runoff Depth>6.86"
Flow Length=514' Tc=2.9 min CN=98 Runoff=6.03 cfs 0.457 af

Subcatchment CB-3: Runoff Area=42,823 sf 100.00% Impervious Runoff Depth>6.86"
Flow Length=195' Tc=1.2 min CN=98 Runoff=7.57 cfs 0.562 af

Subcatchment CB-4-5-6: Runoff Area=74,800 sf 100.00% Impervious Runoff Depth>6.86"
Flow Length=397' Tc=1.9 min CN=98 Runoff=12.98 cfs 0.982 af

Subcatchment CB-7&8: Runoff Area=116,200 sf 83.82% Impervious Runoff Depth>5.68"
Flow Length=439' Tc=14.7 min CN=88 Runoff=12.98 cfs 1.262 af

Subcatchment CB-9&10: Runoff Area=44,240 sf 100.00% Impervious Runoff Depth>6.86"
Flow Length=798' Tc=2.8 min CN=98 Runoff=7.67 cfs 0.581 af

Subcatchment LF 1-1: Runoff Area=445,600 sf 0.00% Impervious Runoff Depth>3.59"
Flow Length=1,730' Tc=8.6 min CN=69 Runoff=38.79 cfs 3.061 af

Subcatchment LF 1-2: Runoff Area=290,700 sf 0.00% Impervious Runoff Depth>3.59"
Flow Length=915' Tc=6.7 min CN=69 Runoff=27.05 cfs 1.998 af

Subcatchment LF 1-3: Runoff Area=167,600 sf 0.00% Impervious Runoff Depth>3.59"
Flow Length=940' Tc=9.8 min CN=69 Runoff=14.05 cfs 1.151 af

Subcatchment LF 1-4: Runoff Area=329,400 sf 0.00% Impervious Runoff Depth>3.59"
Flow Length=950' Tc=7.5 min CN=69 Runoff=29.85 cfs 2.263 af

Subcatchment LF 1-5: Runoff Area=101,200 sf 0.00% Impervious Runoff Depth>3.59"
Flow Length=570' Tc=6.6 min CN=69 Runoff=9.45 cfs 0.695 af

Subcatchment LF 1-6: Runoff Area=478,000 sf 33.97% Impervious Runoff Depth>2.87"
Flow Length=1,300' Slope=0.0330 '/' Tc=6.3 min CN=62 Runoff=35.39 cfs 2.626 af

Subcatchment LF 2-1: Runoff Area=405,400 sf 0.00% Impervious Runoff Depth>3.70"
Flow Length=1,191' Tc=9.2 min CN=70 Runoff=35.54 cfs 2.866 af

Subcatchment LF 2-2: Runoff Area=435,000 sf 0.00% Impervious Runoff Depth>3.59"
Flow Length=1,305' Tc=7.9 min CN=69 Runoff=38.86 cfs 2.989 af

Subcatchment LF 2-3: Runoff Area=329,000 sf 0.00% Impervious Runoff Depth>3.59"
Flow Length=745' Tc=6.8 min CN=69 Runoff=30.52 cfs 2.261 af

Subcatchment LF 2-4: Runoff Area=364,500 sf 0.00% Impervious Runoff Depth>4.44"
Flow Length=1,155' Tc=15.6 min CN=77 Runoff=32.41 cfs 3.099 af

Reach 1-2A: DMH-1-2A Avg. Flow Depth=2.50' Max Vel=9.98 fps Inflow=49.25 cfs 4.450 af
30.0" Round Pipe n=0.013 L=290.0' S=0.0110 '/' Capacity=43.02 cfs Outflow=46.22 cfs 4.449 af

Reach 2-1: DMH-2 - DMH-1 Avg. Flow Depth=1.70' Max Vel=9.75 fps Inflow=34.28 cfs 3.269 af
30.0" Round Pipe n=0.013 L=309.0' S=0.0110 '/' Capacity=43.03 cfs Outflow=34.53 cfs 3.268 af

Reach 3-2: DMH-3 - DMH-2 Avg. Flow Depth=2.00' Max Vel=8.73 fps Inflow=28.92 cfs 2.337 af
24.0" Round Pipe n=0.013 L=91.0' S=0.0120 '/' Capacity=24.76 cfs Outflow=24.81 cfs 2.336 af

Reach 5-4-3: DMH-5 - DMH-4 - DMH-3 Avg. Flow Depth=1.25' Max Vel=10.35 fps Inflow=12.98 cfs 0.982 af
15.0" Round Pipe n=0.013 L=171.0' S=0.0300 '/' Capacity=11.19 cfs Outflow=11.78 cfs 0.982 af

Reach 10-2A: DMH-10->2A Avg. Flow Depth=1.21' Max Vel=8.14 fps Inflow=16.18 cfs 1.843 af
24.0" Round Pipe n=0.013 L=410.0' S=0.0111 '/' Capacity=23.83 cfs Outflow=16.06 cfs 1.842 af

Reach 12-2: DMH-12-DMH-2 Avg. Flow Depth=1.50' Max Vel=5.97 fps Inflow=12.91 cfs 0.934 af
18.0" Round Pipe n=0.013 L=410.0' S=0.0078 '/' Capacity=9.27 cfs Outflow=9.38 cfs 0.933 af

Reach 13-3: DMH-13 - DMH-3 Avg. Flow Depth=1.22' Max Vel=6.77 fps Inflow=10.50 cfs 0.793 af
18.0" Round Pipe n=0.013 L=158.0' S=0.0100 '/' Capacity=10.50 cfs Outflow=10.30 cfs 0.793 af

Reach LF1-R1: Avg. Flow Depth=2.32' Max Vel=3.97 fps Inflow=81.84 cfs 6.722 af
n=0.033 L=450.0' S=0.0050 '/' Capacity=257.98 cfs Outflow=78.17 cfs 6.708 af

Reach LF1-R2: Avg. Flow Depth=2.15' Max Vel=3.90 fps Inflow=71.99 cfs 5.582 af
n=0.033 L=400.0' S=0.0052 '/' Capacity=264.35 cfs Outflow=68.01 cfs 5.571 af

Reach LF1-R3: Avg. Flow Depth=0.41' Max Vel=4.47 fps Inflow=9.45 cfs 0.695 af
n=0.033 L=700.0' S=0.0420 '/' Capacity=747.69 cfs Outflow=8.73 cfs 0.693 af

Reach LF2-R2: Avg. Flow Depth=3.04' Max Vel=9.23 fps Inflow=95.45 cfs 8.108 af
48.0" Round Pipe n=0.010 L=630.0' S=0.0030 '/' Capacity=102.28 cfs Outflow=92.73 cfs 8.098 af

Reach LF2-R3: Avg. Flow Depth=2.86' Max Vel=8.49 fps Inflow=72.14 cfs 5.853 af
42.0" Round Pipe n=0.010 L=570.0' S=0.0030 '/' Capacity=71.64 cfs Outflow=69.84 cfs 5.847 af

Reach LF2-R4: Avg. Flow Depth=1.94' Max Vel=7.37 fps Inflow=35.54 cfs 2.866 af
36.0" Round Pipe n=0.010 L=270.0' S=0.0030 '/' Capacity=47.49 cfs Outflow=35.02 cfs 2.864 af

Pond 1A: POND 1A Peak Elev=93.41' Storage=92,965 cf Inflow=127.37 cfs 11.767 af
Outflow=80.95 cfs 11.205 af

Pond 1B: POND 1B Peak Elev=87.19' Storage=307,645 cf Inflow=80.95 cfs 11.205 af
Outflow=6.03 cfs 6.376 af

Pond 2A: POND 2A Peak Elev=96.03' Storage=503,532 cf Inflow=189.60 cfs 19.597 af
Outflow=11.72 cfs 12.323 af

Total Runoff Area = 99.687 ac Runoff Volume = 34.513 af Average Runoff Depth = 4.15"
78.03% Pervious = 77.786 ac 21.97% Impervious = 21.901 ac

Summary for Subcatchment AU-1:

Runoff = 15.67 cfs @ 12.01 hrs, Volume= 1.029 af, Depth> 5.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
46,200	69	50-75% Grass cover, Fair, HSG B
54,400	98	Paved parking & roofs
100,600	85	Weighted Average
46,200		45.92% Pervious Area
54,400		54.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	250	0.0400	4.06		**Shallow Concentrated Flow, PAVEMENT & ACROSS LAND** Paved Kv= 20.3 fps

Summary for Subcatchment AU-2:

Runoff = 59.85 cfs @ 12.05 hrs, Volume= 4.179 af, Depth> 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
106,000	69	50-75% Grass cover, Fair, HSG B
263,000	98	Paved parking & roofs
369,000	90	Weighted Average
106,000		28.73% Pervious Area
263,000		71.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	540	0.0200	2.87		**Shallow Concentrated Flow, PAVEMENT** Paved Kv= 20.3 fps

Summary for Subcatchment CB-1:

Runoff = 9.57 cfs @ 12.03 hrs, Volume= 0.725 af, Depth> 6.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
55,240	98	Paved parking & roofs
55,240		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	232	0.0140	2.40		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.1	20	0.0150	5.56	4.36	**Pipe Channel, CB-1 TO DMH-8** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
1.7	252	Total			

Summary for Subcatchment CB-11&12:

Runoff = 5.41 cfs @ 12.02 hrs, Volume= 0.406 af, Depth> 6.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
30,900	98	Paved parking & roofs
30,900		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	193	0.0125	2.27		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.0	14	0.0150	5.56	4.36	**Pipe Channel, CB-11 TO DMH-11** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
1.4	207	Total			

Summary for Subcatchment CB-13:

Runoff = 7.90 cfs @ 12.06 hrs, Volume= 0.528 af, Depth> 4.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
33,500	98	Paved parking & roofs
33,370	49	50-75% Grass cover, Fair, HSG A
66,870	74	Weighted Average
33,370		49.90% Pervious Area
33,500		50.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	1,250	0.0210	5.72	38.62	**Trap/Vee/Rect Channel Flow, GRASSED SWALE** Bot.W=0.00' D=1.50' Z= 3.0 '/' Top.W=9.00' n= 0.030
0.1	25	0.0100	5.26	6.46	**Pipe Channel, CB-13 TO DMH-12** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'

		n= 0.013
3.7	1,275	Total

Summary for Subcatchment CB-14->17:

Runoff = 10.50 cfs @ 12.02 hrs, Volume= 0.793 af, Depth> 6.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
60,440	98	Paved parking & roofs
60,440		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	235	0.0200	2.87		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.2	68	0.0120	5.77	7.08	**Pipe Channel, CB-16 TO DMH-13** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.6	303	Total			

Summary for Subcatchment CB-2:

Runoff = 6.03 cfs @ 12.05 hrs, Volume= 0.457 af, Depth> 6.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
34,850	98	Paved parking & roofs
34,850		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	500	0.0200	2.87		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.0	14	0.0150	7.28	12.87	**Pipe Channel, CB-2 TO DMH-1** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
2.9	514	Total			

Summary for Subcatchment CB-3:

Runoff = 7.57 cfs @ 12.02 hrs, Volume= 0.562 af, Depth> 6.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
42,823	98	Paved parking & roofs
42,823		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	178	0.0170	2.65		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.1	17	0.0100	5.26	6.46	**Pipe Channel, CB-3 TO DMH-3** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.2	195	Total			

Summary for Subcatchment CB-4-5-6:

Runoff = 12.98 cfs @ 12.03 hrs, Volume= 0.982 af, Depth> 6.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
74,800	98	Paved parking & roofs
74,800		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	350	0.0260	3.27		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.1	47	0.0100	5.26	6.46	**Pipe Channel, CB-5 TO DMH-6** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.9	397	Total			

Summary for Subcatchment CB-7&8:

Runoff = 12.98 cfs @ 12.20 hrs, Volume= 1.262 af, Depth> 5.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
97,400	98	Paved parking & roofs
18,800	39	>75% Grass cover, Good, HSG A
116,200	88	Weighted Average
18,800		16.18% Pervious Area
97,400		83.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	170	0.0500	0.22		**Sheet Flow, GRASS AREA** Grass: Short n= 0.150 P2= 2.00"
1.5	247	0.0190	2.80		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.1	22	0.0100	5.26	6.46	**Pipe Channel, CB-8 TO DMH-10** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
14.7	439	Total			

Summary for Subcatchment CB-9&10:

Runoff = 7.67 cfs @ 12.04 hrs, Volume= 0.581 af, Depth> 6.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
44,240	98	Paved parking & roofs
44,240		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	590	0.0460	4.35		**Shallow Concentrated Flow, PAVED AREA** Paved Kv= 20.3 fps
0.5	208	0.0200	7.44	9.14	**Pipe Channel, CB-9 TO DMH-10** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
2.8	798	Total			

Summary for Subcatchment LF 1-1:

Runoff = 38.79 cfs @ 12.12 hrs, Volume= 3.061 af, Depth> 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
399,700	69	50-75% Grass cover, Fair, HSG B
45,900	72	Dirt roads, HSG A
445,600	69	Weighted Average
445,600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
0.9	80	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
0.6	300	0.0500	8.35	56.80	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.033
0.2	350	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
2.0	950	0.0160	7.86	94.34	**Channel Flow, DRAINAGE SWALE** Area= 12.0 sf Perim= 10.0' r= 1.20' n= 0.027
8.6	1,730	Total			

Summary for Subcatchment LF 1-2:

Runoff = 27.05 cfs @ 12.10 hrs, Volume= 1.998 af, Depth> 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
290,700	69	50-75% Grass cover, Fair, HSG B
290,700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
1.0	90	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
0.6	395	0.0500	10.21	69.42	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.2	380	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
6.7	915	Total			

Summary for Subcatchment LF 1-3:

Runoff = 14.05 cfs @ 12.14 hrs, Volume= 1.151 af, Depth> 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
167,600	69	50-75% Grass cover, Fair, HSG B
167,600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
4.3	400	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
0.5	200	0.0200	6.46	43.91	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.1	290	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
9.8	940	Total			

Summary for Subcatchment LF 1-4:

Runoff = 29.85 cfs @ 12.11 hrs, Volume= 2.263 af, Depth> 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
329,400	69	50-75% Grass cover, Fair, HSG B
329,400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
1.1	100	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
1.3	485	0.0200	6.46	43.91	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.2	315	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
7.5	950	Total			

Summary for Subcatchment LF 1-5:

Runoff = 9.45 cfs @ 12.10 hrs, Volume= 0.695 af, Depth> 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
101,200	69	50-75% Grass cover, Fair, HSG B
101,200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW**
					Grass: Short n= 0.150 P2= 2.00"
1.2	110	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW**
					Short Grass Pasture Kv= 7.0 fps
0.4	165	0.0360	7.09	48.20	**Channel Flow, DIVERSION BERM**
					Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.033
0.1	245	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL**
					Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
6.6	570	Total			

Summary for Subcatchment LF 1-6:

Runoff = 35.39 cfs @ 12.10 hrs, Volume= 2.626 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
162,400	98	Paved parking & roofs
315,600	43	Woods/grass comb., Fair, HSG A
478,000	62	Weighted Average
315,600		66.03% Pervious Area
162,400		33.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0330	1.16		**Sheet Flow, PAVEMENT SHEET FLOW**
					Smooth surfaces n= 0.011 P2= 2.00"
5.6	1,250	0.0330	3.69		**Shallow Concentrated Flow, PAVEMENT**
					Paved Kv= 20.3 fps
6.3	1,300	Total			

Summary for Subcatchment LF 2-1:

Runoff = 35.54 cfs @ 12.13 hrs, Volume= 2.866 af, Depth> 3.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
259,700	69	50-75% Grass cover, Fair, HSG B
145,700	72	Dirt roads, HSG A
405,400	70	Weighted Average
405,400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0200	0.12		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
0.6	125	0.2400	3.43		**Shallow Concentrated Flow, SIDESLOPE FLOW** Short Grass Pasture Kv= 7.0 fps
0.6	370	0.0434	9.51	64.68	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.1	136	0.2350	28.18	619.94	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
0.8	510	0.0078	10.11	485.32	**Channel Flow, DRAINAGE SWALE** Area= 48.0 sf Perim= 16.0' r= 3.00' n= 0.027
9.2	1,191	Total			

Summary for Subcatchment LF 2-2:

Runoff = 38.86 cfs @ 12.12 hrs, Volume= 2.989 af, Depth> 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
379,200	69	50-75% Grass cover, Fair, HSG B
55,800	72	Dirt roads, HSG A
435,000	69	Weighted Average
435,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
1.4	130	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
1.2	400	0.0150	5.59	38.02	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.1	130	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
0.3	580	0.0720	30.72	1,474.50	**Channel Flow, DRAINAGE SWALE** Area= 48.0 sf Perim= 16.0' r= 3.00' n= 0.027
0.0	15	0.1750	32.33	57.13	**Pipe Channel, Lateral Culvert** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010
7.9	1,305	Total			

Summary for Subcatchment LF 2-3:

Runoff = 30.52 cfs @ 12.10 hrs, Volume= 2.261 af, Depth> 3.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
319,500	69	50-75% Grass cover, Fair, HSG B
9,500	72	Dirt roads, HSG A
329,000	69	Weighted Average
329,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0500	0.17		**Sheet Flow, PLATEAU FLOW** Grass: Short n= 0.150 P2= 2.00"
1.3	120	0.0500	1.57		**Shallow Concentrated Flow, PLATEAU FLOW** Short Grass Pasture Kv= 7.0 fps
0.5	270	0.0370	8.78	59.72	**Channel Flow, DIVERSION BERM** Area= 6.8 sf Perim= 9.0' r= 0.76' n= 0.027
0.1	290	0.3300	33.39	734.64	**Channel Flow, LET DOWN CHANNEL** Area= 22.0 sf Perim= 15.0' r= 1.47' n= 0.033
0.0	15	0.1000	24.44	43.18	**Pipe Channel, LATERAL CULVERT** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010
6.8	745	Total			

Summary for Subcatchment LF 2-4:

Runoff = 32.41 cfs @ 12.21 hrs, Volume= 3.099 af, Depth> 4.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.10"

Area (sf)	CN	Description
364,500	77	Newly graded area, HSG A
364,500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0115	0.23		**Sheet Flow, ACCESS ROAD AREA** Fallow n= 0.050 P2= 2.00"
7.3	470	0.0115	1.07		**Shallow Concentrated Flow, ACCESS ROAD AREA** Nearly Bare & Untilled Kv= 10.0 fps
4.6	635	0.0535	2.31		**Shallow Concentrated Flow, LOWER ACCESS ROAD** Nearly Bare & Untilled Kv= 10.0 fps
15.6	1,155	Total			

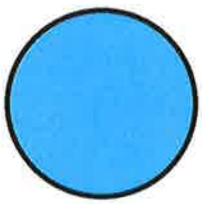
Summary for Reach 1-2A: DMH-1-2A

Inflow Area = 8.400 ac, 90.88% Impervious, Inflow Depth > 6.36" for 100 Year Storm event
Inflow = 49.25 cfs @ 12.05 hrs, Volume= 4.450 af
Outflow = 46.22 cfs @ 12.14 hrs, Volume= 4.449 af, Atten= 6%, Lag= 5.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.98 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 3.91 fps, Avg. Travel Time= 1.2 min

Peak Storage= 1,450 cf @ 12.08 hrs
Average Depth at Peak Storage= 2.50'
Bank-Full Depth= 2.50' Flow Area= 4.9 sf, Capacity= 43.02 cfs

30.0" Round Pipe
n= 0.013
Length= 290.0' Slope= 0.0110 '/'
Inlet Invert= 101.55', Outlet Invert= 98.36'



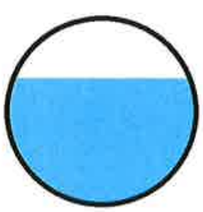
Summary for Reach 2-1: DMH-2 - DMH-1

Inflow Area = 6.332 ac, 87.90% Impervious, Inflow Depth > 6.20" for 100 Year Storm event
Inflow = 34.28 cfs @ 12.07 hrs, Volume= 3.269 af
Outflow = 34.53 cfs @ 12.07 hrs, Volume= 3.268 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.75 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 3.57 fps, Avg. Travel Time= 1.4 min

Peak Storage= 1,102 cf @ 12.07 hrs
Average Depth at Peak Storage= 1.70'
Bank-Full Depth= 2.50' Flow Area= 4.9 sf, Capacity= 43.03 cfs

30.0" Round Pipe
n= 0.013
Length= 309.0' Slope= 0.0110 '/'
Inlet Invert= 105.00', Outlet Invert= 101.60'



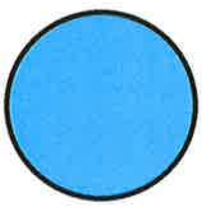
Summary for Reach 3-2: DMH-3 - DMH-2

Inflow Area = 4.088 ac,100.00% Impervious, Inflow Depth > 6.86" for 100 Year Storm event
Inflow = 28.92 cfs @ 12.03 hrs, Volume= 2.337 af
Outflow = 24.81 cfs @ 12.08 hrs, Volume= 2.336 af, Atten= 14%, Lag= 2.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.73 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.44 fps, Avg. Travel Time= 0.4 min

Peak Storage= 286 cf @ 12.00 hrs
Average Depth at Peak Storage= 2.00'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 24.76 cfs

24.0" Round Pipe
n= 0.013
Length= 91.0' Slope= 0.0120 '/'
Inlet Invert= 109.09', Outlet Invert= 108.00'



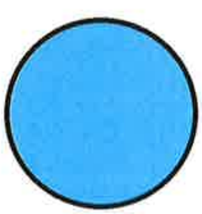
Summary for Reach 5-4-3: DMH-5 - DMH-4 - DMH-3

Inflow Area = 1.717 ac,100.00% Impervious, Inflow Depth > 6.86" for 100 Year Storm event
Inflow = 12.98 cfs @ 12.03 hrs, Volume= 0.982 af
Outflow = 11.78 cfs @ 12.02 hrs, Volume= 0.982 af, Atten= 9%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.35 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.90 fps, Avg. Travel Time= 0.7 min

Peak Storage= 211 cf @ 12.04 hrs
Average Depth at Peak Storage= 1.25'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 11.19 cfs

15.0" Round Pipe
n= 0.013
Length= 171.0' Slope= 0.0300 '/'
Inlet Invert= 117.85', Outlet Invert= 112.72'



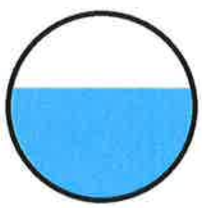
Summary for Reach 10-2A: DMH-10->2A

Inflow Area = 3.683 ac, 88.28% Impervious, Inflow Depth > 6.00" for 100 Year Storm event
Inflow = 16.18 cfs @ 12.18 hrs, Volume= 1.843 af
Outflow = 16.06 cfs @ 12.18 hrs, Volume= 1.842 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.14 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 3.01 fps, Avg. Travel Time= 2.3 min

Peak Storage= 811 cf @ 12.18 hrs
Average Depth at Peak Storage= 1.21'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 23.83 cfs

24.0" Round Pipe
n= 0.013
Length= 410.0' Slope= 0.0111 '/'
Inlet Invert= 102.40', Outlet Invert= 97.85'



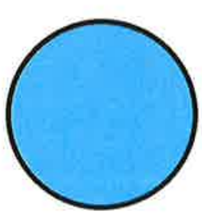
Summary for Reach 12-2: DMH-12-DMH-2

Inflow Area = 2.244 ac, 65.87% Impervious, Inflow Depth > 4.99" for 100 Year Storm event
Inflow = 12.91 cfs @ 12.04 hrs, Volume= 0.934 af
Outflow = 9.38 cfs @ 12.05 hrs, Volume= 0.933 af, Atten= 27%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.97 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 2.24 fps, Avg. Travel Time= 3.1 min

Peak Storage= 725 cf @ 12.05 hrs
Average Depth at Peak Storage= 1.50'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 9.27 cfs

18.0" Round Pipe
n= 0.013
Length= 410.0' Slope= 0.0078 '/'
Inlet Invert= 110.50', Outlet Invert= 107.31'



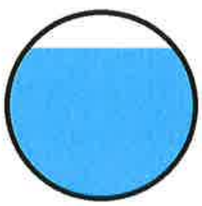
Summary for Reach 13-3: DMH-13 - DMH-3

Inflow Area = 1.388 ac,100.00% Impervious, Inflow Depth > 6.86" for 100 Year Storm event
Inflow = 10.50 cfs @ 12.02 hrs, Volume= 0.793 af
Outflow = 10.30 cfs @ 12.04 hrs, Volume= 0.793 af, Atten= 2%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.77 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.43 fps, Avg. Travel Time= 1.1 min

Peak Storage= 244 cf @ 12.03 hrs
Average Depth at Peak Storage= 1.22'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 10.50 cfs

18.0" Round Pipe
n= 0.013
Length= 158.0' Slope= 0.0100 '/'
Inlet Invert= 111.13', Outlet Invert= 109.55'



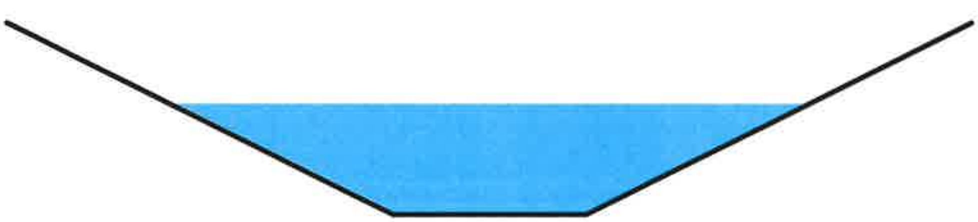
Summary for Reach LF1-R1:

Inflow Area = 24.706 ac, 15.09% Impervious, Inflow Depth > 3.27" for 100 Year Storm event
Inflow = 81.84 cfs @ 12.16 hrs, Volume= 6.722 af
Outflow = 78.17 cfs @ 12.22 hrs, Volume= 6.708 af, Atten= 4%, Lag= 3.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.97 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.52 fps, Avg. Travel Time= 4.9 min

Peak Storage= 9,016 cf @ 12.19 hrs
Average Depth at Peak Storage= 2.32'
Bank-Full Depth= 4.00' Flow Area= 48.0 sf, Capacity= 257.98 cfs

4.00' x 4.00' deep channel, n= 0.033
Side Slope Z-value= 2.0 '/' Top Width= 20.00'
Length= 450.0' Slope= 0.0050 '/'
Inlet Invert= 94.50', Outlet Invert= 92.25'



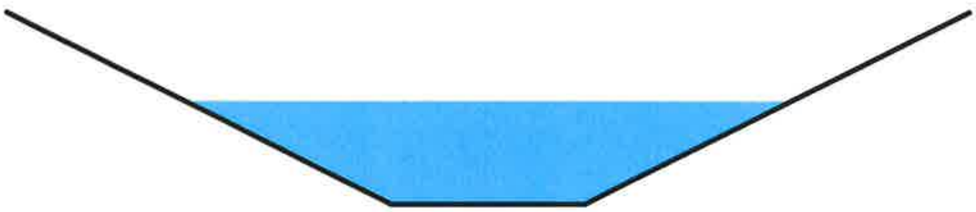
Summary for Reach LF1-R2:

Inflow Area = 20.859 ac, 17.87% Impervious, Inflow Depth > 3.21" for 100 Year Storm event
Inflow = 71.99 cfs @ 12.11 hrs, Volume= 5.582 af
Outflow = 68.01 cfs @ 12.17 hrs, Volume= 5.571 af, Atten= 6%, Lag= 3.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.90 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.45 fps, Avg. Travel Time= 4.6 min

Peak Storage= 7,124 cf @ 12.14 hrs
Average Depth at Peak Storage= 2.15'
Bank-Full Depth= 4.00' Flow Area= 48.0 sf, Capacity= 264.35 cfs

4.00' x 4.00' deep channel, n= 0.033
Side Slope Z-value= 2.0 '/' Top Width= 20.00'
Length= 400.0' Slope= 0.0052 '/'
Inlet Invert= 96.60', Outlet Invert= 94.50'



Summary for Reach LF1-R3:

Inflow Area = 2.323 ac, 0.00% Impervious, Inflow Depth > 3.59" for 100 Year Storm event
Inflow = 9.45 cfs @ 12.10 hrs, Volume= 0.695 af
Outflow = 8.73 cfs @ 12.18 hrs, Volume= 0.693 af, Atten= 8%, Lag= 4.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.47 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 1.44 fps, Avg. Travel Time= 8.1 min

Peak Storage= 1,383 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 4.00' Flow Area= 48.0 sf, Capacity= 747.69 cfs

4.00' x 4.00' deep channel, n= 0.033
Side Slope Z-value= 2.0 '/' Top Width= 20.00'
Length= 700.0' Slope= 0.0420 '/'
Inlet Invert= 126.00', Outlet Invert= 96.60'

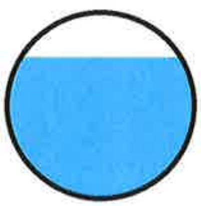
Summary for Reach LF2-R2:

Inflow Area = 26.846 ac, 0.00% Impervious, Inflow Depth > 3.62" for 100 Year Storm event
Inflow = 95.45 cfs @ 12.15 hrs, Volume= 8.108 af
Outflow = 92.73 cfs @ 12.19 hrs, Volume= 8.098 af, Atten= 3%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.23 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 3.81 fps, Avg. Travel Time= 2.8 min

Peak Storage= 6,459 cf @ 12.17 hrs
Average Depth at Peak Storage= 3.04'
Bank-Full Depth= 4.00' Flow Area= 12.6 sf, Capacity= 102.28 cfs

48.0" Round Pipe
n= 0.010
Length= 630.0' Slope= 0.0030 '/'
Inlet Invert= 95.01', Outlet Invert= 93.12'



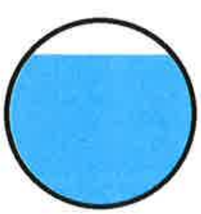
Summary for Reach LF2-R3:

Inflow Area = 19.293 ac, 0.00% Impervious, Inflow Depth > 3.64" for 100 Year Storm event
Inflow = 72.14 cfs @ 12.13 hrs, Volume= 5.853 af
Outflow = 69.84 cfs @ 12.17 hrs, Volume= 5.847 af, Atten= 3%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.49 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 3.50 fps, Avg. Travel Time= 2.7 min

Peak Storage= 4,805 cf @ 12.15 hrs
Average Depth at Peak Storage= 2.86'
Bank-Full Depth= 3.50' Flow Area= 9.6 sf, Capacity= 71.64 cfs

42.0" Round Pipe
n= 0.010
Length= 570.0' Slope= 0.0030 '/'
Inlet Invert= 97.22', Outlet Invert= 95.51'



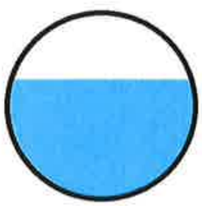
Summary for Reach LF2-R4:

Inflow Area = 9.307 ac, 0.00% Impervious, Inflow Depth > 3.70" for 100 Year Storm event
Inflow = 35.54 cfs @ 12.13 hrs, Volume= 2.866 af
Outflow = 35.02 cfs @ 12.15 hrs, Volume= 2.864 af, Atten= 1%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.37 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 2.90 fps, Avg. Travel Time= 1.6 min

Peak Storage= 1,304 cf @ 12.14 hrs
Average Depth at Peak Storage= 1.94'
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 47.49 cfs

36.0" Round Pipe
n= 0.010
Length= 270.0' Slope= 0.0030 '/'
Inlet Invert= 98.53', Outlet Invert= 97.72'



Summary for Pond 1A: POND 1A

Inflow Area = 41.609 ac, 8.96% Impervious, Inflow Depth > 3.39" for 100 Year Storm event
Inflow = 127.37 cfs @ 12.18 hrs, Volume= 11.767 af
Outflow = 80.95 cfs @ 12.37 hrs, Volume= 11.205 af, Atten= 36%, Lag= 11.9 min
Primary = 80.95 cfs @ 12.37 hrs, Volume= 11.205 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Starting Elev= 82.00' Surf.Area= 2,000 sf Storage= 3,000 cf
Peak Elev= 93.41' @ 12.37 hrs Surf.Area= 16,082 sf Storage= 92,965 cf (89,965 cf above start)
Flood Elev= 93.50' Surf.Area= 16,300 sf Storage= 94,325 cf (91,325 cf above start)

Plug-Flow detention time= 47.0 min calculated for 11.136 af (95% of inflow)
Center-of-Mass det. time= 16.9 min (857.9 - 841.0)

Volume	Invert	Avail.Storage	Storage Description
#1	80.00'	115,875 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.00	1,000	0	0
82.00	2,000	3,000	3,000
84.00	3,850	5,850	8,850
86.00	5,800	9,650	18,500
88.00	7,850	13,650	32,150
90.00	9,850	17,700	49,850
92.00	12,800	22,650	72,500
93.50	16,300	21,825	94,325
94.00	69,900	21,550	115,875

Device	Routing	Invert	Outlet Devices
#1	Primary	87.00'	**18.0" Round Culvert X 4.00** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 87.00' / 86.00' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Primary	93.50'	**170.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=80.79 cfs @ 12.37 hrs HW=93.39' (Free Discharge)
1=Culvert (Inlet Controls 80.79 cfs @ 11.43 fps)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 1B: POND 1B

Inflow Area = 41.609 ac, 8.96% Impervious, Inflow Depth > 3.23" for 100 Year Storm event
Inflow = 80.95 cfs @ 12.37 hrs, Volume= 11.205 af
Outflow = 6.03 cfs @ 16.31 hrs, Volume= 6.376 af, Atten= 93%, Lag= 236.1 min
Primary = 6.03 cfs @ 16.31 hrs, Volume= 6.376 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Starting Elev= 74.00' Surf.Area= 11,000 sf Storage= 32,400 cf
Peak Elev= 87.19' @ 16.31 hrs Surf.Area= 31,494 sf Storage= 307,645 cf (275,245 cf above start)
Flood Elev= 93.50' Surf.Area= 58,225 sf Storage= 559,525 cf (527,125 cf above start)

Plug-Flow detention time= 340.5 min calculated for 5.633 af (50% of inflow)
Center-of-Mass det. time= 115.6 min (973.5 - 857.9)

Volume	Invert	Avail.Storage	Storage Description
#1	70.00'	735,600 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
70.00	5,800	0	0
72.00	7,800	13,600	13,600
74.00	11,000	18,800	32,400
76.00	13,800	24,800	57,200
78.00	16,500	30,300	87,500
80.00	19,700	36,200	123,700
82.00	23,000	42,700	166,400
84.00	26,000	49,000	215,400
86.00	29,300	55,300	270,700
88.00	33,000	62,300	333,000
90.00	36,300	69,300	402,300
92.00	41,800	78,100	480,400
94.00	63,700	105,500	585,900
96.00	86,000	149,700	735,600

Device	Routing	Invert	Outlet Devices
#1	Primary	70.00'	**8.270 in/hr Exfiltration over Surface area**

Primary OutFlow Max=6.03 cfs @ 16.31 hrs HW=87.19' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 6.03 cfs)

Summary for Pond 2A: POND 2A

Inflow Area = 49.710 ac, 36.56% Impervious, Inflow Depth > 4.73" for 100 Year Storm event
Inflow = 189.60 cfs @ 12.13 hrs, Volume= 19.597 af
Outflow = 11.72 cfs @ 15.12 hrs, Volume= 12.323 af, Atten= 94%, Lag= 179.7 min
Primary = 11.72 cfs @ 15.12 hrs, Volume= 12.323 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Starting Elev= 82.00' Surf.Area= 14,400 sf Storage= 24,200 cf
Peak Elev= 96.03' @ 15.12 hrs Surf.Area= 61,216 sf Storage= 503,532 cf (479,332 cf above start)
Flood Elev= 100.00' Surf.Area= 79,400 sf Storage= 777,400 cf (753,200 cf above start)

Plug-Flow detention time= 311.8 min calculated for 11.743 af (60% of inflow)
Center-of-Mass det. time= 161.8 min (958.6 - 796.8)

Volume	Invert	Avail.Storage	Storage Description
#1	80.00'	777,400 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.00	9,800	0	0
82.00	14,400	24,200	24,200
84.00	19,400	33,800	58,000
86.00	24,600	44,000	102,000
88.00	30,200	54,800	156,800
90.00	36,000	66,200	223,000
92.00	42,100	78,100	301,100
94.00	48,500	90,600	391,700
96.00	61,100	109,600	501,300
98.00	67,800	128,900	630,200
100.00	79,400	147,200	777,400

Device	Routing	Invert	Outlet Devices
#1	Primary	80.00'	**8.270 in/hr Exfiltration over Surface area**

Primary OutFlow Max=11.72 cfs @ 15.12 hrs HW=96.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 11.72 cfs)

TOTAL SUSPENDED SOLID REMOVAL CALCULATION WORKSHEET

TSS Removal
Calculation Worksheet

Total Suspended Solid Removal Calculation Worksheet

Location: *Town of Bourne ISWM - Bourne Landfill*
Bourne, MA

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Water Quality Swale	70%	1.00*	0.700	0.300
Forebay	25%	0.300	0.075	0.225
Infiltration Basin	80%	0.225	0.180	0.045

Total TSS Removal= 95.5%

Project: Phase 9 Landfill Expansion

Prepared By: ARQ

Date: 11/2/2022

* Equals remaining load from previous BMP (E) which enters the BMP

APPENDIX C-3

BOURNE LANDFILL, PHASE 9
GEOTECHNICAL EVALUATION REPORT

(GEOCOMP, Corp.)

Bourne Landfill, Phase 9
Geotechnical Evaluation Report

Geocomp Project Number: 221058

Geocomp

125 Nagog Park
Acton, MA 01720

September 3, 2020

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1. INTRODUCTION

1.1 Overview

SITEC Environmental has prepared a design for the Phase 9 Expansion. Geocomp Corporation was engaged by the Town of Bourne to perform a static and seismic stability assessment of the Phase 9 design. This report describes the work performed to complete that assessment and our recommendations resulting from that work.

Figure 1 shows the final proposed grades for the Phase 9 expansion. Pertinent details of the Phase 9 expansion with regards to stability are as follows:

- The Phase 9 expansion consists of up to 60 feet of new municipal solid waste (MSW) placed over low permeability liners constructed for Phases 2, 2A/3A, 3, 4 ,5 and 6.
- Portions of the Phase 2A/3A, 4 and 5 Landfill area liners are underlain by up to 60 feet of the original landfill waste. These liners consist of a double composite liner.
- The entire area of the Phase 9 expansion will be capped when completed. The steepest this slope will be is 1V:3H as shown in Figure 2.
- The outer perimeter of the Phase 9 expansion will be contained by a berm constructed from suitable compacted fill.

Figure 2 shows a cross section of the proposed expansion. The Figure shows the final conditions used in the analysis.

This report describes geotechnical engineering analyses performed in conjunction with the static and seismic stability aspects of the design. This report also evaluates the impacts of potential settlements from the Phase 9 fill in the performance of the Phase 5 Liner.

Geocomp Corporation performed the following previous stability studies on the site:

- Static and Seismic Stability Assessment for Bourne Sanitary Landfill, Phase 3/Stage 3 Bourne, MA prepared by GeoTesting Express (a division of Geocomp Corporation) for Town of Bourne, 12/26/2002.
- Static and Seismic Stability Assessment for Bourne Sanitary Landfill, Phase 2A/3A Stage 1 and 2, Bourne, MA prepared by GeoTesting Express (a division of Geocomp Corporation) for Town of Bourne, 02/18/2004.
- Bourne Landfill, Phase 4, Static and Seismic Stability Assessment by Geocomp prepared for Town of Bourne., 03/2011.
- Bourne Landfill, Phase 5, Static and Seismic Stability Assessment by Geocomp prepared for Town of Bourne, 12/2015.

This report draws on the following information from the previous reports. Specifically, we relied on the

2004 report for conclusions about the landfill Cap Stability and foundation liquefaction potential.

1.2 Purpose and Scope

The Commonwealth of Massachusetts has adopted the US EPA regulations related to the seismic safety of new MSW landfill (MSWLF) facilities. All new MSWLF facilities and lateral/vertical expansions of existing facilities must meet specific requirements in these regulations related to locations adjacent to a recent fault and stability for specified horizontal accelerations from earthquake shaking. Sitec Environmental has prepared a design for the Phase 9 Expansion of the Bourne Landfill. This facility must meet the seismic regulations.

The scope of our work included:

Global Static and Seismic Stability Analysis

- Assemble existing information and data related to static and seismic performance of the design from information provided by Sitec Environmental.
- Assess the static and seismic stability (if required) of the design based on the available information.
- Identify any deficiencies or uncertainties in the design related to static and seismic considerations.
- Develop what additional information and data (if any) are required in the analysis to complete or improve the seismic stability.

Settlement Analysis

- Collect and assemble existing information and data related to the design of the Phase 9 expansion area and piping from information provided by Site Environmental.
- Select representative locations at which 1D settlements are computed.
- Compute and tabulate the results.
- Present the estimated long-term settlement as a contour map overlaid on the original Phase 5 liner contours and drainage piping.
- Assess the magnitude and distribution of the long-term settlement of the existing Phase 5 liner based on the available information.

2. GEOTECHNICAL DESIGN PARAMETERS

2.1 Geometry and Strength Parameters

Figure 1 presents a plan of the existing conditions and final grades for the Phase 9 expansion. The figure shows the location of cross-section A-A', selected as potentially critical with respect to static stability and earthquake shaking. Figure 2 shows details of the section. Section A-A' was selected as most critical because it represents the highest fill areas with the steepest outer slopes. The section also includes a long section of sloping liner/cap with the potential to slide along the Phase 5 liner.

The subsurface conditions present beneath the landfill are summarized in previous reports for the Phase 2A/3A area (GTX, 2004). The natural foundation soils consist of up to 233 feet of medium dense to very dense, gravel and boulders with occasional bands of clay, underlain by bedrock.

Groundwater level is below the existing waste and proposed liner and therefore does not affect static or seismic performance for this facility.

The foundation granular materials are sufficiently dense that they will not experience significant loss of strength during earthquake shaking for the design earthquake.

2.2 Waste Strength

Strength parameters for the new and historic MSW materials were selected from data published by Howland and Landva (1992) and Kavazanjian et al (1995). They summarized all known strength data for MSW materials, including values back figured from landfill failures. The parameters presented in Table 1 for MSW are a conservative fit to the available data for MSW fills.

Since we understand that the proposed waste might consist of incinerated waste (fly ash), we have also evaluated strength characteristics of that waste material. Strength parameters for Fly Ash and Boiler Aggregate materials were obtained from consolidated undrained triaxial tests performed by GTX on samples obtained from the SEMASS Phase III Expansion. These data are dated 9/15/1994 and are included at the back of this report. Figure 3 presents the normal stress versus shear stress relationship for the three possible landfill materials.

For normal stresses greater than approximately 750 psf, the MSW is the weakest material. The CMW Phase III assessment (GTX 09/15/94) considered various combination of the unit weights and strengths to evaluate the effects of filling with flyash or boiler aggregate instead of MSW. The results of these analyses showed no significant difference in stability between filling with MSW and filling with flyash. Therefore, we have considered filling only with MSW as the critical scenario for the stability analysis.

Table 1 – Material Properties for Stability Analysis

Soil	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
MSW	70	500 σ_n 0-750 psf 0 σ_n >750 psf	0 σ_n 0-750 psf 33 σ_n >750 psf
Fly Ash	74	0	48
Boiler Aggregate	115	0	35
Final Cover System	130	0	27
Leachate Drainage layer	130	0	35
Low Permeability Liner Interfaces	---	see Table 2	See Table 2
Soil liner	130	see Table 2	See Table 2
Foundation	130	0	37

The data in Table 1 are for static loading of landfill materials. No data exist to show how rapid cyclic loading from earthquakes affects the strength of landfill materials. The available strength data show plastic behavior and no strain softening, when MSW materials are strained to failure. Such behavior, combined with the fact that the landfill materials are only partially saturated, suggests no to very little strength reduction from cyclic loading. For this assessment, we assumed no reduction in strength of the MSW landfill materials from cyclic loading. The Fly Ash and Boiler Aggregate strengths shown in Table 1 are reduced by 20% from the measured values to account for differences in compaction from the lab to the field and potential strength loss during earthquake shaking.

2.3 Phase 5 Liner Strength

The Phase 9 expansion does not include a new liner system because it is underlain by existing liners. systems. For Section A-A analyzed in this report the critical sliding surface involves the existing Phase 5 liner. Details of the Phase 5 double composite liner system are shown in Figure 4 and consist of the following components from bottom to top;

- 12-in. thick low-permeability clay layer over subgrade of compacted fill or the Phase 1A, B, C Drainage Layer Soils.
- Secondary Geosynthetic Clay Liner (GCL)
- Secondary 60 mil thick textured HDPE geomembrane liner
- Secondary Geocomposite drainage layer
- Primary Geosynthetic Clay Liner (GCL)
- Primary 60 mil thick textured HDPE geomembrane liner.
- Primary 18-in. thick Drainage Sand

Interface strength tests for the Phase 5 liner materials are included in the back of this report and are summarized in Table 2.

Table 2 – Phase 5 Liner Interface Shear Strengths

Material	Sample ID	Normal Stress (psf)	Peak Strength [psf]	Post-Peak Strength [psf]
Clay 1	L-21457	2880	1526.4	1224.0
		5760	3139.2	2505.6
		11520	5731.2	4953.6
Clay 2	50-60 Binney Street	1440	1584.0	---
		2880	2592.0	---
		5760	4464.0	---
Low Perm Soil vs. GCL	DS-1427	1440	1045.4	936.0
		2880	2102.4	1872.0
		5760	4213.4	3168.0
Clay 3	16-DS-1513	1440	460.8	432.0
		2880	849.6	835.2
		5760	1843.2	1742.4
Internal Shear of GCL	Roll # G16G009942	2880	2698.0	318.0
		5760	3216.0	633.0
		11520	4657.0	1163.0
GCL (non-woven side) vs. Geocomposite	GCL Roll # G16G009942 Geocomposite Roll # G16E013485	2880	2128.0	1234.0
		5760	3493.0	913.0
		11520	5511.0	1275.0
GCL (non-woven side) vs. 60 mil HDPE (bottom side)	GCL Roll # G16G009942 HDPE Roll # G16F003178	2880	1440.0	878.0
		5760	3196.0	816.0
		11520	5049.0	1281.0
Geocomposite vs. 60 mil HDPE (Top Side)	Geocomposite Roll # G16E013485 HDPE Roll # G16F003178	2880	1569.0	767.0
		5760	3228.0	1447.0
		11520	5444.0	2604.0
Sand vs. HDPE	DS-1556	1440	878.4	720.0
		2880	1857.6	1440.0
		5760	3816.0	3024.0
Bedding Sand	DS-38	1440	993.6	907.2
		2880	2016.0	1814.4
		5760	3787.2	3456.0

Figures 5 and 6 present plots of peak and post-peak strength versus normal stress. The design peak strength for the liner (shown as a dotted black line on Figure 5) is taken as the strength on the material or interface with the lowest peak strength. As shown in Figure 5 the Clay 3 test series has the lowest peak strength. For normal stresses lower than about 3000 psf the post peak design strength is taken as the corresponding post peak strength for the same clay layer. For normal stresses greater than about 6000 psf it is possible for the peak strengths involving the GCL to be less than the clay peak strength. For normal stresses greater than 6000 psf we have used the internal shear of the GCL for the design post -

peak strength ((shown as a dotted black line on Figure 6).

2.4 Seismicity

Peak Ground Accelerations (PGA) for the Bourne Landfill were obtained from the USGS website. Seismic acceleration and data for a 2% probability of exceedance in 50 years were used. PGA values were initially determined for bedrock (Soil Type B) and modified for the foundation soils. The USGS data is presented in Figure 7. Based on the subsurface information discussed in Section 2.3.1 of this report, the foundation soils are determined to be Soil Type D. A summary of the seismicity data from the USGS website is given in Table 3.

Table 3 - Site Seismicity Data

Soil Type B (Bedrock)		Soil Type D	
PGA (g)	S_{A1}[1] (g)	PGA (g)	S_{A1}[1] (g)
0.099	0.052	0.158	0.125

1. S_{A1} is the soil type adjusted spectral ordinate at a period of one second

2.5 Methodology

The PGA is adjusted for the slope-height effects when the maximum depth of the failure plane below the surface is greater than 20 feet. The procedure follows the recommendations given in the NCHRP 12-70 "Seismic Analysis and Design of Retaining Walls, Buried Structures, Slopes, and Embankments", November 2007.

Based on these recommendations, the seismic acceleration was adjusted using the following equation:

$$k_{max} = \alpha \times PGA$$

Where k_{max} is the height dependent average maximum acceleration.

For site category D, α is calculated from the following equation:

$$\alpha = 1 + \left[\frac{H}{100} (0.5\beta - 1) \right]$$

Where H is the slope height in feet and β is calculated from the equation:

$$\beta = S_{A1} / PGA$$

Where S_{a1} is the soil type adjusted spectral ordinate at a period of one second. The parameters used to determine k_{max} are shown in Table 4.

Table 4 - Height Adjusted Seismic Accelerations for Site Class D

Parameter	units	Value
PGA	g	0.158
S_{A1}	g	0.125
β		0.79
H	feet	57*
α		0.66
k_{max}	g	0.10**

* H is taken as a representative thickness of fill above the critical surface
** kmax ≥ 50% PGA (see text)

Determining the seismic coefficient to be used in the pseudo-static stability analyses is in accordance with the currently accepted methodology of using 50% of the peak ground acceleration at the base of the slope, reflecting the acceptance of 1 to 2 inches of permanent movement (Hynes-Griffin and Franklin 1984). A value of 0.10g was used for horizontal acceleration in the pseudo-static slope stability analysis.

If the factor of safety for the pseudo-static analysis using a horizontal acceleration of K_{max} is less than 1.0, then a deformation analysis is required to determine the maximum seismically induced deformations.

3. STATIC AND SEISMIC STABILITY EVALUATION

3.1 Introduction

An assessment for stability of the geotechnical aspects of a landfill expansion contains the following tasks with respect to static and seismic loading:

- Determine static stability.
- Determine amplification of earthquake motions within the soil and rock foundation and over the Landfill.
- If pseudo-static factor of safety is less than 1.0 then calculate permanent deformations that are likely to occur for the site accelerations.
- Analyze stability at the end of earthquake shaking.

We have completed these tasks for the proposed expansion. This section describes our results and conclusions.

3.2 Seismic Design Requirements

The regulations for stability of MSWLF units contain two requirements related to seismic issues. The first requirement relates to proximity of the proposed facility to a known active fault. The regulations prohibit MSWLF units within 200 feet of faults that have experienced displacement during the Holocene Epoch (about 10,000 year ago).

The second requirement requires owners or operators of MSWLF units located in a seismic impact zone to design the unit to resist the maximum horizontal acceleration in lithified material [hard rock] for the site. The design features to be examined include liners, cover systems, leachate collection systems, and surface water control systems. Seismic impact zones are defined as areas having a 10 percent or greater probability that the maximum expected horizontal acceleration in hard rock will exceed 0.10g in 250 years, based on the most recent maps of acceleration provided by the United States Geological Survey.

3.3 Proximity to Recent Fault Areas

There is no known evidence of recent faulting within 200 feet of the area of the proposed project. The USGS map MF-916 contained in the USGS Department of Interior report entitled "Preliminary Map of Young Faults in the United States as a Guide to Possible Fault Activity," dated 1991, shows no known recent faults near the project. Borings have been performed at this site. The subsurface explorations contained no evidence of recent faulting at the site.

The general view of seismologists is that evidence of surface faulting in the eastern United States is very limited. Actual seismic features associated with surface faulting in the eastern United States are difficult to identify and generally non-existent (Richardson and Kavazanjian, 1994).

Based on the above information, we believe that the likelihood of a recent surface fault existing in the general area of this site is low. We conclude that the location requirement with respect to recent faulting is met by the proposed design.

3.4 Seismic Impact Zones

The USGS recently updated the seismic hazard maps for the United States. These maps indicate maximum horizontal accelerations on firm ground for different return periods. The regulations require the peak acceleration with a 10% likelihood of being exceeded in 250 years to be used for design. The most recent seismic hazard maps produced by the USGS present a peak horizontal acceleration in bedrock of 0.099g for the project site (USGS, 2016). Since this value is less than the 0.10g threshold value established in the regulations, the site is not located within a seismic impact zone. However, previous seismic studies on this site have been based on older versions of the acceleration maps which show a peak horizontal bedrock acceleration of 0.14g. Therefore, to be compatible with the previous expansions at this site, we have performed a seismic assessment of the Phase 9 Expansion. The USGS ASCE7-16 seismic hazard maps were used for the analysis.

3.5 Static Global Landfill Stability

Stability analyses are used to determine the factor of safety against sliding of a large waste mass within the landfill. Static and pseudo-static stability analyses were performed with the computer program, SLIDE Version 6.0, from Rocscience. This program is widely used and allows for the accurate determination of the critical sliding surface. The analysis is performed using limiting equilibrium of forces and moments. The effect of an earthquake is included as a destabilizing force equal to the horizontal average peak acceleration times the total weight of the sliding mass. Circular and Non-circular shaped failure surfaces are analyzed using Spencer's method of slices. For a given geometry and set of soil data, hundreds of trial surfaces are analyzed to identify the surface that gives the lowest factor of safety. This surface is the critical surface for that set of conditions.

Figures 8 and 9 present the results of the static stability analyses for circular and non-circular failure surfaces for Section A-A'. As indicated in the figure, the lowest computed factor of safety (FS) against stability failure, for no earthquake loading and with the peak strength parameters, is 2.11 for non-circular failure surfaces. The critical failure surface for both failure modes passes thru the new landfill material and along the existing Phase 5 liner. Standard engineering practice requires a minimum factor of safety of 1.5 for long-term static loading conditions. Thus, the design has an adequate factor of safety against a static failure through the cover system, waste mass, liner, and underlying foundation.

3.6 Seismic Global Stability

A pseudo-static stability analysis was performed to determine the likely impact of the design earthquake on the landfill mass and environmental systems. The critical cross-sections for static stability were examined for seismic stability using post-peak liner strengths. A horizontal acceleration equal to the average peak acceleration over the full height of the landfill, K_{max}=0.10g (see table 4) was applied to the landfill mass, and the factor of safety computed using SLIDE Version 6.0 as described above for the static stability analyses.

The lowest computed factor of safety against seismic failure, with post-peak strength parameters using K_{max}=0.10g for Section A-A' is 1.35, (See Figure 10). Standard engineering practice requires a minimum factor of safety of 1.0 for seismic loading conditions. Thus, the design has an adequate factor of safety against a static failure through the cover system, waste mass, liner, and underlying foundation.

3.7 Cap Stability

The static and seismic stability of the cap system was analyzed in 2004 by GTX for a 3H: 1V slope. The 2004 report concluded that the cap would be stable with the minimum cap material strength parameters given in Table 2, and the corresponding predicted permanent displacements would be up to 3 inches.

The cover slopes for the Phase 9 Expansion have the same slope geometry as those considered in 2004, and the reduction in the design acceleration since that time would result in a greater factor of safety than that calculated in 2004. Thus, the results of the 2004 analysis are still valid.

3.8 Unstable Areas

Earthquake shaking can cause saturated granular soil to lose its load carrying capacity, a process called liquefaction. Liquefaction is most likely to occur in loose, non-plastic granular soils. Over the past 30 years, the geotechnical profession has developed a semi-empirical technique that uses Standard Penetration Test (SPT) "N values" and earthquake acceleration to determine a factor of safety against liquefaction. Loose, saturated granular deposits with low N values (typically less than 10), have a correspondingly low factor of safety against liquefaction. The materials underlying the Expansion area are outwash sand and rock. The SPT N values for the outwash sand, which are generally greater than 10 blows per foot at this site, indicate the foundation soils are not susceptible to liquefaction for the design earthquake conditions at this site. Previous studies on the site performed for the Bourne landfill (GTX 2004) concluded that the landfill subgrade is not susceptible to liquefaction.

Unrelated to seismic issues, but included in the regulations, is a requirement that owners and operators demonstrate that MSWLF facilities located in "unstable areas" have adequate structural stability. The regulations define "unstable areas" as locations that are susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill structural components responsible for preventing releases from the landfill. According to the regulations, unstable areas are characterized by localized or regional ground subsidence, settling of overburden, or by slope failure. Unstable areas generally include poor foundation conditions, areas susceptible to mass movement, areas susceptible to sinkhole development, etc.

The Phase 9 Expansion has no features that might cause it to be classified as an unstable area. The sand and bedrock comprising the foundation can provide adequate bearing capacity. Any regrading of the site and/or addition of materials for preparing the subgrade will utilize materials and construction methods that produce adequate bearing capacity.

4. SETTLEMENT EVALUATION

Settlement of the Phase 5 liner system, placed on top of Phase 1A, B, and C will result in ongoing consolidation of the existing waste under its own weight, as well as consolidation of the existing waste from the additional weight of the Phase 5 fill and the proposed Phase 9 expansion. The magnitude of settlement at any location depends on the thickness of the existing fill, the thickness of the added fill; and the compression characteristics of the existing fill. Figure 11 shows the thickness of the existing waste beneath the Phase 5 liner. The maximum thickness of waste beneath the liner is about 70 feet and occurs in the portion of the liner located nearest the center of the landfill. Figure 12 shows the thickness of the existing and proposed waste above the liner. The maximum thickness is about 66 feet and occurs near the center of the landfill.

Settlement of each the Phase 1A,B,C Fill beneath the Phase 5 liner was computed from the following equation:

$$Settlement = H * CR * log\frac{\sigma'_{vo}+\Delta\sigma_v}{\sigma'_{vo}} + H * C_\alpha * log\frac{t_f}{t_o}$$

Where:

H	thickness of the layer
CR	compression ratio of the layer
C_α	coefficient of secondary compression of the layer
$\sigma_{\Delta\sigma v}$	change in vertical stress from added weight
σ'_{vo}	initial vertical effective stress
t_o	starting time for secondary compression
t_f	time at end of secondary compression

The parameters used to estimate settlements are listed in table 5.

Table 5 - Consolidation Parameters used for Settlement Calculations

Parameter	units	Value
CR	---	0.15
Cα	---	0.048
Unit Weight	pcf	70
t_o	year	30
t_f	year	60

CR and C_α for the existing waste were back figured from measurements collected from the settlement platforms on the SEMASS Landfill North located in Carver, MA. These values also agree with compression parameters reported for other landfills in eastern Massachusetts (Bjärngard, 1989) and also with data back figured from test fills constructed on existing waste at the East Bridgewater and Peabody landfills. $\sigma=_{vo}$ was computed from the thickness and unit weight of each layer. $\Delta\sigma_v$ was computed from the planned thickness of waste over each point times a unit weight of waste of 70 pcf. t_o was taken as 30 years corresponding to estimated approximate end of filling date for the Phase 1A, B, C Landfill. t_f was taken as 60 years.

Using the data from Figures 11 and 12, we estimated the total magnitude of settlements that can be expected due to the existing and proposed expansion. Maximum settlements after approximately 30 years are estimated to vary from about 2 feet at the edge of the expansion area, to approximately 6.5 feet under the crest of the slope.

Figure 13 presents a contour plot of the calculated total settlements due to the existing and proposed expansion overlain on the Phase 5 leachate collection system. To check the potential for a reverse slope on a portion of the collection pipes we check the slopes using two points on the 6" HDPE Leachate collection pipe shown on Figure 13. The two points are about 128 feet apart with an as built slope of about 3.9%. The calculations predict a long-term differential settlement between these points of about 2.2 feet. The settlement will reduce the slope on the leachate collection pipe by about 2.2 ft/128 ft = 1.7%. The predicted slope after settlement will still be about 3.9%-1.7%=2.2%. This slope exceeds the MDEP recommended minimum slope of 1% for trunk lines. Therefore, the Phase 5 liner and leachate collection pipe grades are enough to exceed the regulatory minimums after the estimated settlements occur.

The settlement will also induce tensile strains in the liner system due to lateral spreading. Using the settlement calculation, the induced strain is calculated to be about 0.1%. This value is much less than the industry acceptable maximum strain of about 5% for the HDPE pipe and Liner material. Therefor the design is acceptable.

5. SUMMARY AND CONCLUSIONS

We have completed an assessment of the static and seismic stability of the proposed Phase 9 expansion for the Bourne Landfill, in Bourne, Massachusetts. Our assessment has indicated the following:

1. Enough information exists to complete a static seismic evaluation of the geotechnical aspects of the proposed Phase 9 Expansion.
2. The section of the regulations related to Fault Areas does not impact the project, since no known recent faults exist within 200 feet of the project.
3. The section of the regulations related to Seismic Impact Zones does not apply to the project because updated USGS mapping indicates a maximum horizontal acceleration at rock of 0.099g (less than the 0.1g threshold limit). However, to be consistent with previous expansion designs, we have performed a seismic assessment using the most recent USGS 2016 seismic hazard maps.
4. Our analyses indicate that the current design is adequate to withstand the maximum horizontal acceleration at rock of 0.099g.
5. Conclusion 4 above is predicated on the cover materials and the interfaces between these materials having at least the minimum strengths given in Tables 1 and 2. Design documents should include requirements for the contractor to demonstrate that the materials and methods will meet or exceed these minimum requirements.
6. Settlement of the Phase 5 liner system, placed on top of Phase 1A, B, C will result from ongoing consolidation of the existing waste under its own weight, as well as consolidation of the existing waste from the additional weight of the proposed Phase 9 expansion. Our analysis shows that the grades on the Phase 5 liner will be reduced but will still exceed the minimum MDPE guidelines for slopes on leachate collections systems and liners.

Our assessment of the impact of the Massachusetts regulations for Static and Seismic Stability for the Bourne Landfill, Phase 9 expansion indicates that the current design meets these requirements, subject to the following provisions:

1. The expansion does not include any new liners separating it from the existing waste fills.
2. The as-placed cap (including soil, geosynthetics and the interface between soil and geosynthetics) must have strengths that equal or exceed the specified minimum requirements in Table 2 of this report. Provisions should be made in the contract documents to have the Contractor demonstrate with test data that this requirement is met for the actual materials that will be used.
3. All waste material placed in the landfill is assumed to be any combination of MSW, Fly Ash or Boiler Aggregate, and that it is compacted to average densities not exceeding the values shown in Table 1. Significantly, higher densities may lower the stability and increase the predicted displacements caused by earthquake shaking.

6. LIMITATIONS OF OUR WORK

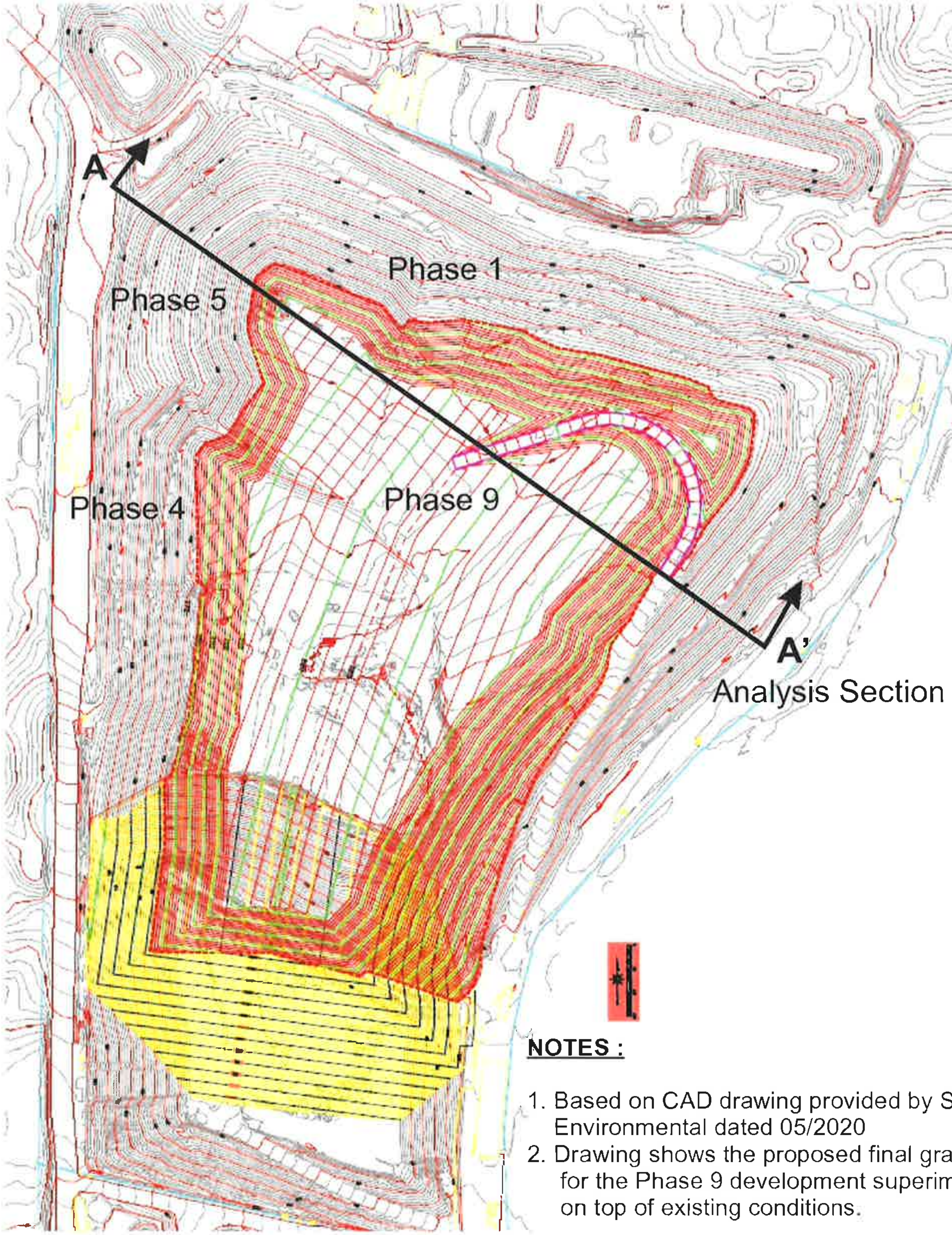
Our services described in this report consist of professional opinions and recommendations made in accordance with generally accepted geotechnical engineering principles and practices. Our work is based on the information provided to us and the assumption that this information accurately reflects actual conditions. Site conditions can be different from what we have used or change with time. Should different conditions be encountered, our conclusions and recommendations might not be valid, and we should be contacted for advice on how to proceed. Any changes by us are not valid unless provided by us in writing. No warranty expressed or implied of merchantability or fitness is made or intended in connection with this work.

We appreciate the opportunity to provide you with this assessment. Please don't hesitate to contact us, if you have any questions or require additional information.

Martin Hawkes, P.E.
Senior Project Engineer

Anant Panwalkar, P.E.
Senior Project Manager

Attachments: APPENDIX "A" - Phase 5 liner strength tests
APPENDIX "B" - Fly Ash and Boiler Aggregate Strength Tests



NOTES :

1. Based on CAD drawing provided by Sitec Environmental dated 05/2020
2. Drawing shows the proposed final grading for the Phase 9 development superimposed on top of existing conditions.

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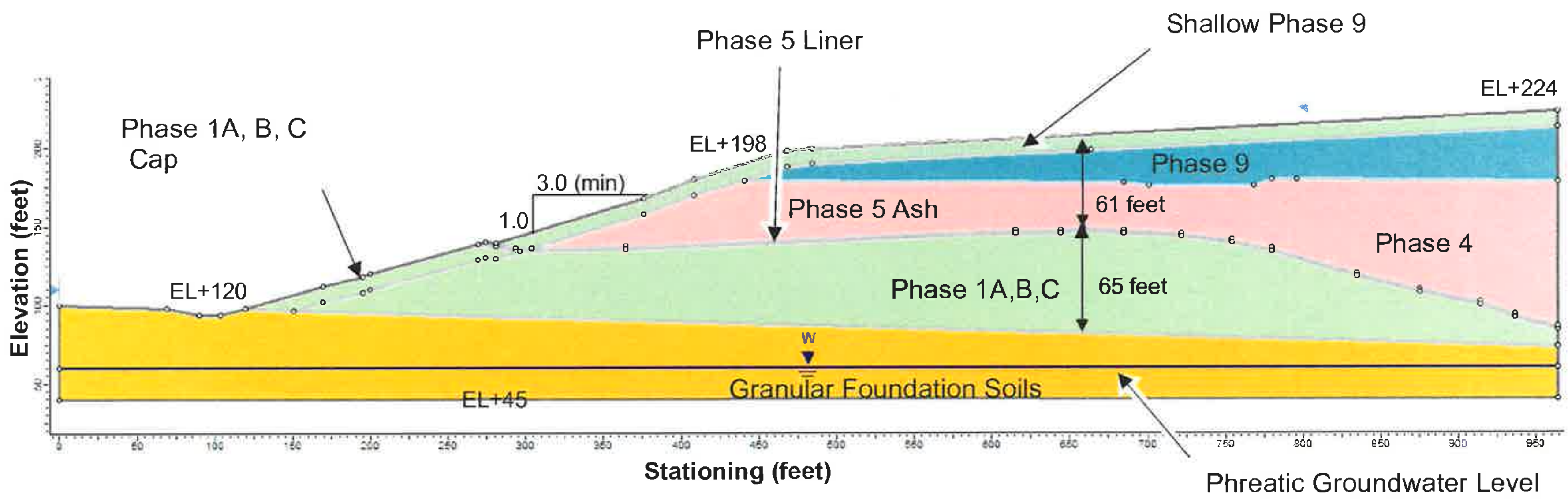
221058 Bourne Landfill Phase 9

Plan Showing Location of Phase 9 Critical Section

July 2020

20298.110515.BourneLF Phase 5.Portrait Figures.cdr

Figure 1



NOTES :

1. Section geometry based on Profile B-B' on drawing provided by Sitec Environmental dated 01/31/2020.
2. Drawing produced from SLIDE2 Modeler showing material boundaries

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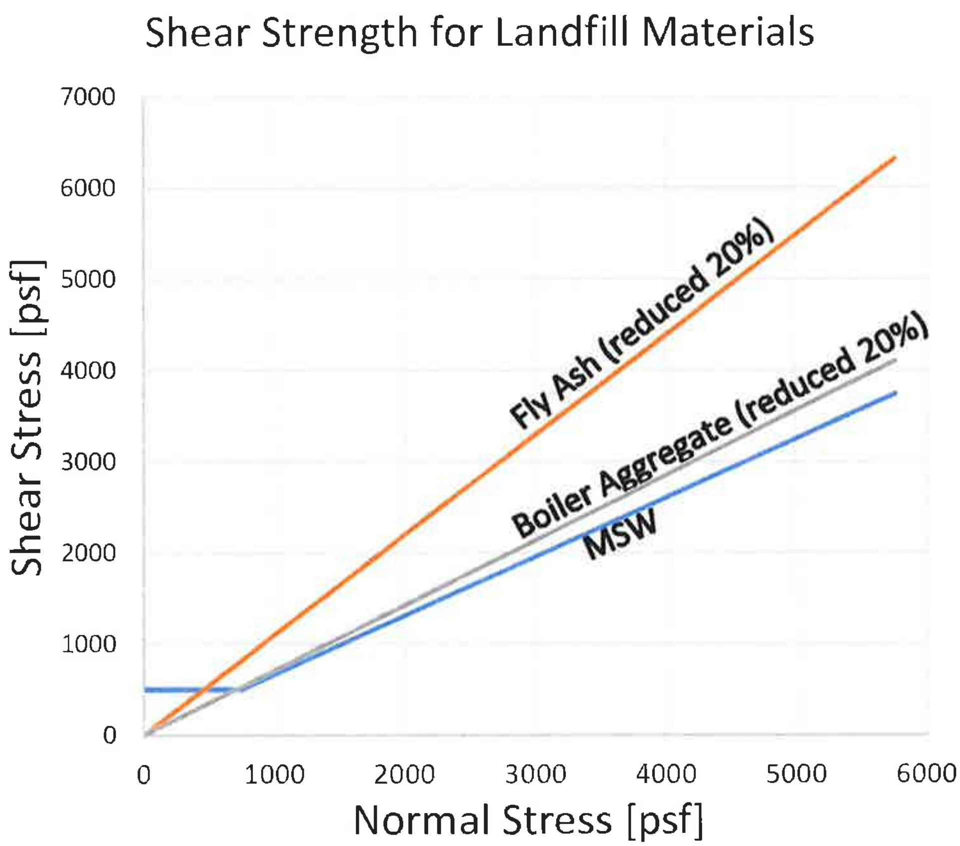
221058 Bourne Landfill Phase 9

Phase 9 Section A-A' Details

August 2020

Figure 2

221058 Bourne Land Fill Phase 9.Landscape.cdr

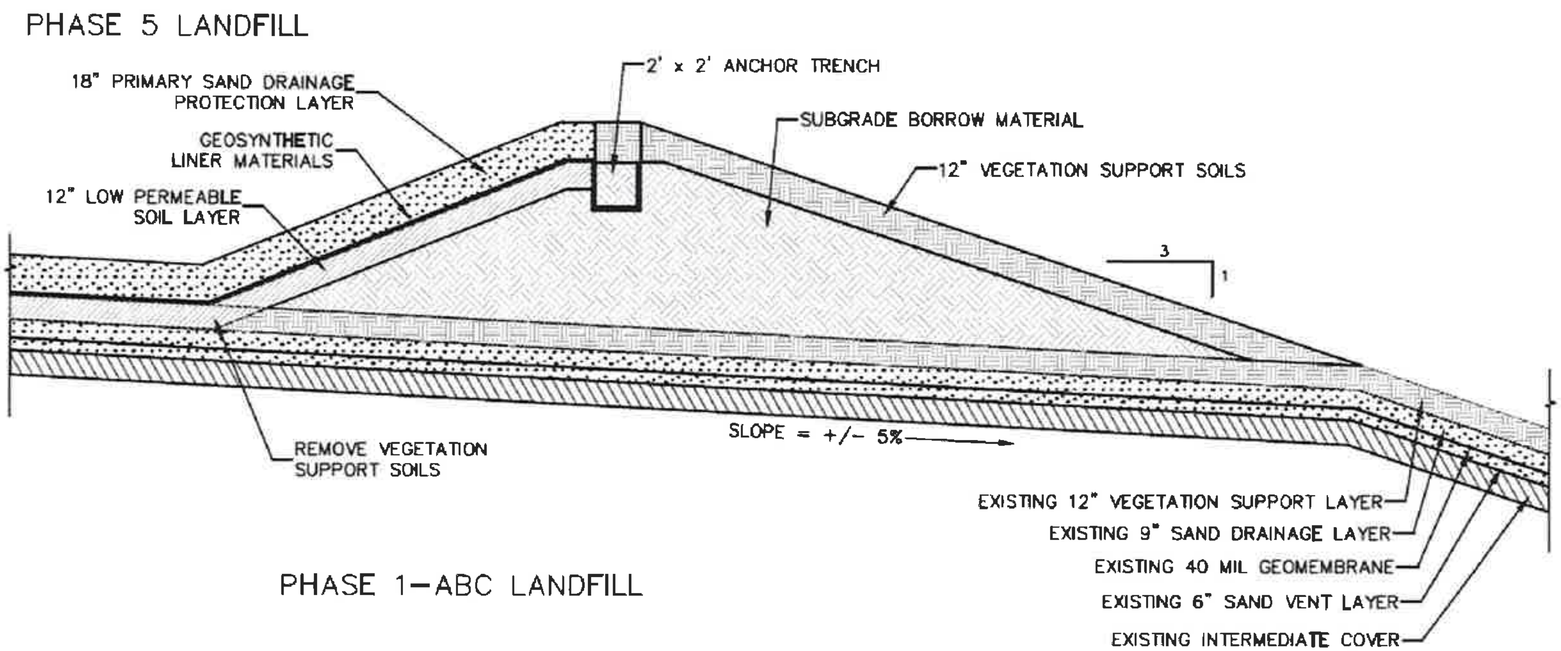


NOTES :

1. MSW Strength from Kavazanjian (1995).
2. Fly Ash and Boiler Aggregate Strength from Consolidated Undrained triaxial tests on samples provided by SEMAS to GTX (1994).
3. Fly Ash and Boiler Aggregate samples were compacted at optimum moisture to 95% modified Proctor, and saturated by backpressuring.
4. Strength is reduced by 20% to account for for potential strength reduction from earthquake shaking.

Geocomp CORPORATION	220633 Bourne Landfill Phase 5 **Shear Strength of Landfill Materials**

Figure 3



PHASE 5 OVER PHASE 1ABC
PERIMETER BERM WITH ANCHOR TRENCH

NOT TO SCALE

NOTES :

1. Based on drawing provided by Sitec Environmental via email dated 11/24/16

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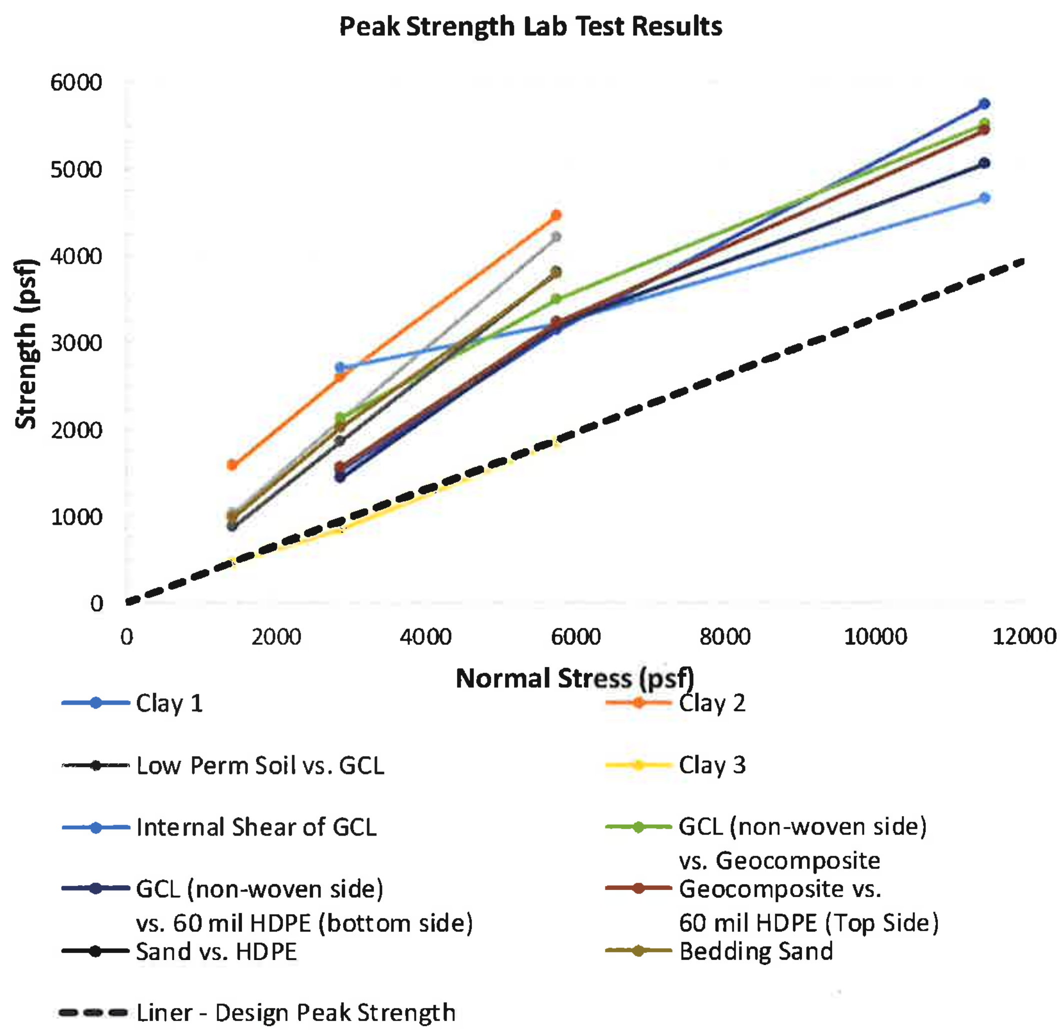
221058 Bourne Landfill Phase 9

Phase 5 Liner Details

July 2020

221058 Bourne Land Fill Phase 9.Landscape.cdr

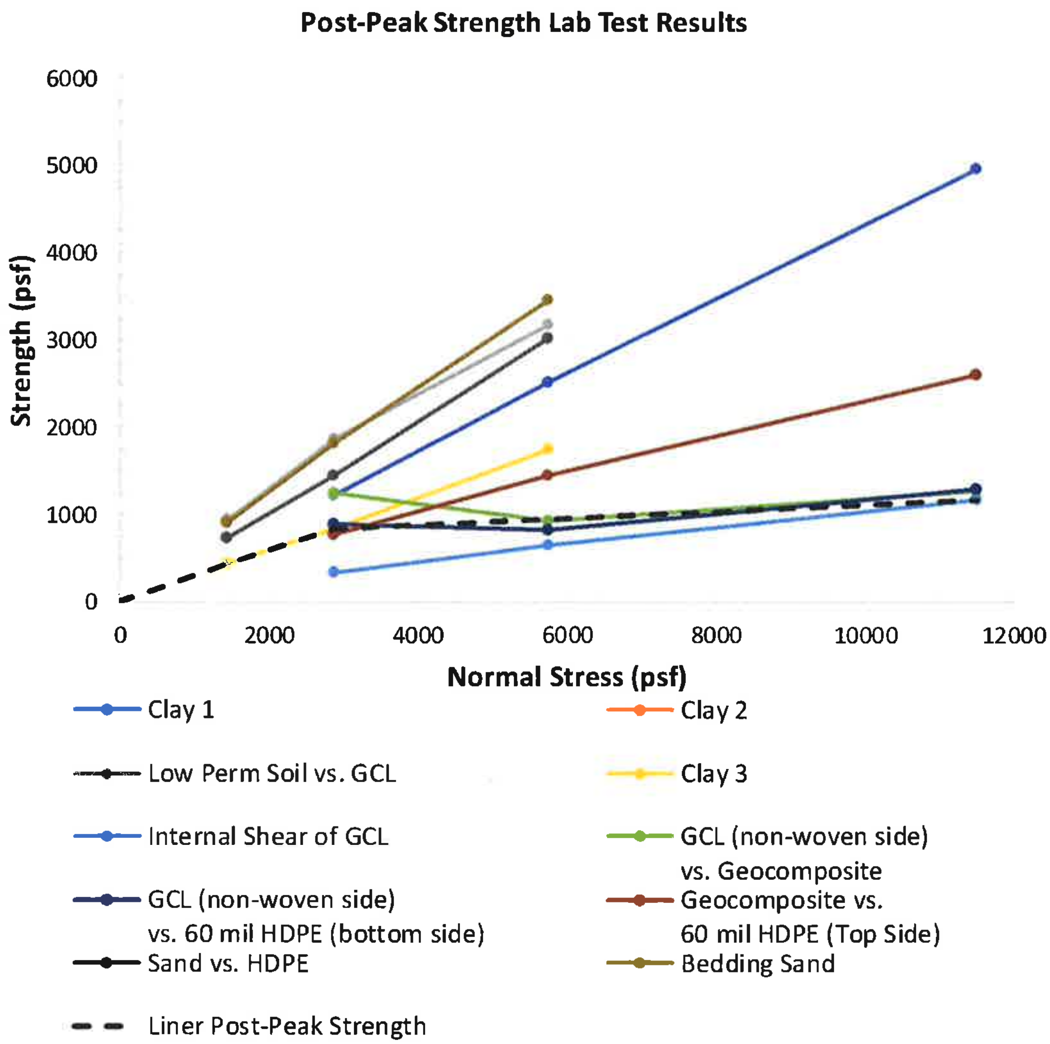
Figure 4



NOTES :

1. Tests performed by Geotechnics, GeoTesting Express or Yankee Engineering & Testing from 10/2013 through 08/2016.
2. Tests performed according to ASTM D3080, D6243 or D5321
3. See attachments to this report for test data sheets
4. Peak Design Strength taken as minimum strength envelope from all tests.

Geocomp CORPORATION	221058 Bourne Landfill Phase 9 **Peak Shear Strength of Phase 5 Liner** **August 2020**



NOTES :

1. Tests performed by Geotechnics, GeoTesting Express or Yankee Engineering & Testing from 10/2013 through 08/2016.
2. Tests performed according to ASTM D3080, D6243 or D5321
3. See attachments to this report for test data sheets
4. Post Peak Design Strength taken as minimum post peak strength envelope associated with material which have a minimum peak strength.
5. The post peak design strength is greater than the Internal Shear of the GCL because the peak Internal shear of the GCL is greater than the design Peak Strength,

Geocomp CORPORATION

221058 Bourne Landfill Phase 9

Post Peak Shear Strength of Phase 5 Liner

August 2020

▼ request:
date: "2020-08-07T21:06:08.158Z"
referenceDocument: "ASCE7-16"
status: "success"
▼ url: "https://earthquake.usgs.gov/ws/designmaps/asce7-16.json?latitude=41.782&longitude=-70.58&riskCategory=III&siteClass=D&title=BourneLandfillPhase9"
▼ parameters:
latitude: 41.782
longitude: -70.58
riskCategory: "III"
siteClass: "D"
title: "BourneLandfillPhase9"
▼ response:
▼ data:
pgauh: 0.099
pgad: 0.5
pga: 0.099
fpga: 1.6
pgam: 0.158
ssrt: 0.182
crs: 0.944
ssuh: 0.193
ssd: 1.5
ss: 0.182
fa: 1.6
sms: 0.291
sds: 0.194
sdcs: "B"
s1rt: 0.052
cr1: 0.922
s1uh: 0.056
s1d: 0.6
s1: 0.052
fv: 2.4
sm1: 0.125
sd1: 0.083
sdc1: "B"
sdc: "B"
tl: 6
t-sub-l: 6
cv: 0.7

NOTES :

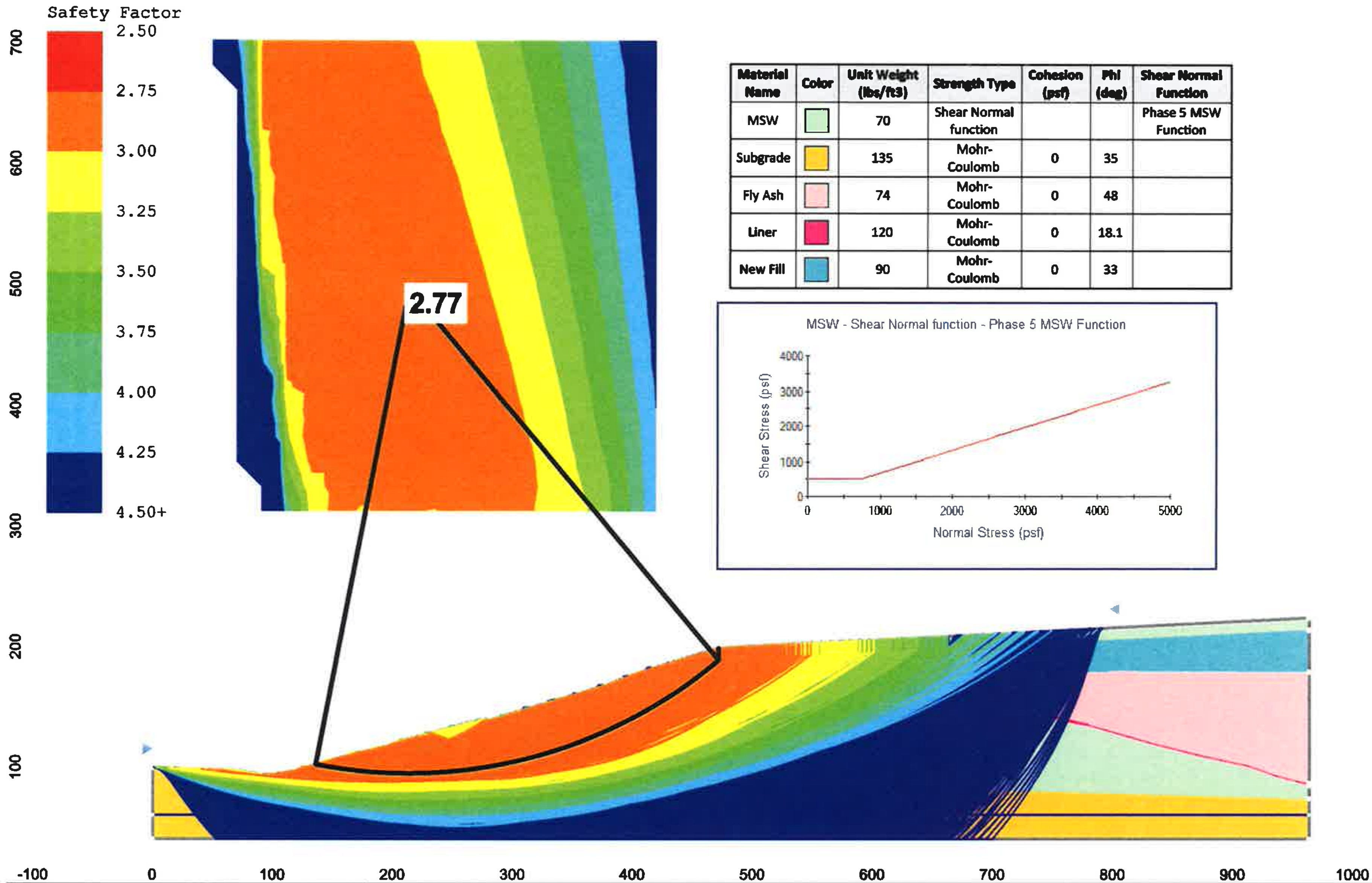
1. Information from USGS website at https://earthquake.usgs.gov/ws/designmaps/asce7-16.json?latitude=41.782 &longitude=-70.578&riskCategory=III&siteClass=D&title=BourneLandfillPhase9
2. Coordinates of the site are 41.782N, 70.578W

Geocomp CORPORATION

221058 Bourne Landfill Phase 9

USGS Design Seismic Criteria

August 2020



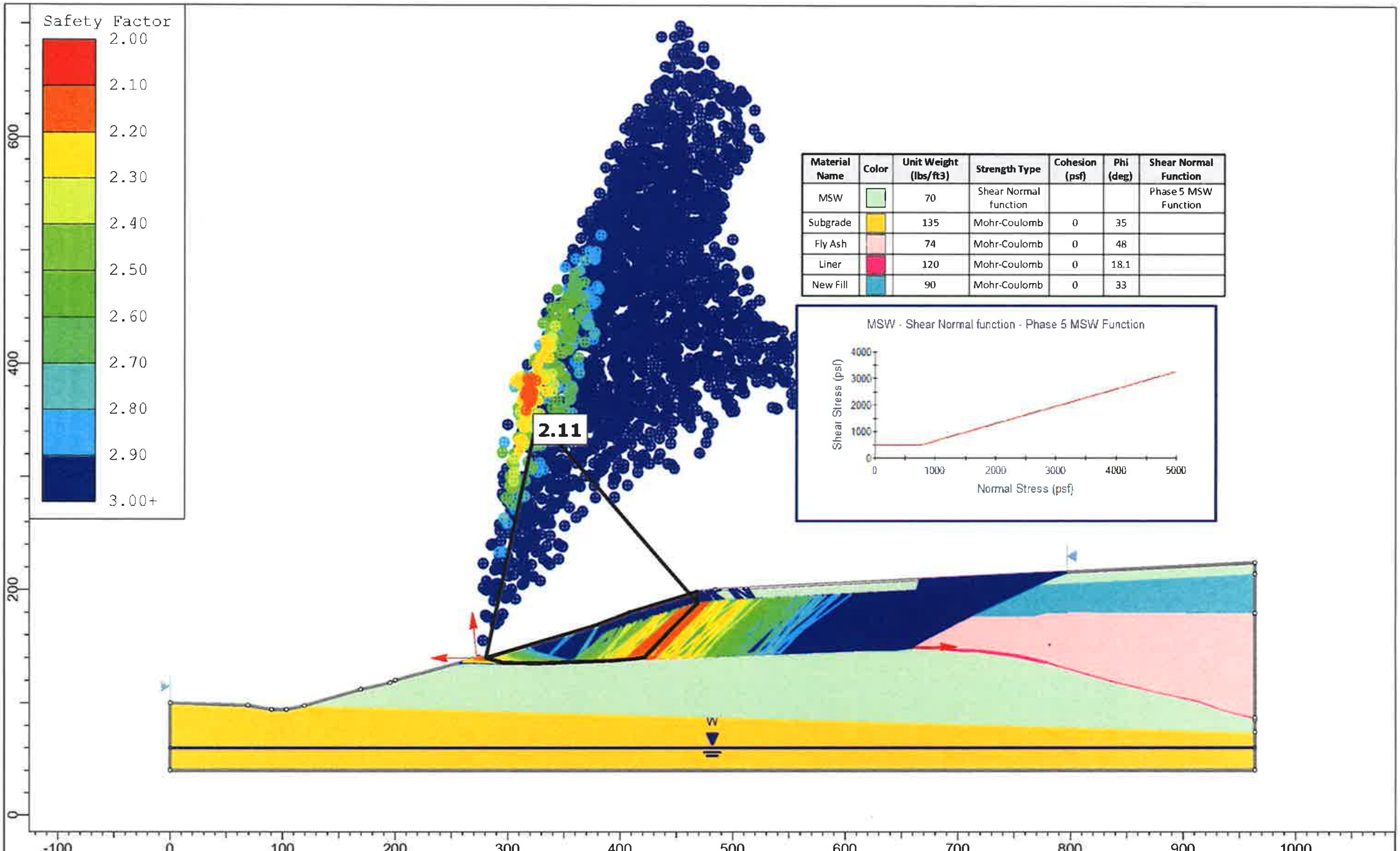
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function
MSW		70	Shear Normal function			Phase 5 MSW Function
Subgrade		135	Mohr-Coulomb	0	35	
Fly Ash		74	Mohr-Coulomb	0	48	
Liner		120	Mohr-Coulomb	0	18.1	
New Fill		90	Mohr-Coulomb	0	33	

Geocomp
Technologies to manage risk for infrastructure

SLIDEINTERPRET 9.008

Project	Bourne Landfill Phase 9 Expansion
Analysis Description	Section A-A' Static Global Stability Results for Circular Failure Surfaces
Drawn By	R. van der Heijden
File Name:	Section_B_Global_Stability.slim
Date	8/31/2020
Analysis Method:	Spencer

Figure 8

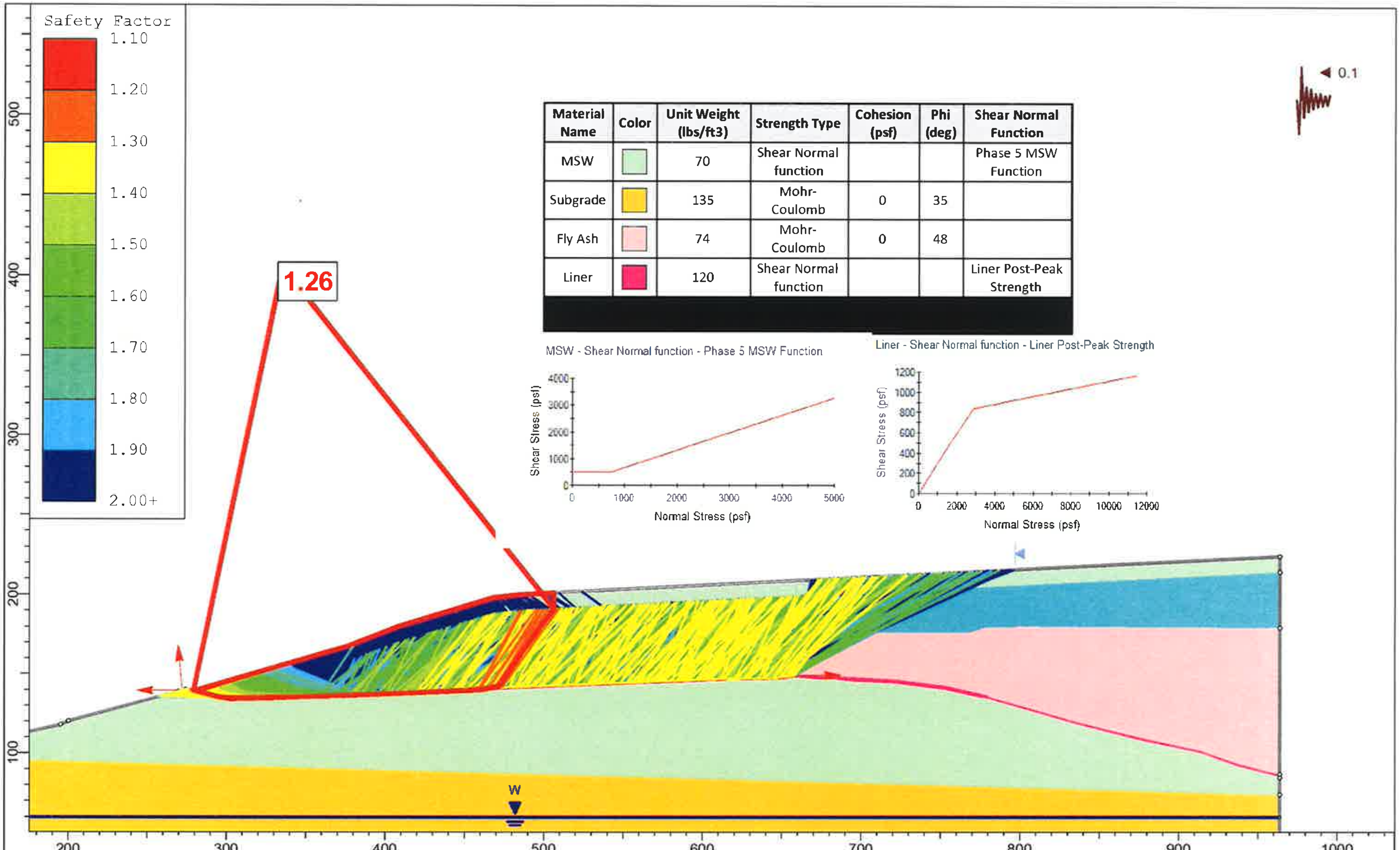


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function
MSW		70	Shear Normal function			Phase 5 MSW Function
Subgrade		135	Mohr-Coulomb	0	35	
Fly Ash		74	Mohr-Coulomb	0	48	
Liner		120	Mohr-Coulomb	0	18.1	
New Fill		90	Mohr-Coulomb	0	33	

Geocomp
Technologies to manage risk for infrastructure

SLIDEINTERPRET 9.008

Project	Bourne Landfill Phase 9 Expansion
Analysis Description	Section A-A' Static Global Stability Results for Non-Circular Failure Surfaces
Drawn By	R. van der Heijden
File Name:	Section_B_Block_Search.slim
Date	8/31/2020
Analysis Method:	Spencer
	Figure 9



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function
MSW		70	Shear Normal function			Phase 5 MSW Function
Subgrade		135	Mohr-Coulomb	0	35	
Fly Ash		74	Mohr-Coulomb	0	48	
Liner		120	Shear Normal function			Liner Post-Peak Strength

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Technologies to manage risk for infrastructure

SLIDEINTERPRET 9.008

Project: Bourne Landfill Phase 9 Expansion

Analysis Decription: Section A-A' Pseudo-Static Seismic Results for Non-Circular Failure Surfaces

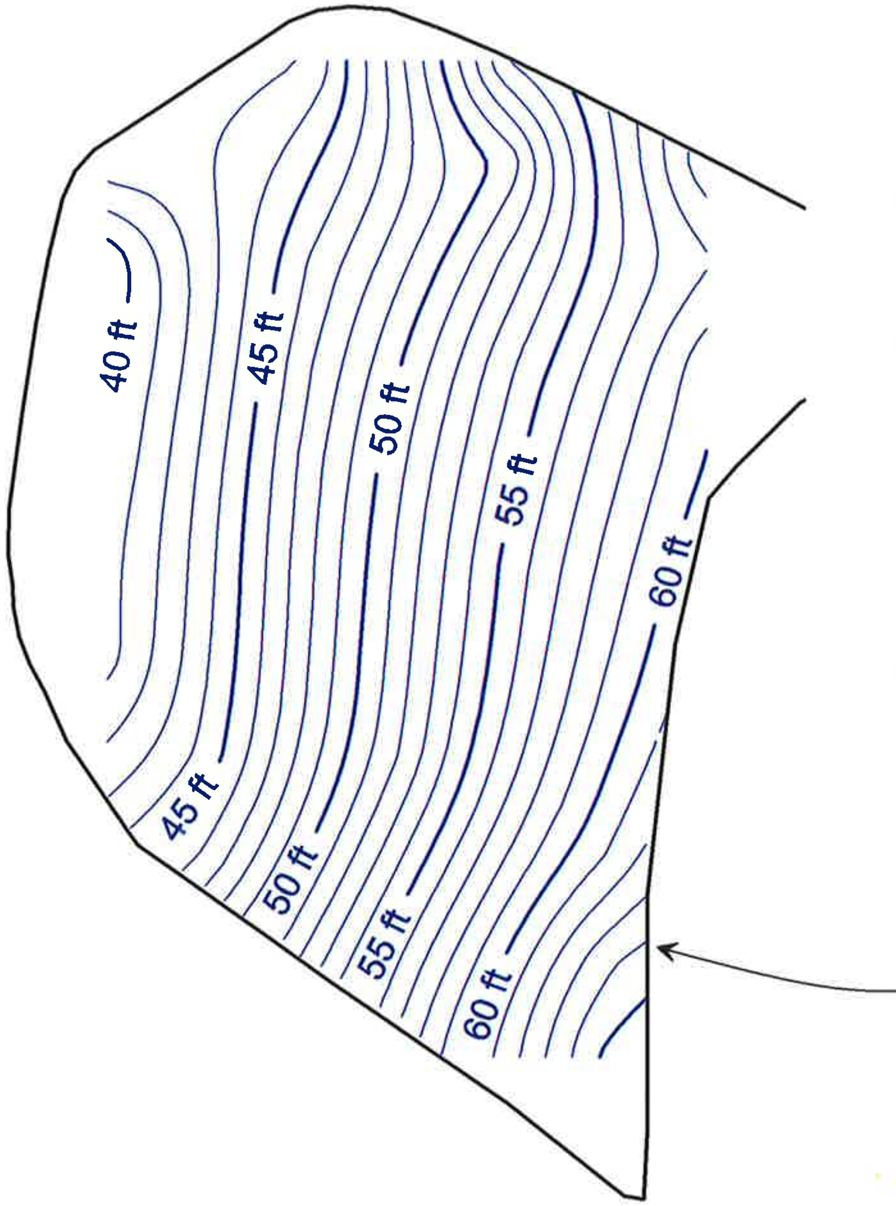
Drawn By: R. van der Heijden

File Name: Section_B_Block_Search_Seismic.slim

Date: 8/31/2020

Analysis Method: Spencer

Figure 10



NOTES:

1. Phase 5 Liner Elevation taken from "Record Drawing of the Phase 5 Expansion Low Permeability Soil Layer at Bourne Landfill", DWG. No R5-2 prepared by ETL dated 12/29/16.
2. Bottom of waste taken from "Site Buidout Profiles", Pepared by SITEC Environmental dated 01/31/20.

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221058 Bourne Landill Phase 9

Thickness of existing Waste used to Predict Settlement of Phase 5 Liner

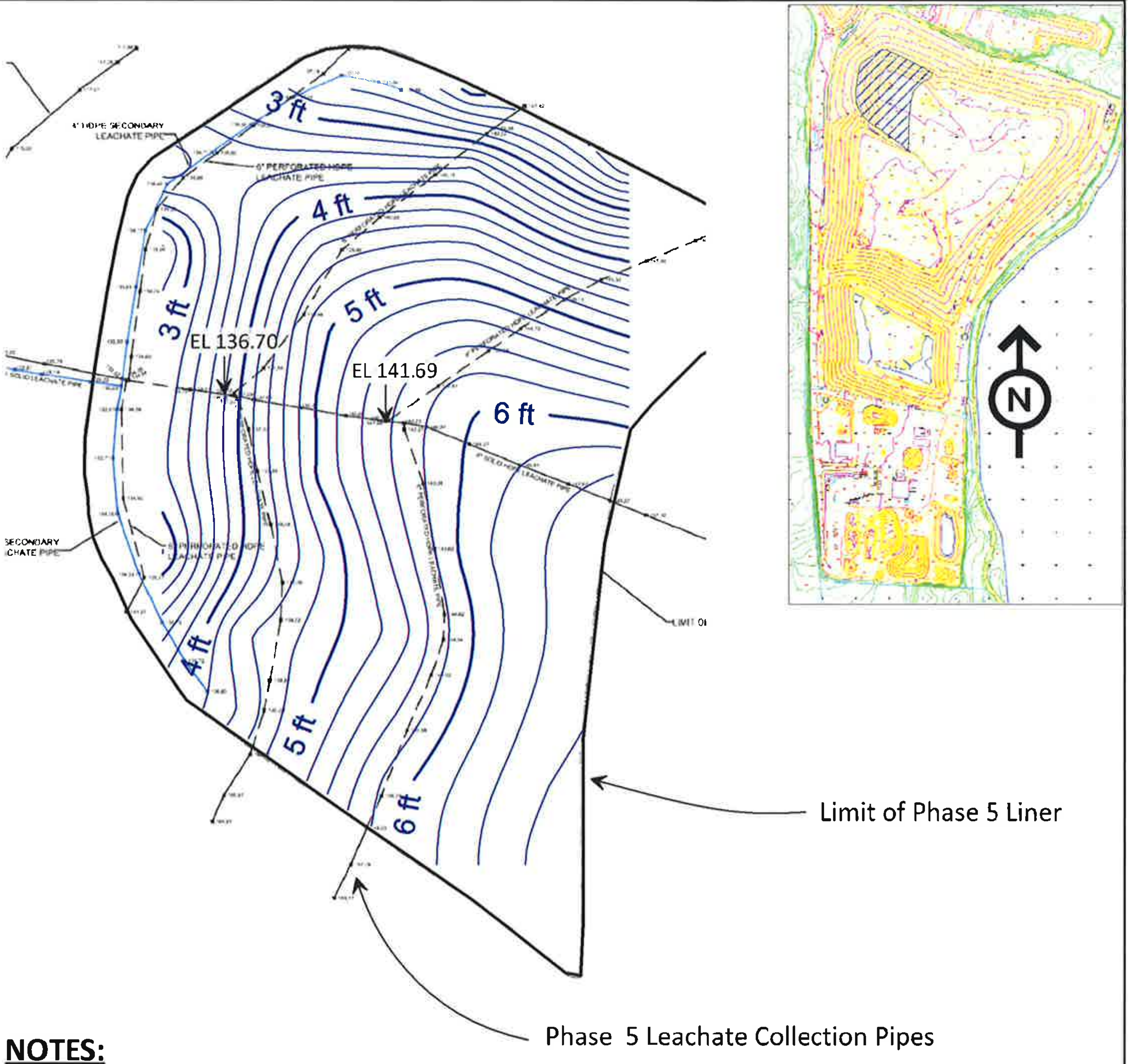
Figure 11

NOTES:

1. Phase 5 Liner Elevation taken from "Record Drawing of the Phase 5 Expansion Low Permeability Soil Layer at Bourne Landfill", DWG. No R5-2 prepared by ETL dated 12/29/16.
2. Top of waste taken from AutoCAD file "BOURNE CONC PH9 OVERFILL", recieved from SITEC Environmental dated 03/18/20.

Geocomp Technologies to manage risk for infrastructure	221058 Bourne Landill Phase 9 Thickness of Waste above liner used to Predict Settlement of Phase 5 Liner

Figure 12



NOTES:

1. Phase 5 Leachate Collection Pipes from "Record Drawing of the Phase 5 Expansion Leachate Pipe System at Bourne Landfill", DEWG. No R5-5 prepared by ETL dated 12/30/16.
2. Long Term Settlements calculated using thickness of existing waste and thickness of new waste shown on Figures XX and XX.

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221058 Bourne Landill Phase 9

Predicted Total Long Term Settlement of Phase 5 Liner

Figure 13

APPENDIX "A"

Phase 5 Liner Strength Tests

YANKEE ENGINEERING & TESTING, INC.

October 30, 2013

Mr. John Bates
J. Bates & Son LLC
57 Lawrence Street
Clinton, MA 01510

RE: Low Perm Soil Direct Shear Test Results
Bourne S.L.F Site
Bourne, Massachusetts

Project # 13044

Dear Mr. Bates:

We submit herewith the laboratory test results from a saturated direct shear test (ASTM D-3080) completed on the submitted sample (L-21457) being used as low permeability soil at the above project. It should be noted that the laboratory gradation, hydrometer, Atterberg limits, and modified proctor (ASTM D-1777) results have been previously forwarded.

The soil's internal maximum friction ("shear") angle was calculated based on the applied normal stress values versus the measured maximum shear stress values. The following Table presents the specific material and shear test information.

Soil Sample #L–21457 **Source: Bourne Clay** **Soil Description: CL: Gray clay trace sand**
D-1557 Soil Proctor Data: Maximum Dry Density = 110.6 pcf Optimum Moisture = 13.3%

Test Condition: Dry Density = 99.5± pcf Moisture = 16±% Compaction = 90±%

Applied Normal Stress, psi	20	40	80
Maximum Shear Stress, psi	10.6	21.8	39.8
Cohesion (C) Value, psi	1.6	1.6	1.6
Individual Friction Angle	**24.2°**	**26.8°**	**25.5°**

Soil Internal Friction Angle, slope from the attached graph = 26°

As shown above, and on the attached direct shear data sheet, the soil internal friction angle was 26°, which met the project specified 19° minimum.

Should you have any questions, or if we can be of additional testing assistance, please do not hesitate to contact me at our Worcester office.

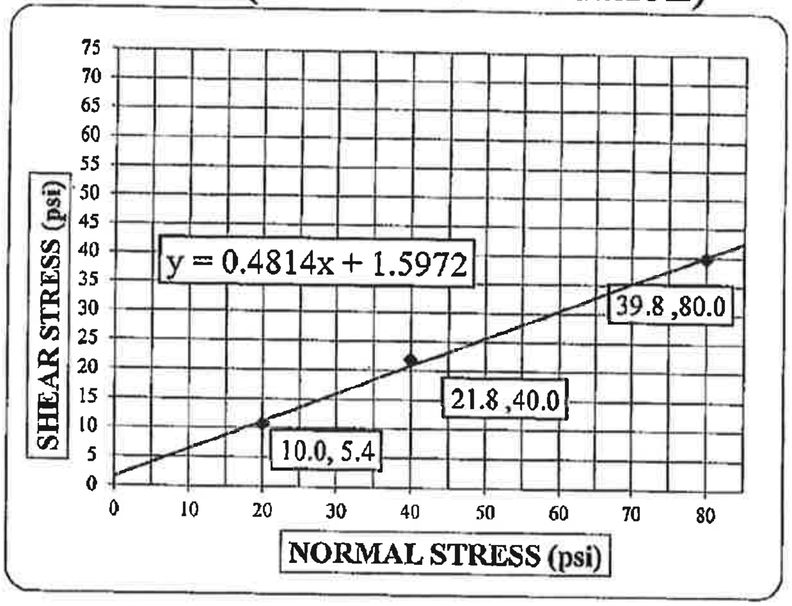
Very truly yours,

Whitney J. Parker, P.E.
Director of Testing Services
WJP/rap
enc.
d/works/13044/clay/lab/21457 soil shear.20.40.80.10303

10 Mason Street, Worcester, Massachusetts 01609
TEL (508) 831-7404 FAX (508) 831-7388
CONSTRUCTION INSPECTION & MATERIALS TESTING
www.yankeeengineering.com

ASTM D-3080 Soil Direct Shear (Saturated Condition)

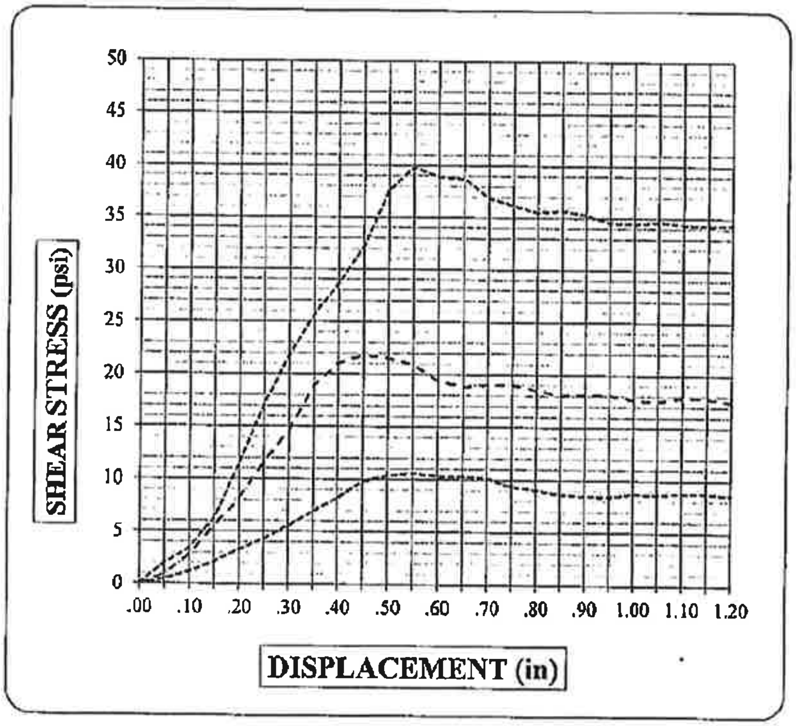
Project:	13044		
Project #:	Bourne SLF		
Soil ID #:	L-21457		
Soil Desc:	Gray clay trace sand		
Gravel	Sand	Silt	Clay
0.2	6.3	52.0	41.5
Atterberg	PL = 25	LL = 48	PI = 23
Max. Dry Density:		110.6	pcf
Optimum Moisture:		13.3	%
Test Dry Density:		99.5±	pcf
Test % Compaction:		90±	%
Test % Moisture:		16±	%
Shear Rate:		0.04 in/min.	
Shear Correction:		0	psi
Date:	October 23 to 29, 2013		
Tech:	RM/AS/RM/KN/WP		



Disp.	#1	#2	#3
0.00	0	0	0
0.05	65	130	285
0.10	165	405	490
0.15	310	795	900
0.20	475	1180	1650
0.25	620	1660	2460
0.30	800	2100	3130
0.35	1000	2720	3700
0.40	1185	3030	4110
0.45	1410	3140	4640
0.50	1490	3100	5420
0.55	1525	3010	5730
0.60	1490	2790	5600
0.65	1480	2710	5580
0.70	1465	2740	5310
0.75	1350	2740	5210
0.80	1305	2670	5110
0.85	1245	2600	5140
0.90	1225	2610	5080
0.95	1220	2610	4970
1.00	1255	2550	4960
1.05	1245	2530	4990
1.10	1260	2580	4950
1.15	1260	2570	4930
1.20	1240	2520	4950
1.25	1245	2540	4970
1.30	1225	2500	4950
1.35	1255	2540	4990
1.40	1240	2540	4990
1.45	1240	2560	4960
1.50	1250	2540	4980

Soil Cohesion = 1.6 psi | Soil Friction Angle = 26 °

#1	Normal	20 psi	Max.	10.6 psi	Residual	8.5 psi
#2	Normal	40 psi	Max.	21.8 psi	Residual	17.4 psi
#3	Normal	80 psi	Max.	39.8 psi	Residual	34.4 psi

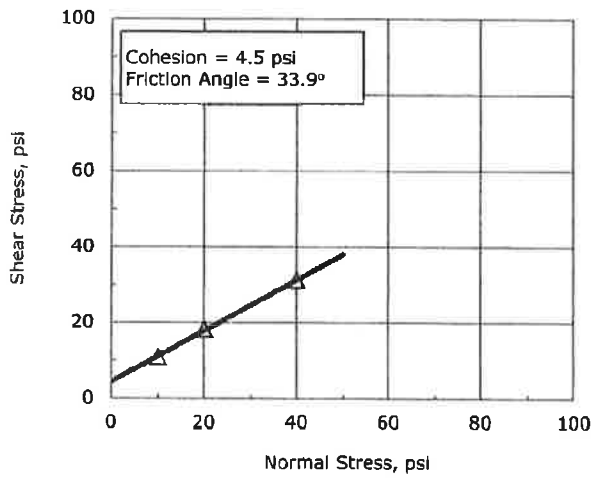


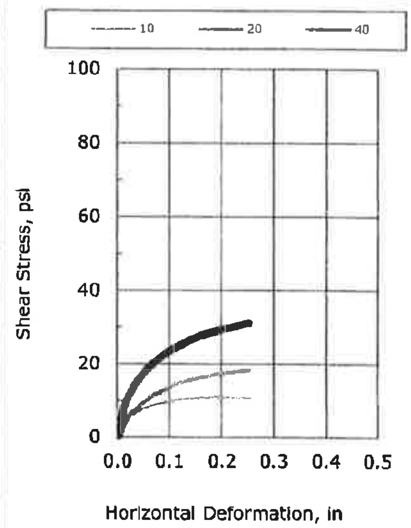
Remarks: Soil internal friction/shear angle was 26°, which met the required 19° minimum.
Refer to the letter dated October 30, 2013 for a summary of the above test results.

Yankee Engineering and Testing, Inc.
10 Mason St., Worcester, MA 01609

Client:	W.L. French Excavating Corp.
Project Name:	Bourne Landfill Expansion
Project Location:	---
GTX #:	305048
Test Date:	08/12/16
Tested By:	md
Checked By:	jdt
Boring ID:	---
Sample ID:	50-60 Binney Street
Depth, ft:	---
Visual Description:	Moist, gray clay

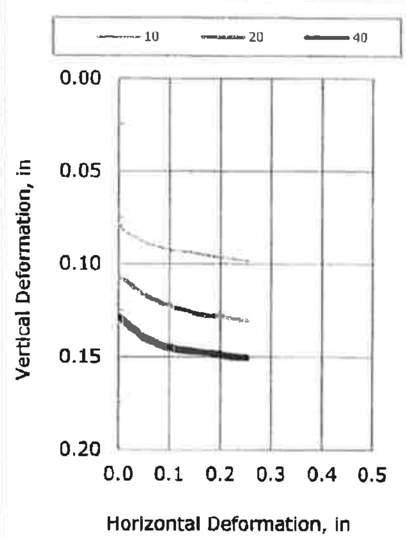
Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D3080





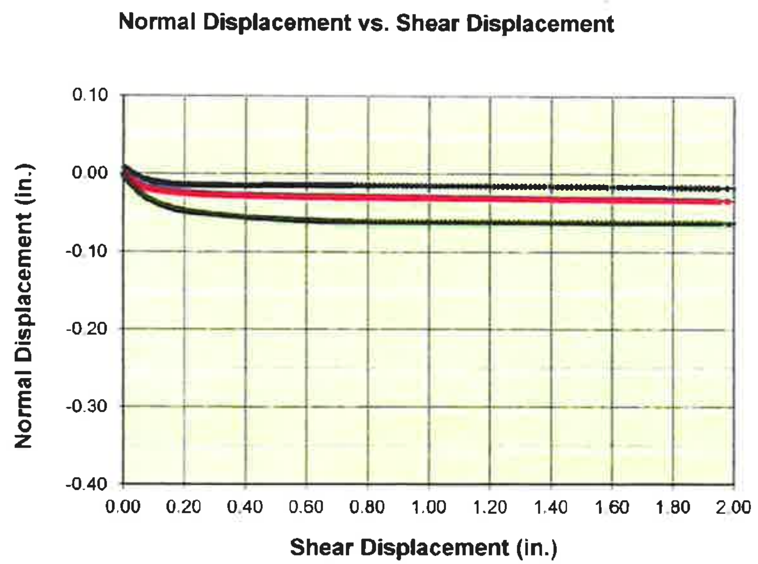
Test No.:	DS-4	DS-5	DS-6
Initial Diameter, in:	2.5	2.5	2.5
Initial Height, in:	1.0	1.0	1.0
Initial Mass, grams:	170.5	170.5	170.5
Initial Dry Density, pcf:	112.5	112.5	112.5
Initial Moisture Content, %:	17.7	17.7	17.7
Initial Bulk Density, pcf:	132.3	132.3	132.3
Initial Degree of Saturation:	95.5	95.5	95.5
Initial Void Ratio:	0.50	0.50	0.50
Final Dry Density, pcf:	115.5	116.1	117.2
Final Moisture Content, %:	19.8	19.2	18.6
Final Bulk Density, pcf:	138.4	138.4	139.0
Normal Stress, psi:	10	20	40
Maximum Shear Stress, psi:	11	18	31
Shear Rate, in/min:	0.0004	0.0004	0.0004

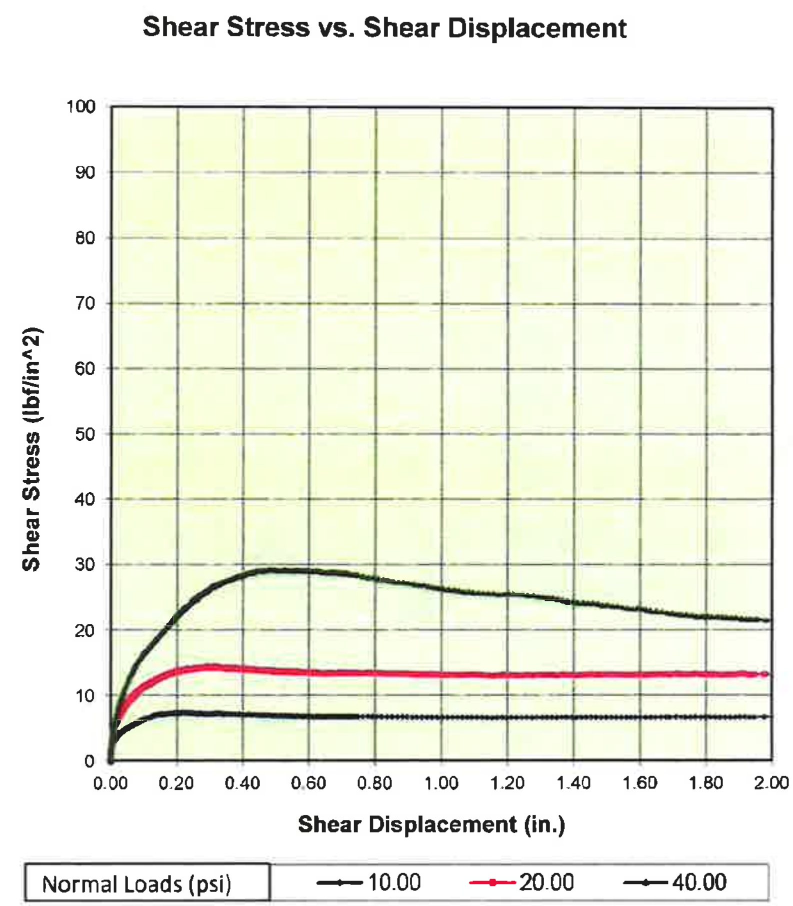
Sample Type:	reconstituted
Estimated Specific Gravity:	2.70
Liquid Limit:	---
Plastic Limit:	---
Plasticity Index:	---
% Passing #200 sieve:	---
Soil Classification:	---
Group Symbol:	---

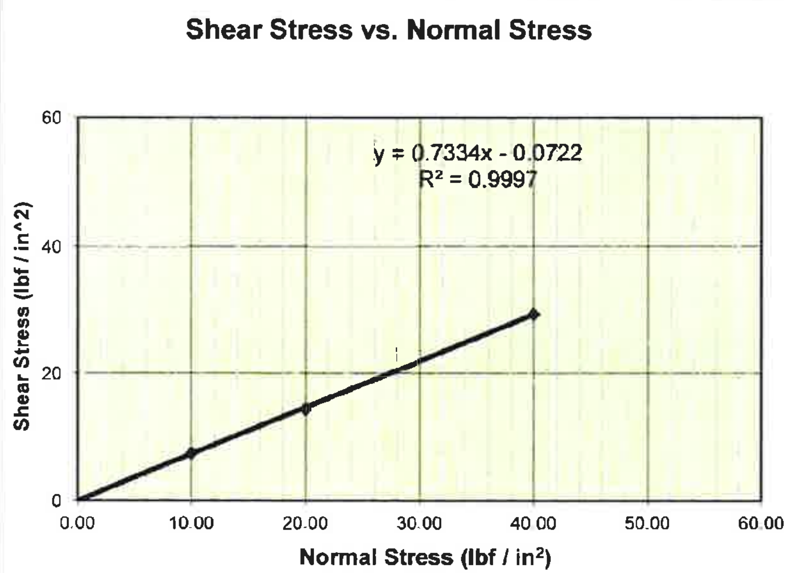


Notes:
Material greater than #5 sieve screened out of sample prior to testing
Moisture content obtained before shear from sample trimmings
Moisture Content determined by ASTM D2216
Percent passing #200 sieve determined by ASTM D422
Target Compaction: 112.7 pcf at 17.6% moisture content. Values specified by client.
Values for cohesion and friction angle determined from best-fit straight line to the data for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site-specific conditions.
"---" indicates testing required to determine these values was not requested.

Interface Shear Tests (ASTM D5321)



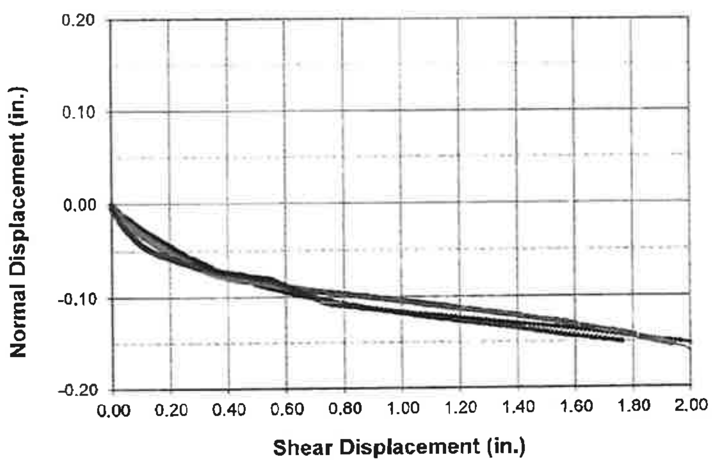




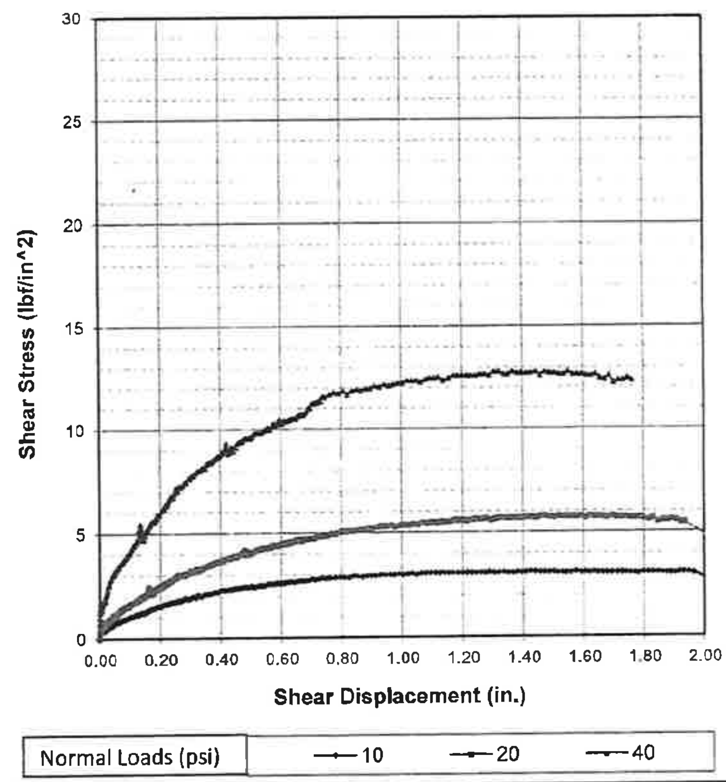
Project	Bourne Landfill	Project Manager	K. Maynard
Location	Bourne, MA	Assigned By	J. Balboni
File No.	CTS-74-16-0002.167	Tested By	RR
Test No.	DS-1427	Reviewed By	MJC
Date	10.31.16	**Shear Angle (°)**	**36.3**
Density	Similar to in-situ (~90%)	Intercept (lbf/in^2)	0.0722
Test Material	Low Perm Soil vs GCL	Source	Binney Street
Condition	Saturated	Area (in^2)	36.0

Direct Shear Tests (ASTM D3080)

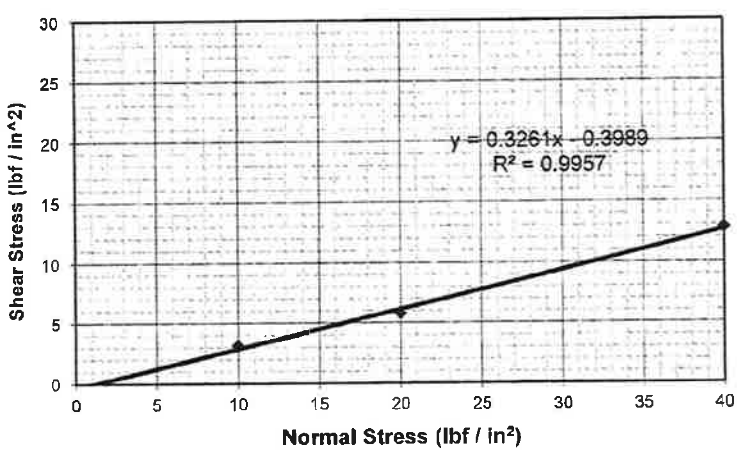
Normal Displacement vs. Shear Displacement



Shear Stress vs. Shear Displacement



Shear Stress vs. Normal Stress



Project	Bourne Landfill	Project Manager	K. Maynard
Location	Bourne, MA	Assigned By	J. Balboni
File No.	CTS-74-16-0002.167	Tested By	RR
Test No.	16-DS-1513	Reviewed By	MJC
Date	11.17.16	**Shear Angle (°)**	18.1
		Intercept (lbf/in^2)	-0.3989

Source **Peabody Covanta** Material **Clay**

Sample **< 0.375" Material** Area (in^2) 36.0 (6" x 6") square mold

Notes: Test sample material was compacted to 90% of maximum dry density (107.3 pcf) at 23.2% moisture content by tamping method per section 7.5.2 of ASTM D3080-04. Material was tested at saturated condition.

02400 - 7

INTERFACE FRICTION TEST RESULTS
ASTM D 6243

geotechnics
INTEGRITY IN TESTING

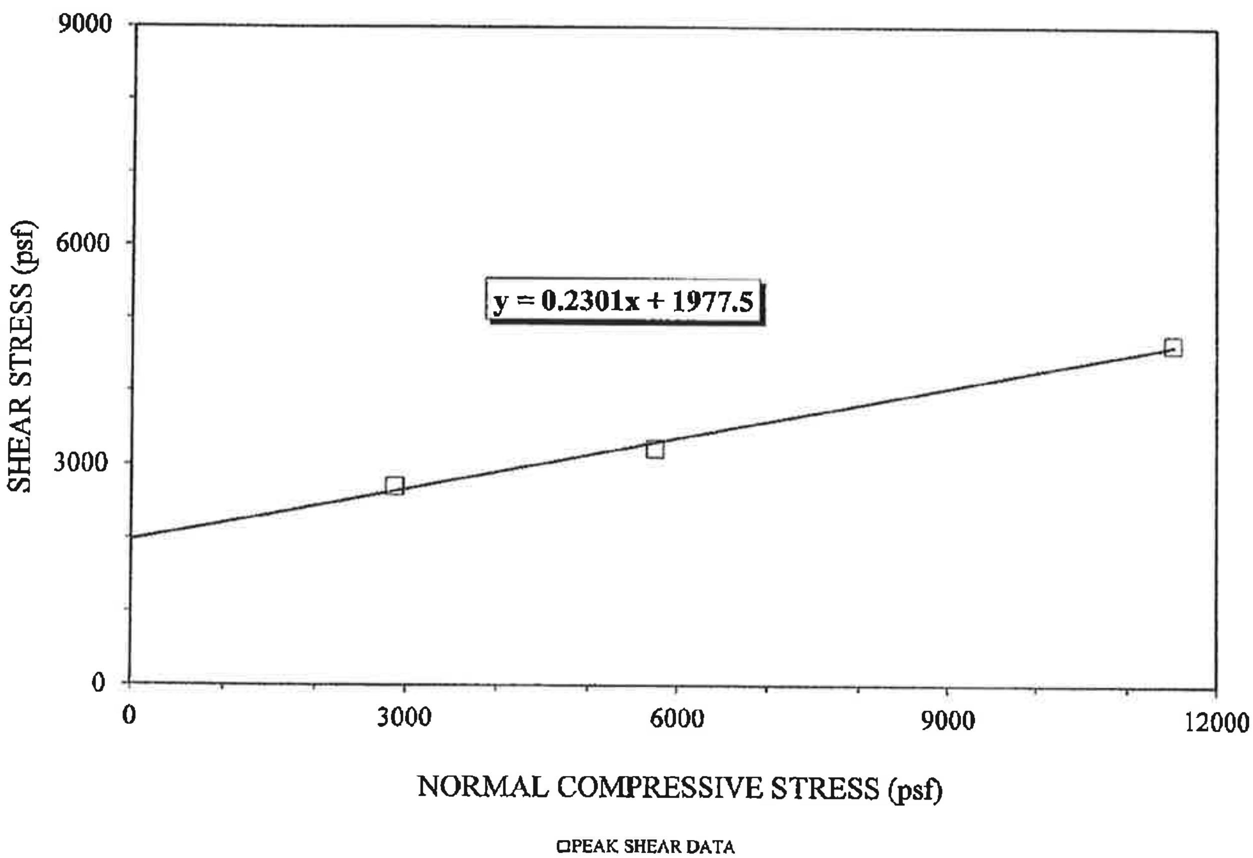
H-2

CLIENT : New England Liner Systems, Inc.
CLIENT PROJECT : Bourne ISWM Phase 5 Expansion
PROJECT NO. : L16145-03
LAB I. D. NO.: Agru NN66 GCL, Roll # G16G009942 (L16145-02-04)

INTERFACE : **Internal Shear of GCL**

		PEAK SHEAR
FRICTION ANGLE (deg) :	Φ =	**13.0**
COEFFICIENT OF FRICTION :	=	**0.230**
ADHESION [Calculated] (psf):	a =	**1978**

NOTES:
1.) GCL specimens were hydrated at 1 psi for 48 hours.
2.) The specimens were loaded, inundated with water & seated for 24 hours prior to shearing.
3.) The peak friction angle was calculated using linear regression on the three data points.



APPROVED BY : [signature] DATE : 11-7-16

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INTERFACE FRICTION TEST RESULTS
ASTM D 6243

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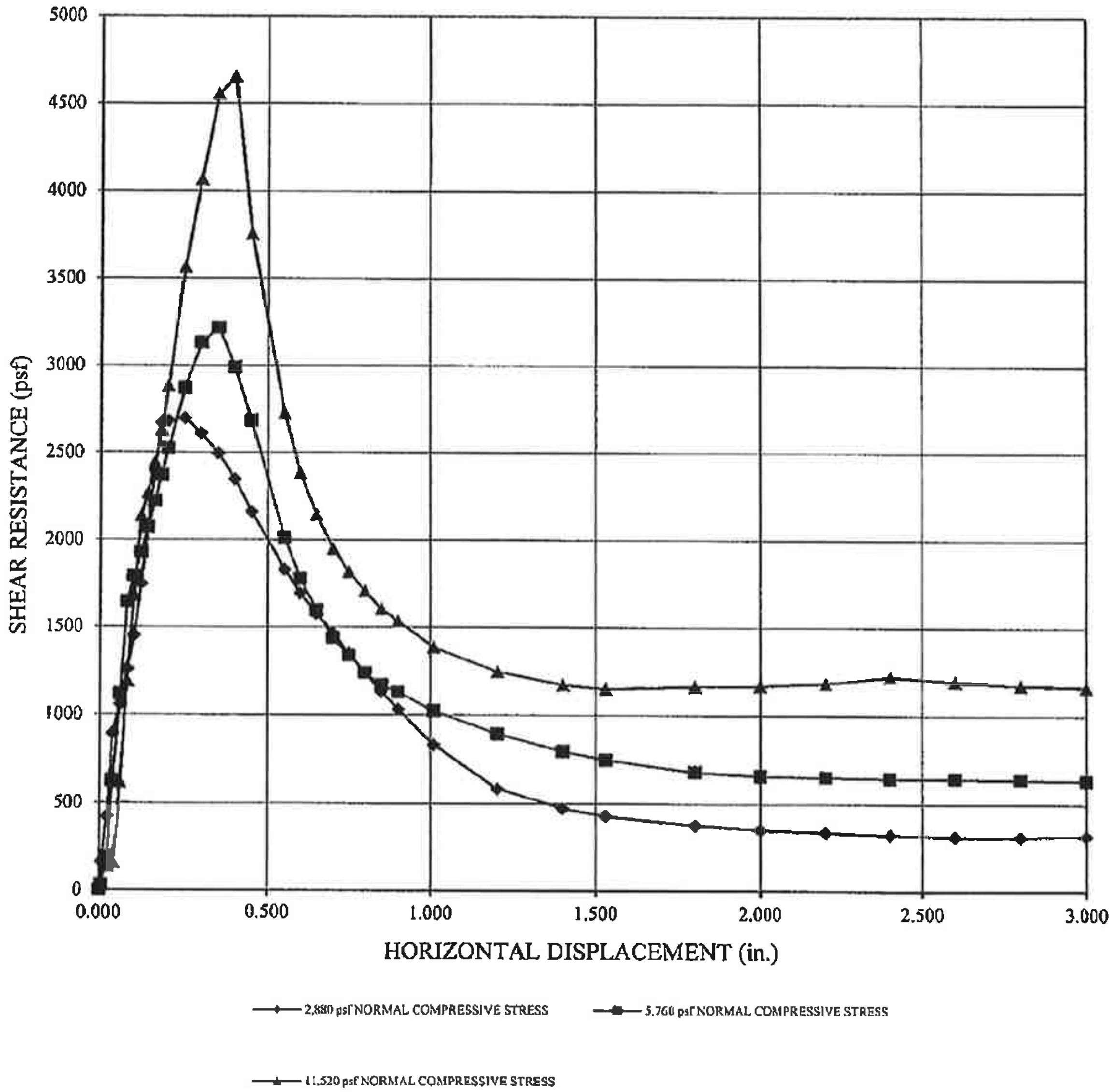
INTEGRITY IN TESTING

CLIENT : New England Liner Systems, Inc.
CLIENT PROJECT : Bourne ISWM Phase 5 Expansion
PROJECT NO. : L16145-03
LAB I. D. NO.: Agru NN66 GCL, Roll # G16G009942 (L16145-02-04)

INTERFACE : **Internal Shear of GCL**

SHEAR RESISTANCE VS HORIZONTAL DISPLACEMENT



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INTERFACE FRICTION TEST RESULTS
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INTEGRITY IN TESTING

CLIENT : New England Liner Systems, Inc.
CLIENT PROJECT : Bourne ISWM Phase 5 Expansion
PROJECT NO. : L16145-03
LAB I. D. NO.S: Agru NN66 GCL, Roll # G16G009942 (L16145-02-04)

INTERFACE : **Internal Shear of GCL**

STRAIN RATE (in / min) : 0.001
PLACEMENT CONDITION: Inundated
DIRECT SHEAR UNIT: Durham Geo
NORMAL LOAD: Bladder System

NORMAL LOAD (psf)	2880	NORMAL LOAD (psf)	5760	NORMAL LOAD (psf)	11520
PEAK SHEAR STRESS (psf)	2698	PEAK SHEAR STRESS (psf)	3216	PEAK SHEAR STRESS (psf)	4657
PEAK SECANT ANGLE (deg)	43.1	PEAK SECANT ANGLE (deg)	29.2	PEAK SECANT ANGLE (deg)	22.0
RESIDUAL SHEAR (psf)	318	RESIDUAL SHEAR (psf)	633	RESIDUAL SHEAR (psf)	1163
RESID. SECANT ANGLE (deg)	6.3	RESID. SECANT ANGLE (deg)	6.3	RESID. SECANT ANGLE (deg)	5.8

HORIZONTAL			HORIZONTAL			HORIZONTAL		
DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)
0.000	0	0	0.000	0	0	0.000	0	0
0.005	161	161	0.005	27	27	0.005	65	65
0.023	420	420	0.023	190	190	0.023	137	137
0.038	895	895	0.038	628	628	0.038	158	158
0.060	1060	1060	0.060	1118	1118	0.060	618	618
0.080	1262	1262	0.080	1645	1645	0.080	1193	1193
0.100	1453	1453	0.100	1794	1794	0.100	1684	1684
0.120	1748	1748	0.120	1927	1927	0.120	2136	2136
0.140	2081	2081	0.140	2070	2070	0.140	2268	2268
0.160	2396	2396	0.160	2218	2218	0.160	2444	2444
0.180	2669	2669	0.180	2370	2370	0.180	2628	2628
0.200	2683	2683	0.200	2524	2524	0.200	2881	2881
0.250	2698	2698	0.250	2870	2870	0.250	3567	3567
0.300	2610	2610	0.300	3133	3133	0.300	4071	4071
0.350	2496	2496	0.350	3216	3216	0.350	4556	4556
0.400	2346	2346	0.400	2991	2991	0.400	4657	4657
0.450	2160	2160	0.450	2683	2683	0.450	3758	3758
0.550	1832	1832	0.550	2012	2012	0.550	2731	2731
0.600	1696	1696	0.600	1778	1778	0.600	2384	2384
0.650	1575	1575	0.650	1596	1596	0.650	2146	2146
0.700	1466	1466	0.700	1436	1436	0.700	1949	1949
0.750	1350	1350	0.750	1340	1340	0.750	1816	1816
0.800	1243	1243	0.800	1240	1240	0.800	1707	1707
0.850	1133	1133	0.850	1170	1170	0.850	1604	1604
0.900	1032	1032	0.900	1130	1130	0.900	1535	1535
1.010	832	832	1.010	1024	1024	1.010	1385	1385
1.200	583	583	1.200	894	894	1.200	1247	1247
1.400	473	473	1.400	796	796	1.400	1173	1173
1.530	428	428	1.530	748	748	1.530	1150	1150
1.800	376	376	1.800	680	680	1.800	1165	1165
2.000	352	352	2.000	658	658	2.000	1168	1168
2.200	338	338	2.200	651	651	2.200	1183	1183
2.400	324	324	2.400	646	646	2.400	1221	1221
2.600	314	314	2.600	643	643	2.600	1193	1193
2.800	313	313	2.800	638	638	2.800	1173	1173
3.000	318	318	3.000	633	633	3.000	1163	1163

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L16145-03

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11/7/2016

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L16145-03

INTERFACE FRICTION TEST RESULTS

ASTM D 6243

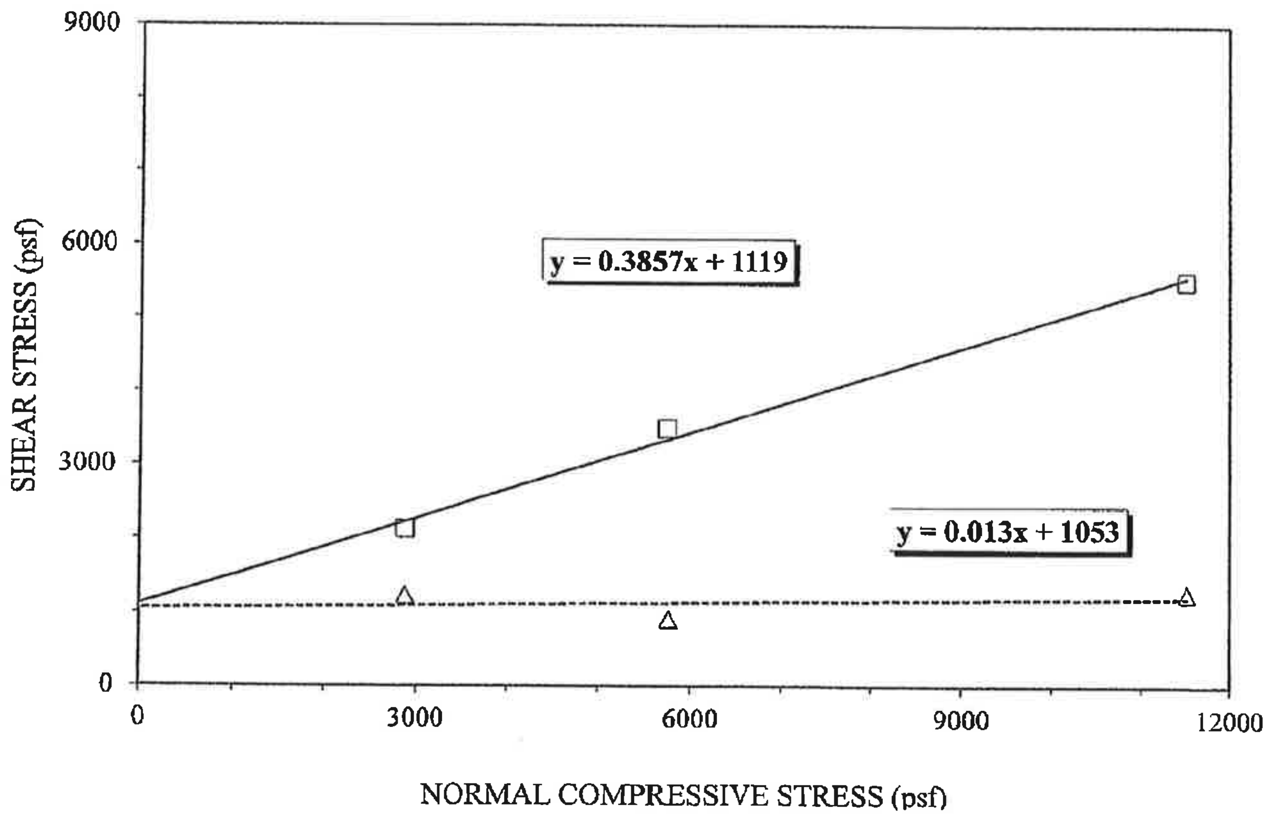
geotechnics INTEGRITY IN TESTING

CLIENT : New England Liner Systems, Inc.
CLIENT PROJECT : Bourne ISWM Phase 5 Expansion
PROJECT NO. : L16145-03
LAB I. D. NO.: Agru NN66 GCL, Roll # G16G009942 (L16145-02-04)
Agru 8-250-8 Geocomposite, Roll # G16E013485 (L16145-01-02)

INTERFACE : **GCL (Scrim Non-Woven Side) vs. Geocomposite**

	PEAK SHEAR		RESIDUAL SHEAR	
FRICTION ANGLE (deg) :	Φ =	21.1	Φ =	0.7
COEFFICIENT OF FRICTION :	=	0.386	=	0.013
ADHESION [Calculated] (psf):	a =	1119	a =	1060

NOTES:
1.) GCL specimens were hydrated at 1 psi for 48 hours.
2.) The interface was loaded, inundated with water & consolidated for 24 hours prior to shearing.
3.) The peak friction angle was calculated using linear regression on the three data points.
4.) The residual friction angle was calculated using linear regression on the end of test values.
5.) The GCL specimen experienced partial internal shearing at the 5,760 & 11,520 psf normal loads.



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INTERFACE FRICTION TEST RESULTS
ASTM D 6243

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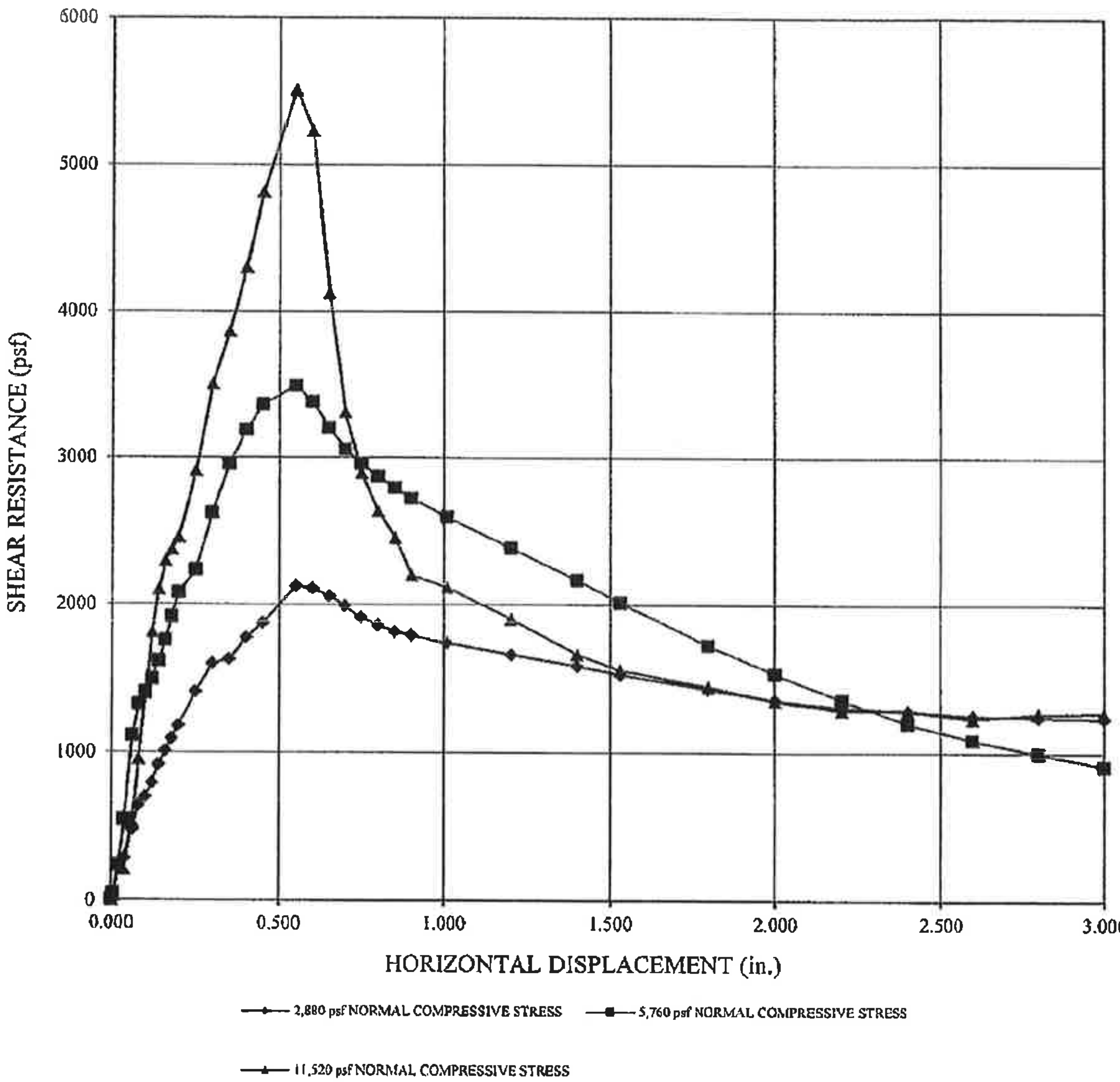
INTEGRITY IN TESTING

CLIENT : New England Liner Systems, Inc.
CLIENT PROJECT : Bourne ISWM Phase 5 Expansion
PROJECT NO. : L16145-03
LAB I. D. NO.: Agru NN66 GCL, Roll # G16G009942 (L16145-02-04)
Agru 8-250-8 Geocomposite, Roll # G16E013485 (L16145-01-02)

INTERFACE : **GCL (Scrim Non-Woven Side)**
vs. Geocomposite

SHEAR RESISTANCE VS HORIZONTAL DISPLACEMENT



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DATE : 10-31-16
10/31/2016

INTERFACE FRICTION TEST RESULTS
ASTM D 6243

geotechnics
INTEGRITY IN TESTING

CLIENT : New England Liner Systems, Inc.
CLIENT PROJECT : Bourne ISWM Phase 5 Expansion
PROJECT NO. : L16145-03
LAB I. D. NO.S: Agru NN66 GCL, Roll # G16G009942 (L16145-02-04)
Agru 8-250-8 Geocomposite, Roll # G16E013485 (L16145-01-02)

INTERFACE : **GCL (Scrim Non-Woven Side) vs. Geocomposite**

STRAIN RATE (in / min) : 0.04 DIRECT SHEAR UNIT: LNL
PLACEMENT CONDITION: Inundated NORMAL LOAD: Platen Weight

NORMAL LOAD (psf)	2880	NORMAL LOAD (psf)	5760	NORMAL LOAD (psf)	11520
PEAK SHEAR STRESS (psf)	2128	PEAK SHEAR STRESS (psf)	3493	PEAK SHEAR STRESS (psf)	5511
PEAK SECANT ANGLE (deg)	36.5	PEAK SECANT ANGLE (deg)	31.2	PEAK SECANT ANGLE (deg)	25.6
RESIDUAL SHEAR (psf)	1234	RESIDUAL SHEAR (psf)	913	RESIDUAL SHEAR (psf)	1275
RESID. SECANT ANGLE (deg)	23.2	RESID. SECANT ANGLE (deg)	9.0	RESID. SECANT ANGLE (deg)	6.3

	HORIZONTAL			HORIZONTAL			HORIZONTAL	
DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)
0.000	0	0	0.000	0	0	0.000	0	0
0.005	55	55	0.005	47	47	0.005	32	32
0.023	225	225	0.023	240	240	0.023	237	237
0.038	286	286	0.038	548	548	0.038	208	208
0.060	481	481	0.060	1115	1115	0.060	534	534
0.080	644	644	0.080	1326	1326	0.080	958	958
0.100	701	701	0.100	1413	1413	0.100	1400	1400
0.120	793	793	0.120	1499	1499	0.120	1818	1818
0.140	918	918	0.140	1618	1618	0.140	2104	2104
0.160	1013	1013	0.160	1759	1759	0.160	2300	2300
0.180	1095	1095	0.180	1918	1918	0.180	2377	2377
0.200	1182	1182	0.200	2083	2083	0.200	2462	2462
0.250	1412	1412	0.250	2237	2237	0.250	2908	2908
0.300	1601	1601	0.300	2625	2625	0.300	3507	3507
0.350	1630	1630	0.350	2960	2960	0.350	3866	3866
0.400	1776	1776	0.400	3191	3191	0.400	4304	4304
0.450	1877	1877	0.450	3364	3364	0.450	4816	4816
0.550	2128	2128	0.550	3493	3493	0.550	5511	5511
0.600	2112	2112	0.600	3383	3383	0.600	5231	5231
0.650	2056	2056	0.650	3204	3204	0.650	4128	4128
0.700	1993	1993	0.700	3058	3058	0.700	3314	3314
0.750	1917	1917	0.750	2962	2962	0.750	2897	2897
0.800	1864	1864	0.800	2870	2870	0.800	2635	2635
0.850	1822	1822	0.850	2795	2795	0.850	2456	2456
0.900	1799	1799	0.900	2724	2724	0.900	2201	2201
1.010	1741	1741	1.010	2597	2597	1.010	2117	2117
1.200	1664	1664	1.200	2386	2386	1.200	1904	1904
1.400	1587	1587	1.400	2169	2169	1.400	1666	1666
1.530	1532	1532	1.530	2017	2017	1.530	1559	1559
1.800	1432	1432	1.800	1728	1728	1.800	1450	1450
2.000	1358	1358	2.000	1538	1538	2.000	1353	1353
2.200	1308	1308	2.200	1360	1360	2.200	1288	1288
2.400	1284	1284	2.400	1199	1199	2.400	1290	1290
2.600	1255	1255	2.600	1090	1090	2.600	1233	1233
2.800	1245	1245	2.800	998	998	2.800	1269	1269
3.000	1234	1234	3.000	913	913	3.000	1275	1275

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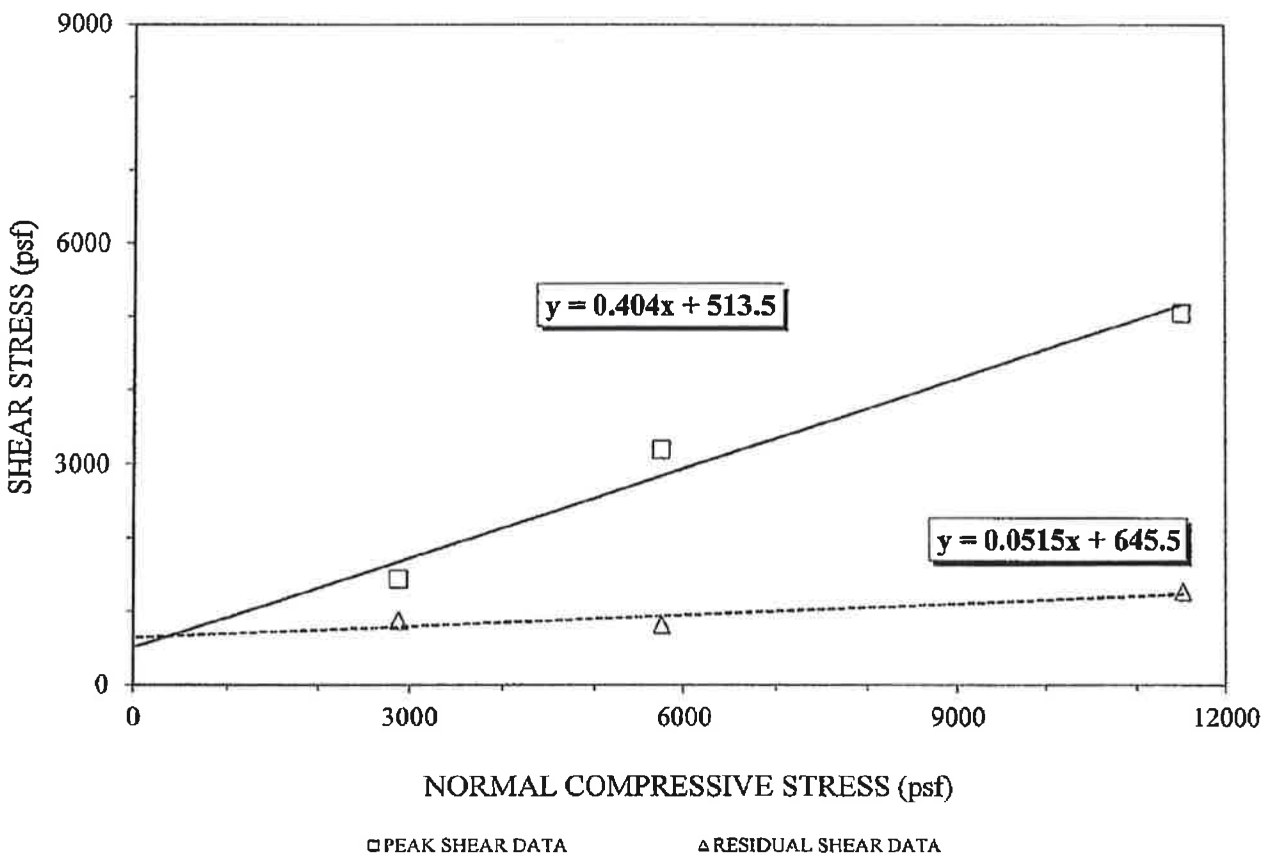
INTERFACE FRICTION TEST RESULTS
ASTM D 6243

CLIENT : New England Liner Systems, Inc.
CLIENT PROJECT : Bourne ISWM Phase 5 Expansion
PROJECT NO. : L16145-03
LAB I. D. NO.: Agru NN66 GCL, Roll # G16G009942 (L16145-02-04)
Agru 60 mil HDPE Microspike, Roll # G16F003178 (L16145-03-01)

INTERFACE : **GCL (Non-Woven Side)**
vs. 60 mil HDPE Microspike (Bottom Side)

	PEAK SHEAR		RESIDUAL SHEAR	
FRICTION ANGLE (deg) :	Φ =	22.0	Φ =	2.9
COEFFICIENT OF FRICTION :	=	0.404	=	0.051
ADHESION [Calculated] (psf):	a =	514	a =	646

NOTES:
1.) GCL specimens were hydrated at 1 psi for 48 hours.
2.) The interface was loaded, inundated with water & consolidated for 24 hours prior to shearing.
3.) The peak friction angle was calculated using linear regression on the three data points.
4.) The residual friction angle was calculated using linear regression on the end of test values.
5.) The GCL specimen experienced partial internal shearing at the 5,760 & 11,520 psf normal loads.



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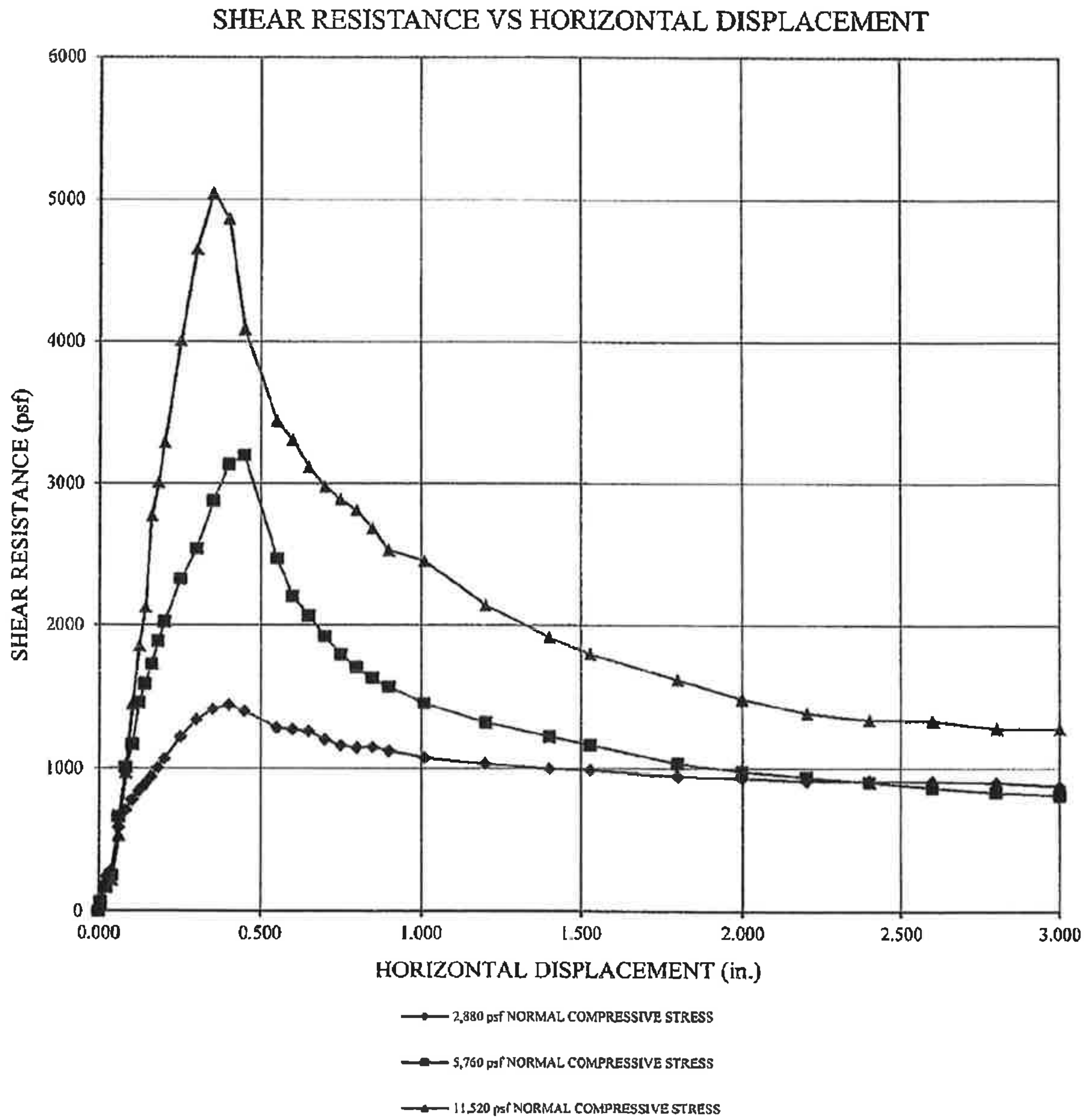
INTERFACE FRICTION TEST RESULTS
ASTM D 6243

CLIENT : New England Liner Systems, Inc.
CLIENT PROJECT : Bourne ISWM Phase 5 Expansion
PROJECT NO. : L16145-03
LAB I. D. NO.: Agru NN66 GCL, Roll # G16G009942 (L16145-02-04)
Agru 60 mil HDPE Microspike, Roll # G16F003178 (L16145-03-01)

INTERFACE : **GCL (Non-Woven Side)**
vs. 60 mil HDPE Microspike (Bottom Side)



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INTERFACE FRICTION TEST RESULTS
ASTM D 6243

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CLIENT : New England Liner Systems, Inc.
CLIENT PROJECT : Bourne ISWM Phase 5 Expansion
PROJECT NO. : L16145-03
LAB I. D. NO.S: Agru NN66 GCL, Roll # G16G009942 (L16145-02-04)
Agru 60 mil HDPE Microspike, Roll # G16F003178 (L16145-03-01)

INTERFACE : **GCL (Non-Woven Side)**
vs. 60 mil HDPE Microspike (Bottom Side)

STRAIN RATE (in / min) : 0.04 DIRECT SHEAR UNIT: LNL
PLACEMENT CONDITION: Inundated NORMAL LOAD: Platen Weight

NORMAL LOAD (psf)	2880	NORMAL LOAD (psf)	5760	NORMAL LOAD (psf)	11520
PEAK SHEAR STRESS (psf)	1440	PEAK SHEAR STRESS (psf)	3196	PEAK SHEAR STRESS (psf)	5049
PEAK SECANT ANGLE (deg)	26.6	PEAK SECANT ANGLE (deg)	29.0	PEAK SECANT ANGLE (deg)	23.7
RESIDUAL SHEAR (psf)	878	RESIDUAL SHEAR (psf)	816	RESIDUAL SHEAR (psf)	1281
RESID. SECANT ANGLE (deg)	17.0	RESID. SECANT ANGLE (deg)	8.1	RESID. SECANT ANGLE (deg)	6.3
ASPERITY	33	ASPERITY	32	ASPERITY	33

HORIZONTAL			HORIZONTAL			HORIZONTAL		
DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)
0.000	0	0	0.000	0	0	0.000	0	0
0.005	53	53	0.005	62	62	0.005	48	48
0.023	241	241	0.023	167	167	0.023	204	204
0.038	284	284	0.038	251	251	0.038	217	217
0.060	587	587	0.060	659	659	0.060	531	531
0.080	708	708	0.080	1005	1005	0.080	970	970
0.100	781	781	0.100	1165	1165	0.100	1445	1445
0.120	840	840	0.120	1453	1453	0.120	1855	1855
0.140	886	886	0.140	1586	1586	0.140	2128	2128
0.160	940	940	0.160	1725	1725	0.160	2772	2772
0.180	1005	1005	0.180	1882	1882	0.180	3007	3007
0.200	1066	1066	0.200	2025	2025	0.200	3289	3289
0.250	1220	1220	0.250	2326	2326	0.250	4010	4010
0.300	1338	1338	0.300	2541	2541	0.300	4653	4653
0.350	1413	1413	0.350	2879	2879	0.350	5049	5049
0.400	1440	1440	0.400	3134	3134	0.400	4866	4866
0.450	1399	1399	0.450	3196	3196	0.450	4092	4092
0.550	1280	1280	0.550	2470	2470	0.550	3439	3439
0.600	1271	1271	0.600	2203	2203	0.600	3305	3305
0.650	1256	1256	0.650	2065	2065	0.650	3119	3119
0.700	1199	1199	0.700	1921	1921	0.700	2977	2977
0.750	1159	1159	0.750	1790	1790	0.750	2886	2886
0.800	1145	1145	0.800	1704	1704	0.800	2811	2811
0.850	1146	1146	0.850	1627	1627	0.850	2682	2682
0.900	1120	1120	0.900	1565	1565	0.900	2528	2528
1.010	1076	1076	1.010	1449	1449	1.010	2455	2455
1.200	1034	1034	1.200	1317	1317	1.200	2142	2142
1.400	997	997	1.400	1221	1221	1.400	1917	1917
1.530	986	986	1.530	1163	1163	1.530	1796	1796
1.800	946	946	1.800	1033	1033	1.800	1615	1615
2.000	932	932	2.000	978	978	2.000	1480	1480
2.200	913	913	2.200	940	940	2.200	1385	1385
2.400	915	915	2.400	902	902	2.400	1338	1338
2.600	912	912	2.600	866	866	2.600	1335	1335
2.800	903	903	2.800	836	836	2.800	1285	1285
3.000	878	878	3.000	816	816	3.000	1281	1281

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L16145-03

DATE : 10-31-16
10/31/2016

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INTERFACE FRICTION TEST RESULTS
ASTM D 5321

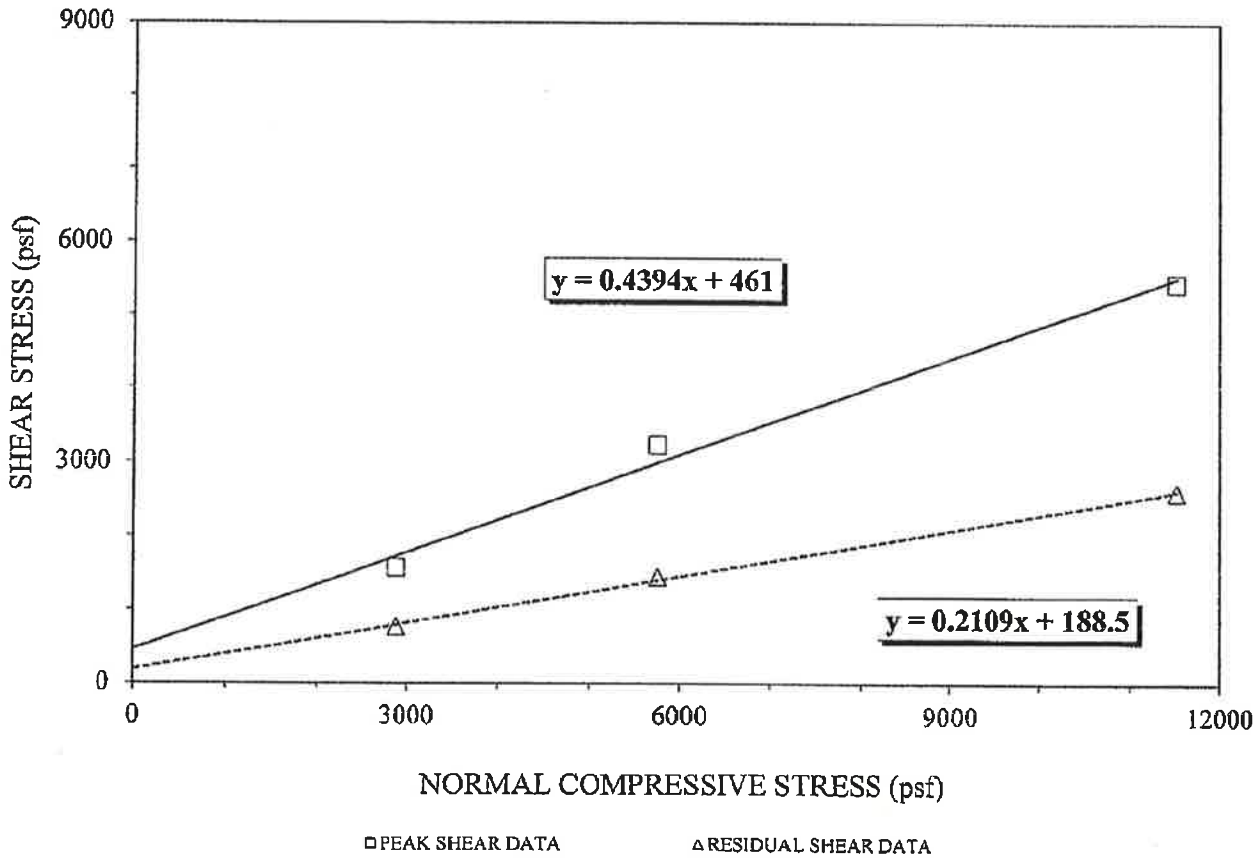
geotechnics
INTEGRITY IN TESTING

CLIENT : New England Liner Systems, Inc.
CLIENT PROJECT : Bourne ISWM Phase 5 Expansion
PROJECT NO. : L16145-03
LAB I. D. NO.: Agru 8-250-8 Geocomposite, Roll # G16E013485 (L16145-01-02)
Agru 60 mil HDPE Microspike, Roll # G16F003178 (L16145-03-01)

INTERFACE : **Geocomposite**
vs. 60 mil HDPE Microspike (Top Side)

	PEAK SHEAR		RESIDUAL SHEAR	
FRICTION ANGLE (deg) :	Φ =	23.7	Φ =	11.9
COEFFICIENT OF FRICTION :	=	0.439	=	0.210
ADHESION [Calculated] (psf):	a =	461	a =	189

NOTES: 1.) The interface was loaded, inundated with water & seated for 24 hours prior to shearing.
2.) The peak friction angle was calculated using linear regression on the three data points.
3.) The residual friction angle was calculated using linear regression on the end of test values.



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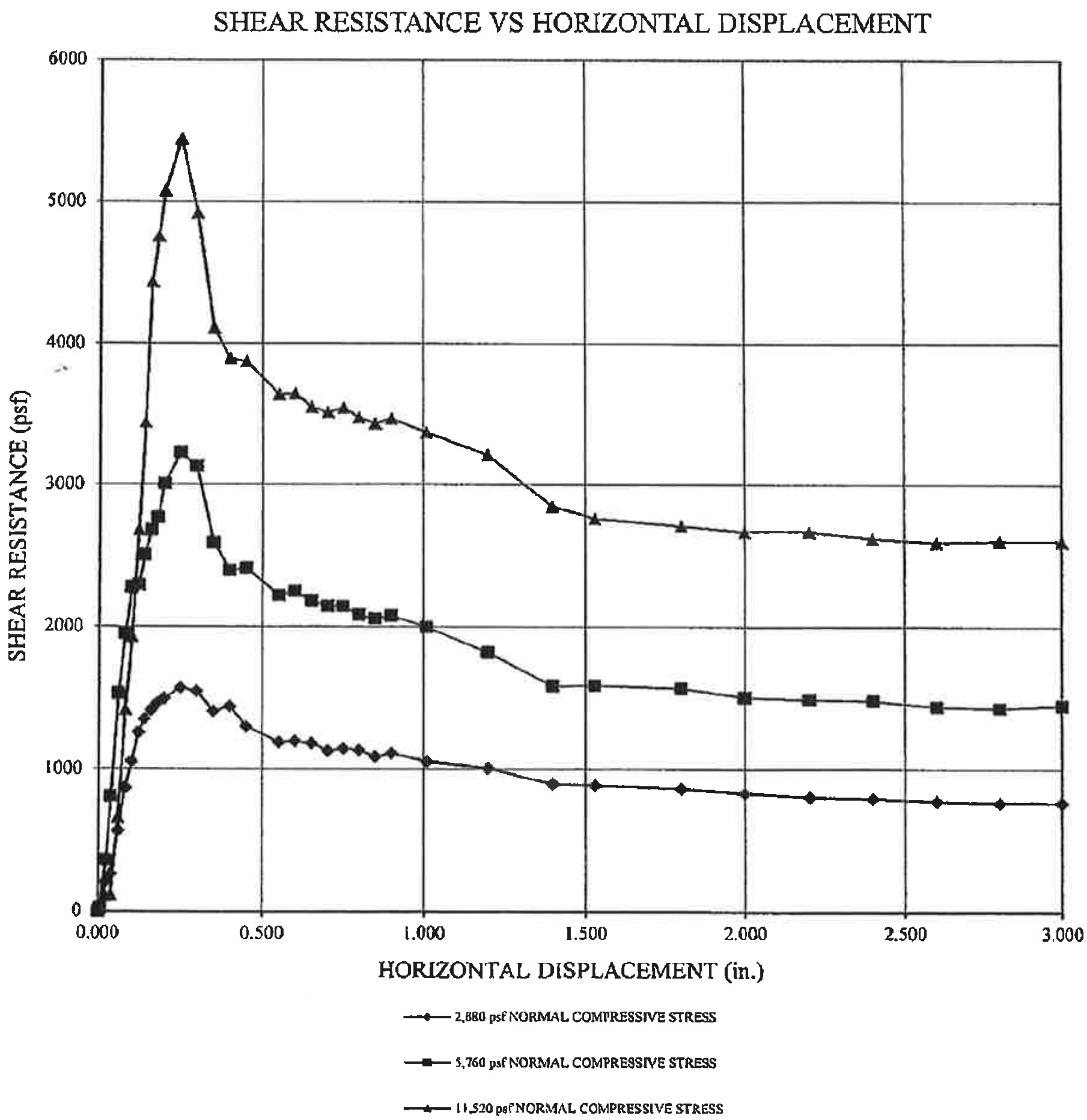
INTERFACE : **Geocomposite**
vs. 60 mil HDPE Microspike (Top Side)



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ASTM D 5321

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Agru 60 mil HDPE Microspike, Roll # G16F003178 (L16145-03-01)

INTERFACE : **Geocomposite**
vs. 60 mil HDPE Microspike (Top Side)

STRAIN RATE (in / min) : 0.04 DIRECT SHEAR UNIT: LNL
PLACEMENT CONDITION: Inundated NORMAL LOAD: Platen Weight

NORMAL LOAD (psf)	2880	NORMAL LOAD (psf)	5760	NORMAL LOAD (psf)	11520
PEAK SHEAR STRESS (psf)	1569	PEAK SHEAR STRESS (psf)	3228	PEAK SHEAR STRESS (psf)	5444
PEAK SECANT ANGLE (deg)	28.6	PEAK SECANT ANGLE (deg)	29.3	PEAK SECANT ANGLE (deg)	25.3
RESIDUAL SHEAR (psf)	767	RESIDUAL SHEAR (psf)	1447	RESIDUAL SHEAR (psf)	2604
RESID. SECANT ANGLE (deg)	14.9	RESID. SECANT ANGLE (deg)	14.1	RESID. SECANT ANGLE (deg)	12.7
ASPERITY	25	ASPERITY	27	ASPERITY	27

	HORIZONTAL			HORIZONTAL			HORIZONTAL	
DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)	DISPLACE. (in.)	SHEAR FORCE (lbs)	STRESS (psf)
0.000	0	0	0.000	0	0	0.000	0	0
0.005	30	30	0.005	24	24	0.005	38	38
0.023	208	208	0.023	361	361	0.023	108	108
0.038	261	261	0.038	809	809	0.038	117	117
0.060	568	568	0.060	1531	1531	0.060	663	663
0.080	868	868	0.080	1953	1953	0.030	1414	1414
0.100	1054	1054	0.100	2277	2277	0.100	1929	1929
0.120	1257	1257	0.120	2296	2296	0.120	2683	2683
0.140	1351	1351	0.140	2504	2504	0.140	3443	3443
0.160	1412	1412	0.160	2680	2680	0.160	4438	4438
0.180	1465	1465	0.180	2769	2769	0.180	4758	4758
0.200	1496	1496	0.200	3007	3007	0.200	5078	5078
0.250	1569	1569	0.250	3228	3228	0.250	5444	5444
0.300	1548	1548	0.300	3128	3128	0.300	4920	4920
0.350	1406	1406	0.350	2592	2592	0.350	4111	4111
0.400	1440	1440	0.400	2399	2399	0.400	3890	3890
0.450	1297	1297	0.450	2412	2412	0.450	3872	3872
0.550	1190	1190	0.550	2222	2222	0.550	3638	3638
0.600	1198	1198	0.600	2251	2251	0.600	3646	3646
0.650	1181	1181	0.650	2182	2182	0.650	3549	3549
0.700	1130	1130	0.700	2147	2147	0.700	3513	3513
0.750	1145	1145	0.750	2145	2145	0.750	3546	3546
0.800	1134	1134	0.800	2086	2086	0.800	3477	3477
0.850	1089	1089	0.850	2058	2058	0.850	3433	3433
0.900	1110	1110	0.900	2077	2077	0.900	3468	3468
1.010	1055	1055	1.010	1998	1998	1.010	3371	3371
1.200	1008	1008	1.200	1819	1819	1.200	3209	3209
1.400	898	898	1.400	1583	1583	1.400	2847	2847
1.530	889	889	1.530	1588	1588	1.530	2762	2762
1.800	864	864	1.800	1567	1567	1.800	2711	2711
2.000	833	833	2.000	1505	1505	2.000	2670	2670
2.200	806	806	2.200	1488	1488	2.200	2670	2670
2.400	796	796	2.400	1482	1482	2.400	2623	2623
2.600	777	777	2.600	1437	1437	2.600	2596	2596
2.800	764	764	2.800	1428	1428	2.800	2606	2606
3.000	767	767	3.000	1447	1447	3.000	2604	2604

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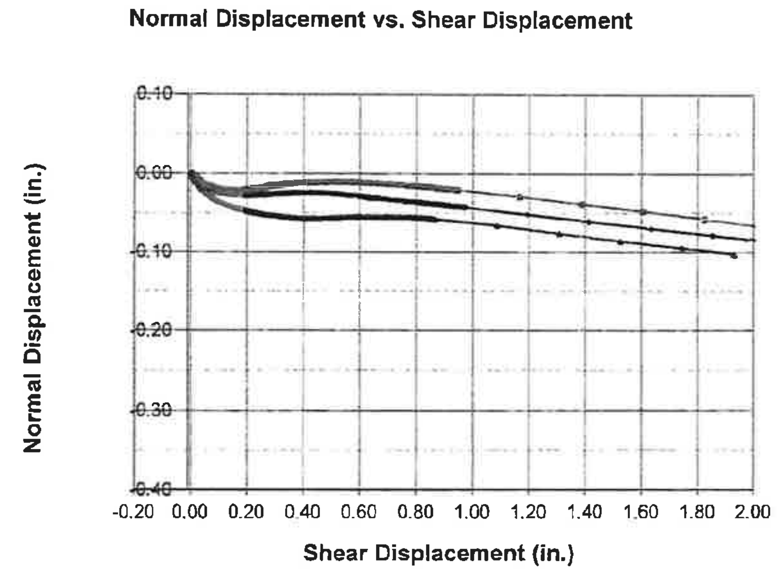
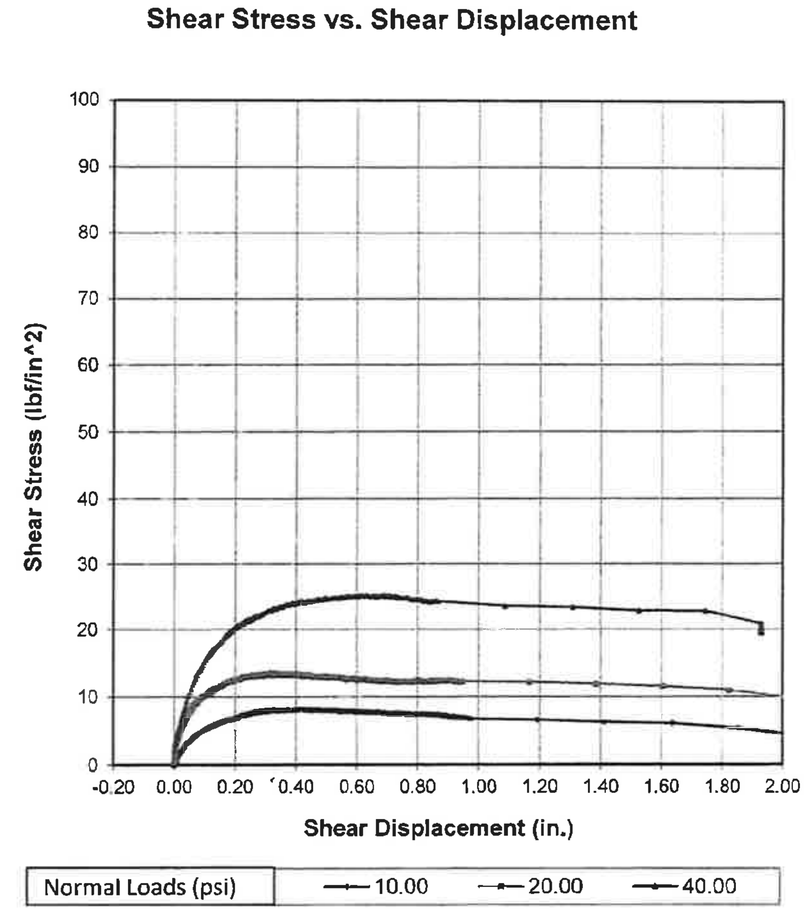
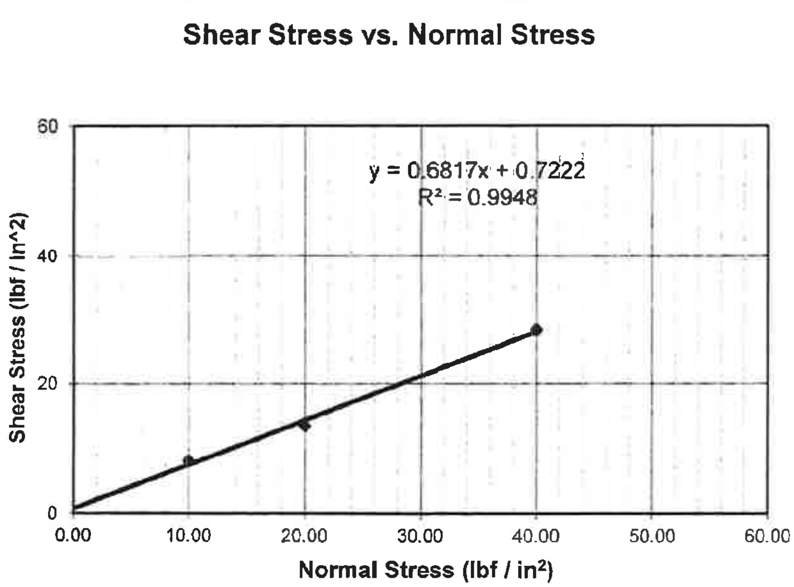
Interface Shear Tests (ASTM D5321)



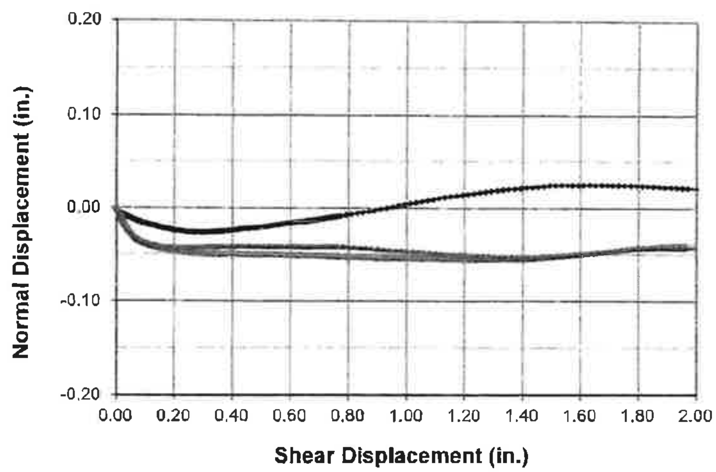




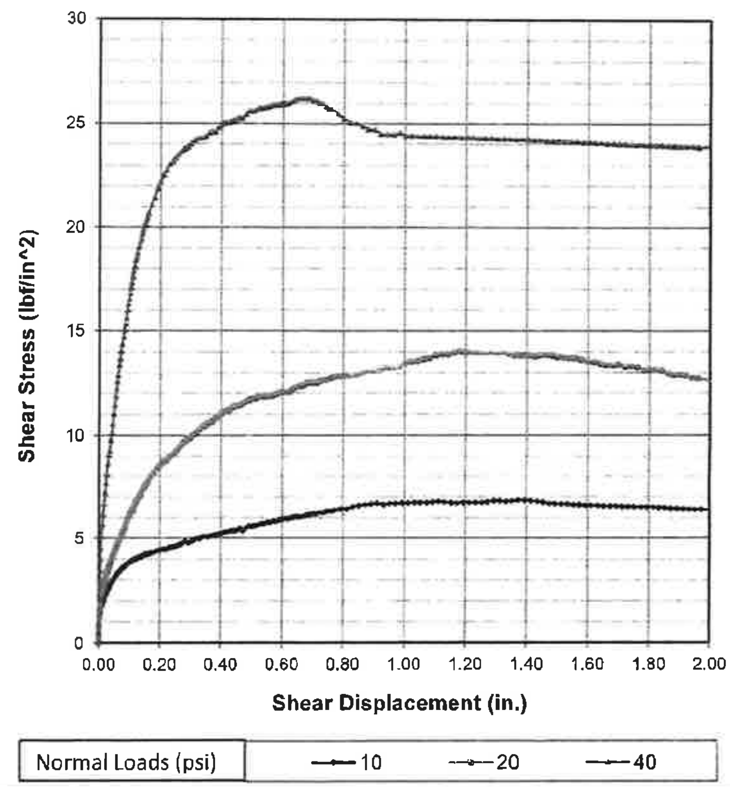
Project	Bourne Landfill	Project Manager	K. Maynard
Location	Bourne, MA	Assigned By	J. Balboni
File No.	CTS-74-16-0002.167	Tested By	RR
Test No.	DS-1556	Reviewed By	MJC
Date	11.17.16	**Shear Angle (°)**	**34.5**
Density	Similar to in-situ (~90%)	Intercept (lbf/in^2)	0.7222
Test Material	Sand vs HDPE	Source	On-site Borrow
Condition	Saturated	Area (in^2)	36.0

Sand Direct Shear Tests (ASTM D3080)

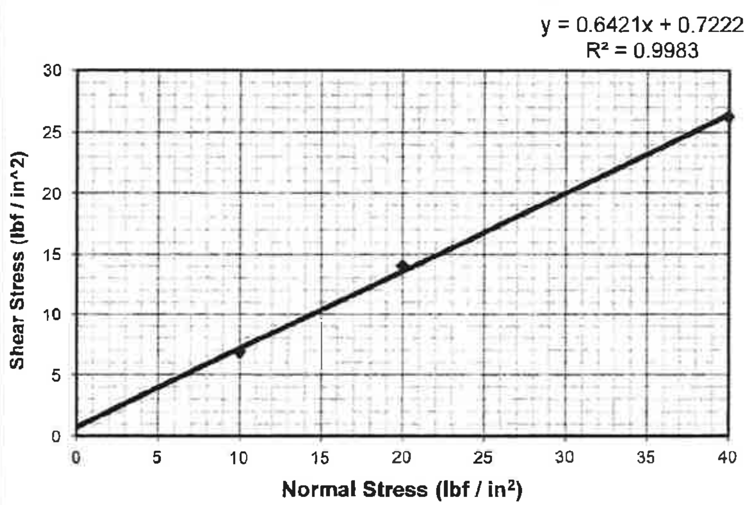
Normal Displacement vs. Shear Displacement



Shear Stress vs. Shear Displacement



Shear Stress vs. Normal Stress



Project	Bourne Landfill	Project Manager	J. DiGregorio
Location	Bourne, MA	Assigned By	J. Balboni
File No.	CTS-74-16-0003.13A	Tested By	AS
Test No.	DS-38	Reviewed By	MJC
Date	9/14/2016	**Shear Angle (°)**	**32.7°**
		Intercept (lbf/in^2)	0.722

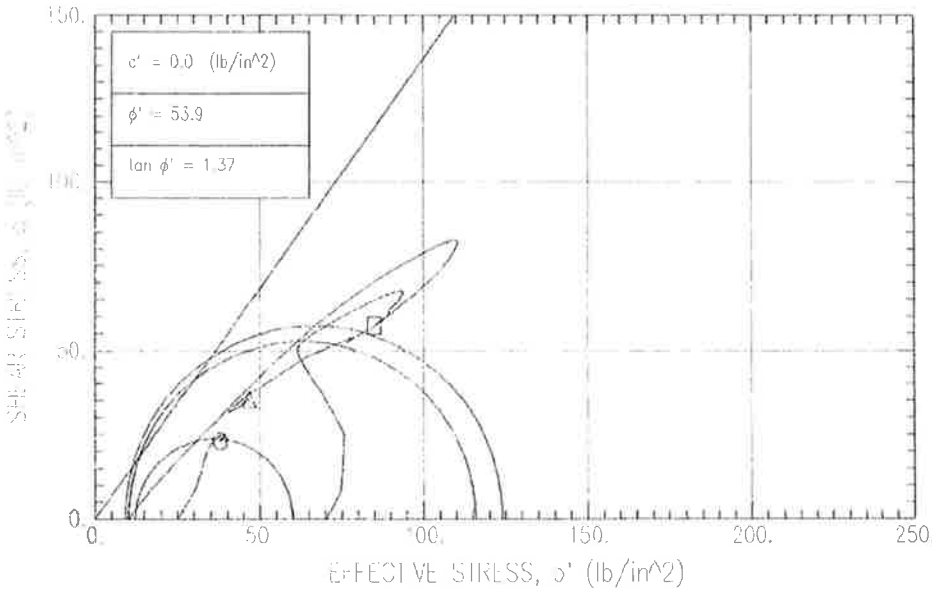
Source **On-site screened** Material **Bedding Sand**

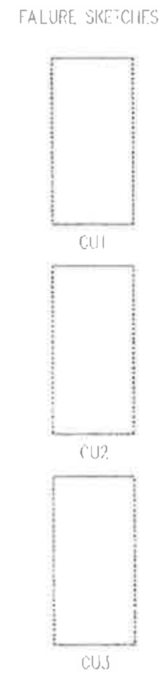
Sample **< 0.375" Material** Area (in^2) 36.0 (6" x 6") square mold

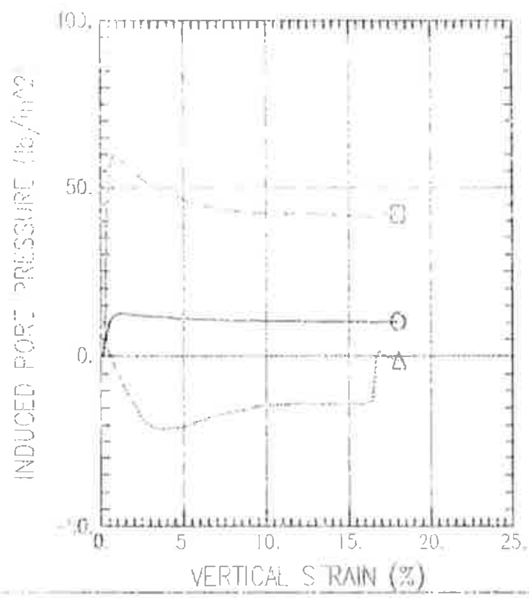
Notes: Test sample material was compacted to 90% of maximum dry density (102.2 pcf) at 12.3% moisture content by tamping method per section 7.5.2 of ASTM D3080-04. Material was tested at saturated condition.

APPENDIX “B”

Fly Ash and Boiler Aggregate Strength Tests







SYMBOL		○	△	□	
TEST NO.		CU1	CU2	CU3	
INITIAL	WATER CONTENT (%)	28.14	26.85	28.00	
	DRY DENSITY (lb/ft^3)	80.57	81.89	81.52	
	SATURATION (%)	79.43	78.55	81.09	
	VOID RATIO	0.843	0.814	0.822	
BEFORE SHEAR	WATER CONTENT (%)	38.70	35.55	35.34	
	DRY DENSITY (lb/ft^3)	76.72	79.46	80.05	
	SATURATION (%)	98.44	97.34	98.36	
	VOID RATIO	0.936	0.869	0.855	
	BACK PRESS (lb/in^2)	80.01	83.51	51.03	
MINOR PRIN. STRESS (lb/in^2)		25.03	10.15	70.06	
MAX. DEV. STRESS (lb/in^2)		49.89	165.14	135.02	
TIME TO FAILURE (min)		24	12	27	
RATE OF STRAIN INCR (%/min)		0.00	0.00	0.00	
INITIAL DIAMETER (in)		2.87	2.87	2.87	
INITIAL HEIGHT (in)		6.24	6.10	5.48	

CONTROLLED STRAIN TEST

DESCRIPTION OF SPECIMENS: 1) Fly Ash 2) Fly Ash

3) Fly Ash

LL	PL	PI	GS 2.38	TYPE OF SPECIMEN Compacted	TYPE OF TEST CU (R)

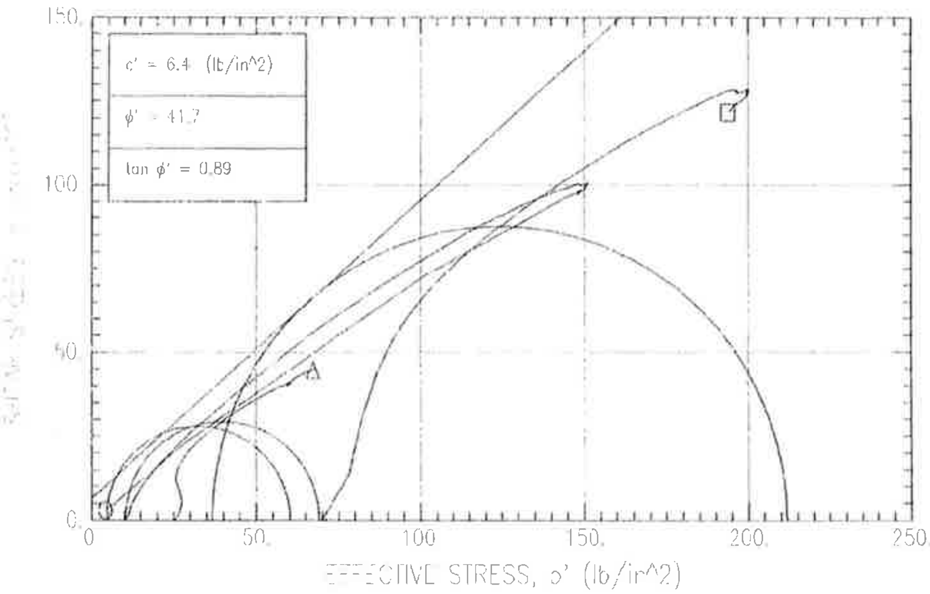
REMARKS:

1) Sigma=5 psi, MC=27.5%, 95% Ydry= 85.4 pcf

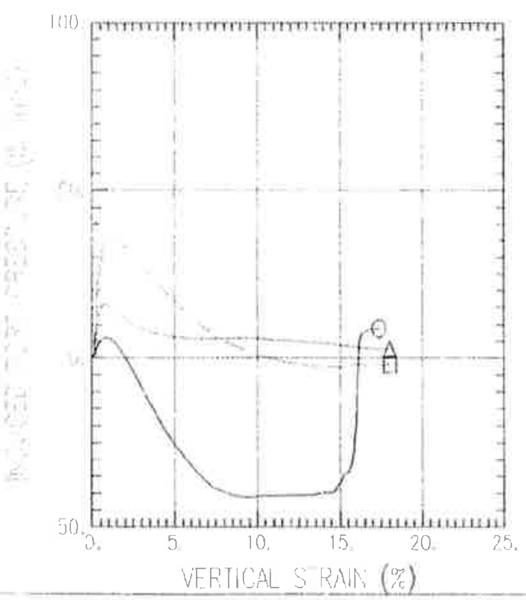
PROJECT CMW Phase III Landfill				
PROJECT NO.GTX-447				
BORING NO ---	SAMPLE NO	1	2	3
TECH rl	DEPTH/ELEV	----	----	----
LABORATORY	DATE	8/31/94	9/1/94	9/6/94

TRIAXIAL COMPRESSION TEST REPORT

GeoTesting Express



FAILURE SKETCHES



SYMBOL		○	△	□
TEST NO.		CU4	CU5	CU6
INITIAL	WATER CONTENT (%)	8.70	8.70	8.70
	DRY DENSITY (lb/ft^3)	111.46	108.09	111.55
	SATURATION (%)	52.86	47.80	53.00
	VOID RATIO	0.4[illegible]6	0.461	0.415
BEFORE SHEAR	WATER CONTENT (%)	17.22	27.06	20.83
	DRY DENSITY (lb/ft^3)	109.42	100.77	106.29
	SATURATION (%)	98.38	120.84	108.62
	VOID RATIO	0.443	0.567	0.485
	BACK PRESS. (lb/in^2)	85.99	45.90	55.10
MINOR PRIN. STRESS (lb/in^2)		10.05	25.12	69.75
MAX. DEV. STRESS (lb/in^2)		201.17	90.19	257.06
TIME TO FAILURE (min)		38	180	40
RATE OF STRAIN INCR (%/min)		0.00	0.00	0.00
INITIAL DIAMETER (in)		2.87	2.87	2.87
INITIAL HEIGHT (in)		6.10	6.35	6.10

CONTROLLED STRAIN TEST

DESCRIPTION OF SPECIMENS: 1) Boiler Aggregates 2) Boiler Aggregates 3) Boiler Aggregates

LL	PL	PI	GS 2.53	TYPE OF SPECIMEN Compacted	TYPE OF TEST CU (R)

REMARKS:

1) 95% γdry max, @OPT. MC; Conf. pres = 10 psi.
2) 95% γdry max, @OPT. MC; Conf. pres.= 25 psi.
3) 95% γdry max, @OPT. MC; Conf. pres.= 70 psi.

PROJECT CMW Phase III Landfill				
PROJECT NO GTX-447				
BORING NO. — —	SAMPLE NO.	4	5	6
TECH. rh	DEPTH/ELEV	---	---	---
LABORATORY	DATE	09/09/94	09/11/94	09/09/94

TRIAXIAL COMPRESSION TEST REPORT

GeoTesting Express

PART D

DRAFT OPERATION AND MAINTENANCE PLAN
FOR THE
PHASE 9 LANDFILL EXPANSION
BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY

DRAFT OPERATION AND MAINTENANCE PLAN
AUTHORIZATION TO CONSTRUCT

PHASE 9 LANDFILL EXPANSION
BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY
BOURNE, MASSACHUSETTS

Prepared for:

Town of Bourne
Department of Integrated Solid Waste Management
Bourne, Massachusetts 02532

Prepared by:

SITEC Environmental, Inc.
769 Plain Street, Unit C
Marshfield, Massachusetts 02050

December 6, 2022

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BOURNE, MASSACHUSETTS

DRAFT OPERATION AND MAINTENANCE PLAN
APPLICATION FOR AUTHORIZATION
TO CONSTRUCT A LANDFILL
PHASE 9 LANDFILL EXPANSION

1.0 INTRODUCTION

1.1 General

This Draft Operation and Maintenance Plan (Plan) has been developed for the Phase 9 Landfill Expansion at the Bourne Integrated Solid Waste Management Facility (the Facility) located in Bourne, Massachusetts in accordance with the requirements set forth in 310 CMR 19.000 of the Massachusetts Solid Waste Management Regulations. This Plan is intended to describe steps necessary to operate and maintain Phase 9 in accordance with the operating permits, the Massachusetts Department of Environmental Protection's (the Department, MassDEP) Solid Waste Management Regulations and the Landfill Technical Guidance Manual

1.2 Format of this Document

This Plan has been organized to address MassDEP regulatory requirements for the operation of landfills, in accordance with the following outline.

OPERATIONS PLAN OUTLINE		
Section in this Plan	**Operational Procedures**	**Regulations**
Section 1.0	Introduction	---
Section 2.0	Project Description	310 CMR 19.104 (5)(a)
Section 3.0	Requirements of Operations	310 CMR 19.130
Section 4.0	Recycling and Composting	310 CMR 19.130 (27)
Section 5.0	Landfill Operational Sequence	310 CMR 19.104 (5)(a)
Section 6.0	Storm Water Management	310 CMR 19.115
Section 7.0	Leachate Management	310 CMR 19.104 (5)(c)
Section 8.0	Landfill Gas Management	310 CMR 19.121
Section 9.0	Staffing	310 CMR 19.104 (5)(d)
Section 10.0	Inspections and Maintenance	310 CMR 19.104 (5)(e)
Section 11.0	Safety	310 CMR 19.104 (5)(f)
Section 12.0	Environmental Monitoring	310 CMR 19.104 (5)(g)
Section 13.0	Nuisance Control Plans	310 CMR 19.130 (16)

2.0 PROJECT DESCRIPTION

2.1 General

The Bourne Integrated Solid Waste Management Facility (the Facility) is owned and operated by the Town of Bourne. The Facility, consisting of three parcels totaling approximately 112 acres and located at 201 MacArthur Boulevard (Route 28) in Bourne, Massachusetts, approximately one mile south of the Bourne Bridge. The first parcel consists of a site-assigned area of 74.05 acres on which the landfill is constructed and operated. The parcel was originally described as 78 acres, based upon a "taking plan" prepared in the 1960s and the site assignment also describes the parcel as 78 acres. Subsequent recorded survey plans have determined that the parcel is more correctly 74.05 acres. The second parcel is a 25-acre parcel of land, also owned by the Town of Bourne, which abuts the site-assigned landfill parcel along its southerly boundary. This parcel is site assigned to conduct solid waste handling and landfilling operations. The Town has constructed and operates a construction and demolition (C&D) material transfer station and a residential recycling center on this parcel. The Town also operates a single stream recyclable material transfer station and conducts leaf and yard waste composting activities along with soil stockpiling on this parcel. A third parcel consisting of approximately 12 acres abuts the 25-acre parcel to the south. This parcel is currently undeveloped, however the Town is pursuing plans to utilize this acreage to support expansion of the current integrated solid waste management operations once it has obtained the necessary permits, including approvals from the Natural Heritage and Endangered Species Program. The 12-acre parcell has been site assigned for solid waste handling operations. This parcel is an important part of the long-term site development master plan as the landfill is expanded southward onto the 25-acre parcel. Vacant woodlands border this parcel to the south and Route 28 borders the Facility to the west. Facility is bordered to the north by property owned by Monument Beach Sportsmen's Club. The easterly bordering property consists of primarily undeveloped land on the Joint Base Cape Cod.

This Application for Authorization to Construct (ATC) addresses the construction, operations, monitoring and closure for the proposed Phase 9 Landfill Expansion at the Bourne Landfill located in Bourne, Massachusetts. The proposed expansion is located within the central portion of the original Landfill property. The total footprint of the area to be filled will encompass approximately 28-acres, which completely overlays previously lined and landfilled areas. Phase 9 will be a vertical expansion over portions of the Phase 2, Phase 3, Phase 2A/3A, Phase 4, Phase 5 and Phase 6, or in other words all lined landfill phases. Consequently there will be no liner construction conducted as part of the Phase 9 Landfill Expansion. The gross available volume for Phase 9 will be approximately 1,255,000 cubic yards.

The design of the expansion incorporates the existing liner systems of the underlying landfills as its double composite liner system. The liner system includes primary and secondary leachate collection systems, designed in accordance with the requirements of 310 CMR 19.000 and current MassDEP policy. The secondary leachate collection systems provide leak detection capabilities for the primary liner system. Leachate will be collected from the primary and the secondary liner systems and will flow to the respective leachate collection sumps. This leachate will be pumped to either the 207,000 gallon or to the 125,000 gallon above ground storage tanks. Leachate will be removed from the storage tanks on a regular basis and transported to an approved treatment facility.

The Phase 9 Expansion will have a maximum disposal capacity of approximately 1,192,000 tons. Currently, the Facility is accepting ash for disposal and daily cover, at a rate of approximately 230,000 tons per year. At that rate the life expectancy of the Phase 9 Landfill will be about five years, two months.

2.2 Landfill Description

The Landfill site is currently developed in seven phases: Phase 1, Phase 2, Phase 3, Phase 2A/3A, Phase 4, Phase 5, and Phase 6. Phase 9, the subject of this plan, while not number sequentially will be the eighth phase. Phase 1 consists of four cells. Three of which, Phases 1A, 1B and 1C (Phase 1ABC) comprise a 21-acre unlined landfill located in the northwesterly corner of the Facility. Phase 1ABC received a final cover system in the summer of 2000. Phase 1D was a separate 6-acre unlined area located southwest of the former residential recycling center. This landfill has been completely reclaimed and its area has been incorporated into the Phase 4 Landfill. The Town of Bourne received approval from the Department for the reclamation of Phase 1D. Site preparation work for the Phase 1D Reclamation project commenced in November 2002 and reclamation activities commenced in January 2003. This work temporarily halted for the construction of the Phase 3, Stage 3 Landfill during the summer and fall seasons of 2003. Reclamation activities began again during the winter months of 2004 and halted again for the construction of Stage 1 of the Phase 2A/3A landfill cell. The Phase 1D Reclamation activities again began in March of 2011 in preparation for the Phase 4 development and were completed in December 2011, in order to allow for the construction of Phase 4. In order to complete the Phase 4 work the former residential recycling center had to be relocated from the western limits of the Phase 4 area to the southern portion of the site. A detailed report of the Phase 1D reclamation project was part of a Notice of Project Change (NPC) submitted to the Massachusetts Environmental Policy Act (MEPA) office in December 2015 along with an update on Phase 5.

Phase 2 is an 8-acre lined cell divided into two stages and is located in the northeasterly corner of the Facility. A final cover system was completed in accordance with a DEP-approved Corrective Action Design (CAD) plan in the fall of 2002.

Phase 3 was developed in three stages. Stages 1 and 2 are fully constructed comprising approximately 8 acres of landfill cell using a double composite liner system with leak detection. A final cover system was installed over the eastern sideslope of these areas in the fall of 2004 and was constructed in accordance with a DEP-approved Corrective Action Design (CAD). The western sideslope of the Phase 3 landfill has been overlain with waste material as part of Phase 2A/3A, Stage 1 operations. Phase 3, Stage 3 has been constructed along the southerly extent of Phase 3 and includes approximately 4.25 acres of double composite landfill liner with leachate collection and leak detection capabilities. A final cover system was installed over the eastern sideslope of the Phase 3, Stage 3 area in the fall of 2006 and was constructed in accordance with a DEP-approved

Corrective Action Design (CAD). The remaining sideslopes of the Phase 3, Stage 3 area were either overlain by the Phase 2A/3A, Stage 1 or Phase 4 operations or are currently being overlain be the active Phase 6 Landfill operations.

Phase 2A/3A, Stage 1 consisted of a north and south cell, constructed in the valley created between Phase 1 and the Phase 2 and Phase 3 cells. Together, the cells consist of 15.7 acres of liner, including a constructed 6.2-acre double composite liner system with leachate collection and leak detection located on the western portion of the Stage 1 area. The design on the eastern portion of the Stage 1 area incorporated components of the Phase 2 and Phase 3 liner and final cover systems. Approximately 5.3 acres of Phase 2 had previously been capped with a standard 40 mil. HDPE final cover system. The western 2.3 acres of the Phase 2 final cover system have been overlain with waste material during the Phase 2A/3A, Stage 1 landfilling operations.

Phase 2A/3A, Stage 2 consists of a single cell, built on the eastern sideslope of the Phase 1ABC landfill. The cell consists of 4.55 acres of double composite liner system with leachate collection and leak detection. The design of the Stage 2 area did not incorporate any components of the Phase 1ABC final cover system into the liner. The top soil of the Phase 1ABC cap was removed, leaving the sand drainage layer and 40 mil HDPE cap generally undisturbed. The double composite liner system was then built up above the remaining cap components and is tied into the Phase 2A/3A, Stage 1 liner and leachate collection systems.

Phase 4 is located in the western central portion of the Landfill parcel. It was constructed in two Stages, with Phase 1 being constructed in 2011 and 2012 and the second stage in 2013. The Phase 4, Stage 1 area was closed and capped in 2015, with the Stage 2 sideslopes being capped in 2021.

The Phase 5 Landfill area consists of a 3.5 acre, double composite landfill liner constructed across the top plateau of the Phase 1ABC Landfill and overlays the western sideslope of the Phase 2A/3A Landfill and northern sideslope of the Phase 4, Stage 1 Landfill. The construction of this landfill expansion provided approximately 200,000 cubic yards (125 acre-feet) of gross air space capacity to the Facility. Phase 5 has been used for the disposal of ash from the Covanta SEMASS Facility. The Phase 5 sideslopes were capped in 2021.

The Phase 6 landfill is the final portion of the horizontal development of the Landfill on the original 74-acre site assigned parcel. The Phase 6 Landfill area consists of landfill liner construction within previously unlandfilled area. Operations overlay the southern sideslopes of the Phase 3, Stage 3 and the Phase 4, Stage 2 Landfills. The maximum potential build out of the Phase 6 Landfill Expansion would include the construction of about 9.8 acres of new landfill liner. The construction of this maximum build out of the Phase 6 Landfill Expansion would add up to approximately 1,670,000 cubic yards (1,035 acre-feet) of gross air space capacity (including cover materials) to the Facility. However, the Phase 6 liner construction and capacity as approved by issuance of an Authorization to Construct (ATC) by MassDEP on July 16, 2018 is a smaller liner area (6.9 acres) which provides approximately 920,000 cubic yards (570 acre-feet) of gross air space capacity. This approved configuration will allow for future landfill expansion southward into Phase 7, which is to be located adjacent and to the south of Phase 6 and will extend onto the 25-acre parcel. Phase 9 will extend to the limit of the existing Landfill including Phase 6. The Phase 6 Landfill is currently being used for the disposal of MSW from Bourne and the Town of Falmouth and ash from Covanta SEMASS.

This Draft Operation and Maintenance (O&M) Plan is for the Phase 9 Landfill Expansion. The Phase 9 area is a vertical expansion over lined and previously landfilled areas. Prior to landfilling operations site preparation work will include the removal of portions of the existing cap, modifications to the existing gas collection system and extensions to the existing leachate collection system, as shown on the Plans. The total area of the Phase 9 Landfill Expansion covers about 28-acres of the existing landfilled area. The construction of the maximum build out of the Phase 9 Landfill Expansion will add up to approximately 1,255,000 cubic yards (260 acre-feet) of gross air space capacity (including cover materials) to the Facility. The Phase 9 Landfill will be used for the disposal of MSW and ash from the Covanta SEMASS Facility.

2.3 Waste Acceptance

The Town may operate the Landfill seven days per week, 52 weeks per year, Monday through Saturday 7:00 AM to 4:00 PM and Sunday from 7:00 AM to 12:00 PM. The Town may landfill an average of 600 tons per day of MSW, residual C&D waste and other non-MSW wastes with a maximum of 700 tons per day. The Landfill shall not accept more than 4,900 tons per week or more than 219,000 tons of waste for disposal per year. The definition of non-MSW for the purpose of this permit includes bulky waste, difficult-to-manage waste, soils under the Department's reuse policy, municipal waste combustor ash and special wastes that have received prior written approval from the Department and only in accordance with Department policy.

2.4 Non-MSW Waste Management

In September 2004, the Town submitted a Minor Modification Application for Phase 3, Stage 3 (transmittal # W050698) that addressed future management of non-MSW at the Facility. On February 8, 2005, the Department issued a Permit Approval, Landfill – Minor Modification of Facility Operations that approved portions of the Town's Application, with conditions. In its approval DEP approved the first three issues and advised the Town to take certain actions on the last three issues of the Application. The MassDEP's resolution of the six Application issues are discussed below. The approved solid waste management operations, as described in the first three issues discussed below, are proposed for implementation in this Operation & Maintenance Plan for the Phase 6 Landfill.

C&D transfer- As of July 1, 2004, ISWM ceased processing C&D within the lined landfill. Since then and with subsequent schedule extensions ISWM was allowed to transfer non-MSW from the landfill face to regional processing facilities, providing that adequate protection of the liner system is maintained. Subsequently, ISWM constructed a new transfer station on the southern 25-acre parcel. The Authorization to Operate Permit was issued by MassDEP on March 31, 2009 and C&D

transfer operations began in the new facility on April 7, 2009.

Non-MSW volume reduction- The Town proposed to process difficult-to-manage (DTM) and bulky waste, other than C&D, in the lined landfill cell using either its tub grinder or other heavy equipment it deems appropriate. By doing this, ISWM extended the life of the Landfill and increased operational efficiency, as well as provided regional options for this type of waste in the absence of recycling opportunities and at times of extenuating circumstances such as storm events. MassDEP approved the proposed operations but reserved the right to require recycling of these materials if new and suitable technologies for these operations are developed.

In the past the facility would grind non-recyclable wood such as pressure treated wood, utility poles and railroad ties. Subsequently, MassDEP directed the facility to cease these operations, which it has. In the future the facility may provide notice and request approval from MassDEP to grind these materials, in accordance with 310 CMR 19.017*Waste Bans* (6) *Exceptions*.

Waste Ban Compliance Plan (WBCP) Update- The Town submitted an amended WBCP to address its change to accepting MSW in its disposal waste stream. Subsequently the Town submitted amended WBCPs to address the change of operations to a predominantly ash landfill and to update the Plan as regulations were changed. MassDEP approved the most recently revised WBCP on November 7, 2022, which is an update to comply with the most recent regulatory requirements. This is the WBCP that will be used for Phase 9 operations. See Appendix A for a copy of the currently approved Waste Ban Compliance Plan.

Animal carcasses- Bourne is located on Cape Cod, which has been the site of numerous strandings of marine mammals and sea turtles on its shores, including large whales. The Town had applied to manage these carcasses, and other large animal carcasses, as it does small carcasses such as road kill. The Town submitted a Special Waste Permit Application BWP SW 14 (Major), in order to receive approval to conduct these operations. MassDEP issued an approval of this application on September 12, 2006. When at all possible, operators will be provided with a day's notice prior to delivery of the carcasses. Handling procedures will ensure that carcasses are treated to prevent odor, during both shipment and disposal at the Landfill. On the day of the scheduled delivery a suitable hole will be prepared to immediately receive the carcass. Upon placement of the carcass into the hole, it will be immediately backfilled. This method eliminates that possibility that entrails or fluids might be spread around the working face, or contact Landfill workers or equipment, as well as controlling odors and access to vectors. The burial locations are to be marked and recorded so as to eliminate possible future exposure by drilling or excavation. No carcasses shall be disposed that are subject to Massachusetts Regulation 105 CMR 480, which regulates contaminated carcasses, body parts, and bedding used by research animals exposed to pathogens.

Town generated C&D- ISWM operates a residential recycling center where residents deposit C&D into roll-off containers. Loads are received in vehicles with a capacity less than 5 cubic yards. The Town will maintain its prerogative to directly landfill C&D from the residential recycling center. However, materials generated by the Town at various municipal projects (schools, renovations, etc.)

that are in containers larger than 5 cubic yards will be managed at the C&D transfer station with other C&D.

Catch Basin Cleanings- In accordance with DEP's fact sheet entitled "Management of Catch Basin Cleanings", ISWM sought approval to use catch basin cleanings as daily cover, as well as grading and shaping material for the Landfill. MassDEP advised the Town to submit applications for either a Beneficial Use Determination or a Landfill Operations Minor Modification.

Additionally, Pursuant to DEP **Policy # BWP-96-012: Concerning Non-Friable Asbestos-Containing Material,** if the on-site inspector determines that the only suspect ACM within a waste load is vinyl asbestos tile and/or asphalt based asbestos-containing siding products and asphalt based asbestos-containing roofing materials, then the entire load may be disposed at the Landfill using best management practices to prevent emissions, and the load is exempt from the remainder of this protocol, and does not require testing or notification to DEP. The load should not be culled, compacted or otherwise handled in a manner that causes breakage of the suspect ACM material.

3.0 REQUIREMENTS FOR OPERATIONS

3.1 General - 310 CMR 19.130 (1)

The Bourne Integrated Solid Waste Management Facility (the Facility) must be operated in conformance with requirements at 310 CMR 19.130. Operations at the Facility must follow accepted and approved practices to assure that conditions of approvals and permits are met, that no threats exist to the public health and to the environment and no nuisance conditions are allowed to develop. A copy of this Operation and Maintenance Plan and all associated regulatory permits and approvals are maintained at the Facility. These documents are available for inspection by regulating agencies and are used by operations personnel.

3.2 Operator Supervision - 310 CMR 19.130 (2)

The overall care, maintenance and responsibility for the Facility are under the direction of a qualified operator who has the necessary expertise and is given the appropriate authority to direct Facility operations. The Town has sent its managers to training provided by the Solid Waste Association of North America (SWANA) which has a multi-day course with an exam for landfill operations titled Manager of Landfill Operations, or MOLO. The General Manager, Operations Manager and Manager of Facility Compliance and Technology Development each has taken and passed this course.

3.3 Special Wastes - 310 CMR 19.130 (3)

No wastes classified as a special waste pursuant to 310 CMR 19.061(2) may be accepted unless expressly authorized in writing by the DEP, the Board of Health and the General Manager. Special wastes include asbestos waste, infectious waste, sludges and any waste that requires special management to ensure protection of public health, safety and the environment. Large animal carcasses have been defined to be Special Waste by the Department and are approved for management per the previous approval.

3.4 Banned or Restricted Solid Wastes - 310 CMR 19.130 (4) & 310 CMR 76

The following wastes are banned from disposal at the Facility:

- Asphalt Pavement, Brick and Concrete (ABC)
- Cathode Ray Tubes (CRTs)
- Clean gypsum wallboard
- Commercial Organic Material
- Glass Containers
- Lead Batteries
- Leaves
- Mattresses
- Metal
- Metal Containers
- Recyclable Paper
- Single Polymer Plastics
- Textiles
- Tires
- White Goods
- Wood
- Yard Waste
- Mercury containing materials (this is banned under 310 CMR 76.

All waste categorized as hazardous, whether in solid, liquid or gaseous form, along with "banned waste" are explicitly prohibited from disposal at the Facility. Facility personnel have been trained to recognize and properly manage unacceptable waste. Signage listing banned items has been posted at the scale and at the entrance to the landfill.

3.5 Hazardous Waste - 310 CMR 19.130 (5)

The Facility does not accept for disposal any substance subject to the Commonwealth of Massachusetts Hazardous Waste Regulations, 310 CMR 30.000, EPA 40 CFR 261 RCRA or EPA 40 CFR 761. A hazardous waste detection and exclusion program has been implemented at the Facility.

The program includes the following components:
1. Inspections of incoming loads of waste.
2. Record-keeping related to implementation of the detection and exclusion program.
3. Training of facility personnel.

4. Notification of the Massachusetts Department of Environmental Protection, Southeast Regional Office, Solid Waste Management Section.

Waste Inspections

With the exception of local residents accessing the residential recycling center, all waste-hauling vehicles entering the Facility stop at the scale house to be weighed. Once at this location, a radiation screen has taken place and the weight has been recorded. Another video camera is situated at the scale that can be used to make a visual inspection of the vehicle. The weigh master prepares an inbound weight ticket, provides the ticket to the driver and directs the driver to the landfill.

The vast majority of waste material coming into the Landfill is currently either MSW ash from the SEMASS facility or curbside collection packers from the Towns of Bourne and Falmouth. After each vehicle leaves the scale, the driver follows signage to the queuing area where the equipment operators direct the vehicles to the proper dumping locations.

Other vehicles that are allowed to use the Landfill on a case by case basis are subject to a more directed process for discharging their waste material. After each vehicle leaves the scale, the driver follows signage to the queuing area where personnel review the scale weight slip, which indicates the contents of the load and its origination. The queuing area personnel communicate with the equipment operators in the landfill who will indicate when and where the vehicle will be accepted for unloading. The queuing personnel then direct the vehicle to the proper location.

Once the truck is admitted to the landfill and is shown where to deposit its load, it is observed off-loading its cargo and the waste is spread and inspected. The equipment operators at the active face constantly monitor the off-loading trucks and waste for any material which may be classified as restricted waste, special waste or is otherwise unacceptable to dispose of in the landfill. In addition, the landfill personnel conduct random inspections of loads of wastes delivered to the landfill. In accordance with the approved Waste Ban Plan, the inspections are documented and a copy of the written report is retained in the ISWM files. These inspections are performed in a secure area and an appropriate standard of care is exercised to ensure that the health and safety of the inspection personnel is not compromised.

All inspections must be performed in strict conformance with applicable OSHA requirements. If any part of a load is suspected of being unacceptable to deposit in the landfill, it must be isolated and the truck that brought the material identified. If the identification is made prior to the truck departing the active face, the offending vehicle operator must be notified about the infraction. If the identification is made after the truck leaves the working face, but prior to its exiting the facility, the information shall be relayed to the scale house and the truck will be intercepted.

If the identification is made after the truck is no longer on the premises, the material will be separated from the operating face of the landfill and properly secured by ISWM personnel. The owner of the truck shall be informed of the problem and presented with options for management. If appropriate, the owner can arrange to take back the load or hire a third party to safely remove it. ISWM may also have its contractor remove the material and charge the customer. If the driver and/or the owner of the truck refuse to cooperate in the proper disposal of the material, the General

Manager or other designated individual may ban that company from the facility. In any event, the material will be properly managed.

Record-Keeping
All reports and inspection logs related to the Facility's hazardous waste exclusion program are to be maintained in the Facility operating record.

Notification
All incidents involving the discovery of regulated hazardous waste or PCB waste at the Facility will be immediately reported to:

Massachusetts Department of Environmental Protection
Solid Waste Management Section
Southeast Regional Office
20 Riverside Drive
Lakeville, Massachusetts 02347
(508) 946-2700

3.6 Bulky Wastes – 310 CMR 19.130 (6)

Bulky waste delivered to the site will be weighed at the scalehouse and directed via signs to the active cell. A spotter will be at the active face to direct off-loading of waste.

Great care must be taken when landfilling bulky wastes near a newly constructed groundwater protection system (GWPS, Section 5.4). These wastes may damage the GWPS if placed directly on the leachate collection layer. Bulky waste, as with all other wastes, may be landfilled only over the five-foot select waste layer situated over the drainage/protection layer. To the extent possible, bulky wastes will be reduced in size by a tub grinder in the landfill per previous approval by DEP.

3.7 Liquid Wastes– 310 CMR 19.130 (7)

The Facility will not accept liquid wastes for disposal, except for those approved by MassDEP via a demonstration project variance granted for injection of effluent from the on-site landfill gas scrubbers and condensate from the landfill gas collection system.

3.8 Solid Waste Handling – 310 CMR 19.130 (8)

The Facility currently utilizes the lined landfill to dispose of up to an average of 600 tons per day of primarily waste combustion ash, with the remainder being MSW, residual C&D and other non-MSW waste streams. Non-MSW for the purpose of this report includes bulky waste, difficult to manage waste and other special waste that has received a prior written approval from the Department and the Board of Health. C&D material transfer operations are being conducted in the C&D transfer station located in the southern section of the site assigned facility.

Waste handling at the Facility shall conform to the following requirements:

1. No waste shall be deposited in or allowed to enter surface water or groundwater.
2. No waste shall be unloaded at the landfill unless it is performed under the direct supervision of the designated staff.
3. Waste deposition shall be confined to the smallest area feasible to limit the area requiring daily cover at the end of the day.
4. The operator will use signs, or other suitable means, to direct vehicles to appropriate areas.

3.9 Bird Hazards– 310 CMR 19.130 (9)

Scavenging birds can produce nuisance conditions or pose a hazard to aircraft; therefore, birds will be controlled by implementing a number of bird control techniques. The following bird controls are routinely employed:

Timely cover placement
Although daily cover must be applied at the end of each operating day, there may be occasions when more frequent placement of daily cover is necessary to limit the number of scavenging birds at the landfill. Processed Bottom Ash (PBA) is used for daily cover material and not soil.

Eliminate standing water
Areas of standing water are minimized. After rain events, storm water accumulates in storm water management basins. These basins are maintained to promote infiltration of water into the sandy natural soils, in order to eliminate ponding and standing water, which can be an attraction to birds.

Sonic devices
Pyrotechnics are used to frighten scavenging birds. The timing of the shots is varied to prevent predictability.

Flight pattern interruption structures
It is well known that seagulls need a large area in which to glide to a landing. Techniques that interrupt this glide path are effective in discouraging birds. These include the use of monofilament fishing line strung across strategic areas, tethered balloons and cables. Permanent steel wire has been installed on the single stream recycling facility and has worked successfully.

Depredation
In addition to the above methods, and as a last measure, the Facility has a Federal bird "depredation permit", which it may use successfully in controlling scavenging birds on an as-needed basis.

3.10 Equipment and Equipment Shelter – 310 CMR 19.130 (10)

The Facility must have adequate numbers and the appropriate types and sizes of equipment to ensure adequate compaction of waste and proper operations. A list of the equipment used at the Facility is presented below:

EQUIPMENT LIST	
DESCRIPTION	**MAKE & MODEL**
(3) Front-End Loaders	(2) CAT 966 Nexgen/CAT 908
(4) Bulldozers	(2) CAT D6 LGP Nexgen/(2) Military D7
(2) Compactors	CAT 826H
(2) Excavators	CAT 323F/CAT 323 Nexgen
(2) End Dump	John Deere 350D/CAT 735
(2) Fifth-wheel Tractors	Military 2 ½ -ton and 5-ton
Tub Grinder	Diamond Z 1463B
(3) Screeners	McCloskey R155
(2) Skid-steer loaders	CAT 272D, CAT299D3
(3) Roll-off Trucks	Volvo/Volvo Autocar/F550 Super Duty
(3) Pick-up Trucks	(2) Ford F250 and Ford F350
(2) Water Trucks	5 ton, 3,000 Gal. Military Truck/6,000 Gal. Osh-Kosh Tanker

The Facility is responsible for maintaining all equipment in good working order and making sure that the equipment is adequate to meet the demands of the landfill and recycling operations. In addition, the Facility provides adequate shelter and protection for equipment.

3.11 Staffing – 310 CMR 19.130 (11)

The Facility must have an adequate number of trained staff to ensure the Facility is operated and maintained as designed and in accordance with good solid waste management practices. Typically, staff at the Facility includes:

- One General Manager
- One Operations Manager
- One Manager of Facility Compliance and Technical Development
- One Landfill Crew Chief
- One Mechanics Crew Chief
- One Recycling Crew Chief
- One Wellfield Technician
- One Scale Attendant
- Three Residential Recycling Center Attendants
- Two Utility/laborers
- Seven Equipment Operators
- Two Mechanics
- Two Clerical Office Staff

This roster of employees enables the Facility to be operated and maintained in compliance with the Facility's approvals and applicable regulations. Part-time employees and temporary workers may be necessary to supplement the full-time staff during vacations, sick days or special projects. A complete description of staffing is provided in Section 9.0.

3.12 Employee Facilities – 310 CMR 19.130 (12)

The Facility is equipped with sufficient lighting, heat, drinking water, sanitary hand washing, toilet facilities and telephone services. These facilities are currently available at the Integrated Solid Waste Management office, the scale house, the maintenance facility and the single stream transfer facility. Chemical toilets are currently provided at the residential recycling area and the transfer station. The transfer station operators can access phone and water at the residential recycling center adjacent to the transfer station.

3.13 Accident Prevention and Safety – 310 CMR 19.130 (13)

All Facility employees undergo training in emergency medical procedures and in safety practices that must be followed at the Facility. The telephone numbers for emergency medical care and ambulances are conspicuously posted in the scalehouse and Facility offices by the telephones. Personnel communicate with radios in emergency situations to coordinate the proper response.

First aid kits are maintained at the Bourne Integrated Solid Waste Management office, scalehouse, the transfer station, single stream transfer facility, the maintenance facility and the residential recycling center and are clearly visible and easily accessible. Typically, Facility equipment carries small first aid kits, containing bandages and disinfectants. All employees must be instructed in the basics of first aid and accident prevention. The site also maintains an automated external defibrillator.

3.14 Spreading and Compacting of Solid Waste– 310 CMR 19.130 (14)

As waste is deposited on the working face it is spread across the area in layers not more than two feet thick. Once spread, the waste is inspected for unacceptable materials and recyclables. The waste is densified by driving over it with compaction equipment. Three to five passes are required to compact each layer of waste.

3.15 Cover Material– 310 CMR 19.130 (15)

Daily Cover

The objectives of daily cover are to:

- Prevent fires.
- Prevent vectors (rodents, etc.) from proliferating and/or burrowing into landfilled wastes.
- Minimize odors and related nuisance conditions.
- Control windblown litter.
- Provide a stable base for Landfill traffic.

Bottom ash is used as the primary material for daily cover. There is also an abundant supply of on-site sand and gravel that has historically been used for Daily Cover.

Alternative Daily Cover (ADC) materials approved by the Department are foundry sands, crushed glass (per the DEP Beneficial Use Determination), auto shredder residue (ASR), incinerator bottom ash and reclaimed landfill material (RLM). The Facility investigates the possibility of using other alternative daily cover materials as they become available. Among the sources of daily cover that are approved for the Bourne Landfill are contaminated soils under DEP Policy # COMM-97-001 and process bottom aggregate (PBA) from the SEMASS facility

Daily cover is placed over all exposed waste at the end of the operating day and compacted to a six-inch (minimum) thick layer. When circumstances such as adverse weather conditions or potential odor and vector problems warrant, more frequent applications of daily cover are made and/or thicker layers are applied. Sufficient stockpiles of daily cover material are maintained at the Facility to supply the needs of the Landfill for a 14-day period.

Intermediate Cover

The purpose of intermediate cover is to provide a stable cover over landfilled areas that are temporarily inactive or have reached final grades prior to the construction of final cover. Intermediate cover also prevents storm water infiltration in these areas. To accomplish this objective, intermediate cover soils are less permeable than daily cover soils.

Intermediate cover is placed in a six-inch or twelve-inch layer, in addition to daily cover, over landfill areas that have not been or will not be active for a period of 30 days or more. When landfill operations will not be conducted in an area for a period of over 30 days, six inches of compacted intermediate cover is placed in addition to the daily cover. When operations will not be resumed in an area for six months, twelve inches of compacted intermediate cover is to be placed. In some instances ISWM has applied geomembrane as intermediate cover.

All intermediate cover material used at the landfill must fulfill certain Unified Soil Classification System (USCS) requirements. Specifically, the soils must contain sufficient quantities of clay materials and be sufficiently plastic to be classified as GC, SC, CL or OH by the USCS system (see 310 CMR 19.130). The Facility has in the past been using a blend of emulsion mix and clayey soils for intermediate cover materials. Currently mildly contaminated soils (COMM 97-001) are the materials that are primarily used for intermediate cover.

Final Cover

The purpose of final cover is to divert precipitation from completed landfill areas, facilitate the proper control of landfill gases, to provide stability to erosion prone slopes and to isolate landfill materials from the environment. Final cover must also be capable of accommodating landfill subsidence without sacrificing its integrity, and withstanding environmental stress, such as extremes of temperature and the forces of erosion resulting from rain and wind.

Final cover shall be installed within 90 days after one of the following events:

1. Whenever a new lift has not or will not be placed within a one year period.
2. Upon reaching final approved elevations.
3. Whenever a phase of the landfill has been completed.

Final cover must be maintained to prevent erosion and to ensure its integrity. A description of the final cover system is provided in Section 5.4.

3.16 Vector, Dust, and Odor Control – 310 CMR 19.130 (16)

The Facility shall be operated to prevent vectors, dust, odors and other nuisance conditions.

Vector Control
Vector control at the landfill may be accomplished by employing the following control methods:

- **Periodic application of cover material.** If vectors are a problem, cover material should be placed more often.
- **Immediate application of cover material.** Waste loads that attract vectors should be covered immediately to discourage the proliferation of vectors.
- **Mixing waste with soil.** Some waste loads may be mixed with soil materials to discourage vector contact.

By far the best method for minimizing vectors is the timely application of cover materials and placing cover materials in sufficiently thick layers to prevent vector contact with the waste.

Since the Facility accepts some MSW at the present time, there is an attraction for vectors to be present at the site of the operation. In order to reduce the presence of vectors the operators of the Facility maintain a contract with a licensed exterminator to conduct vector control actions, such as setting bait stations on a regular schedule and as needed.

Rodents
Proper compaction techniques, most of the waste material being ash, and the application of six-inches of daily cover soil at the end of daily operations will reduce the presence of rodents. Additionally, the size of the daily operating area at the Landfill's face will be kept to a minimum. This promotes good compaction and helps to control litter and odors that might attract rodents to the operating face. The contracted licensed exterminator also conducts rodent control actions concurrent with vector controls.

Dust Control
Due to the nature of landfilling operations, dust will be generated during dry periods of the year. The following control measures are employed at the Facility:

- Soil wetting. Facility access roads, on and off the landfill, are wetted using a water truck. This task is regularly performed several times during an operating day in the summer months.

- Application of calcium chloride. Calcium chloride, a soil wetting agent, may be used to control dust. However, using calcium chloride in large quantities is costly and may affect groundwater quality.
- Vegetative cover. Inactive landfill areas may be seeded to encourage the growth of vegetation and reduce barren soils.
- Secure Material Delivery. All Trucks delivering MSW, stone, soil or any other material to the site must have their loads covered.
- Pavement sweeping. The Facility operates a sweeper that it regularly uses to remove accumulated dirt from paved areas of the site. Removal of this dirt reduces dust generation caused by vehicle kick up of the material.

Odor Control

A potential source of odor is at the operating face of the landfill. Proper compaction and covering methods (daily and intermediate cover) help to minimize odors generated at the operating face. The operators are instructed to immediately deal with odors at the operating face should they arise. Measures such as the placement of daily cover and/or dry lime, as needed, to the surface of the area(s) that may be generating excessive odors are effective mitigation measures that are used at the Facility. ISWM has placed a ban on its acceptance of C&D residuals and fines materials, in order to reduce the generation of hydrogen sulfide. (See Section 13.4 for a more extensive discussion of odor control actions that are taken by the facility.)

Noise

Certain levels of noise are associated with the operation of trucks and heavy equipment at the Facility. The operation of equipment, the dropping of tailgates and the sound of back up signals are some of the more common and unavoidable sounds at the Facility. Back up signals are a requirement meant to provide a safer environment for the workers and visitors to the Facility.

Active operation and concurrent construction activities have occurred regularly at the Facility, without any indication that receptors have been adversely impacted by noise. The site is well buffered by distance, traffic noise along Route 28 and vegetation, mitigating potential impacts. The construction and operation of Phase 6 will not result in any significant change of conditions from present and past noise impacts. For additional information, refer to Section 13.0 – Nuisance Control Plans.

3.17 Litter Control– 310 CMR 19.130 (17)

Facility operations must be conducted to minimize blowing litter. The level of effort needed to control windblown litter is dictated by waste materials accepted, weather conditions and wind directions. Methods available to control windblown litter include the following:

- Portable litter fence. The most suitable location for litter control fence should be determined on a daily, or even more frequent, basis, based on the wind's direction. The fence should be placed as close to the active face as practical without disturbing the landfilling operations. The fencing should be constructed to allow the wind to pass through it. Permanent litter fencing has been installed along the northern, eastern and western property lines. The existing fencing, as supplemented by proposed fencing along the western property line, should be adequate for the Phase 6 Landfill operations.

- Application of cover material. Cover material should be applied frequently on the active face on windy days, if required, to minimize the blowing of lightweight waste materials.
- Active face on interior slopes. On windy days, the active face should be maintained on sheltered interior slopes, if possible. Waste disposal on outer slopes should be avoided when it is windy.
- Litter patrols. Litter collection crews are deployed regularly and as needed to gather windblown litter. In addition, these crews must routinely police areas along MacArthur Boulevard and properties abutting the Facility.
- Temporary fence installed at strategic locations within the operating landfill to create additional interception and collection points for wind-blown liter.

For additional information, refer to Section 13.0 - Nuisance Control Plans.

3.18 Top Slope and Side Slopes– 310 CMR 19.130 (18)

Exterior, permanent landfill side slopes shall be no greater than a slope of 3:1 (three horizontal to one vertical). All slopes shall be constructed in a manner that ensures there will not be excessive erosion. Hay bales and/or siltation fence may be installed perpendicular to the slope in areas that experience repeated erosion problems. If these materials do not adequately slow run-off, erosion mats or other erosion control devices may be needed. Intermediate cover soils placed on exterior slopes must be maintained to prevent storm water runoff from coming in contact with the daily cover and waste materials below.

The top slope of the active landfill must be graded to ensure that storm water that comes in contact with either solid waste or daily cover material does not drain from the lined landfill cell. This runoff must be fully contained within the cell and managed as leachate. This will be accomplished during the operations of the Phase 6 landfill by grading the active landfill surface inward.

3.19 Storm Water Drainage - 310 CMR 19.130 (19)

Sufficient storm water drainage controls must be provided to prevent ponding on the Landfill or uncontrolled ponding next to the filled area. The controls have been designed and constructed and shall be maintained to prevent erosion on the Landfill.

The proper and efficient management of storm water is an important aspect of landfill operations. Prior to landfilling in new areas at the Landfill, the Facility must implement all provisions necessary to control run-off, including prevention of mingling of contact and non-contact runoff, and to prevent run-on.

The storm water management plan for the Facility includes designs for operational and post-closure storm water handling. Included is separate handling of contact and non-contact run-off, collection of final side slope run-off by swales (on areas furnished with final cover), conveyance of top slope and side slope run-off to perimeter swales via side slope channels and the treatment of run-off in retention/sedimentation basins. A complete description of the storm water management plan for the Facility is provided in Section 6.0.

The storm water collection system should be inspected weekly and after major storm events to ensure that the system functions to prevent erosion and discharge of pollutants and to protect the physical integrity of the landfill. Storm water basins, perimeter swales and drainage structures on the landfill must be inspected and cleaned periodically to ensure that a buildup of silts and sediments does not occur.

3.20 Erosion Control – 310 CMR 19.130 (20)

Erosion controls must be implemented, as needed, to ensure the retention and integrity of the cover systems on the Landfill. Proper grooming of landfill slopes, with particular attention to planting and maintaining a vegetative cover, is the most important aspect of erosion control on the Landfill. Efforts to control erosion on intermediate slopes should include establishing vegetation and placing of siltation barriers (hay bales and/or siltation fencing). Surface slopes on the Landfill should be graded so that channeling of water is minimized, unless provisions are made to prevent surface scouring, such as stone lined channels. Intermediate cover is also used on slopes to effectively prevent erosion and seal in waste.

Vegetation on landfill surfaces should be native grasses or other low-lying vegetation with relatively shallow root penetration. During non-growing seasons, cover soils may be stabilized using straw, mulch or erosion mats.

The storm water management system consists of perimeter swales, diversion berms, let-down channels, bench swales and storm water basins. These structures are designed to remove surface run-off from the side slopes and filter out sediments. All erosion and sediment control structures must be cleaned and maintained so that they can carry out their function unimpeded.

3.21 Boundary and Elevation Markers – 310 CMR 19.130 (21)

Benchmarks on permanent and stable structures are established and shall be maintained in areas near the Landfill, where they may be conveniently utilized in operations and site preparation activities. Temporary benchmarks for short-term use may be established elsewhere on-site as the need arises. No permanent benchmarks should be placed on landfilled materials.

3.22 Access Roads – 310 CMR 19.130 (22)

Access to the Facility is from MacArthur Boulevard at the site entrance in the northwest corner of the site utilizing a deceleration lane. The road is paved from the entrance through the former recycling area, which has been reconstructed with new truckscales and traffic paths. The access road continues past a side street leading to the Integrated Solid Waste Management office building and on further to the Residential Recycling Center. Roads on the surface of the Landfill are constructed of granular soil materials or processed ABC materials. Some roads are temporary and will be re-located to accommodate traffic as operations move. All roads should be crowned and sloped to allow safe traffic movements. The access road surfaces must be continually maintained and regraded as needed to assure that they are passable during all weather conditions.

Landfill access roads must be established and maintained to assure that traffic flow will continue uninterrupted during bad weather. Traffic routing must enable vehicles traveling to or from the active area to proceed without delay. This may be achieved with one-way routing or by maintaining roads at sufficient widths to allow two trucks to pass. The Phase 6 Landfill will be accessed by multiple roads that will vary as the Landfill is developed.

3.23 Security – 310 CMR 19.130 (23)

Access to the Facility is by a single access point off MacArthur Boulevard. Gates at the entrance and at Phase 1ABC are secured and locked when the Facility is closed. There are also several video cameras that record activity at the Landfill, the scale and other locations.

3.24 Posting of the Landfill – 310 CMR 19.130 (24)

The Facility shall maintain adequate signage posted at its entrance, stating the name of the Facility, the owner, an emergency telephone number for the Facility, a list of banned wastes and the days and times of operation. Signs are also posted throughout the Facility, to direct traffic to the various services provided at the Facility.

3.25 Open Burning – 310 CMR 19.130 (25)

Open burning will not be conducted at the Facility.

3.26 Fire Protection and Control – 310 CMR 19.130 (26)

Procedures for handling fires must be posted at an appropriate location on-site and must include names and telephone numbers of authorities to be called during an emergency. The Solid Waste Management Section of the Southeast Regional Office of the DEP and the Bourne Fire Department must be notified whenever any fire, smoldering or smoking waste is discovered at the Facility. Disposal activities shall be suspended in the vicinity of smoldering, smoking or burning areas. Any disruption of the finished grade or covered surface as a result of fire-fighting activities must be repaired or replaced immediately upon termination of fire-fighting activities.

Heavy equipment utilized in the Facility operation are equipped with fire extinguishers as an added measure of safety to handle small flare-ups that might occur on these vehicles or at other locations around the site. Additionally, the site maintains a supply of organic firefighting foam and has two water trucks on-site..

All necessary precautions are implemented at the Facility to prevent fire from breaking out in the Landfill. These precautions include timely and proper covering of all disposed refuse, and an enforced ban on smoking within the Landfill. Furthermore, all materials stored, stockpiled, held or accumulated anywhere on site must be kept in such a manner to prevent fire hazards.

A designated hot load area will be located either in an excavated area on the 25-acre parcel. This area is used for the dumping of any incoming material that may be smoldering, smoking or burning. In case fire breaks out within the landfill, or signs of a fire are observed, local fire-fighting authorities and the Department must be alerted. No refuse may subsequently be deposited in the burning area.

The nearest continually manned fire station is located in Buzzards Bay, approximately three miles from the Facility. Operating municipal fire hydrants exist on the southwesterly portion of the property along the paved access road and along the southerly boundary of the site assigned property in the vicinity of the ISWM offices. There are additional hydrants in the area of the transfer station on the southern parcel. In addition, the facility has two water trucks available on site to help any fire suppression efforts.

3.27 Convenience and Recycling Drop-off Areas – 310 CMR 19.130 (27)

Convenience and recycling drop-off areas are operated in an orderly, safe and environmentally sound manner, and maintained to prevent nuisance conditions. Containers provided for the collection and storage of recyclables for transport off-site must be emptied when full or every 60 days, whichever is less. MSW is contained within an enclosed compaction unit. This operation is located on the 25-acre parcel, to the south of the landfill site assignment area.

3.28 Waste Oil Collection – 310 CMR 19.130 (28)

Waste oil is collected at the residential recycling center and within the vehicle maintenance facility in accordance with the Department regulations.

3.29 Household Hazardous Waste Collection – 310 CMR 19.130 (29)

Household hazardous waste shall not be collected at the Facility without prior authorization of the Department. Bourne participates in multiple, regional household hazardous waste collection days each year, usually during the months of April through October, in conjunction with the towns of Falmouth, Mashpee and Sandwich.

3.30 Leachate Collection, Treatment and Disposal – 310 CMR 19.130 (30)

The Phase Landfill is tributary to the existing double composite liner Groundwater Protection Systems (GWPS, refer to Section 5.0 for more details). The GWPS will be operated so that the storage of leachate does not exceed one foot of hydraulic head on the primary geomembrane liner, except during storm events. Leachate from the primary leachate collection systems (PLCS) will drain in a downgradient direction until it is intercepted by a perforated leachate collection pipe. The leachate collected in the pipe will flow by gravity into the leachate collection system sumps. The leachate collection system sumps are constructed along the easterly and westerly sides of the Landfill. From thesumps, the leachate is pumped into the existing four inch (4") force mains and to either the existing 207,000 gallon glass fused steel, above ground leachate storage tank located along the easterly property line opposite the Phase 3, Stage 3 Landfill area or to the newer 125,000 gallon tank located along the westerly side of the site, south of Phase 6.

The lined landfills were constructed with Secondary Leachate Collection Systems (SLCS). The SLCS is an independent system designed to collect leachate, should leakage occur within the PLCS. The SLCSs are comprised of a geocomposite drainage material, which is hydraulically connected and discharges to a perforated piping system that is installed between the primary and secondary composite liner systems, which conveys collected secondary leachate (leakage) to the secondary sumps. The SLCS sumps are equipped with an independent pumping system that conveys the leachate to either of the aboveground storage tanks.

The primary and secondary pump systems are designed to operate manually and automatically. When set in the automatic mode, the pump will start and stop automatically when a specified liquid level is reached in the sump area. The pumps are equipped with level sensors that signal the control panel to start and stop the pumps at specified levels. The quantity of pumped leachate is continuously recorded. The data generated by these reports are kept in the facility records.

A chemical addition system has been added to the Phas 6 leachate collection system. Experience has shown that being an ash landfill has resulted in solids accumulation occurring in the leachate collection and force main piping systems. Experience has also shown that a chemical named REDUX-300, which has active ingredients of a proprietary organic acid and potassium hydroxide, keeps the ash leachate from solidifying. The chemical feed system will consist of a manually operated chemical feed pump, a header pipe, a series of valved lateral pipes that extend to the leachate sump and a series of perforated pipes off of each of the lateral pipes which are installed along the primary leachate collection pipes and around the sump. The system will be manually operated to feed REDUX-300 to each of the lateral systems, to mix with the ash leachate in the leachate collection pipes, in order to keep the liquid from solidifying. In addition there is a four inch (4") HDPE pipe connected to the back of the 24" primary leachate sump collection pipe that will allow television inspection and power jet cleaning of the 24" collection pipe.

The leachate collection system is inspected regularly to ensure that the system is working properly. Visual inspection of the piping system is made through manholes and clean-outs to ensure that there is no blockage or leakage.

Leachate is removed from the site by a licensed liquid waste hauler that has multiple facilities to utilize for proper disposal of the leachate.

3.31 Phase Completion – 310 CMR 19.130 (31)

Landfill operations are to be conducted in phases to reduce the amount of exposed active area. Final cover is placed on completed phases as they achieve final subgrade elevations. The construction of the Phase 9 Landfill Expansion Project consists of seven stages of development, operation and closure. Drawings 4 through 11 in Part G of the Authorization to Construct Application present the sequencing of the seven stages, as described below.

Drawing No. 4 - Phase 6 Interim and Phase 9, Stage 1 Grading Site Plan
This drawing shows interim subgrades for the currently active Phase 6 Landfill. These interim grades provide better support for the vertical expansion of this area and shows a supplemental leachate collection line that will be connected to a leachate cleanout that is connected to the Phase 6 primary leachate sump. During this period, three existing gas extraction wells (EW-49, EW-50 and EW-51) along with two of their remote well heads may have to be abandoned. During the Phase 6 operating period, these wells have been vertically extended and will continued to be extended for as long as practical or a horizontal collection system may have to be installed as an interim measure. This drawing also shows the Phase 9, Stage 1 final subgrades over he existing Phase 5 Landfill.

Drawing No. 5 - Phase 9, Stage 2 Preparation Grading Site Plan
This drawing shows interim Stage 2 site preparation grades. This includes the construction of a berm around the Stage 2 area that will contain leachate to the area over the supplemental leachate collection line.

Drawing No. 6 - Phase 9, Stage 2 Filling and Stage 3 Preparation Grading Site Plan
This drawing shows final Stage 2 grades, with the expansion of the gas collection system in this area, including ten and eight inch gas header extensions and the installation of eight gas extraction wells. Gas system extensions are also shown over the Stage 1 area for future connections. Site preparations for Stage 3 include the removal of the existing cap and the berm construction for containment of this area. A supplemental leachate collection pipe will be extended into Stage 3 from a leachate interceptor line on the west side of the Landfill. The leachate line will be valved to allow the bleeding of leachate collected in the Stage 3 area following storms, into the leachate system. There will be a significant amount of modifications done to the existing gas collection system within this area. Generally these modifications will be to convert the existing direct mounted wellhead systems to remote wellheads. A typical modification is shown on the Landfill Gas System Details Plan in Part G - Drawings. Drawing No. 6 also shows the limits of final cap and the stormwater management facilities that are to be constructed on the Stage 1 and Stage 2 areas.

Drawing No. 7 - Phase 9, Stage 3 Filling and Stage 4 Preparation Grading Site Plan
This drawing shows final Stage 3 subgrades and the site preparation work for Stage 4. The Stage 4 preparation work includes removing the existing cap and grading to berm the area, as well as adding a leachate collection line connected to the leachate line that was extended into Stage 3 and the modification of existing gas wells in this area to being remote wellheads.

Drawing No. 8 - Phase 9, Stage 4 Filling and Stage 5 Preparation Grading Site Plan
This drawing shows final Stage 4 grades, along with the expansion of the gas collection system to add a ten inch gas header extension and two horizontal gas collection systems. This drawing also shows the limits of final cap and stormwater management facilities that are to be constructed on the Stage 3 and Stage 4 areas. Stage 5 preparation work includes berming the area for containment, gas well modifications to remote wellheads and the extension of a leachate line from the Phase 3, Stage 3 primary leachate sump.

Drawing No. 9 - Phase 9, Stage 5 Filling and Stage 6 Preparation Grading Site Plan

This drawing shows final Stage 5 subgrades and the site preparation work for Stage 6. The Stage 6 preparation work includes removing the existing cap and grading to berm the area, as well as adding a leachate collection line connected to the line that was extended into Stage 5 and the modification of existing gas wells to being remote wellheads.

Drawing No. 10 - Phase 9, Stage 6 Filling and Stage 7 Preparation Grading Site Plan
This drawing shows final Stage 6 grades, along with the expansion of the gas collection system to add a ten inch gas header extension and one horizontal gas collection system. This drawing also shows the limits of final cap and stormwater management facilities that are to be constructed on the Stage 5 and Stage 6 areas. Stage 7 preparation work includes berming, gas well modifications to remote wellheads and adding a leachate collection line connected to the line that was extended into Stage 5.

Drawing No. 11 - Phase 9, Stage 7 Filling and Final Grading Site Plan
This drawing shows final Stage 7 grades, with the expansion of the gas collection system in this area, including ten and eight inch gas header extensions and the installation of ten gas extraction wells. This drawing also shows the limits of final cap and stormwater management facilities that are to be constructed on the Stage 7 area, which completes the Phase 9 Vertical Expansion.

3.32 Disruption of Landfill Areas – 310 CMR 19.130 (32)

As described in the section above, portions of the existing cap will be removed as the stage areas are prepared for development. Operations preparing the stages for development will be conducted in such a manner as to mitigate potential odors or erosion and sedimentation.

3.33 Construction of Buildings – 310 CMR 19.130 (33)

No buildings shall be constructed on previously landfilled areas without the written approval of the Department.

3.34 Records for Operation and Plan Execution – 310 CMR 19.130 (34)

The Facility maintains a daily log of the landfill operation, including the type, weight and source of solid waste entering the Facility. Records must also be kept covering the status of all environmental monitoring systems. The Facility must submit an annual report to the Department summarizing the operations of the previous calendar year using a form designed by the Department. This report must be submitted no later than February 15th and includes such information as total tonnage that was landfilled and used as cover material.

3.35 Inspections – 310 CMR 19.130 (35)

The Facility must operate in full compliance with all applicable federal, state and local regulations. Compliance inspections are, and will continue to be performed bi-monthly under the direction of a Massachusetts Registered Professional Engineer experienced in solid waste management and approved by MassDEP, in accordance with *310 CMR 19.018 Third-Party Inspections*. Operations and Maintenance and Waste Ban inspection reports will be submitted in accordance with that regulation.

3.36 Recirculation of Leachate – 310 CMR 19.130 (36)

The Facility does not recirculate leachate into the Landfill. The Facility does have an approval for a Major Demonstration Project (Transmittal No. X262760) for the injection of effluent from the now inactive hydrogen sulfide scrubbers and landfill gas condensate. The Demonstration Project was approved on the basis of an application that provided adequate information on the goals and expectations of the project; detailed engineering considerations on the landfill stability; impacts to the leachate collection system and landfill gas issues; identified potential adverse impacts and provided contingency plans to address them; provided methods to monitor the performance of the injection project; provided amounts and rates of leachate to be injected and design of the distribution system; and addressed the financial assurance to provide corrective actions, if required. MassDEP's approval provided construction, operations, monitoring and reporting requirements that are intended to assure that adverse impacts do not occur as a result of the Major Demonstration Project. ISWM no longer operates the injection system but intends to renew the Demonstration Project approval and maintain the equipment, should reactivation of the system seem beneficial.

3.37 End-of-life Mercury-added Products – 310 CMR 19.130 (37)

The residential recycling center provides collection of End-of-life Mercury-added Products to Bourne residents. The collected products are transported to a recycler/reuser for proper disposal.

3.38 Additional Operation and Maintenance Requirements for Landfills that Accept Ash – 310 CMR 19.131

The vast majority (+/- 86%) of the waste materials placed in the Landfill is municipal incineration ash from the SEMASS facility. When the ash is loaded onto trucks at SEMASS it is wetted throughout its volume, so as to create no dust but not to have free draining water. The ash is to be cool and fully extinguished when it arrives at the Landfill. When the trucks arrive at the Landfill they are weighed in, and out, and are directed to the specific location where they are to dump the ash. The ash is not to generate dust during its delivery, dumping, handling/spreading and compaction. If dust is generated from these actions, SEMASS is to be notified and directed to make adjustments to its wetting operation to mitigate the dust condition.

A wheel wash station is not proposed for the ISWM facility. After approximately four and one half years of receiving a significant volume of ash on a daily basis, there has been no indication of the ash trucks, or other vehicles, tracking ash off of the site. Should such conditions arise a vehicle wash down station may be established on the Landfill. The station will consist of a water tank truck with a pump and hose. Each exiting ash truck will stop at the station to be inspected for accumulated ash on the body and wheels of the vehicle. Any observed accumulation of ash will be removed from the vehicle by spraying water from the tank truck. The operation will be conducted on the Landfill so that all water will be collected as leachate and not run off to surface water collection points.

4.0 RECYCLING AND COMPOSTING OPERATIONS

4.1 Infrastructure Description

The residential recycling center is located near the southern extent of the Facility. These operations are separate and complimentary to the Landfill. The area is paved for the convenience of residential vehicles and to minimize dust generation.

Traffic is directed southerly along the westerly property line toward the residential recycling center guard shack at the entrance where residential stickers are checked and directions are given to residents as to where to unload certain items. The daily use of the center is restricted to the Town of Bourne residents/property owners that have received a sticker for their vehicle. Residential customers from neighboring towns and local businesses or haulers with recyclables may utilize the facility but first must go over the scale and pay prevailing rates. This operation is located on the southern 25-acre parcel of the Facility. The facility includes access roads and a Swap Shop. A retaining wall separates the residential operations from the single stream transfer station and container storage operations at a lower elevation. The area includes a 250,000 gallon, subsurface water storage tank that is part of a fire suppression system.

4.2 Recycling Operations

The residential recycling center provides Bourne residents with a comprehensive and convenient facility to bring materials. Containers and designated areas are marked for a variety of materials. ISWM normally has two attendants on duty to direct traffic, sell stickers and answer questions.

Residents may bring household recyclables (glass, mixed paper, magazines, cardboard, chipboard, newspaper, mixed plastic containers, aluminum and steel cans, and redeemable bottles and cans), waste oil, used oil filters, tires, used antifreeze, fluorescent bulbs, mercury containing materials, auto/marine and household batteries, used paint, scrap metal, white goods, construction & demolition material, municipal solid waste, difficult-to-manage waste, CRTs and other e-wastes, textiles, leaves and grass, brush and stumps, propane tanks and items for a Swap Shop.

The residential recycling center is paved. All rainwater flow at the facility is directed away from storage and parking areas, into drainage structures, so that there is no ponding of water in areas where residents walk, containers exist or where materials are stockpiled.

4.2.1 Handling Procedures

Recyclables are stored on-site normally for a period of less than 60 days in the recycling center containers (as is the case for glass, aluminum, cans, mixed paper, newspapers); or in the single stream transfer building. Single stream material accumulation operations occur within an enclosed building in the south, central area of the site. Material outlets for recyclables vary as prices vary.

4.3 Leaf and Yard Waste Composting Operations

The yard waste is either delivered by residents or transported for processing by Facility personnel and equipment to the composting area currently situated east of the residential recycling area. Stumps, branches and brush are also collected in this area and are periodically chipped via the Facility's tub grinder, prior to being used for mulch or sent for boiler fuel. The temperatures of the piles are monitored and they are occasionally turned via a front-end loader. Materials in various stages of decomposition exist throughout the area, and the chief end-product use is as vegetative support layer material for the final cover system at the Landfill.

4.4 ABC Processing

The processing or crushing of asphalt paving, brick and concrete materials (ABC) also occurs periodically via an outside contractor. This work is conducted whenever on-site stockpiles reach a volume sufficient to make the operation economically feasible. Metals are removed during the crushing operation so that only a reusable aggregate of mixed ABC remains. The end product can be used as a road base for on-site internal roadways.

4.5 Waste Oil and Hazardous Materials

Waste oil is accepted in the residential recycling center area to provide the community with a safe outlet for a material that might otherwise be improperly disposed. The waste oil receiving and holding system was provided to the Town through a MassDEP grant and includes the required containment structure.

Household hazardous wastes, such as oil based paints and solvents are removed from the waste stream when discovered in the active landfill or within the residential recycling center. A ventilated metal storage shed, with a sump, has been provided for the storage of these types of wastes. The Town has retained a licensed hazardous waste company to periodically remove them in accordance with hazardous waste material regulations. Bourne also participates in several, regional household hazardous waste collection days each year in conjunction with the towns of Falmouth, Mashpee and Sandwich. Bourne residents are also able to participate in other collections throughout Barnstable County after filling out a registration form and paying a fee.

4.6 Equipment and Staff

Personnel are dedicated full-time to the recycling operations including a guard to monitor incoming traffic and to continually ensure the area is clean and materials have been placed in their proper receptacles. All laborers report to a Recycling Crew Chief who is in charge of the residential recycling area.

The Facility also has a single stream recyclables transfer operation where collected single stream recyclables are shipped to processors. The transfer operation is conducted in a steel-framed building constructed on the Town's southern 25-acre parcel in 2005. The Town Department of Public Works provides weekly curbside collection of recyclables and MSW. Compost management operations, such as turning piles or moving material is conducted by Facility personnel and machinery.

5.0 LANDFILL OPERATIONAL SEQUENCE

5.1 General

Landfill construction and development in the Phase 9 area of the Facility will consist of the following procedures, in sequence:

- Subgrade and base grade preparations, including removal ofexisting cap structures.
- Modifications to existing gas collection facilities.
- Filling with waste material.
- Covering of waste material.
- Installation of gas management devices.
- Capping and closure of the landfill.

Subgrade and base grade preparations for this phase involves the excavation and removal of existing final and intermediate cover systems and grading to allow for gas system modifications to remote wellhead systems. The subgrades will be constructed so as to enhance the vertical flow of leachate generated in Phase 9, downward into the existing landfill phase for collection by the leachate collection system. The design and construction requirements for the consruction of Phase 9 are presented in Part C – Design Plan, Part E – Construction Quality Assurance Plan, Part F – Technical Specifications and Part G - Drawings sections of the Application for Authorization to Construct (ATC).

5.2 Waste Placement

Waste placement in all phases of Phase 9 must be carried out with great care to ensure that:

1. Leachate collection piping is not damaged or moved from the design alignment during the placement of waste.
2. The placement and compaction of waste does not create instability and result in displacement of the existing sideslope capping systems that are to remain in place.
3. The placement and compaction of waste does not create instability and result in displacement of the landfill mass.

Recommended filling procedures for waste being placed in Phase 9 are described below.

5.2.1 Waste Placement

The following is a general description for the sequencing of operations and is intended to be used as a guideline. Modifications to this plan may be required as landfilling operations progress and changes to the staging plan may be required. Since Phase 9 is operated and developed for the management of solid waste, which will primarily be ash, operations sequencing is important to ensure the integrity of the underlying liners, leachate collection systems, and to maintain the stability of the landfilled waste.

Initial Filling
As described above in *Section 3.31 Phase Completion*, Phase 9 will be filled in seven stages. Typically each stage will be prepared for filling by initially removing existing interim or final cap material; construction gas collection system modifications including subgrade preparation; some stages will include the extension of the leachate collection system piping and construction of perimeter containment berms with ash or reused soils. Following the site preparation work for each stage, as shown on the Drawings, filling will commence. Initial filling operation will be critical and must be done in a manner that will not risk the integrity of the gas extraction and leachate collection systems. Excavations into the existing waste fill may be conducted in areas where cover material are deep, in order to promote the downward flow of leachate and hamper the horizontal flow which might result in sideslope breakouts. Some excavations may be backfilled with recycled glass to optimize the vertical flow of leachate.

Ensuing Lifts
In addition to exercising caution during the first lift, continued caution must be taken during the placement of ensuing lifts. Waste should be spread and compacted in lifts, approximately 10 feet thick, in a controlled manner until final elevations are attained. Each lift should be substantially completed before beginning a new lift. Waste should be compacted with a landfill compactor and/or a vibratory roller in layers no greater than two (2) feet thick. As subsequent lifts are developed, the initial filling will be to construct a perimeter berm, which will define the exterior sideslope subgrade. The berm will define the limit of filling and will establish a stabilizd exterior slope for erosion control and leachate containment purpose.

General Filling
Waste placement in general should be performed as follows:

1. Incoming waste should be directed to the active face using signs or spotters.
2. The active area should be kept as small as feasible to minimize the amount of exposed waste - usually an active face width of 50 to 75 feet is adequate to meet the disposal needs for a landfill operation like that of Phase 9.
3. Once the waste is placed on the active face it should be spread in a layer no thicker than two (2) feet to assure maximum compaction - usually three to five passes with the compactor will provide the most efficient level of compaction, additional passes do not typically add substantially to the degree of compaction.
4. Daily cover must be placed on all waste received during a given operating day. The cover shall be applied in a layer not less than six inches (6") thick. The incoming bottom ash waste is suitable for daily cover.

Additional waste handling and covering requirements are provided in Section 3.0.

Waste Compaction
Maximum waste compaction at the landfill is desirable for the following reasons:

1. It reduces the rate of air-space consumption and allows a greater amount of waste to be placed in the landfill.
2. It reduces future settlement of the waste, which reduces long-term care of landfill surfaces.
3. It reduces the amount of soil material needed to cover the waste, if soil is needed.

Generally speaking, it is best to spread waste from the toe upward onto the active face. Good compaction is best achieved on an active face that is sloped at less than 20 percent (1 foot vertical to 5 feet horizontal).

5.3 Gas Management System

The Phase 9 gas management system will eventually be connected to the existing gas extraction and flare system. Modifications to the existing gas collection systems will occur as stages are developed. Basically those modifications will be to convert existing gas wells with in-place wellheads to remote wellhead types, in order to allow for the continued use of those wells where up to forty feet of fill will be placed over the current surface elevations. Part of the conversion work will be to provide a continuous upward slope for the lateral pipe from the well locations to the perimeter final grades, where the remote wellheads will be located and connected to existing or new gas collection system manifolds. In those areas where remote wellheads are developed, horizontal gas collection systems will be installed to provide collection of gasses generated in the +/- forty feet of Phase 9 filling. Additionally, areas that do not currently have gas extraction wells will have new vertical wells installed and connected to extended gas manifolds, upon reaching final subgrade locations.

5.4 Final Cover

The placement of the cover system will be the final component of the landfill's operational sequence. A description of the final cover is provided below.

- A subgrade layer for surface preparation purposes, which may consist of 12 inches of graded daily or intermediate cover.
- A gas-venting layer, consisting of a minimum of 6 inches of granular material having a minimum hydraulic conductivity of 1×10^{-3} centimeters per second.
- A textured geomembrane high-density polyethylene (HDPE) or low-density polyethylene (LDPE), 40 mils thick.
- A drainage/protection layer, consisting of a minimum of 12 inches of granular material having a minimum hydraulic conductivity of 1×10^{-2} centimeters per second.
- A vegetative support layer, consisting of a minimum of 9 inches of soil capable of sustaining a healthy vegetative growth on the final cover.

Once the landfill final cover installation has been certified and all other aspects of landfill closure are complete, the post-closure care and monitoring period for the landfill will commence. Additional information regarding the closure and post-closure process for the landfill was provided in the Design Plan included as PART C of the Application for Authorization to Construct.

6.0 STORM WATER MANAGEMENT

6.1 Active Area Controls

Storm water management in active landfill areas requires that intermediate operations ensure that run-off, which has contacted solid waste (contact run-off), does not mix with non-contact run-off. The following are the storm water management measures that are to be taken in landfill areas that have not been furnished with final cover.

Non-Contact Run-off
Non-contact run-off is the storm water run-off from the active portion of the Landfill, which has had no contact with landfilled waste or daily cover materials. This run-off should be directed away from the active landfill face by grading the surfaces of the Landfill to direct runoff away from uncovered waste. Active areas in the central portion of the Landfill should be provided with temporary surface swales to allow non-contact run-off to move to the perimeter of the Landfill. Runoff will then be directed to the stormwater retention basins via drainage swales around the Landfill perimeter.

Side Slope Drainage
Landfill side slopes will have intermediate cover placed as they reach their subgrade elevations. Storm water runoff from side slopes will flow to drainage swales (constructed along the side slopes), that direct the runoff to let-down channels. The let-down channels empty into swales at the base of the side slopes, which carry the water to retention basins. As landfill operations get progressively higher in elevation, side slopes will be provided with a quick-growing vegetative cover to slow run-off and minimize erosion. Areas experiencing repeated erosion problems will be covered with mulch and/or provided with hay bales and/or siltation fences installed perpendicular to the slope to further slow run-off and reduce erosion.

Top Slope Drainage
Top slope areas in the active portion of the Landfill will be graded to drain away from the active landfill face. Normally, intermediate grades of two to five percent are adequate to ensure that ponding and excess infiltration of storm water into the Landfill is avoided. Top slopes that have reached final elevations will be graded at a minimum of five percent. Intermediate and final top slopes will be shaped and groomed to prevent the concentrated flow of run-off to one location, unless a means is available to prevent erosion.

Contact Run-off
Contact run-off is the fraction of run-off that has had direct contact with waste or daily cover materials. This runoff will be collected in the Landfill leachate collection and removal system. The active face is graded to direct run-off to a central location, near the active face, where the run-off can infiltrate to the leachate collection system

6.2 Completed Area Controls

Once landfilled areas have reached final grades, the final cover system will be constructed to serve as an infiltration barrier to minimize further leachate production from the Landfill. The final cover system for the Landfill includes the following storm water control components:

- Permanent vegetative cover will be established on all surfaces of the final cover. A seed mixture of grasses suitable for the application should be used.
- Permanent earthen diversion berms, lined with erosion mats, will be installed on the final cover to divert slope run-off to let-down channels. The berms will be used to reduce unmanaged sheet flow and, thereby, minimize slope erosion. Sub-drains will be constructed beneath the berm within the drainage layer to intercept flow and discharge it into the let-down channels.
- Permanent stone-lined, side slope let-down channels will be constructed to capture run-off from several diversion berms and subdrains and direct the run-off to the existing swales and sedimentation basins along the perimeter of the landfill.

All final cover runoff will be diverted, via drainage swales and interceptor drainage piping, into the two main storm water sedimentation basins.

7.0 LEACHATE MANAGEMENT

The performance requirements for the leachate collection and removal system is the ability to remove leachate from the Groundwater Protection System. These systems must be designed to drain leachate quickly and efficiently from the Landfill in order to normally maintain a hydraulic head of leachate above the geomembrane liners of no greater than 12 inches, except during and soon after storm events.

Generation
Phase 9 is designed to promote vertical flow of leachate into the existing landfill collection systems and with extensions of the existing leachate collection systems that will reduce that volume by providing a direct path for leachate to the leachate sumps. This design is intended to provide sufficient leachate drainage capacity to normally maintain a hydraulic head less than 12 inches on the geomembrane liners except during and soon after storm events. The Hydrologic Evaluation of Landfill Performance (HELP) Version 4.0 model program was used to estimate the head conditions when the Landfill is fully built out with the completion of Phase 9. Leachate generation calculations were provided in the Design Plans included as PART C of the Application for Authorization to Construct.

Leachate Sump
Leachate produced in Phase 9 will either drain vertically through the existing landfill phases or to and through the leachate system extensions constructed as part of the Phase 9 preparations to the existing leachate collection system sumps. From any of the existing sumps, the leachate will be pumped through force mains into either the existing 207,000 gallon glass fused steel, above ground leachate storage tank located along the easterly property line opposite the Phase 3, Stage 3 Landfill area, or the 125,000 gallon tank, of similar construction, located to the south of the southwest corner of the Phase 6 Landfill.

Submersible pumps from the secondary and primary leachate collection systems lift leachate from the sumps and convey the leachate to one of the above-ground leachate storage tanks, which have secondary containment system volumes of the primary containment plus ten percent. The secondary and primary submersible pumps include switches to control the operation of the pumps. The pumps are located within a section of perforated HDPE piping resting on the floor of the sumps and are connected to solid risers placed up the sideslopes of the Landfills. A control panel controls the pumps, meters the amount of leachate pumped and provides both audio and visual alarms. The panel also displays the depth of leachate in the sumps (hydraulic head) by digital read-out. In the event that the submersible pumps fail, the Facility has a back-up pumps available on site.

Leachate Loading
The following procedure is conducted for loading leachate from the leachate storage tank to the tanker trucks:

- Upon arrival at the site, the empty tanker truck will stop at the scale and register its tare weight. The truck will then proceed to the storage tank.
- The tanker truck will park within the leachate load out structure that has been constructed adjacent to the tank to contain spillage should it occur during pump out operations.
- Open the air vent on top of the tanker.
- Connect the hose from the outlet of the loading station's pump to the tanker.
- Open the drain valve on the storage tank.
- Open the tanker valve.
- Close the drain valve on the pump. Start the pump.
- Monitor the level of leachate in the tanker to prevent overfilling. Report any spills immediately to the General Manager or Operations Manager. Shut off the pump when tanker is full.
- Close the tanker valve.
- Close the tanker vent.
- Close the drain valve to the storage tank.
- Prior to departing the site, stop at the scale and register the weight. Also, report the tank levels to the scale house attendant. The truck will then depart from the site.

Disposal
Leachate collected at the landfill is transported and disposed by a contractor, as needed. The quantity of leachate generated is recorded and the leachate quality monitored in accordance with the leachate disposal permits and the Solid Waste Management Regulations.

Action Notification Flow Rate (ANFR)
Monitoring the flow of leachate in the secondary leachate collection system (SLCS) is part of the general landfill operations. The Facility regularly reports SLCS flow measurements to the Department with the Facility's bimonthly inspection reports.

If it is determined that either a single day or the average monthly SLCS flow rate exceeds the approved Notification Flow Rate (NFR), the following shall be performed:

1. Verify that the primary leachate collection system (PLCS) is operational. If the PLCS flow

appears to be low, evaluate the need to clean the PLCS pipe.

2. Notify the Department by the end of the next business day (Monday through Friday, except holidays).

If it is determined that the SLCS flow rate at the sump area exceeds a specified volume higher than the Action Flow Rate or AFR, the following shall be performed:

1. Verify that the primary leachate collection system (PLCS) is operational.
2. Notify the Department by the end of the next business day (Monday through Friday, except holidays) and schedule a meeting to review the situation.
3. Conduct an engineering evaluation to identify possible sources of flow, to identify measures available to reduce SLCS flow, and other investigations that may be needed to assess the situation.
4. Submit the engineering evaluation to the Department within 30 days, unless an alternative schedule is approved by the DEP.

The most recent action leakage rate (AFR) were calculated for the Phase 6 Landfill area. (See Appendix B for the Phase 6 AFR calculations.) The calculations are based on the laboratory measured transmissivity (7.49×10^{-4} m^2/sec) for the bi-planar material that was installed in the Phase 6 cell and the minimum slope of the liner of approximately 2.0% (0.02 ft/ft). Based upon these calculations, the calculated AFR is 2,804 gallons per day per acre (gpd/acre). This is less than the actual capacity of the four inch (4") diameter secondary leachate pipe, which is 17,000 gpd/acre, thus the AFR of 2,804 gpd/acre is the controlling factor.

The 2,804 gpd/acre is in itself a fairly high value for an AFR and is greater than ISWM would accept for performance of its system, without taking action to reduce the secondary collection system's flow rate. Because of this, ISWM proposes to maintain the AFR of 200 gallons per day per acre for a single day flow rate and 100 gallons per day per acre for a rolling thirty day flow rate. The TFRs, or notification rates, are half of the AFRs, or 100 gallons per day per acre for a single day flow rate and 50 gallons per day per acre for a rolling thirty day flow rate. Leakage above the TFR, but below the AFR, will trigger a step up in the SLCS monitoring program and actions to try to identify the source of the leakage. The intention is to use the TFR to initiate action and take preventive measures before the AFR is triggered.

8.0 LANDFILL GAS MANAGEMENT

A conceptual gas extraction and control system has been designed to collect gases generated within Phase 9 as waste decomposes and combust the gas at the existing flare station located adjacent to the Phase 2 landfill area. With Phase 9 being used primarily as an ash disposal landfill, it is not expected to generate a significant amount of gas. The conceptual layout of this gas system along with installation details are included in the Drawings that were submitted with the Application for Authorization to Construct. Positive pressure is generated in the landfill by anaerobic decomposition of the refuse, which produces primarily methane and carbon dioxide, along with odor nuisance causing gases, such as hydrogen sulfide. If not relieved, pressure within the landfill can force these gases into the atmosphere, potentially causing hazardous or nuisance conditions to develop. A gas extraction and collection system will relieve the positive pressure by applying a vacuum throughout Phase 9 and the rest of the Landfill. The gas will be conveyed to the skid-mounted open flare, located in the northeast corner of the site, adjacent to the closed Phase 2 Landfill. Design of modifications to the existing gas collection systems that allow for the the forty foot vertical expansion of Phase 9 are included in the Drawings of the ATC. Draft designs of the extensions of the existing gas collection to collect gases within Phase 9 were also included in the Phase 9 ATC. Final designs will be prepared for construction as phased closure of the system is conducted. The designs will be based on the existing conditions, at that time, and will be presented to the Department for approval.

9.0 STAFFING

9.1 General

The personnel recommended for successful operation of the Facility are as follows:

- One General Manager
- One Operations Manager
- One Manager of Facility Compliance and Technical Development
- One Landfill Crew Chief
- One Mechanics Crew Chief
- One Recycling Crew Chief
- One Wellfield Technician
- One Scale Attendant
- Three Residential Recycling Center Attendants
- Two Utility/laborers
- Seven Equipment Operators
- Two Mechanics
- Two Clerical Office Staff

This roster of employees will enable Phase 9 to be operated and maintained in compliance with the Facility's approvals and applicable regulations. Part-time employees may be necessary to supplement the full-time staff during vacations, sick days or special projects.

Staff responsibilities shall be as follows:

General Manager
The General Manager is responsible for ensuring that the operational staff has the resources to perform all the Facility operations. In this role, the General Manager serves as the liaison between the operational staff, the Town Administrator, the Board of Selectmen and the Board of Health. The General Manager is responsible for facility administration, regulatory oversight, accounting and purchasing, among other duties.

Operations Manager
The Operations Manager is responsible for all aspects of the Facility operations. In this role, the

Operations Manager functions as the foreman by identifying work tasks and projects, which must be completed, and by ensuring that daily operating needs are met.

Manager of Facility Compliance and Technology Development
The Manager of Facility Compliance and Technology Development is responsible for maintaining environmental compliance at the Facility, permitting, training and personnel health and safety compliance, as well as strategic planning and site development activities in coordination with the General Manager.

Scale Attendants
The Scale Attendants are responsible for documenting the weight and origination of incoming loads, directing the loads to the appropriate destination (active face, transfer station or recycling areas), preliminary screening of incoming waste loads for inappropriate materials, waste ban items and other inappropriate wastes. Attendants also track loads that fail waste ban inspections and provide the documentation to the Environmental Manger for recording in the waste ban log.

Recycling Attendants
Two Recycling Attendants are responsible for directing the residents where to properly deposit the recyclables and other items at the residential recycling center.

Utility Personnel/Laborers
The Utility Personnel/Laborers maintain environmental control structures (i.e. storm water basins, leachate collection systems and roadways). These personnel also maintain the Facility's grounds in an orderly condition, collect windblown litter and assist with truck spotting and work inspection. This staff may be supplemented periodically during certain landfill construction projects and to assist with other Facility needs that may arise.

Equipment Operators
Equipment Operators compact and cover waste and inspect waste loads as they are unloaded. During normal operations, the eight Equipment Operators are active throughout the day. One Equipment Operator is normally assigned as a relief person and will help with the spotting of incoming vehicles at the working face. Work breaks are staggered to assure that the active face is attended during all working hours.

9.2 Staff Training and Emergency Situations

All landfill employees undergo training in emergency medical procedures and safety practices that must be followed in the vicinity of heavy equipment. First aid kits are maintained at the office trailer, scalehouse and on landfill vehicles. All vehicles and buildings are equipped with two-way radios to expedite communications between all areas of the landfill and to effect response to emergency situations.

10.0 INSPECTIONS AND MAINTENANCE

10.1 Compliance Inspections

The Bourne Integrated Solid Waste Management Facility must be operated in full compliance with all applicable Federal, State and Local regulations. In particular inspections and reporting will be conducted in accordance with *310 CMR 19.018 Third-Party Inspection* requirements. Compliance inspections will be performed at the frequency required by the Facility's permit by an engineer experienced in solid waste management and licensed to do so under the regulation. Each inspection will include a complete facility tour, with observations of the operation of the active face, inspection of storm water control systems, landfill cover, cover stockpiles, operating equipment and an overall inspection of the landfill site. Each inspection will include an interview with the Operations Manager and a discussion of any immediate operational improvements, which should be implemented. The Operations Manager, as well as the General Manager, will be informed of any observed deficiencies at the time of the inspection. Required Operation and Maintenance and Waste Ban reporting will be made.

10.2 Maintenance

Environmental Monitoring Station Maintenance

Maintenance of environmental monitoring stations must be conducted in full compliance with the requirements outlined in 310 CMR 19.133. The Department of Environmental Protection will be notified in writing of damaged or destroyed groundwater or surface water monitoring devices and the extent of the damage. Notification will be made within fourteen days of discovery. The notification will detail a schedule for repair or replacement of the damaged components, and the repair or replacement will be completed prior to the next scheduled sampling round.

Leachate Collection and Storage Facility Maintenance

The leachate collection system will be inspected regularly to ensure that the system is working properly. Visual inspection of the piping system will be made to ensure that the system is operating normally and that there is no indication of blockages or leakage in the system. Leachate collection pipes can be accessed and serviced via clean-out pipes. If there are indications that the system is not operating normally, the system can be visually inspected by closed circuit television cameras that are specifically designed and are routinely used to inspect piping systems.

Storm Water Collection System Maintenance

The storm water collection system will be inspected routinely to ensure that the system functions to prevent erosion and discharge of pollutants and to protect the physical integrity of the Landfill. Storm water basins, perimeter swales and drainage structures on the Landfill will be inspected and cleaned periodically to ensure that a buildup of silts and sediments does not occur.

Slope Maintenance

Proper grooming of landfill slopes, with particular attention to planting and maintenance of vegetation, is the most important aspect of erosion control on the Landfill itself. Also important for the prevention of siltation is the upkeep of perimeter swales and, where indicated, the placement and replenishment of siltation fencing. The detrimental effects of erosion can be prevented by maintaining all erosion control structures so that they can carry out their function unimpeded. Landfill areas that are inactive should be seeded to encourage the growth of vegetation.

10.3 Reporting Requirements

The Facility must maintain a daily log of the operation of the Landfill, including the type, weight and source of solid waste and cover material entering the Landfill. Records must also be kept on the status of all environmental monitoring systems.

The Facility must operate in full compliance with all applicable federal, state and local regulations. Compliance inspections are, and will continue to be performed bi-monthly under the direction of a Massachusetts registered Professional Engineer experienced in solid waste management and approved by MassDEP, in accordance with *310 CMR 19.018 Third-Party Inspections*. Operations and Maintenance and Waste Ban inspection reports will be submitted in accordance with that regulation.

Each inspection will include:

- A complete facility tour, with observations of the operations of the active face.
- Inspection of storm water control systems, landfill cover, cover stockpiles, operating equipment and an overall inspection of the site.
- Interview with the Operations Manager and discussion of any observed deficiencies and operational improvements that should be implemented.
- Waste Ban Compliance Inspections will be conducted on the required number of incoming loads of refuse (excluding ash) and e-filing the required data.

Reports (O&M and Waste Ban Compliance) will be prepared and submitted to the Department within fourteen (14) days after each inspection.

The Facility must submit an annual report to the Department summarizing the operations of the previous calendar year using a form designed by the Department. This report must be submitted no later than February 15th and includes such information as total tonnage landfilled, volumes of generated leachate and cover material tonnages.

11.0 SAFETY

11.1 General

All landfill employees undergo training in emergency medical procedures and in safety practices that must be followed in the vicinity of heavy equipment. A first aid supply kit is maintained in the office and in operating equipment at the active face. The telephone numbers for emergency medical care and ambulances are posted by every telephone in the office.

Pursuant to 40 CFR Part 258.25, the Bourne Integrated Solid Waste Management Facility controls public access to prevent illegal dumping of wastes, public exposure to hazards and unauthorized vehicular traffic. Access to the Landfill is by a single access point off MacArthur Boulevard. The gate at the entrance is secured and locked when the facility is closed. A sign is posted stating the hours of operations as well as the types of waste that are accepted by the Facility.

11.2 Fire Control

All necessary precautions will continue to be implemented at the Landfill, in order to prevent fire from breaking out. These precautions include timely and proper covering of all disposed refuse, and an enforced ban on smoking near the Landfill. Furthermore, all materials stored, stockpiled, held or accumulated anywhere on site will be kept in a manner that prevents fire hazards.

A hot load area will be reserved near a reliable source of water for the dumping of any incoming material that may be smoldering, smoking or burning. In case fire breaks out within the Landfill, or signs of a fire are observed, local fire-fighting authorities and the Department of Environmental Protection will be alerted and no refuse may subsequently be deposited in the burning area. The nearest continually manned fire station is located in Pocasset Village in Bourne, approximately four miles from the Facility. Designated hot load areas will be located in the excavated areas on the 25 acre parcel to the south of Phase 6. In addition, ISWM maintains a water truck with a pump for a fire hose and stockpiles of organic foam.

11.3 Hazardous Waste

The Bourne Integrated Solid Waste Management Facility shall not accept for disposal any substance subject to the Massachusetts Hazardous Waste Regulations, 310 CMR 30.00, or any waste that is considered hazardous under EPA's Solid Waste Disposal Facility Criteria, 40 CFR Part 258. A program for monitoring incoming waste for the presence of hazardous waste is provided in Section 3.0.

12.0 ENVIRONMENTAL MONITORING PROGRAM

12.1 Monitoring Plan

Groundwater, leachate and landfill gas monitoring will be conducted in accordance with the Massachusetts Solid Waste Management Regulations located at 310 CMR 19.132, the Department's Landfill Technical Guidance Manual and Standard Reference for Monitoring Wells. The purpose of the monitoring is to track groundwater quality downgradient from the Phase 1 unlined landfill, which is expected to improve over time and to provide verification of base liner integrity in Phases 2, 3, 2A/3A, 4, 5 and 6. The monitoring program also tracks the remnant nitrate contamination from the former septage lagoon area, which is expected to decrease to less than the relevant MMCL concentrations.

Groundwater and leachate will be analyzed for similar parameters so that the results can be easily reviewed and interpreted. The minimum analytical parameter list for groundwater and leachate includes:

- Field analytes including pH, temperature, specific conductance and dissolved oxygen.
- Inorganic analytes including alkalinity, nitrate, total dissolved solids, chloride, sulfate and chemical oxygen demand.
- Metals including iron, manganese, arsenic, barium, cadmium, chromium, copper, cyanide, lead, mercury, selenium, silver and zinc.
- Volatile organic compounds included in EPA Method 8260 and methyl ethyl ketone, methyl

isbutyl ketone, acetone, 1,4 dioxane and any unknown peaks greater than five times the background intensity.

Groundwater monitoring locations have been established at the Bourne Integrated Solid Waste Management Facility. In accordance with MassDEP's June 5, 2017 approval of the Bourne Landfill's Comprehensive Site Assessment (CSA), the on-site groundwater-monitoring network consists of twenty (20) wells. Fourteen (14) of the wells will be sampled quarterly and six of the wells will be sampled semiannually. Surface water is monitored in the storm water retention basin located in the northwest corner of the site, when there is an adequate volume of water in the basin to sample. A grab sample of leachate is taken from the leachate storage tank. ISWM intends to reevaluate the scope of the groundwater monitoring plan, taking into account the monitoring results that have been developed since 2017. It is anticipated that ISWM will seek approval to reduce the scope of the program. In addition to sampling the groundwater, surface water and leachate, nine gas monitoring wells are field screened as part of the Environmental Sampling Program. The Town may seek to modify the sampling regime as a Minor Modification based on historical trends as discussed in section 12.2.1.

Maintenance of environmental monitoring locations is conducted in full compliance with the requirements outlined in 310 CMR 19.133. The Department of Environmental Protection will be notified in writing of damaged or destroyed monitoring devices and the extent of the damage. Notification will be made within fourteen days of discovery. The notification will detail a schedule for repair or replacement of the damaged components, and the repair or replacement will be completed prior to the next scheduled sampling round.

12.2 Monitoring Well Network

12.2.1 Groundwater Monitoring Wells

Groundwater monitoring is conducted utilizing the existing network of wells in accordance with the Solid Waste Management Regulations. Before sampling, the condition of each well will be inspected and a groundwater elevation will be determined. Sampling will be conducted in accordance with DEP guidance and its approval of the Bourne Landfill CSA. The current Environmental Monitoring Program includes sampling of groundwater at twenty (20) existing monitoring wells, one surface water sample (when available), one leachate sample and ten gas well screenings. The analytical parameters consists of those listed at 310 CMR 19.132(1)(h). The following locations will continue to be monitored, until the program is modified.

- Quarterly at upgradient groundwater monitoring well MW-1S.
- Quarterly at downgradient groundwater monitoring wells MW-5S, MW-5D, MW-8S, MW-8D, MW-11SR, MW-11DR, MW-14S, MW-14D, MW-14DD, MW-18SR, MW-18D, MW-19S, and MW-19D.
- Semiannually at downgradient groundwater monitoring wells MW-5DD, MW-8DD MW-10SR, MW-10D, MW-12S, and MW-12D.

12.2.2 Gas Monitoring Wells

A system of landfill gas monitoring wells have been installed at the Facility. Ten of those wells are used to monitor soil gas concentrations in the immediate vicinity of the Landfill. G-1 is adjacent to the Monument Beach Sportsman's Club located north of the Facility. Two additional gas monitoring wells, G-2 and G-3, are located along the northern property boundary. G-4 is located along the eastern property boundary adjacent to MW-1S and MW-1D. G-5 and G-6 were installed between the Phase 3, Stage 3 landfill and the Facility and DPW buildings. These two wells have been abandoned because of construction and have recently been replaced by wells G-10, G-11 and G-12, which were installed along the southeasterly portion of the landfill parcel and in the vicinity of the office and garage buildings. The gas monitoring wells utilize well screens installed from two to three feet below the low groundwater table elevation to within approximately six feet of the surface to monitor the unsaturated zone. Based upon surrounding land use, the gas monitoring well configuration will adequately monitor the unsaturated zone near the property boundary. In addition to monitoring potential landfill gas migration, monitoring wells G-1, and G-2 may also be used to measure the elevation of groundwater during the regular groundwater monitoring events.

Landfill Gas Monitoring

Landfill gas monitoring must be conducted quarterly at the ten gas monitoring wells, the scale house, the Facility and DPW buildings and buildings north of the Facility. The wells are fitted with caps and sample ports designed to prevent atmospheric air from entering. The concentration of methane will be determined. If the concentration is less than five-percent methane, the percent of the lower explosive limit (LEL) for methane will be determined. At the time of monitoring, the barometric pressure, temperature and general weather conditions will be logged. Appropriate action will be undertaken in accordance with 310 CMR 19.132(4) should landfill gas concentrations exceed the action levels established by the Department.

Landfill gas monitoring should also be conducted weekly in the scale house area. The concentration of methane will be determined. If the concentrations are less than five-percent methane, the percent of the lower explosive limit (LEL) for methane will be determined. At the time of monitoring, the barometric pressure, temperature and general weather conditions will be logged. Appropriate action will be undertaken in accordance with 310 CMR 19.132(4) should landfill gas concentrations exceed the action levels established by the Department. Underground conduit and utilities exist proximate to the scale house and in the vicinity of the unlined Phase 1-ABC Landfill.

13.0 NUISANCE CONTROL PLANS

The following is a Nuisance Control Plan for the Facility, which includes contingencies for dust, noise, odor, litter and vector control, including a detailed Gull Control Plan.

13.1 Gull Control Plan

13.1.1 Introduction

The Town of Bourne began operating a municipal solid waste (MSW) landfill at the present location in 1967. The Town ceased accepting municipal solid waste for disposal at the site about January 1996 and began transferring its MSW to the SEMASS waste-to-energy facility located in Rochester, Massachusetts for a 10-year period. The Facility currently accepts MSW and non-MSW items. The majority of material that is accepted for landfilling is bottom ash generated at the SEMASS facility.

Historically, it had not been necessary to implement gull control at the site. While gulls were present in varying numbers, the isolated location of the Landfill presented a natural buffer to the surrounding community.

The Town of Bourne is located on Cape Cod and the Landfill is located within a few miles of the ocean, which is prime gull habitat. The Town recognized that as it planned to move forward with a proposed expansion of operations to a regional operation and commensurate increase in tonnage, it needed to make efforts to reduce impacts from gulls. To meet this challenge the Town has taken several measures to deter and control gulls. These are listed below.

1. Eliminated ponding, which was prevalent in the lower portions of the site.
2. Consistently use adequate daily cover utilizing soils and/or BUD materials.
3. Reduced the size of the active working face to a small, tightly controlled area.
4. Initiated growth of vegetation on the slopes of intermediately and permanently closed areas of the landfill.
5. Provided information to local businesses about how to prevent gulls from loafing on the roofs utilizing fishing line, and installed line on the roofs of local businesses and abutters.
6. Installed an automatic propane cannon to scare gulls.
7. Installed a gull distress call broadcaster.
8. Several personnel are assigned scare-away guns that launch bird bangers and screamers.
9. Purchased a fogger and methyl anthranilate to irritate the birds.
10. Implementation, as needed, of the Facility's approved Gull Depredation program, as permitted by Federal and State agencies.

The Town has periodically evaluated the effectiveness of these measures and has made modifications as necessary.

13.1.2 Goals and Objectives

It is the policy of the Facility to control, and to the extent possible, deter any and all gulls from roosting and/or feeding at the Landfill. This is accomplished utilizing a management plan based upon guidelines outlined by the Metropolitan District Commission, Department of Environmental Protection and the Massachusetts Division of Fisheries & Wildlife, which recommend a gull control hierarchy beginning with the least intrusive or destructive control measures followed by more aggressive methods.

The effectiveness of the gull control program will be measured by several factors:

- the sheer number of gulls present at the site.
- the reason for their presence.
- the type of activity by the gulls, such as swarming high above the landfill or loafing on the side slopes.

- the degree of and types of impacts to abutters, surrounding residents and businesses.

The thresholds for evaluating the need for new and additional measures will be:

1. The degree to which gulls have generated a visual or other impact to the community because of their activity at the site.
2. The receipts of complaints from abutters, public officials or residents and businesses.
3. Evidence that gulls are being provided with a regular and substantial source of food at the site.
4. Notification from the Massachusetts Department of Environmental Protection.

13.1.3 Notification

Upon receiving a complaint by an abutter or public official on any three (3) consecutive days, or any five (5) days within a one month period, the General Manager or Operations Manager will notify, by telephone, the Department of Environmental Protection, Southeast Regional Office, Solid Waste Management Section. Information pertaining to the nature of the complaints will be provided, as well as an outline of actions to be taken in response.

Complaints will be forwarded to the Facility and recorded in a daily log. Following receipt of a complaint, an investigation will be conducted to verify the impacts noted, including a visit if necessary, followed by an evaluation of current control methods and implementation. Depending on the nature of the complaint, a follow up with the individual may be necessary as well as a response at the site of the impact.

Additionally, it is the responsibility of the Facility to ensure proper notification and education of abutters or nearby individuals and commercial establishments that might be potentially affected by a selected control measure. This may be done by telephone, in person, or in writing. The impacts to abutters by a control method should be carefully weighed before it is selected as a remedy.

13.1.4 Alternatives Analysis

Past methods used at the Facility focused on the landfill operational controls and habitat controls outlined in the Department's policy, and more aggressive measures had not been needed. As MSW landfilling began, more aggressive techniques were implemented. Techniques for habitat control, such as using fishing line in patterns along areas where the birds might loaf, are being implemented. Harassment methods, such as utilizing tethered balloons with moving tails that simulate predators or spraying a mist of water at the birds with a hydroseeder, might also be employed. Personnel have been assigned to bird control in addition to other regular tasks to constantly harass and dissuade the birds from roosting and gaining access to the working face, thereby modifying their behavior.

13.1.5 Selected Control Methods

The selected control methods are listed below. These methods can be accomplished with the existing personnel and equipment currently in use at the Facility.

- Tight control of a small working face.

- Elimination of ponding at the site.
- Rapid vegetation of inactive areas.
- Monitoring off site impacts and potential roosting areas both on site and at nearby businesses.
- Employee education to recognize causes of vectors, how to employ good management practices and how to use a daily log.
- Consistent and adequate use of daily cover.
- Use of harassment techniques including propane cannon, distress calls and methyl anthranilate fog.
- Implementation of the Federal depradation permit

13.1.6 References

The selected control methods were chosen primarily to match the number of gulls that may be present at the site from time to time. The chief resource used for formulating this plan was a document entitled Manual for Gull Control at Massachusetts Landfills. The main criteria in choosing these methods were:

- Rapidity and ease of implementation.
- Effectiveness in controlling the current population at the site.
- Cost.
- Disruption to operations and impacts to abutters.
- Safety for site personnel and visitors.
- Safety for the gulls.

13.1.7 Contingency Measures

Should the gull population at the Facility rise beyond the control of the currently selected methods of management, the Facility implements, as appropriate, progressively more aggressive measures. Included in these contingencies is for the Facility to implement its DEP approval to conduct a "Gull Depredation" program. Also, the Facility may employ the use of outside consultants with expertise in gull control to advise the Facility and/or seek guidance from the Department as soon as it is apparent that chosen control methods are not adequately effective.

13.1.8 Resources

As stated earlier, it is the policy of the Facility to deter any and all gulls from roosting and/or feeding at the site. It is the responsibility of the General Manager, along with the Operations Manager, to evaluate the effectiveness of selected control measures, to assign personnel for implementing these measures and to rapidly modify the control plan as needed. Additionally, a specific budget should be maintained, if needed, to implement extraordinary measures.

13.1.9 Personnel

The primary contact for the gull program will be the General Manager or Operations Manager. Both Managers have the responsibility of ensuring that the Facility has a current gull control plan that is effective and up-to-date. This includes allocating the proper equipment, assigning subordinate personnel, keeping track of records and allocating financial resources as needed. Additionally, the General Manager and Operations Manager report to the Bourne Town Administrator, who may be reached at 508-759-0600.

13.1.10 Implementation

Implementation of the selected control measures began with the commencement of Phase 3, Stage 3 operations. The current selected control measures do not require any additional special permits and the site personnel have already been trained to implement them.

13.2 Vector Control

Vectors, including rodents and breeding insects, can be controlled through many of the same basic methods used to deter the gulls, which are: the periodic or more frequent application of a sufficiently thick layer of cover material; the immediate application of cover, when waste loads contain any type of putrescible waste and the mixture of waste loads with soil.

Although the refuse itself is generally the greatest attraction for vectors, piles of tires and other salvaged materials, stagnant ponding water, unmanaged brush and stump piles will also attract vectors. It is important to maintain the tire and salvageable metal piles and brush/stump areas, for instance, in an orderly manner and process or remove them periodically to eliminate conditions conducive to the harboring of rodents and the breeding of other vectors.

The proper management of the operating face of the Landfill is instrumental in deterring rodents and gulls via the confinement of the active cell and the placement of at least six inches of daily cover. The Facility has retained a rodent and/or vector control specialist who inspects the facility on a regular basis and restocks bait traps. This specialist is a licensed exterminator, knowledgeable in detecting the presence of vectors and in application of extermination techniques to eliminate or at least mitigate the presence of these vectors.

13.3 Dust Control

Due to the nature of landfilling operations, dust will be generated during dry periods throughout the year. The following control measures may be employed at the Facility:

Roadway sweeping and wetting
Access roads, including all internal service roads and the site's entrance road, will be swept and/or wetted using sweeper and tanker truck equipment, which are currently available and are regularly used on-site. Of utmost importance is the minimization of dust that could impact residents using the recycling center. Although most of the major Facility roadway is paved, it must be occasionally swept and/or wetted due to the constant use of site construction and waste processing activities. The dirt roads circumventing the closed and active phases require additional wetting when they are used for hauling construction materials.

The tanker truck can draw water as needed from any of the on-site hydrants. The existing water line extends to service the southern portion of the site, including the Facility offices, the single stream recyclables transfer building, the Residential Recycling Center and the C&D Transfer Station.

Calcium chloride application
Calcium chloride is a soil wetting agent, which may be used on unpaved internal roadway surfaces to control dust from traffic. It must be applied in relatively small amounts, since over-use may affect water quality. It is also costly, and only lasts a short period of time, thus requiring re-application frequently. Generally, often-used roads should be paved to the extent feasible and properly maintained.

Vegetation
Inactive landfill areas and non-landfill surfaces may be loamed and seeded to encourage the growth of vegetation on barren soils that could generate windblown dust.

Haul truck covering
All haul vehicles, whether carrying soils, BUD materials or waste, should be covered adequately with a tarp or similar cover to prevent dust from blowing toward residents in the recycling area or facility personnel or visitors to the Facility. This means that the load should be covered until it reaches the active landfill or drop-off area, and not uncovered any sooner.

Vehicle wheel wash and equipment wash pad.
Vehicles can be washed on the Landfill or at the leachate loading pad where rinseate is collected for off-site disposal with leachate.

13.4 Odor Control

A Landfill Odor Response Plan has been prepared for the Bourne Landfill in order to assist ISWM in addressing potential odor problems resulting from the Facility's operations. The Landfill Odor Response Plan is included, by reference, in this Operations and Maintenance Plan. A 24-hour odor response hotline is available as well.

13.5 Noise Control

Certain noise levels are associated with the operation of trucks and heavy equipment at the Facility. Spreading, compacting and covering operations; vehicle unloading techniques, such as the dropping of tailgates; and back-up beeper signals from haul trucks and landfill equipment are all common and unavoidable sounds generated at the facility. Construction activities, such as liner and closure construction, increase the level of activity, which will generate more noise.

Fortunately, this Facility is located in a remote location with few sensitive receptors. The closest receptor, to the west, is shielded from the noise, as well as visually, by the physical location of the landfilling operations and the screening provided by vegetation and Route 28. During future phase operations, consideration will be given to the potential impact from noise to abutters, based on those future operating conditions.

13.6 Litter Control

Litter control activities have been aggressively implemented to maintain litter free conditions. Proper compaction and covering techniques should be utilized, and more frequent covering or an application of soil on the waste may be needed on excessively windy days if conditions warrant. In addition, portable litter fence should be used in the vicinity of the active face. The portable fencing should be located in the immediate area downwind of the active operations. The portable fencing should be relocated upon any change in the wind direction or velocity.

The Facility currently has a 30-foot high permanent litter fence along the eastern boundary and part of the northern and western boundaries of landfill areas to prevent off-site migration of litter. As part of the completion of the Phase 4 Landfill Expansion project, the litter fence was established to the west and adjacent to the Phase 4 landfill. That litter fence was extended further south, as part of the Phase 6 construction. The permanent fence must be regularly inspected and repaired.

The Landfill's operation should be situated in a manner where the terrain can assist in minimizing the generation of windblown litter. The active face should be maintained as much as possible on the interior slopes of the Landfill, which are more sheltered from the wind.

Litter pick-up crews are employed on a regular and on an as needed basis to pick up litter on and off site, including the routine policing of the entrance road, Canalview Road on the JBCC and MacArthur Boulevard.

APPENDIX A

WASTE BAN COMPLIANCE PLAN

Attachment A

Ongoing Monitoring Recording Sheet

Record every load over 5 cubic yards meeting or exceeding action level **Date:**

Scale Ticket # or Time	Hauling Company or Community (and generator, when known)	Truck #	Truck Type	Material(s) Causing Load to Fail	How was Failed Load Managed?				
					Separate & Recycle	Reject	Dispose or Transfer for Disposal	Reason for Disposal (*not an option for whole tires at landfills, white goods, lead acid batteries, CRTs, and C&D materials)*	Date "Failed Load" Letter Sent

Action Level of Restricted Materials Per Load								
Material	Recyclable Paper (includes corrugated cardboard)	Leaves & Yard Waste	Commercial Organic Material	Glass, Metal, Plastic Containers	Textiles	Asphalt Pavement, Brick, Concrete, Metal, Wood, and/or Clean Gypsum Wallboard	Lead Acid Batteries, CRTs, White Goods, Mattresses	Whole Tires
Quantity	10% by volume	10% by volume OR 10 bags	10% by volume	10% by volume		20% by volume	Any	Any (at landfills)

Cumulative Banned Materials Action Level: 30% or more by volume for all restricted materials combined.

☐ All other waste loads were monitored and did not contain banned material above action levels

__________ Total number of waste loads delivered

Signature ________________________

Attachment B
WASTE BAN COMPREHENSIVE LOAD INSPECTION
REPORTING SHEET

Date & time of inspection ________________ **Hauling Co.** __________________ **Truck #** ______

Size of Truck __________ **Type of Truck** ________________ **Quantity of Waste** _______________

Waste Generator Name ________________ **Waste Generator Location** ______________________

Banned Material Documentation Thresholds		**Amounts Found During Inspection** *(fill in quantities)*
Material	**QTY.**	**QTY.**
Recyclable Paper (includes corrugated cardboard)	10% or more of load by volume	%
Single Polymer Plastic, Metal & Glass Containers	10% or more of load by volume	%
Textiles	10% or more of load by volume	%
Mattresses	Any	
White Goods	Any	
Lead Acid Batteries	Any	
Whole Tires (landfills only)	Any	
CRTs	Any	
Leaves and Yard Waste	10% or more of load by volume OR 10 bags	% #
Commercial Organic Material	10% or more of load by volume	%
Asphalt Pavement, Brick, Concrete, Metal, Wood and/or Clean Gypsum Wallboard	20% or more of load by volume	%
Combined Materials (Recyclable Paper; Glass, Metal, and Plastic containers; Leaves and Yard Waste; Asphalt Pavement, Brick, Concrete, Metal, Wood and/or Clean Gypsum Wallboard: and Commercial Organic Material)	30% or more of load by volume	%

Communication re: Failed Load: ☐ **Notified driver that load failed inspection**
☐ **Requested generator information from hauler**

Disposition of Failed Load: *(check one)*

☐	**Accept, separate, and recycle the banned material.**
☐	**Reject or reload when substantial amounts of recoverable materials in the load and reasonable outlets for the material.**
☐	**Dispose, or transfer for disposal, when the waste cannot be recycled, rejected or reloaded** *(not an option for white goods, lead acid batteries, whole tires, CRTs, and C&D materials).* ☆ **Use space below to explain reason for disposing, or transferring for disposal banned materials.**

_____________________ _____________________ _____________________
signature of inspector *print inspector's name* *title*

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ATTACHMENT C

Sample Letter from Facility to Hauler Regarding Failed Waste Load

Dear [Name of Hauling Company]:

A recent inspection of a waste load delivered by your company revealed materials restricted from disposal at transfer stations and disposal facilities. Massachusetts solid waste regulations (310 CMR 19.017) ban the disposal or transfer for disposal of certain recyclable and hazardous materials. A summary of the Department of Environmental Protection's (MassDEP's) waste ban regulations is included for your reference.

Specifically, truck number _____ on *(date)* delivered *(material)* to this facility. Please inform your customer(s) serviced by that truck about the state waste ban regulations and the banned materials observed. You may wish to forward this letter and the enclosed MassDEP summary to your customers as a reminder.

Add sentence if commercial organic material: [If this material came from a customer that disposes of more than one-half ton of that material per week, then you and your customer are subject to the waste ban and future loads from that customer may be subject to waste ban enforcement by MassDEP.]

As a MassDEP-permitted facility, we are required to ensure that restricted materials are not accepted for disposal. If *(name of hauling company)* continues to deliver restricted material to this facility, your loads may be rejected, handling fees may be charged, and/or your drivers may experience delays due to the reloading of banned waste. Also, MassDEP will be monitoring our records of load inspections to follow up with repeat violators and may issue enforcement against *(name of hauling company)* and/or the waste generator.

We appreciate your cooperation in this matter.

Yours truly,

(facility operations manager)

ATTACHMENT D

WASTE BAN FACT SHEET

(To be distributed to facility's customers as needed)

Summary of Waste Ban Regulations

This document summarizes the waste ban regulations pursuant to 310 CMR 19.017 of the General Requirements, Procedures and Permits for Solid Waste Management Facilities. These regulations are designed to conserve capacity at existing disposal facilities and stimulate recycling markets by diverting recyclable materials from the waste stream. They also prohibit certain toxic materials that may adversely affect the environment when landfilled or incinerated.

These regulations apply to solid waste landfills, municipal waste combustors and transfer stations. It is the responsibility of the facility operator to ensure that prohibited materials accepted at the facility are appropriately managed when evident. Facilities should monitor their waste streams and inspect all loads of waste for restricted materials. A facility may reject loads containing recoverable restricted materials.

Definitions of Materials Restricted by 310 CMR 19.017:

Asphalt Pavement, Brick and Concrete: asphalt pavement, brick and concrete from construction activities and demolition of buildings, roads and bridges and similar sources. This includes both coated (e.g. painted) or uncoated ABC.

Cathode Ray Tubes: any intact, broken, or processed glass tube used to provide the visual display in televisions, computer monitors and certain scientific instruments such as oscilloscopes.

Clean Gypsum Wallboard: gypsum wallboard that is not contaminated with paint, wallpaper, joint compound, adhesives, , or other substances after manufacture. Gypsum wallboard means a panel (also known as drywall) with a gypsum core and faced with a heavy paper or other material on both sides.

Clean Wood: discarded material consisting of trees, stumps and brush, including but not limited to sawdust, chips, shavings, bark, and new or used lumber. Clean wood does not include:

(1) wood from commingled construction and demolition waste;
(2) engineered wood products; and
(3) wood containing or likely to contain:
  (a) asbestos;
  (b) chemical preservatives such as, but not limited to, chromated copper arsenate (CCA); creosote or pentachlorophenol; or
  (c) paints, stains or other coatings, or adhesives.

Commercial Organic Material: effective through October 31, 2022 means food material and vegetative material from any entity that generates more than one ton of those materials for solid waste disposal per week, but excludes material from a residence. Effective beginning November 1, 2022 means food material and vegetative material from any entity that generates more than one-half ton of those materials for solid waste disposal per week, but excludes material from a residence. [1].

Glass Containers: glass bottles and jars (soda-lime glass) but excluding light bulbs, glass cookware, plate glass, drinking glasses, windows, windshields and ceramics.

Lead Batteries: lead-acid batteries used in motor vehicles or stationary applications.

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[1] **Food Material:** material produced from human or animal food production, preparation and consumption activities and which consists of, but is not limited to, fruits, vegetables, grains, and fish and animal products and byproducts.
Vegetative Material: plant material.

Leaves: deciduous and coniferous leaf deposition.

Mattresses: any resilient material or combination of materials that is enclosed by ticking, used alone or in combination with other products, and that is intended for sleeping upon, except for mattresses that are contaminated with mold, bodily fluids, insects, oil, or hazardous substances. Mattress includes any foundation or box-spring. "Mattress" does not include any mattress pad, mattress topper, sleeping bag, pillow, car bed, carriage, basket, dressing table, stroller, playpen, infant carrier, lounge pad, crib bumper, liquid or gaseous filled ticking, including any water bed and any air mattress that does not contain upholstery material between the ticking and the mattress core, and mattresses in futons and sofa beds.

Metal: ferrous and non-ferrous metals derived from used appliances, building materials, industrial equipment, transportation vehicles, and manufacturing processes.

Metal Containers: aluminum, steel or bi-metal beverage and food containers.

Recyclable Paper: all paper, cardboard, and paperboard products excluding tissue paper, toweling, paper plates and cups, wax-coated cardboard, and other low-grade paper products.

Single Polymer Plastics: plastic containers including bottles, jugs, jars, and tubs.

Textiles: clothing, footwear, bedding, towels, curtains, fabric, and similar products except for textiles that are contaminated with mold, bodily fluids, insects, oil, or hazardous substances.

Tires: a continuous solid or pneumatic rubber covering intended for use on a motor vehicle.[1]

White Goods: appliances employing electricity, oil, natural gas or liquefied petroleum gas to supply heat or motor power to preserve or cook food, to wash or dry clothing, cooking or kitchen utensils or related items; or to cool or to heat air or water. These include, but are not limited to, refrigerators, freezers, air conditioners, water coolers, dishwashers, clothes washers, clothes dryers, gas or electric ovens and ranges, and hot water heaters. White goods do not include microwave ovens.

Wood: treated and untreated wood, including clean wood.

Yard Waste: deciduous and coniferous seasonal depositions (e.g. leaves), grass clippings, weeds, hedge clippings, garden materials, and brush 1" or less in diameter (excluding diseased plants).

For more information regarding waste disposal restrictions, contact the appropriate MassDEP regional office

[1] Shredded tires, defined as tires that have been cut, sliced or ground into four or more pieces such that the circular form of the tire has been eliminated, can be landfilled.

Massachusetts Department of ENVIRONMENTAL PROTECTION

fact sheet

Your Business and the Waste Bans: What You Need to Know

What are waste bans?

"Waste bans" are restrictions on the disposal, transfer for disposal and contracting for disposal of certain hazardous items and recyclable materials at solid waste facilities in Massachusetts.

The waste bans are designed to:

- Conserve capacity at existing disposal facilities.
- Minimize the need for new facility construction.
- Provide recycling markets with large volumes of material on a consistent basis.
- Keep certain toxic substances or materials from adversely affecting our environment when landfilled or combusted.
- Promote business and residential recycling efforts.

What do I need to do? Remove & Recycle!

Business managers should remove and recycle any banned materials they generate or run the risk that waste loads will be rejected at a disposal site, charged an additional handling fee or face potential enforcement penalties. Recycling at businesses can be easier and more economical than recycling at home, because the materials are generated in larger quantities and are easier to keep separate from the rest of the trash. Recycling prevents unnecessary disposal of usable raw materials, saves energy and reduces air and water pollution. Recycling also reduces disposal costs and can save businesses money by diverting materials from the trash dumpster to the recycling bin.

Your waste hauler may be able to help you establish a recycling program. The RecyclingWorks in Massachusetts program has an extensive list of companies that collect or process recyclable materials available at www.recyclingworksma.com.

What is banned?

Asphalt Pavement, Brick, and Concrete: asphalt pavement, brick and concrete from construction and demolition of buildings, roads, bridges, and similar sources.

Batteries: Lead-acid batteries used in motor vehicles or stationary applications.

Cathode Ray Tubes: Any intact, broken or processed glass tube used to provide the visual display in televisions, computer monitors and certain scientific instruments.

Clean Gypsum Wallboard: A panel (known as drywall) with a gypsum core and faced with a heavy paper or other material on both sides that is not contaminated with paint, wallpaper, joint compound, adhesives, nails, or other substances after manufacture.

Glass Containers: Glass bottles and jars. The ban does not cover light bulbs, Pyrex cookware, plate glass, drinking glasses, windows, windshields and ceramics.

Leaves & Yard Waste: Leaves, grass clippings, weeds, garden materials, shrub trimmings, and brush one-inch or less in diameter (excluding diseased plants).

Mattresses (effective Nov. 1, 2022): Any resilient material or combination of materials that is enclosed by ticking, used alone or in combination with other products, and that is intended for sleeping upon, except for mattresses that are contaminated with mold, bodily fluids, insects, oil, or hazardous substances. Mattress includes any foundation or box-spring. "Mattress" does not include any mattress pad, mattress topper, sleeping bag, pillow, car bed, carriage, basket, dressing table, stroller, playpen, infant carrier, lounge pad, crib bumper, liquid or gaseous filled ticking, including any waterbed and any air mattress that does not contain upholstery material between the ticking and the mattress core, and mattresses in futons and sofa beds.

Metal: Ferrous and non-ferrous metals derived from used appliances, building materials, industrial equipment, vehicles, and manufacturing processes.

Metal Containers: Aluminum, steel or bi-metal beverage and food containers.

Recyclable Paper: All paper, cardboard, and paperboard products (EXCEPT tissue paper, toweling, paper plates and cups, wax-coated cardboard and other low-grade paper products).

Textiles (effective Nov. 1, 2022): Clothing, footwear, bedding, towels, curtains, fabric, and similar products except for textiles that are contaminated with mold, bodily fluids, insects, oil, or hazardous substances.

Single Resin Narrow-Necked Plastics: Bottles, jars, jugs, and tubs.

White Goods: Appliances employing electricity, oil, natural gas or liquefied petroleum gas. These include refrigerators, freezers, dishwashers, clothes washers, clothes dryers, gas or electric ovens and ranges, and hot water heaters.

Whole Tires: Motor vehicle tires of all types (Combustion facilities can accept whole tires for disposal. Shredded tires are not restricted).

Wood: Treated and untreated wood, clean wood (trees, stumps, and brush, including but not limited to sawdust, chips, shavings and bark). (Combustion facilities can accept wood for disposal.)

Commercial Organic Material: Food and vegetative material from businesses and institutions that dispose of one ton or more organic material per week. (effective Nov. 1, 2022 this threshold will drop to ½ ton per week.)

Did You Know?

The waste bans apply to all solid waste destined for a Massachusetts landfill, combustion facility, or transfer station.

Waste generators are responsible for ensuring that they do not contract for the disposal of banned items.

Waste facility operators are responsible for ensuring that unallowable quantities of banned materials are not disposed or transferred for disposal from their facilities. Facilities must check incoming waste in two ways. First, all loads must be visually monitored for the presence of banned materials. Second, random inspections of waste load contents must be conducted.

MassDEP conducts inspections at solid waste facilities to identify haulers and generators (businesses, institutions, municipalities, etc.) that dispose of banned materials.

Massachusetts Department of
Environmental Protection
One Winter Street
Boston, MA 02108-4746

Commonwealth of
Massachusetts

Executive Office of
Environmental Affairs

Department of
Environmental Protection

Produced by the
Bureau of Air and Waste
November 2021

This information is available in alternate format by calling our ADA Coordinator at (617) 574-6872.

Businesses and municipalities that do not divert banned items from their waste run the risk of having solid waste facilities reject their waste and charge additional handling fees, and potential enforcement penalties from MassDEP.

For more information:

Visit the MassDEP Waste Bans home page:
http://www.mass.gov/eea/agencies/massdep/recycle/solid/massachusetts-waste-disposal-bans.html

For assistance with finding a recycling service provider, contact the RecyclingWorks in Massachusetts program at (888)254-5525, via email at info@recyclingworksma.com, or visit the program website at www.recyclingworksma.com.

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Massachusetts Department of ENVIRONMENTAL PROTECTION

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fact sheet

What are Massachusetts Waste Bans?

Why does Massachusetts have waste bans?
Waste bans help to increase recycling and support the recycling economy, which provides thousands of jobs and millions of dollars in economic activity in Massachusetts. By reducing the disposal of banned materials, we also capture valuable resources, reduce greenhouse gas emissions, save energy, and reduce our need for landfills and incinerators.

What materials are banned from disposal?

- Glass, metal, and plastic containers (bottles, cans, jars, jugs and tubs)
- Paper, paperboard, and cardboard
- Leaves, grass and brush (less than 1 inch in diameter)
- Large appliances such as refrigerators, freezers, stoves, washers, and dryers
- Tires
- Cathode ray tubes (older televisions and computer monitors)
- Vehicle batteries
- Construction materials including asphalt pavement, brick, concrete, metal, wood, and clean gypsum wallboard
- Mattresses (effective Nov. 1, 2022)
- Textiles (effective Nov. 1, 2022)
- Food material (only from businesses or institutions that dispose of one ton or more per week. (Will drop to ½ ton per week effective Nov. 1, 2022.)

What does this mean for residents?
Most waste ban materials are collected through regular municipal collection or drop-off programs. In some cases, particularly with larger items such as cathode ray tubes or appliances, materials are collected through separate collections or drop-off events. In other cases, materials such as vehicle batteries, tires, and cathode ray tubes may be collected by retailers.

For residents who receive private collection services (not through your city or town), ask your service provider for recycling options. You can also check for other recycling options here: http://www.mass.gov/eea/agencies/massdep/recycle/reduce/.

For more information on the waste bans see:
http://www.mass.gov/eea/agencies/massdep/recycle/solid/massachusetts-waste-disposal-bans.html

Massachusetts Department of ENVIRONMENTAL PROTECTION

Summary

Waste Ban Regulations 310 CMR 19.017

Materials restricted from disposal: Glass, metal and plastic containers; paper, including cardboard; leaf and yard waste; lead-acid batteries; mattresses (effective Nov. 1, 2022); textiles (effective Nov. 1, 2022); whole tires; white goods (large appliances); cathode ray tubes (TVs and computer monitors); asphalt pavement, brick, concrete, metal; wood; clean gypsum wallboard; and commercial organic material.

Why waste bans?

- Capture more recyclables
- Conserve disposal capacity
- Keep hazards out of the environment

G u i d a n c e B r i e f

Haulers & Waste Ban Compliance

The Massachusetts waste bans (found at 310 CMR 19.017) are prohibitions on the disposal or transfer for disposal of certain recyclable and/or toxic materials. They are intended to spur the reuse and/or recycling of banned waste materials, conserve disposal capacity across the state, and minimize adverse environmental impacts.

People who generate solid waste and people who transport it to disposal facilities are subject to waste ban requirements. The Department of Environmental Protection (MassDEP) conducts ongoing inspections at solid waste facilities to identify waste haulers and generators who improperly dispose of banned materials.

Three key strategies can lower your company's risk of transporting prohibited wastes:

- **Train Your Employees.** Be sure they understand what the waste ban regulations require, and also that MassDEP may take enforcement action against your company when your waste loads are found to contain banned materials.
- **Educate Your Customers.** Let them know which materials are banned from disposal in Massachusetts and help them develop procedures for preventing those items from entering the waste stream.
- **Keep Good Records.** Track and document all procedures and transactions, as well as the steps you have taken to prevent shipping non-conforming waste loads.

These strategies are discussed in more detail below.

Employee Training & Protocols

All employees of your waste hauling business – not only drivers, but also sales and customer service personnel – should be well acquainted with the waste bans. The better they educate your customers about keeping prohibited materials out of the trash, the easier it will be for your company meet its compliance obligations.

MassDEP recommends that your company require all new employees to be trained about the waste bans, and that you offer periodic refresher training for all employees. This training should include waste ban quality assurance/quality control procedures for all facets of your operation.

Your drivers can be a critical component of a successful compliance strategy:

At Pick-Up

- Check for banned materials when picking up waste loads and after tipping waste loads at the facility, and report violations or potential violations both to the customer and to the company's home office.
- Ask customers to remove banned items, inform them that service fees may be levied to separate and process banned materials, or refuse to pick up non-conforming loads, and notify customer service representatives responsible for managing the affected accounts.
- Provide literature, container stickers and other educational materials for on-site replacement or to provide to customers as needed.

At the Receiving Facility

- Be knowledgeable about the policies of each waste facility and the materials that each can and cannot accept. (For example, whole tires are banned at landfills but not at combustion facilities.)
- Get out of trucks whenever possible and inspect loads at waste transfer or disposal facilities. Document and take photographs of any failed loads, and notify customer service representatives as above.

Sales & Customer Service

The initial point of sale provides a convenient opportunity to offer recycling services and an ideal starting point for an ongoing dialogue with customers about the waste bans, the specific materials prohibited from disposal, and the fact that as waste generators, they too are subject to MassDEP enforcement action for throwing away banned items. It is a good idea to:

- Provide each customer with "Your Business and the Waste Bans: What You Need to Know" (http://www.mass.gov/eea/docs/dep/recycle/wstban01.pdf) or a similar educational handout.
- Affix labels or stickers to all containers you distribute to let customers know what materials can and cannot be placed in each receptacle.
- Advise customers of appropriate procedures for handling banned materials.

You can use your business policies and procedures to help educate your customers:

- Incorporate waste ban compliance requirements into all contracts.
- Advise customers that you will not accept prohibited materials, that you may levy service fees or surcharges on non-conforming loads, and that you could discontinue service to them for repeat offenses.
- Show customers photographs of failed loads, facility turn-away letters and details of failed load surcharges, and offer them follow-up waste ban education and additional material management services.
- Notify MassDEP of chronic or serious waste ban violations and ask the agency to send warning letters to offending customers.

Good Records Are Valuable

Keeping good records can help you monitor progress in complying with the waste bans and identify opportunities for improvement. It is important to keep on file:

- All applicable signed documents.
- Copies of emails and faxes, and records of phone calls.
- QA/QC procedures.
- Records of failed load observations, notifications issued by receiving facilities and follow-up actions.

For Additional Information:

- Visit the MassDEP Waste Bans home page: **http://www.mass.gov/eea/agencies/massdep/recycle/solid/massachusetts-waste-disposal-bans.html**
- Contact the Recycling Works in Massachusetts program at (888)254-5525, via email at info@recyclingworksma.com, or visit the program web site at www.recyclingworksma.com.

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ATTACHMENT E

Sample Letter from Facility to Generator Regarding Failed Waste Load

Dear Customer:

A recent inspection of a waste load generated or contracted from your facility or program revealed materials restricted from disposal at transfer stations and disposal facilities. Massachusetts solid waste regulations ban the disposal or transfer for disposal of certain recyclable and hazardous materials. A summary of the Department of Environmental Protection's (MassDEP) waste ban regulations is included for your reference.

Specifically, *(material)* were delivered to this facility on *(date)*. As a MassDEP-permitted facility, we are required to ensure that restricted materials are not accepted for disposal. If *(name of generator)* continues to deliver restricted material to this facility, your loads may be rejected, handling fees may be charged, your drivers may experience delays due to the reloading of banned waste, and/or the matter may be referred to MassDEP for enforcement action.

MassDEP will be monitoring our inspection records to follow up with those who continue to deliver banned waste. For more information on how to start a new recycling program or improve an existing program, please visit www.recyclingworksma.com.

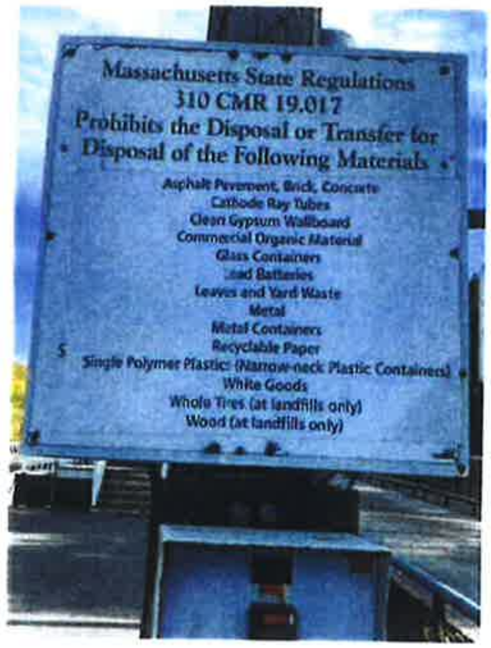
We appreciate your cooperation in this matter.

Yours truly,

(facility operations manager)

ATTACHMENT F

Example of the signage to be posted by November 1, 2022 that will include additional language addressing mattresses and textiles as highlighted below.



Asphalt Pavement, Brick, Concrete
Cathode Ray Tubes
Clean Gypsum Wallboard
Commercial Organic Material
Glass Containers
Lead Batteries
Leaves and Yard Waste
Mattresses
Metal
Metal Containers
Recyclable Paper
Single Polymer Plastics (bottles, jugs, jars, and tubs)
Textiles
White Goods
Whole Tires (at landfills only)
Wood (at landfills only)

Attachment G

Important:
When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

Part A: General Information

1. Facility Information

MassDEP Facility #: RO Acct# 172356	
Facility Name: Town of Bourne Landfill	*Street Address:* 201 MacArthur Boulevard
City, State, ZIP: Bourne, MA 02532	*Contact Name, Title:* Mr. Daniel T. Barrett, General Manager
Telephone Number: 508-759-0600, x. 4240	*Email:* dbarrett@townofbourne.com

Facility Type (check one):
☐ Transfer/handling facility
☒ Landfill
☐ Solid Waste Combustor
☐ Construction and Demolition Waste Facility Permitted for C&D Material Separation
☐ Construction and Demolition Waste Facility Permitted for C&D Material Separation & Acceptance of MSW

2. Owner Information

Owner Name: Town of Bourne, MA	*Street Address:* 24 Perry Avenue
City, State, ZIP: Buzzards Bay 02532	*Contact Name, Title:* Ms. Marlene McCollem, Town Administrator
Telephone Number: 508-759-0600, x. 1308	*Email:* mmccollem@townofbourne.com

3. Operator Information

Operator Name: Town of Bourne, ISWM Department	*Street Address:* 201 MacArthur Boulevard
City, State, ZIP: Bourne, MA 02532	*Contact Name, Title:* Mr. Daniel T. Barrett, General Manager
Telephone Number: 508-759-0600, x. 4240	*Email:* dbarrett@townofbourne.com

Part B: General Requirements

1. Application Requirements

Under 310 CMR 19.017, each solid waste facility must submit either a revised waste ban compliance plan or a waste ban plan certification form, as described below, to MassDEP by July 1, 2022

Landfills, municipal waste combustors and construction and demolition waste handling facilities need to submit a revised Waste Ban Compliance Plan with a BWP SW 45 permit application form, which provides for presumptive approval under 310 CMR 19.034. This form is available at: http://www.mass.gov/eea/agencies/massdep/recycle/approvals

The exceptions to this are if the facility proposes a significant physical modification as part of its waste ban compliance plan or if the plan deviates significantly from MassDEP's waste ban plan template.

Solid waste transfer stations that are not construction and demolition debris waste transfer stations need to prepare a revised Waste Ban Compliance Plan. However, under 310 CMR 19.035, they do not need to submit this plan to MassDEP as long as the plan is consistent with the guidance document. The plan must be kept on site and available for MassDEP review. Only a waste ban plan certification form is required to be submitted. This form is available at: http://www.mass.gov/eea/agencies/massdep/recycle/solid/massachusetts-waste-disposal-bans.html#5

Check which form is being submitted.

☐	Certification	Solid Waste transfer station (not C&D waste transfer station) (does not require submittal of waste ban plan)
☒	BWP SW 45	Alternative Review Process (presumptive approval process under 310 CMR 19.034)
☐	BWP SW 22	Landfills – Minor Modifications
☐	BWP SW 21	Modification of a Small Handling Facility ***Incinerators not submitting BWP SW 45 also submit this form***

2. Training

How will requirements of waste ban compliance plan be communicated to relevant staff? Check all boxes that apply.

☒ Will conduct annual waste ban training to staff.

☐ Distribute compliance plan to staff.

☒ Discussion at regularly scheduled meetings.

☒ Other: Plans and other relevant handouts will be available at the ISWM office.

3. Signage

Please attach photographs, or 8.5" X 11" specification sheet, of signs posted or to be posted at facility entrance and waste receiving areas that inform users of the prohibition against disposal, or transfer for disposal, of asphalt pavement, brick, concrete, cathode ray tubes, commercial organic material, glass containers, lead batteries, leaves and yard waste, mattresses, metal, metal containers, recyclable paper, single polymer plastics (narrow-neck plastic containers), textiles, white goods, whole tires at landfills and wood at landfills. *(See Attachment F of the Guidance Document for sample signage)*

Signs were posted on: (Date: MM/DD/YYYY) | **Signs will be posted on:** By 11/1/2022 (Date: MM/DD/YYYY)

Part C: Ongoing Waste Stream Monitoring

1. Detection

How will the facility screen all incoming loads for unacceptable quantities of restricted materials? See Guidance Document Section V – "Ongoing Waste Stream Monitoring/Inspection" for description.
Please check all that apply:

☒ Staff will inspect vehicles prior to dumping

☒ Staff will look for banned materials as waste is dumped by truck.

☒ Staff will look for banned materials by observing and communicating with residents disposing of waste in designated areas.

☒ Staff will look for banned materials as waste is handled by facility personnel operating heavy equipment (i.e., a bulldozer, front end loader).

☐ Staff will look for banned materials during separation process on tipping floor.

☐ Staff will look for banned materials during separation process on picking lines

☐ Other:

2. Record Keeping

Pursuant to 310 CMR 19.017 (5), the facility operator will record and maintain the following information on all loads discovered through ongoing monitoring to contain banned material above Action Levels delivered in vehicles or containers with a capacity greater than 5 (five) cubic yards (*See Attachment A of the Guidance Document for suggested format):*

- Date of inspection;
- Origin of waste (if known); company, address, contact name, phone number, job site name and address
- Quantity of restricted materials discovered;
- Hauler and truck number;
- Scale ticket number (or other facility specific load record number)
- Disposition of restricted materials; and
- Documentation of communication follow-up with haulers and/or generators connected with failed loads, as described in the Guidance Document, Section VIII.

Please check:

☒ Attached is an example of facility's Ongoing Monitoring Recording Sheet

☒ Facility Operator will record this information on the attached Ongoing Monitoring Recording Sheet

☐ Facility does not accept loads in vehicles or containers with a capacity greater than 5 (five) cubic yards

Part D: Comprehensive Load Inspections

Please note: If the facility serves customers with vehicles or loads with a capacity under 5 (five) cubic yards it is not required to conduct comprehensive load inspections. Please proceed to Part E: Failed Load Follow-Up.

Facilities should conduct a minimum number of comprehensive load inspections per month as indicated on the following Inspection Frequency Chart :

Please check the appropriate box on the chart below based on the facility's permitted size.

Inspection Frequency Chart

	Facility Size in Permitted Tons per day	Minimum Number of Vehicles to Inspect per Month *(vehicles must have capacity of greater than 5 cubic yards)*
☐	Municipal transfer station with no private haulers or commercial users with.vehicle capacity over 5cy	0
☐	1-99	4
☒	100-299	8
☐	300-499	12
☐	500-999	16
☐	1000 +	20

2. Load Selection

The proposed method of selecting vehicles for inspection should be random. Please refer to the Guidance Document, Section VI for description. **Please describe below how loads will be randomly selected for comphrensive inspections. Attach additional pages if necessary.**

This Waste Ban Comliance Plan addresses the Bourne Landfill. The Bourne Landfill will be required to inspect 8 loads per month based on the potential quantity of MSW disposed of at the landfill. The landfill currently accepts 189,000 tons per year of ash under contract with SEMASS which are not inspected for waste bans. The facility personnel will select loads randomly during the month on any given day, depending on weather conditions. Generally, rear-load and front-end load packers are the vehicles that will be identified for inspection.

Inspection Procedure

ee Guidance Document, Section V for a description of inspection procedures. **Please describe below how the icility will conduct its comprehensive load inspections for all banned materials. Include information on which ersonnel are involved and what kinds of equipment will be used:**

ersonnel: See attached.

quipment: See attached.

rocedure: See attached.

4. Record Keeping

Pursuant to 310 CMR 19.017 (5) the facility operator will record and maintain the following information on comprehensive load inspection activities. *See Attachment B of the Guidance Document for suggested format.*

- Date and time of inspection
- Origin of waste for failed loads (if known) company, address, contact name, phone number, job site name and address
- Quantity of restricted materials discovered
- Tons or cubic yards of waste in each inspected load
- Hauler name and address and truck number
- Scale ticket number (or other facility specific load record number)
- Disposition of the load and, if accepted, the banned material
- Documentation of communication follow-up with haulers and/or generators connected with failed loads, as described in the Guidance Document.

Please check:

☒ Attached is an example of facility's comprehensive inspection recording sheet

☒ Facility operator will record this information on the attached sheet

Part D 3. Inspection Procedure

Personnel: Generally, a manager at the facility will conduct this operation. However, depending on manpower needs and operations on any particular day, an equipment operator, or other designee will be substituted.

Equipment: A compactor, wheel loader, excavator or skid steer load will be available to spread out loads as necessary. Rakes or other hand held utensils may be employed as well.

Procedure: For comprehensive load inspections, the inspector will randomly select a vehicle. He or she will approach the driver and explain that we need to inspect his or her load for waste ban compliance per DEP regulations. Once the load has been discharged, an equipment operator will spread out the load as needed. Then, using MA DEP guidance procedures, the load will be inspected and recorded on the enclosed reporting sheet included in Attachment B. For ongoing monitoring, equipment operators and/or laborers at the working face will report failed loads to the scale via radio communications and coordinate management of the banned items. C&D loads (Category 1 and Category 3) from small facilities (accepting loads less than 5 cubic yards), including the Bourne's residential recycling center, that have approved waste ban plans from MA DEP will be landfilled in accordance with MA DEP's policy allowing this option and thus will not be considered failed loads. If a customer has identified a separated banned item to the scale operator, the load will not be failed and they will be directed where to take the item. If it is not declared and separated, it will fail as it was mixed into the load.

If a load fails, the driver will be notified and arrangements will be made to separate and recycle, compost or otherwise divert from disposal the recoverable materials, or reject and reload the materials depending on equipment and staff availability. If a load fails and has unrecoverable materials it will be landfilled and a note will be made on the reporting sheet. This is not an option for tires, white goods, CRTs or lead acid batteries. Clean recyclable mattresses will be segregated, however contaminated mattresses will be landfilled in accordance with DEP guidance. Loads with mattresses that were already contaminated from the source will not be considered failed loads, such as from mattress processors, illegal dumping cleanups or obvious reason like a fire or flood. Mattresses where there is doubt about the source and it appears they were contaminated from the load in transit, are assumed to have been recyclable and will be treated as a failed load.

Surcharges for banned items are employed as a deterrent and either inspectors, equipment operators or laborers will report surchargeable items to the scale for all loads. The list of surchargeable items may grow and the price may be increased over time. Each day, all violations of the waste bans are reported to the scale, including both ongoing monitoring violations and those found during comprehensive inspections. This includes violations found at the transfer station and the landfill. At the end of the day, the scale operator provides copies of tickets for loads that failed to office staff and also produces a daily report detailing the total number of loads received that day. This information is recorded in an ongoing monitoring log using Attachment A. This sheet is produced on a computer so that there is an electronic backup as well as a hard copy. Letters for all failed loads will be mailed close to the time of violation, including loads either ongoing monitoring or comprehensive load inspections. In the case of cash customers, ISWM will attempt to get a mailing address or will provide the driver a letter explaining that a violation has occurred, summary of the waste bans and a ticket with a notation about the failed item(s) at the time of the violation. This will ensure that all violators will receive timely communication. The scale operator, inspector or equipment operators will also attempt to determine the identity, mailing address for the generator.

Part E: Failed Load Follow-Up

1. Communication

Please refer to the Guidance Document for a description of communication procedures.

- **WASTE SOURCE – COMMERCIAL/PRIVATE HAULER**
  Please provide sample letters that will be sent to any hauler and generator (where it can be determined) that delivers a failed load to the facility, describing which material(s) caused the failure, and encouraging the hauler to work with its customers to separate their trash. Accompanying this letter should be a MassDEP Fact Sheet explaining the waste bans. *Refer to the Guidance Document, Attachment C, for suggested language, and Attachment D for the fact sheet.*

- **WASTE SOURCE – MUNICIPALLY-RUN OR CONTRACTED COLLECTION**
  Please provide a sample letter that will be sent to any municipality from which unacceptable quantities of banned material was received, describing the materials and encouraging the community to contact MassDEP for technical assistance. Accompanying this letter should be a MassDEP Fact Sheet explaining the waste bans. *See Attachment E for suggested language and Attachment D for the fact sheet.*

- **WASTE SOURCE –WASTE DELIVERED IN VEHICLES WITH A CAPACITY OF 5 CUBIC YARDS OR LESS**
  How will the facility inform individuals identified through ongoing monitoring that are not separating banned material from their solid waste? (check all that apply)

  ☐ Verbally inform the individual about the waste bans and that the facility is not allowed to mix restricted materials with solid waste
  ☐ Give the individual the MassDEP Waste Ban Fact Sheet or similar written material
  ☐ Direct the individual to the facility's recycling and/or composting area
  ☐ Give the individual a recycling brochure
  ☐ Other:
  ☒ N/A – The facility does not service individuals delivering waste in small vehicles

2. Failed Load Disposition

☒ **When a failed load is identified, the facility will adhere to the procedures outlined below in the following hierarchy presented:**

- Waste ban materials should be separated and recovered to the greatest extent possible.
- Reject or reload if there are substantial quantities of recoverable materials in the load and there are reasonable outlets for the material, or
- Accept, separate, and recycle material(s) that caused the load to fail.
- For asphalt pavement, brick, concrete, metal, wood and/or clean gypsum wallboard first separate the clean gypsum wallboard for recycle/re-use, then transfer ABC, metal and wood to a C&D processor that is compliant with MassDEP's Minimum Performance Standard Policy for C&D facilities.,
- As a last resort, dispose (or transfer for disposal), when the waste cannot be recycled, rejected or reloaded because reloading the waste would endanger workers or substantially disrupt facility operations. The facility operator's rationale for disposing a failed load must be recorded and retained in facility's operating logs.

☒ Other (please describe): Bourne manages ABC and metals on-site.

3. Materials Management

To the greatest extent possible, waste ban materials will be separated and recovered. On an average day, specify how will the facility manage each restricted material.

	Reject/Reload	Accept/Separate/ send to recycling/reuse facility	Transfer to another permitted facility for separation	Dispose/ transfer for disposal
Lead Batteries	☒	☒		
White Goods	☒	☒		
Whole Tires (at landfills)	☒	☒		
CRTs	☒	☒		
Commercial Organic Material	☒	☒		☒
Glass Containers	☒	☒		☒
Metal Containers	☒	☒		☒
Single-Resin Plastic Containers	☒	☒		☒
Recyclable Paper	☒	☒		☒
Leaves	☒	☒		☒
Yard waste	☒	☒		☒
Mattresses	☒	☒	☒	☒
Textiles	☒	☒	☒	☒
Asphalt Pavement, Brick and/or Concrete	☒	☒	☒	
Metal	☒	☒	☒	
Wood	☒	☒	☒	
Clean gypsum wallboard	☒	☒		

Comments

(1) Identify (name and location) the proposed receiving facilities to be used for outgoing separated recyclable materials for each material type.

(2) Identify (name and location) the proposed receiving facilities to be used when transferring waste materials for separation of recyclable material at the receiving facility. If located out-of-state, attach the receiving facility's state issued operating permit describing its operations.

(3) Mattresses should only be transferred for disposal if a recycling facility will not accept them.

(4) C&D materials should only be transferred to another facility that meets MassDEP's Minimum Performance Standard after first separating clean gypsum wallboard.

Part E 3. Materials Management (continued)

(1) Identify (name and location) the proposed receiving facilities to be used for outgoing separated recyclable materials for each material type.

The Town of Bourne may update the vendor list depending on market conditions, availability and pricing.

Lead Batteries: Middleboro Recycling, Middleboro, MA
White goods: Managed at the Town of Bourne, ISWM Department and sold to scrap markets via Mid City Scrap in Westport, MA and Schnitzer in Everett, MA.
Whole tires: Bob's Tire's, New Bedford, MA
CRTs: Complete Recycling Solutions LLS, Fall River, MA
Commercial organics: Black Earth Compost, Gloucester, MA
General Recyclables (glass and metal containers, single-resin plastic containers and recyclable paper): EL Harvey, Westboro, MA
Leaves and Yard Waste: Town of Bourne, ISWM Department, Bourne, MA
Mattresses: Green Mattress, Milford, MA
Textiles: Red Cross, Planet Aid, Salvation Army containers picked up at Town of Bourne, ISWM Department, Bourne, MA
Asphalt, Brick and Concrete: Town of Bourne, ISWM Department, Bourne, MA
Metal: Managed at the Town of Bourne, ISWM Department and sold to scrap markets via Mid City Scrap in Westport, MA and Schnitzer in Everett, MA
Wood: Managed at the Town of Bourne, ISWM Department at the C&D transfer station to MPS compliant facilities including but not limited to: United Materials Management, Leominster, MA; Champion City Recovery, Brockton, MA; JR Vinagro, Johnston, RI; Northern Tree Service, Inc., 1290 Park Street, Palmer, MA (telephone poles or railroad ties)
Clean gypsum wallboard: New England Recycling, 569 Winthrop Street, Taunton, MA

(2) Identify (name and location) the proposed receiving facilities to be used when transferring waste materials for separation of recyclable material at the receiving facility. If located out-of-state, attach the receiving facility's state issued operating permit describing its operations.

The Town of Bourne may update the vendor list depending on market conditions, availability and pricing.

General Recyclables (glass and metal containers, single-resin plastic containers and recyclable paper): EL Harvey, Westboro, MA
Wood: Managed at the Town of Bourne, ISWM Department at the C&D transfer station to MPS compliant facilities including but not limited to: United Materials Management, Leominster, MA; Champion City Recovery, Brockton, MA; JR Vinagro, Johnston, RI; Northern Tree Service, Inc., 1290 Park Street, Palmer, MA (telephone poles or railroad ties)
Clean gypsum wallboard: New England Recycling, 569 Winthrop Street, Taunton, MA

STATE OF RHODE ISLAND
AND
PROVIDENCE PLANTATIONS
DEPARTMENT OF

ENVIRONMENTAL MANAGEMENT
LICENSE

THIS LICENSE IS ISSUED TO:

J.R. Vinagro Corporation

TO OPERATE A CONSTRUCTION AND DEMOLITION DEBRIS PROCESSING FACILITY AND TRANSFER STATION SOLID WASTE MANAGEMENT FACILITY, KNOWN AS THE: J.R. VINAGRO CORPORATION CONSTRUCTION AND DEMOLITION DEBRIS PROCESSING FACILITY AND TRANSFER STATION LOCATED AT: 116 SHUN PIKE IN: JOHNSTON, RHODE ISLAND, IN CONFORMITY WITH CHAPTER 23-18.9 OF THE GENERAL LAWS OF RHODE ISLAND, 1956, AS AMENDED, AND THE RULES AND REGULATIONS ADOPTED THEREUNDER *AND SUBJECT TO THE ATTACHED CONDITIONS.*

ISSUED: FEBRUARY 14, 2011 EXPIRES: FEBRUARY 14, 2014

NO. 69

DIRECTOR,
DEPT. OF ENVIRONMENTAL MANAGEMENT

Attachment A

License Conditions for J. R. Vinagro Corp.
116 Shun Pike Johnston, Rhode Island
Date: February 2011
Construction and Demolition Debris Processing Facility and Transfer Station

1. The facility shall be operated in accordance with the approved June 4, 2010 operating plan, including the July 29, 2010 revisions and in accordance with any subsequent RIDEM approved operating amendments.

2. The facility shall also be operated in accordance with the January 1997 "Rules and Regulations for Composting Facilities and Solid Waste Management Facilities", amended October 25, 2005, in particular, Solid Waste Regulation No. 3 for transfer stations and Solid Waste Regulation No. 7 for Construction and Demolition Debris Processing Facilities.

3. The construction and demolition processing facility shall not receive more than 2000 tons per day of construction and demolition debris (C & D).

4. The transfer station facility shall not receive more than 500 tons per day of solid waste.

5. Prior to commencement of transfer station activities and acceptance of any non-C&D solid waste, J.R. Vinagro Corporation shall receive an approval to accept such waste from the Town of Johnston.

6. In accordance with R.I.G.L. 23-19-13.1(a) and the Office of the Attorney General Opinion No. 89-07-36, dated July 26, 1989, no waste generated from outside the State of Rhode Island shall be deposited in the Central Landfill.

7. In accordance with Section 1.5 of the Operating Plan, a final set of construction and engineering plans for the C & D processing facility and transfer station building, equipment, and site, shall be stamped by a registered P.E and provided to the Department for its review and approval, prior to the start of facility construction.

8. In accordance with Section 2.2 of the C & D processing facility operating plan, J.R. Vinagro Corporation ("the Corporation") shall provide details and specifications of the final types of C & D processing equipment to be used to RIDEM for its review and approval, prior to the start of facility construction. The equipment specifications in Attachment E of the application shall be modified accordingly.

9. J. R. Vinagro shall maintain financial assurance for the C&D activities in the amount of $479,930.00 and for the transfer station activities in the amount of $82,000.00 to satisfy financial assurance requirements per rules 1.5.10, 3.1.06, 7.1.06 and 7.2.08 of the Regulations.

10. J.R. Vinagro shall not exceed the storage limit of C&D waste as outlined in Section 2.2.3.6 of the approved operating plan.

11. J.R. Vinagro Corporation shall separate out all used asphalt, brick, concrete, metal, wood and clean gypsum wallboard from the loads received and divert these materials from disposal to recycling and reuse markets.

12. J.R. Vinagro Corporation shall submit a Quality Assurance/Quality Control (QA/QC) Plan for water quality monitoring that meets the Department's latest standards. Said QA/QC Plan shall include but not be limited to: a) Field Sampling Standard Operating Procedures detailing and providing rationale for sampling locations, sampling design, equipment used, QA/QC field procedures implemented, chain-of-custody procedures followed, and field observations including recording of a measurable rainfall within the previous 5 days; b) Laboratory SOP's detailing sample handling, equipment and instruments used, standard methods followed, detection limits and quantitation levels for each parameter analyzed and how the detection limit and quantitation limit were determined; c) Annual affirmation of sampling plan; d) Metals sampling shall follow the procedures specified in EPA's *Standard Operating Procedure for the Collection of Low Level Metals Ambient Water Samples* (ECASOP-Metals, revision 2, May 21, 2007).

    The Department may require the submission of data in an excel format supplied by the Department.

13. J.R. Vinagro Corporation shall maintain RIPDES permit coverage under the Multi-Sector Industrial Storm Water General Permit (MSGP) (permit No: RIR50N008) and shall comply with all of the conditions of the MSGP."

14. It shall be the responsibility of J.R. Vinagro Corporation to comply with all requirements and conditions set forth in its Fire Protection Plan, as approved by the Town of Johnston Fire Marshal, dated May 20, 2010. Any subsequent modifications to said plan shall be forwarded to the Department within twenty-one (21) days after approval by the Town of Johnston Fire Marshal.

15. J.R. Vinagro Corporation shall provide the Department, its authorized officers, employees, and representatives, and all other persons under Department oversight, an irrevocable right of access to the facility at all reasonable times for the purposes of performing inspections, investigations, testing, and examining records. The Department or other authorized designated personnel shall have the right to access the facility at all reasonable times for the above-stated purposes without prior notice. Refusal to permit reasonable inspections, tests and investigations shall constitute valid grounds for denial, revocation or suspension of a license; denial, revocation or suspension of a registration; and/or issuance of a Notice of Violation with Administrative Penalty.

16. It shall be the responsibility of J. R. Vinagro to ensure compliance with all zoning requirements and other applicable laws of the Town of Johnston. The granting of this license shall in no way restrict the Town's right or ability to enforce all applicable local laws. In the event that local zoning limits the operation of the facility to more stringent conditions than provided in this license, the facility must submit a proposed amendment to this license within twenty-one (21) days of the effective date of those conditions to reflect consistency with the conditions imposed by the Town of Johnston..

17. Issuance of this Solid Waste License does not relieve J.R. Vinagro Corporation from complying with all applicable local, state and federal laws and regulations.

Materials Management (continued)

Please describe how materials will be handled for recycling:

☒ Individuals place materials in designated areas

☒ Materials will be manually and/or mechanically separated by facility

☐ Other:

4. Construction & Demolition Handling Facilities

If the facility accepts construction and demolition waste, performs separation operations for recyclable materials, and sends the remaining materials to another solid waste facility for disposal or reuse, all of section 4 must be completed. In this section, facilities should identify how they will comply with MassDEP's Minimum Performance Standard (MPS) for C&D facilities.

Facilities which accept 50 tons per day or more of C&D waste and transfer all C&D waste to another permitted facility that meets the MPS for separation and do not transfer for disposal need only demonstrate how they will comply with the following:

- Clean gypsum wallboard must be separated for recycling upon arrival before further handling or transfer of loads. See Clean Gypsum Wallboard Guidance (https://www.mass.gov/doc/gypsum-wallboard-waste-ban-guidance-cd-handling-facilities/download.) In order for C&D Handling Facilities to maintain compliance with the requirement in approved Waste Ban Compliance Plans to separate clean gypsum wallboard to the maximum extent possible for recycling, the following measures are to be taken:
  - Loads that include clean gypsum wallboard must be sorted, to the extent it can be done safely, to remove clean gypsum wallboard to the greatest extent possible prior to any mechanical processing of the C&D waste load.
  - Facilities will not be allowed to transfer (including transfer to another C&D Handling Facility) mixed C&D waste loads that contain clean gypsum wallboard without first safely separating the clean gypsum wallboard for recycling.
  - In order to be eligible to receive mixed C&D waste loads, a C&D handling facility must implement operating procedures to safely and effectively separate clean gypsum wallboard prior to transferring or processing C&D loads.
- Zero-tolerance Items (lead batteries, white goods, whole tires (except tires disposed of at a municipal waste combustion facility) mattresses, and CRTs) must be separated upon arrival before further handling or transfer.

The C&D waste handling facility will accept the following materials: (check all that apply)

☐Category 1 C&D Waste ☐ Category 2 C&D Residuals

☐Category 3 Bulky Waste ☐ MSW

☐ Leaf and yard waste ☐ Other (identify):

Waste Ban Compliance Plan

Attach the following information:

- In a narrative describe the methodology for handling, inspecting and removing waste ban materials for each waste type (e.g., dedicated processing equipment or manual sorting).
- In a narrative, describe the minimum staffing and equipment requirements based on daily tonnage handled. Justification for the minimum staffing requirements must be submitted based on historic operations at the actual facility or similarly equipped facility that demonstrate effective removal of recyclable materials.
- In a narrative, describe the sorting technologies (e.g., conveyors, picking lines, grapples) to be used at the facility and discuss the proposed maximum hourly throughput capacity based on the number of staff performing the separation operation.
- In a narrative, describe the maximum proposed daily tonnage limits for MSW (if applicable) and for Category 1 C&D Waste and the maximum daily tonnage limit for all incoming materials.
- Provide a plan depicting designated areas for incoming material inspection, tipping, processing, waste ban material storage, and outgoing waste material storage.

Compliance Plan Checklist

Are the following items attached?

☒ Sample signage

☒ Comprehensive Inspection Reporting Sheet

☒ Ongoing Monitoring Reporting Sheet

☒ Sample letter to haulers

☒ Sample letter to generators

☒ Sample letter to contract municipality

☒ Permit modification application

☒ Is the certification below signed?

Certification

I hereby certify that I have personally examined the foregoing and am familiar with the information contained in this document and all attachments and, that based on my inquiry of those individuals immediately responsible for obtaining this information, I believe that the information is true, accurate and complete. I am fully authorized to make this attestation on behalf of this facility and am aware that there are significant penalties for submitting false information, including possible fines and imprisonment.

I also understand that adherence to this Waste Ban Compliance Plan constitutes compliance with the provisions of 310 CMR 19.017. I am aware that if the facility is found to be in non-compliance, MassDEP enforcement actions may be taken, including written notices of non-compliance, consent orders, unilateral orders or referral to the Attorney General's office. No modifications of this plan are permitted unless approved in writing by MassDEP

Signature: Dan T. Barrett	*Date (MM/DD/YYYY):* 08/01/22
Print Name: Daniel T. Barrett	*Phone Number:* 508-759-0600, x. 4240 *Email:* dbarrett@townofbourne.com

Title: General Manager	*Organization Name:* Town of Bourne, ISWM Department

Definitions Applicable Only for Construction & Demolition Handling Facilities

For the purpose of Attachment G of the Waste Ban Compliance Plan Guidance, the terms herein shall have the following meaning:

Action Level: See Section IV Waste Ban Compliance Standard and Action Level Thresholds in Guidance for Solid Waste Handling and Disposal Facilities on Compliance with MassDEP's Waste Bans.

Banned Material Picking Area: Inside area designated by the Facility on the Facility Floor Plan for the storage, spreading, and inspection of tipped waste loads and the removal of Waste Ban Materials.

Banned Material Storage Areas: Inside and outside areas designated by the Facility on the Facility Floor Plan for the containerized storage of separated banned materials after separation from the incoming waste stream.

Bulky Waste: Waste items generated during commercial and residential building cleanouts including items not generally accepted during pickup of the typical daily waste stream generated by commercial and residential activities. Examples of bulky waste include but are not limited to, furniture such as tables, chairs, desks, carpets, and temporary partitions such as cubicle walls and toys.

Categories of Waste Material:

- Category 1 - Construction and Demolition Waste - consisting of C&D Waste and partially picked C&D waste. Partially picked C&D waste may include, but is not limited to, materials that may have been previously kicksorted off-site for the removal of metal, large pieces of wood, bulky waste, and Zero Tolerance Items
- Category 2 -Construction and Demolition Residuals
- Category 3 - Bulky Waste

Construction & Demolition Fines (C&D Fines): C&D waste processed through an initial size reduction and screening process in accordance with a MassDEP Beneficial Use Determination (BUD) and **prior to grinding** which is: (a) three inches or less (3" minus) in size; (b) consists primarily of soil and other inert materials, and (c) in no case shall exceed 35% organic content by volume.

Construction & Demolition Residuals (C&D Residuals): C&D material that remains after recyclable materials (asphalt pavement, brick, concrete, metals, wood, clean gypsum wallboard, etc.) have been removed from C&D waste to the greatest extent possible, which may include the C&D fines if not separated out from C&D waste. C&D residuals consist primarily of non-recyclable material.

Construction and Demolition Waste (C&D) Processing Facility: Means a handling facility where construction and demolition waste is brought, stored and processed (usually by sorting, crushing, shredding, screening, etc.) prior to reuse or transport to a solid waste disposal facility or to other types of facilities for recycling, recovery or reuse.

Construction and Demolition Waste (C&D) Transfer Station: Means a transfer station permitted by the Department to accept 50 tons per day or more of construction and demolition waste. A C&D waste transfer station may accept other types of solid waste in accordance with its permit.

Construction & Demolition Waste (C&D Waste):

Building materials and rubble resulting from the construction, remodeling, repair or demolition of buildings, pavements, roads or other structures. Construction and Demolition waste includes, but is not limited to: metal, concrete, bricks, lumber, masonry, road paving materials, rebar, gypsum wallboard and plaster.

Facility Floor Plan; Plan submitted by the Facility within its Waste Ban Compliance Plan application.

Failed Load: A load which, when delivered to and inspected at a handling or disposal facility is determined to contain a quantity of materials banned from disposal above an Action Level defined herein.

Inside Initial Inspection Area: Inside area designated by the Facility on the Facility Floor Plan for the inspection of waste loads in delivery vehicles after entering the enclosed building and prior to tipping.

Kick-sorting: Partial separation of C&D waste material which may include, but is not limited to, the removal of metal, large pieces of wood, bulky waste, Zero Tolerance Items (i.e. cathode ray tubes, whole tires (except tires disposed of at a municipal waste combustion facility), mattresses,, lead batteries, and white goods).

Outside Initial Inspection Area: Outside area designated by the Facility on the Facility Site Plan for the inspection of waste loads in delivery vehicles prior to entering the enclosed building and prior to tipping.

Pre-Sorted Processed Waste Storage Area: Inside area designated by the Facility on the Facility Floor Plan for the storage of C&D Residuals received from other C&D Handling Facilities.

Process Separation Rate (PSR): The ratio of the quantity (by weight) of materials recycled as feedstock, recycled as biomass fuel, or diverted as determined by MassDEP, compared to the quantity (by weight) of the total inbound material accepted as defined in the Minimum Performance Standard available at https://www.mass.gov/guides/massdep-waste-disposal-bans.

Queue Area: Outside area designated on the Facility Site Plan for the queuing of waste delivery vehicles prior to tipping.

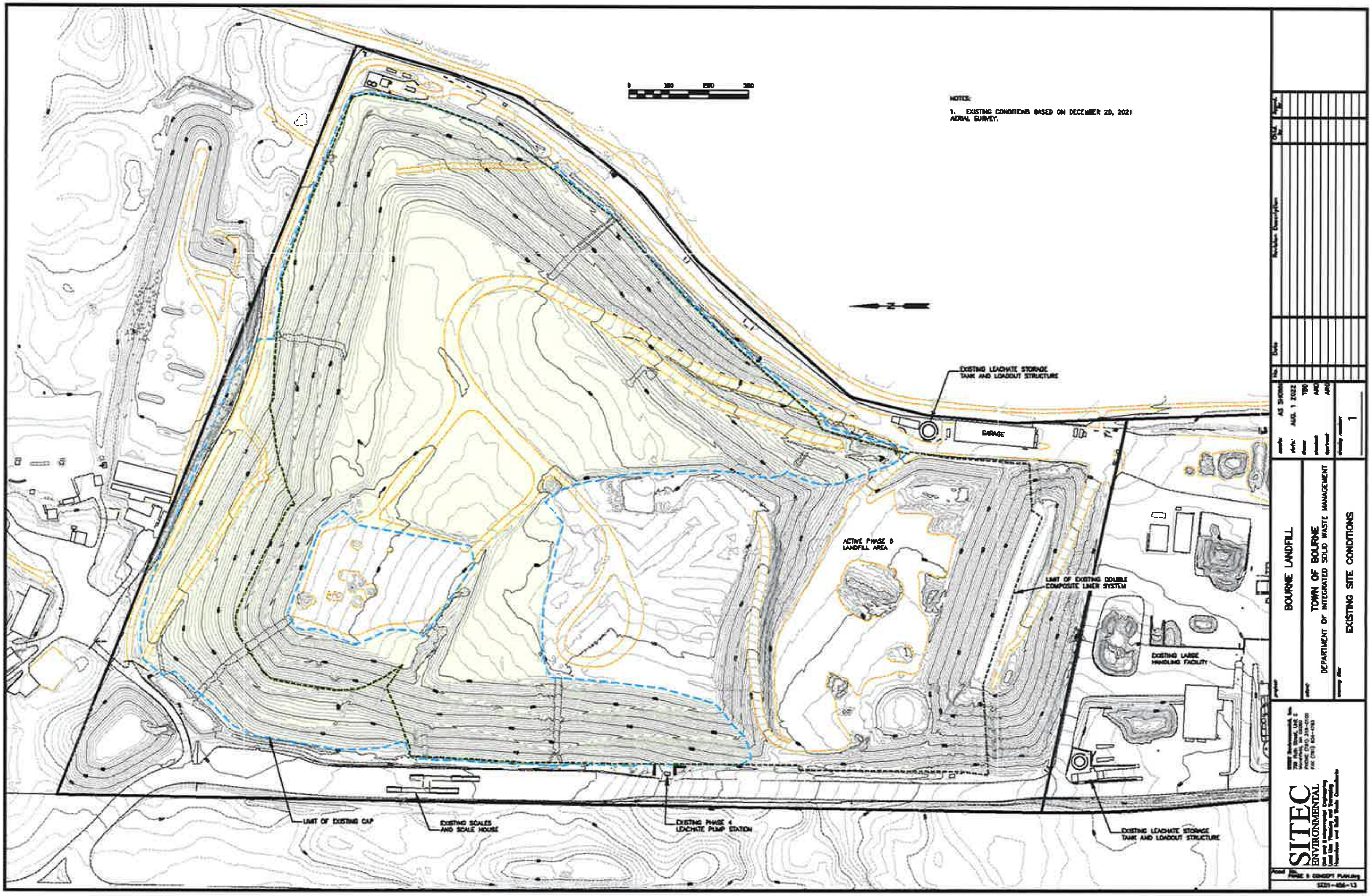
Rejected Load: A load which has been determined by the waste handling or disposal facility operator to be a Failed Load, and which the operator elects to refuse acceptance for handling or disposal, and which the operator must reload in the haulers original delivery vehicle or container and return to the hauler.

Waste Ban Materials: Restricted materials listed in 310 CMR 19.017. For purposes of this approval, Waste Ban Materials are further divided into Zero Tolerance Items and Waste Ban Materials subject to Action Levels above zero. Waste Ban Materials subject to Action Level criteria include recyclable paper, combined asphalt pavement, brick, and concrete, metal, wood, clean gypsum wallboard, glass, metal containers, commercial organic material, textiles and leaves and yard waste.

Waste Tipping Area: Inside area designated by the Facility on the Facility Floor Plan for the tipping of waste loads.

Waste Bulking Storage Area: Inside area designated by the Facility on the Facility Floor Plan for the storage of C&D Residuals generated by the Facility prior to transfer for disposal.

Zero Tolerance Items: Items expressly prohibited from disposal listed in 310 CMR 19.017 where the Department has made an Action Level determination of zero. This includes cathode ray tubes(CRT), whole tires (except tires disposed of at a municipal waste combustion facility), lead batteries, mattresses and white goods.



NOTES:
1. EXISTING CONDITIONS BASED ON DECEMBER 20, 2021 AERIAL SURVEY.
0 100 200 300
N
EXISTING LEACHATE STORAGE TANK AND LOADOUT STRUCTURE
GARAGE
ACTIVE PHASE 6 LANDFILL AREA
LIMIT OF EXISTING DOUBLE COMPOSITE LINER SYSTEM
EXISTING LARGE HANDLING FACILITY
LIMIT OF EXISTING CAP
EXISTING SCALES AND SCALE HOUSE
EXISTING PHASE 4 LEACHATE PUMP STATION
EXISTING LEACHATE STORAGE TANK AND LOADOUT STRUCTURE
BOURNE LANDFILL
TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT
EXISTING SITE CONDITIONS
AS SHOWN
AUG. 1 2022
TBD
ARD
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SITEC ENVIRONMENTAL
No.
Date
Revision Description
SE21-456-13

APPENDIX B

ACTION FLOW RATE CALCULATIONS

BOURNE LANDFILL - PHASE 6 LANDFILL EXPANSION
ACTION FLOW RATE CALCULATION FOR LEAK DETECTION SYSTEM
AS-BUILT CONDITIONS

Q/W = Tltis * i

Q = Flow Rate (m3/sec or gpd) Per Unit Width (1.0 ft)	
W = Unit Width of Biplanar GDL (0.305 m or 1.0 ft)	0.305
Tltis = Long Term In Soil (Adjusted) Transmissivity (m2/sec)	
i = Hydraulic Gradient (Slope = 2.0% or 0.02 ft/ft)	0.02

$$\text{Tltis} = \frac{\text{Tm}}{\text{SF} * \text{RFcc} * \text{RFbc} * \text{RFcr} * \text{RFin}}$$

Tm = GDL Laboratory Measured Transmissivity At 10,000 psf (7.49 x 10-4 m2/sec)	0.000749
SF = Safety Factor (2)*	2
RFcc = Reduction Factor for Chemical Clogging (1.5)	1.5
RFbc = Reduction Factor for Biological Clogging (1.5)	1.5
RFcr = Reduction Factor for Creep (1.4)	1.4
RFin = Reduction Factor for intrusion (1.5)	1.5

* Reduction and Safety Factors are subject to modification based on actual materials incorporated into work.

Tltis = 7.9E-05 m2/sec

Q = Tltis * i * W

Q = 4.8E-07 m3/sec/ft
11.0 gpd/ft

In the Phase 6 Landfill, the Biplanar GDL drains to a perforated 4" diameter pipe, set at a minimum slope of 0.5% (0.005 ft/ft) set in 3/4" stone and drainage sand. The full Phase 6 secondary collection system drainage area (A) is about 6.9 acres, or 300,000 square feet, which discharges to a length (L) of 1,750 feet of the GDL to the secondary leachate collection system pipe.

Therefore the AFR per acre of the Phase 6 landfill area is:

Action Flow Rate = Q x L/A = 2,804 gpd/acre

The approximate capacity of the 4" diameter secondary collection system pipe is 115,000 gallons per day. The total area tributary to the pipe section considered above is about 6.9 acres, thus the AFR for the pipe is about 17,000 gpd/acre.

PART E

CONSTRUCTION QUALITY ASSURANCE PLAN
FOR THE
PHASE 9 LANDFILL EXPANSION
BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY

**BWP SW 26 - APPLICATION FOR AUTHORIZATION
TO CONSTRUCT
PHASE 9 LANDFILL EXPANSION**

**BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY
BOURNE, MASSACHUSETTS**

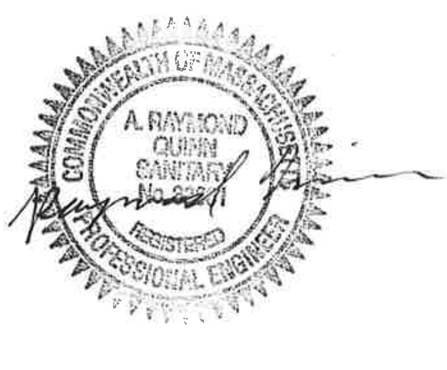
**PART E
CONSTRUCTION QUALITY ASSURANCE PLAN**

Prepared For:

**TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT
24 Perry Avenue
Bourne, Massachusetts 02532**

Prepared By:

**SITEC Environmental, Inc.
769 Plain Street, Unit C
Marshfield, Massachusetts 02050**



December 6, 2022

CONSTRUCTION QUALITY ASSURANCE PLAN
PHASE 9 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY
BOURNE, MASSACHUSETTS

LIST OF APPENDICES

CONSTRUCTION QUALITY ASSURANCE PLAN
PHASE 4 AND PHASE 5 CLOSURE CONSTRUCTION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY
BOURNE, MASSACHUSETTS

1.0 INTRODUCTION

1.1 Objective

The objective of this document is to detail the procedures and testing requirements associated with the implementation of a Construction Quality Assurance (CQA) Program for the installation of landfill final cover and land fill gas extraction systems for the Phase 9 Landfill Expansion project at the Bourne Integrated Solid Waste Management Facility, in Bourne, Massachusetts. The program should serve as the basis for assessing construction procedures and the adequacy of soil material and geosynthetic material installations.

Because the final cover system is an important component of the Landfill's environmental protection system, it is imperative that the cover be constructed in accordance with the approved plans and that a detailed record of the construction be produced to confirm compliance.

This CQA manual has been prepared to meet the requirements of the Department of Environmental Protection (DEP) as described in: Landfill Technical Guidance Manual (May 1997) and 310 CMR 19.106: Construction Certification, as well as United States Environmental Protection Agency (USEPA) Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities (September 1993).

2.0 PROJECT MANAGEMENT

2.1 Project Team

The following defines the responsibilities of the personnel involved with the implementation of the CQA procedures outlined in this document and their respective duties during the construction project. The DEP will be informed of the assigned personnel prior to construction.

Owner
The Owner is the individual or designated representative of the firm, agency or municipality that owns and/or operates the facility. The Owner of this project is the Town of Bourne. The Operator of the Facility is the Town of Bourne's Department of Integrated Solid Waste Management.

Contractor
The Contractor shall be responsible for acquiring and supplying all materials, labor, equipment and testing necessary for the proper completion of the work, unless specified otherwise in the Contract documents. The Contractor's responsibilities also include the supervision of all work involved in the construction. The Contractor will be selected following a public bidding process.

The Contractor may retain an Earthwork Contractor and/or a Geosynthetics Contractor who will be responsible for the installation of the final cover system. The Contractor may also retain the services of a specialty contractor required for the installation of the landfill gas extraction system components of the project. The Earthwork Contractor, Geomembrane Contractor and Gas System Contractor will each assign a Project Superintendent to assure that adequate manpower and equipment are assigned to the project, and that their respective work items are coordinated.

Design Engineer
The Design Engineer is a qualified engineer, knowledgeable in design, construction and testing of final landfill cover systems. The Design Engineer is ultimately responsible for the implementation of the CQA program. This includes providing technical support to the CQA Consultant, interpreting field and laboratory testing data, assuring construction activities are in accordance with design plans, attending meetings, making final determinations of the acceptability of installed work, assisting in the preparation of the final certification report and endorsing the final certification report.

The Design Engineer for this project is SITEC Environmental, Inc. (SITEC).

CQA Consultant
The CQA Consultant must be knowledgeable and experienced in final cover construction projects. The CQA Consultant's field representative will serve as the daily contact person with the Contractors. The CQA Consultant is responsible for coordinating daily activities with the Contractors, maintaining field records, making judgments in conjunction with the Design Engineer on the acceptability of installed materials, maintaining construction summary reports as detailed in Section 4.0, and maintaining routine communications with the Design Engineer.

The CQA Consultant for this project is SITEC Environmental, Inc.

2.2 Project Organization

The following list of involved parties and contacts is provided for reference:

Function	Firm or Agency	Contact	Phone No.
Owner	Town of Bourne	Thomas Guerino Town Administrator	(508) 759-0600
Operator	Town of Bourne, Department of Integrated Solid Waste Management	Daniel Barrett, General Manager	(508) 759-0600 Ext. 4240
Design Engineer	SITEC Environmental, Inc.	A. Raymond Quinn, PE	(781) 319-0100
CQA Consultant	SITEC Environmental, Inc.	A. Raymond Quinn, PE	(781) 319-0100
Contractor	To be determined		
Soils Laboratory	GeoTesting Express	Dr. W. Allen Marr, P.E.	(978) 635-0424
Geomembrane Manufacturer	To be determined		

Function	Firm or Agency	Contact	Phone No.
Geosynthetics Laboratory (Conformance Tests)	To be determined		
Geomembrane Laboratory (Destructive Tests)	To be determined		
Regulatory Agency	Massachusetts DEP/SERO	Alison	(508) 946-2884

The appropriate contact personnel associated with the Contractor and the geomembrane manufacturer will be announced when they have been identified.

3.0 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL

3.1 General CQA/CQC Duties

Once installation begins, it is the CQA Consultant's responsibility to observe and document construction of the final cover system and the installation of theleachate interceptor pipe and the gas extraction system. In order to achieve this, the CQA Consultant must be at the site at all times during all phases of construction.

The CQA Consultant is responsible for observing the installation of the following components:

- Landfill Surface Preparation – This work includes all fine grading, filling, excavating and compaction necessary for the preparation of the landfill surface for the placement of the final cover system;
- Landfill Gas Extraction System - The landfill gas system includes the drilling of vertical wells into the landfill, the installation of header and lateral piping, gas condensate trap installation and connections to the existing system prior to commencement of final cover construction.
- Sub-grade/Gas Venting Layer - This layer will be placed above the landfill surface in a 6-inch thick layer and will be a granular sand having a minimum saturated hydraulic conductivity of 1×10^{-3} centimeters per second.
- Geomembrane Barrier - Textured geomembrane barrier made of high-density polyethylene (HDPE), 40 mil thick, is to be placed in direct contact with the surface of the sub-grade/gas venting layer.
- Drainage/Protection Layer - This layer will be placed above the geomembrane barrier in a 12-inch thick layer and will be granular sand having a minimum saturated hydraulic conductivity of 1×10^{-2} centimeters per second.
- Vegetative Support Layer - This layer will be placed above the drainage/protection layer in a 9-inch thick layer and will be an organic loam, free of large rocks, debris, stumps, and any other unsuitable matter, having the capacity to support vegetation.
- Establishing vegetative cover – Applying a specified mixture of grass seed, lime and fertilizer to the completed landfill slopes and ensuring that a healthy growth of vegetation is established for the stabilization of the slopes.

3.2 Subgrade Layer

3.2.1 Observation Requirements

3.2.1.1 Gas Venting System

The CQA Consultant will observe the landfill borings and the installation of the vertical gas extraction wells. The CQA Consultant will ensure that well drill depths are recalculated prior to drilling based on recent as-built landfill elevations for the protection of the base liner. Borings will be logged and conditions encountered in the landfill will be recorded, included boring depth, material removed from borehole, liquid levels in the borehole, and presence of saturated material. Well installations will also be logged, including screen lengths, backfill materials and well finishing details. Trench excavations and installation of the horizontal headers and laterals will also be observed and recorded. The CQA consultant will ensure that as-built surveys are conducted for all piping installations and that proper slopes have been achieved for condensate management. The CQA Consultant shall observe all pressure testing to be performed on all segments of header and lateral piping in accordance with the specifications. The same testing, observations and records will be made for the leachate interceptor line, as for the gas piping.

3.2.1.2 Landfill Surface Preparation

The CQA Consultant will inspect the surface of the Landfill prior to the placement of the gas-venting layer. Under no circumstances shall the sub-grade/gas-venting layer be placed on the landfill surface without following the specifications.

The Contractor shall remove vegetation, roots, loam, organic matter, debris, solid waste and stones larger than 3-inches in size from the landfill surfaces. All observed objects that protrude more than one inch above the landfill surface should be removed and replaced with Sub-grade Soil. The Landfill surface shall be compacted to a smooth finish, free of ruts and surface irregularities.

3.2.1.3 Sub-Grade/Gas Venting Layer

The sub-grade/gas venting layer will be placed directly on the suitably prepared landfill surface. Before the sub-grade/gas venting layer is installed, the CQA Consultant is responsible for:

- viewing the compaction efforts of the Contractor for all slope areas to be capped (intermediate cover) prior to the installation of the sub-grade/gas venting layer. There should be no soft or yielding areas identified;
- viewing incoming loads of the sub-grade/gas venting layer material;
- ensuring that sub-grade/gas venting layer testing has been performed at the proper frequencies and that the results are reviewed by the Design Engineer; and
- ensuring that the leachate interceptor and the gas extraction system have been installed according to the Design Plans.

The sub-grade/gas venting layer will serve as the protective layer for the geomembrane barrier and must be graded to achieve a smooth and uniform surface. Significant erosion rills or irregularities in grade that develop before the geomembrane barrier is placed must be repaired. During sub-grade/gas venting layer installation, the CQA Consultant will:

- oversee the placement of the sub-grade/gas venting layer material on the surface of the landfill; and
- confirm that the thickness of the sub-grade/gas venting layer conforms with the project specifications.

In addition, before the placement of the geomembrane, the CQA Consultant is responsible for completing a thorough observation of the sub-grade/gas venting layer material to confirm that the layer is ready for the placement of the geomembrane. At a minimum the CQA Consultant will:

- view the sub-grade/gas venting layer area to check for the presence of sharp rocks, construction utensils, debris, survey stakes, organic matter, vegetation, clumps of soil and any other unsuitable objects;
- view the sub-grade/gas venting layer to confirm it is stable enough to support installation equipment and the placement of the geomembrane barrier; and
- confirm the layer is smooth and free of surface depressions, fissures, irregularities and abrupt breaks in slopes.

3.2.2 Pre-Construction Testing

Prior to final cover construction, the Contractor shall submit results of pre-construction testing conducted on representative samples of the Contractor's source of sub-grade/gas venting layer soil material. In addition, the Contractor must submit results for geomembrane interface friction testing in accordance with the table below. The CQA Consultant will review all test results with the Design Engineer.

The Contractor must also submit representative samples of the sub-grade/gas venting soil material for independent pre-construction testing by the Owner or CQA Consultant.

SUB-GRADE/GAS VENTING PRE-CONSTRUCTION TESTING			
Material	**Test**	**Standard**	**Min. Test Frequency**
Sand	Grain Size	ASTM D-422	1 Test/Each Source
	Permeability	ASTM D-2434	1 Test/Each Source
	Interface Shear w/ Geomembrane*	ASTM D-5321	1 Test/Each Source

* An interface shear test will be performed on the gas venting layer/40-mil textured HDPE geomembrane before construction commences. Refer to Section 3.3.2 Conformance/Acceptance Testing for testing conditions.

3.2.3 Construction Testing

The Design Engineer and CQA Consultant must confirm that the necessary grain size and hydraulic conductivity tests have been performed. The Contractor is responsible for taking one sample of the sub-grade/gas venting layer material during placement every 1,500 cubic yards (see table below). The Contractor will be responsible for collecting, packaging and sending all samples to the laboratory.

The Owner and CQA Consultant reserve the right to collect additional samples for testing by the project's independent laboratory.

GAS VENTING CONSTRUCTION TESTING			
Material	**Test**	**Standard**	**Min. Test Frequency**
Gas Venting	Grain Size	ASTM D-422	1 Test/1,500 CY
	Permeability	ASTM D-2434	1 Test/3,000 CY

3.3 Geomembrane Barrier

3.3.1 Observation Requirements

3.3.1.1 General Requirements

The installation of the geomembrane barrier will include the following related activities:

- delivery of geomembrane materials to the project site;
- final viewing of the sub-grade/gas venting layer before placement of the geomembrane;
- delivery of geomembrane materials to the work area from the on-site storage area;
- deployment and positioning of geomembrane panels;
- geomembrane seaming and testing of seams;
- anchoring of geomembrane panels in an anchor trench; and
- placement of the protective layers above the geomembrane.

Each of these activities must be observed and carefully documented by the CQA Consultant.

In addition to observation and documentation of geomembrane deployment, testing must be performed on samples of geomembrane to assure its conformance with project specifications. Testing must also be performed on seams constructed in the field. The Contractor is responsible for collecting samples for these conformance/acceptance tests as well as collecting seam samples for laboratory testing, observing testing of trial seams, and observing non-destructive testing of seams. The Owner reserves the right to collect additional samples for testing by the project's independent laboratory.

3.3.1.2 Materials Transport and Storage

The geomembrane manufacturer and/or Contractor are responsible for the safe and proper transport of all lining materials to the project site. The only involvement of the CQA Consultant will be to ensure the scheduled arrival date of the geomembrane is acceptable to the Owner and to view the storage area before the material arrives at the site.

Once the geomembrane has arrived, the CQA Consultant will view all materials for visual evidence of damage and the conditions under which the geomembrane was transported to the project site. All observations must be documented and, if possible, should be performed in the presence of a representative of the manufacturer or Contractor. At a minimum the observations must include:

- Observing the unloading of the geomembrane at the designated on-site storage area. The storage area must be sufficiently distant from heavy equipment traffic and accessible only to authorized personnel.
- Recording the material quantities and geomembrane identification markings on each roll.
- The Design Engineer shall have the responsibility of conducting a completeness review of geomembrane manufacturer's Quality Control Certificates. Each roll must be accompanied by a certificate, which indicates the manufacturer's name, type of material, roll width and length, resin batch code and date of manufacture. The manufacturer shall provide certification testing results, conducted at the frequency stated in the specifications, which include the material's average thickness, density, melt flow index, carbon black content, carbon black dispersion, tensile properties, tear and puncture resistance, water vapor transmission, and dimensional stability.
- The Design Engineer shall conduct a completeness review of raw material Quality Control Certificates. Since different geomembrane rolls for a specific project may be manufactured from different resin batches, a certificate must be furnished for each resin batch. The certificate should include a listing of the material's density, melt flow index, and carbon black content.

All information compiled must be entered into the project log and subsequently crosschecked with the project specifications.

In addition to viewing manufactured materials delivered to the project site, the CQA Consultant is responsible for viewing the material's storage area. The CQA Consultant should be thoroughly familiar with the manufacturer's storage specifications. Consideration should be given to ambient temperature, control of access, location with respect to vehicular traffic movements, and means proposed to protect the geomembrane from the elements. If the geomembrane is to be stored in contact with the ground, protective mats or sand may need to be spread on the surface to prevent damage from sharp rocks or debris. The surface of the storage area should be relatively level to prevent uncontrolled movement of geomembrane rolls.

3.3.1.3 Final Viewing of Sub-grade/Gas Venting Layer

Before the geomembrane barrier is delivered to the active construction area, a thorough viewing of the sub-grade/gas venting layer must be completed. In order to minimize transport and exposure of the geomembrane to the elements, the sub-grade/gas venting layer should be approved prior to allowing the Contractor to take rolls from storage.

Since the geomembrane is just one component of a multi-layered final cover system, it will be necessary to confirm that all appropriate CQA procedures for the sub-grade/gas venting layer have been followed. The CQA Consultant will view the sub-grade/gas venting surface before the geomembrane is brought to the active construction site. At a minimum the CQA Consultant will:

- Confirm that all required sub-grade/gas venting layer tests have been performed and the results have been accepted and entered into the job log. No geomembrane shall be installed until the sub-grade/gas venting layer has been approved.
- Perform a visual review of the sub-grade/gas venting layer, embankments, and anchor trenches to check that the surface is free of sharp rocks, construction utensils, debris, survey stakes, organic matter, clumps of soil, and any other object, which could potentially damage the geomembrane.
- Confirm all gas extraction system components have been constructed as shown on the drawings.
- Confirm that the sub-grade/gas venting layer is free of surface depressions, fissures, irregularities, and abrupt breaks in slopes.
- Confirm that the geomembrane anchor trench has been properly constructed and has sufficient depth to enable it to function as intended.
- Obtain a sub-grade acceptance form from the geomembrane Contractor.

3.3.1.4 Materials Delivery from On-Site Storage

Although the delivery of the geomembrane from storage to the active construction site may seem a simple task, its safe completion must be ensured. Every time a roll is handled or transported, the potential exists for damage. Therefore, caution must be exercised each time a roll is taken from storage.

Prior to the installation of geomembrane material, the Contractor must provide the CQA Consultant with a description of proposed transportation and handling procedures.

3.3.1.5 Geomembrane Placement and Positioning

Panel placement should commence at the upgradient limit of work and progress in a downhill fashion. The panels can be placed by manually unrolling the geomembrane into position or by using heavy equipment. The panels should be oriented parallel to the line of maximum slope, (i.e., oriented up and down, not across, the slope). In corners and odd shaped geometric locations, the number of field seams should be minimized. No horizontal seams are permitted to be within five feet of the toe of the slope.

After the geomembrane is completely unrolled it must be positioned. If the panel is being installed abutting a previously placed panel, care must be taken to align the sheets for seaming. When positioned, wrinkles should be worked out of the geomembrane, prior to seaming.

All installed panels must be provided with ballast to prevent their movement in windy conditions. The Contractor shall provide ballast, as needed, to prevent the movement of deployed geomembrane. At a minimum, sand in burlap bags should be placed every 1 to 2 feet along a seam.

3.3.1.6 Geomembrane Seaming

Once adjoining panels are placed and aligned, seaming may commence. Two welding methods will be employed to seam the HDPE: (1) the double-track hot-wedge weld, and (2) the extrusion weld. Prior to completing either type of weld, the geomembrane surface to be welded must be generally free of dust, silt and debris. Furthermore, the welding surface must be dry and at the proper temperature. The Contractor should be equipped with an ample supply of clean rags to dry and remove dust from the welding surface. A means for preheating the seam prior to welding may be necessary in cold weather.

Cold Weather Seaming

When the geomembrane sheet temperature is 41°F or less, the following shall apply to seaming operations:

- Seams shall be pre-heated just ahead of the seaming operation. Shielding the geomembrane from the subgrade may be necessary, too.
- Trial welds should be performed more frequently as the length of time a seaming crew may work will likely be reduced.
- Trial welds shall be given additional scrutiny. It is particularly important, in cold weather, to make sure trial seams are made under the same conditions as will be experienced in the work-area. Since subgrade will be cold, the trial weld must simulate this condition.
- The CQA Consultant may require an increase in the frequency of destructive testing.

The lowest temperature at which seaming may take place shall be the lowest temperature at which consistent passing trial seams can be produced under simulated work-area conditions. The CQA Consultant shall monitor temperatures during the installation process. No seaming will be conducted below 20°F.

Hot Weather Seaming

Seaming in hot weather will likely be controlled by the ability of the seaming crew to work under such conditions. Also, during high temperature conditions, seam "burn-outs" can occur. If an excessive number of "burn-outs" occur, seaming operations should cease. The effects of high temperatures on seaming may be counter-acted by increasing the speed of seaming or decreasing the welding temperature. However, this may affect seam strength so seam quality should be checked via trial welds and/or additional destructive tests. No seaming should be attempted above 104°F.

Hot-Wedge Weld

The hot-wedge weld is accomplished using a special device to heat adjoining geomembrane panels. The welding device is equipped with a heating element, referred to as the hot-wedge, which is allowed to contact the bottom of the overlapping panel and the top of the previously placed panel. Once the adjoining panels are overlapped a minimum of four inches are heated via the hot-wedge, the two surfaces are squeezed together with rollers resulting in a bond between the adjoining panels. Since the hot-wedge welding machine is equipped with two wedges and two sets of rollers, the final bond actually consists of parallel welds with an air gap between the welds. The hot-wedge welding method is dependent on the temperature of the hot-wedge and the speed at which the welding is performed. The machine operator controls both of these variables.

Extrusion Weld

Extrusion welding joins abutting geomembrane panels by creating a bond between the panels with an extruded bead of high-density polyethylene. This welding process requires additional preparation above and beyond usual cleaning of the weld surface. Specifically, the weld surface must be abraded to remove the sheen on the surface of the geomembrane and to provide a surface, which is more conducive to accepting a weld. Abrasion of the weld surface is normally accomplished using a disc grinder with an abrasive disc. Great care must be taken to assure that the abrasion process does not sacrifice the strength of the weld by substantially diminishing the thickness of the geomembrane. Testing of an extruded weld seam is performed using a vacuum box (refer to Section 3.3.3.2).

General Seaming Requirements

Regardless of the seaming procedure employed by the Contractor, the following general requirements must be satisfied during the seaming of the geomembrane.

- Seaming shall only be performed under proper weather conditions. The highest and lowest allowable temperatures for welding is based on conditions such as ambient temperature, wind, subgrade conditions, exposure to sunlight, material type, and material thickness. By increasing or decreasing the welding speeds and/or hot-wedge temperature, welding can be performed. Seaming shall be performed when the geomembrane is dry and protected from any wind damage. The CQA Consultant shall determine whether or not the weather conditions are appropriate. An ambient temperature between 32°F and 104°F as measured six inches above the geomembrane surface is recommended.
- All seams must extend the full length of the panels being joined. When seaming adjacent panels along an anchor trench, the seam shall extend completely through the anchor trench.
- All "fish-mouths" and wrinkles on a seam must be removed by cutting the geomembrane and installing an overlapping patch.
- Every seam, once completed, must be tested by non-destructive testing procedures (see Section 3.3.3.2) to check its continuity. Seams, which do not pass such testing, must be repaired and retested.
- Seam samples for destructive testing must be taken at a minimum of one every 500 feet. The CQA Consultant shall randomly select the sample location. Additional testing may be warranted when seaming conditions are not optimal due to ambient temperature or if there is reason to suspect that the seam quality is inadequate.
- The Contractor is responsible for the collection of seam samples. Duplicate samples shall be provided to the CQA Consultant for testing by an independent laboratory.

3.3.2 Conformance/Acceptance Testing Requirements

Geomembrane Resin

The manufacturer of the geomembrane shall supply the CQA Consultant with quality control certificates on each batch of resin used to produce geomembrane and welding rod for the project. The certificates shall be prepared by the resin producer and provide results of tests indicated in the table below:

GEOMEMBRANE RESIN CONFORMANCE TESTS			
Material	**Test**	**Standard**	**HDPE Value**
HDPE	Density	ASTM D1505	0.940 g/cc (min.)
	Melt Flow Index	ASTM D1238	1.0 g/10 minutes (max.)
	Carbon Black Content	ASTM D1603	2%-3%

HDPE values were taken from GRI Standard GM13, Rev. 15, - September 9, 2019, Geosynthetic Research Institute, Drexel University.

Geomembrane Delivered to Project

One geomembrane sample per 100,000 square feet shall be collected for conformance/ acceptance testing. The samples shall be a minimum of three (3) feet long by the entire roll width and shall not include the first five (5) feet of roll length. Each sample must be marked with the following information: the manufacturer's roll identification number, the date the sample was obtained and the machine direction. The sample shall be sent to an independent testing laboratory for analysis of those tests specified in the table provided below. The Design Engineer and CQA Consultant will review all test results.

Geomembrane Rolls

Each roll of geomembrane material supplied by the manufacturer shall be accompanied with a quality control certificate that indicates the information listed in the table below. The data on the certificates will be compared with the project specifications.

GEOMEMBRANE CONFORMANCE/ACCEPTANCE TESTS		
Test	**Standard**	**40 mil Textured HDPE**
Thickness	ASTM D5994	36 mil (min.)
Density	ASTM D1505	0.940 g/cc (min.)
Melt Flow Index	ASTM D1238	1.0 g/10 minutes (max.)
Carbon Black Content	ASTM D1603	2%-3%
Carbon Black Dispersion	ASTM D5596	Category 1 or 2
Tensile Properties	ASTM D6693	Strgth @ Yld = 84 ppi Strgth @ Brk = 60 ppi Elngtn @ Yld = 12% Elngtn @ Brk = 100%
Tear Resistance	ASTM D1004	28 lbs.
Puncture Resistance	ASTM D4833	60 lbs.

HDPE values were taken from GRI Standard GM13, Rev. 15, - September 9, 2019, Geosynthetic Research Institute, Drexel University.

Interface shear tests will be performed in accordance with this Section, before construction commences.

Extrudate Welding Rod

A sample of the extrudate rod material supplied by the manufacturer shall be collected and tested to determine material characteristics. A three-foot long sample of welding rod must be tested by an independent testing laboratory before the geomembrane installation commences. Tests and standards are specified in the table provided below.

EXTRUDATE ROD TESTS				
Material	**Test**	**Standard**	**Min. Test Frequency**	**HDPE Value**
	Density	ASTM D1505	1 Test/Material	0.940 g/cc (min.)
	Melt Flow Index	ASTM D1238	1 Test/Material	1.0 g/10 minutes (max.)
	Carbon Black Content	ASTM D1603	1 Test/Material	2%-3%

HDPE values were taken from GRI Standard GM13, Rev. 15, - September 9, 2019, Geosynthetic Research Institute, Drexel University.

Interface Shear Testing

Interface shearing testing will be performed on each interface of the final cover system in accordance with ASTM D5321 or ASTM D6243. Normal stresses applied to each test will be 1 psi, 2 psi and 3 psi. The materials shall be hydrated to equilibrium conditions and sheared at a displacement rate greater than 0.04 in/min., except as noted, to a minimum horizontal displacement of 3 inches. The following are the interfaces with testing conditions:

- Sub-grade/Gas Venting material and 40 mil textured HDPE geomembrane - to be tested at approximately 87.5 percent of the maximum dry density of the sub-grade/gas venting material under saturated conditions.
- 40 mil textured HDPE geomembrane/Drainage sand material - an interface shear test would only be necessary if the borrow source is different from the sub-grade/gas venting layer source. If different, the interface shear test would be conducted at approximately 87.5 percent of the maximum dry density of the drainage layer material under saturated conditions.

3.3.3 Construction Testing Requirements

3.3.3.1 Trial Seams

Trial welds shall be performed with each welding apparatus to be used as follows:

- At the beginning of each seaming period.
- At least once every four (4) hours.
- When a different operator takes over running the welding equipment.
- When the welding equipment has been shut off or has been unused for a period for one hour or longer.
- If there has been a 20°F rise or drop in ambient temperature since the last passing trial weld.

The frequency of trial welds may need to be increased under cold weather and hot weather conditions (refer to Section 3.3.1.6).

Trial welds shall be performed by the welder responsible for using that piece of equipment. The objective of the trial weld is to simulate field-seaming conditions. No attempt should be made to create an ideal environment for completing a trial weld.

A trial weld shall be performed on fragment pieces of geomembrane; a minimum of 3-feet long for extrusion welded trial seams and a minimum of 10-feet long for fusion welded seams. Once completed, the weld shall be visually observed for deficiencies before taking a minimum of ten, one-inch wide samples from the trial weld. The ten specimens shall be tested by the Geosynthetics Contractor for peel and shear strength (five in peel, five in shear) using a field tensiometer with the results being properly recorded. When peel testing is performed, both welds of double fusion welds should be tested to provide an indication of the quality of the weld. Only those pieces of welding equipment, which provide passing test results, shall be used for seaming or repair work. All trial weld specimens shall exhibit a film tear bond (FTB) and meet or exceed the minimum seam strength requirements as shown in the table below.

FIELD SEAM STRENGTH REQUIREMENTS		
40-Mil Textured HDPE	**Standard**	**Seam Value**
Peel Strength - Fusion Weld	ASTM D6392	60 lb/in
Peel Strength - Extrusion Weld	ASTM D6392	52 lb/in
Shear Strength	ASTM D6392	80 lb/in

Additional trial welds must be performed for failed samples. The welding conditions shall be altered, including adjusting the temperature of the hot-wedge (or extrusion welding gun) and/or the speed at which the weld is performed. Once adjustments have been made, additional trial welds shall be made on fragments of geomembrane, which shall be re-tested. If the specimen fails, the seaming apparatus and procedures will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful trial welds are achieved.

The CQA Consultant will:

- Observe and document the trial welds.
- Confirm trial weld samples are properly labeled (e.g., machine number, welder, temperature control setting and test results).
- Archive trial welds for the Owner.

3.3.3.2 Non-Destructive Testing

The purpose of non-destructive seam testing is to verify the continuity of a field seam, not to provide an indication of the seam's strength. All seams constructed in the field shall be subjected to non-destructive testing along their entire lengths. The CQA Consultant will observe the tests, record test results, the name of the individual performing the test and the location of the test. Areas found to be defective shall be marked as requiring repair. In general, seam testing should be done concurrently with seaming operations. The Geosynthetics Contractor should not be permitted to complete all field seams prior to the commencement of testing.

Non-destructive seam tests shall be completed using the Air Pressure Test or the Vacuum Box Test as outlined in this section, unless otherwise approved by the Design Engineer and/or CQA Consultant.

Air Pressure Test

The air pressure test will be performed on all double-track hot-wedge welds. This test method involves the application of air pressure to the channel between the parallel welds for a specified period of time and observing the stability of the pressure for the duration of the test.

The usual procedure for completing an air pressure test is as follows:

- Seal both ends of the seam length to be tested.
- Insert air feed device (usually a hollow needle) into the air channel between the two parallel welds.
- Pressurize the air channel to a pressure between 30 and 40 psi, and then cease airflow to the seam by closing the valve in the air feed line.
- Once pressurized, the seam shall be allowed to stand for a two-minute "relaxing period." This period will allow the air temperature and pressure in the seam channel to stabilize.
- Record seam pressure at the end of the "relaxing period" and use the recorded pressure as the initial pressure for the seam test. If the initial pressure is below 30 psi, additional air shall be introduced into the seam channel so that a minimum pressure of 30 psi is used to start the test.
- Allow seam channel to stand for 5 minutes. If a pressure loss exceeding 3 psi is observed, the seam shall be considered discontinuous and repairs will have to be made.
- At the conclusion of a passing seam channel test, the end of the seam channel opposite the pressure test gauge must be cut to relieve the test pressure. If the pressure gauge does not detect a drop in pressure, it must be assumed that the seam channel is blocked. In this case, the location of the blockage must be identified and the seam retested in segments for continuity.

Following the seam test, the CQA Consultant will verify that seam channel perforations and cuts made during the test have been properly sealed. Any defective areas shall be marked, repaired and re-tested by the Contractor using the vacuum box test method, as detailed in the next section.

AIR PRESSURE TESTING			
Material	**Test**	**Standard**	**Min. Test Frequency**
HDPE	Seam Continuity	Air Pressure Test	100% of Double Fusion Weld Seams

Vacuum Box Test

The vacuum box test is typically used on seams that cannot be tested by air pressurization. This test is predominantly used on extrusion welds used for patches and repairs.

The procedure for completing a vacuum box test is as follows:

- Apply a generous amount of soapy solution to the seam length to be tested.
- Place vacuum box test apparatus over wetted portion of the seam and apply a vacuum of at least 8 inches of mercury (4 psi) to the seam.
- Allow test apparatus to stand at the applied vacuum for a period not less than 10 seconds. During the test, the response of the soapy solution should be observed and noted. Bubbling of the solution indicates the presence of a hole or discontinuity, the location of which shall be marked and repaired.
- Move the vacuum box over to adjoining areas with a minimum three-inch overlap, and repeat the process.

Since the test apparatus must be moved along the length of the seam to perform a complete seam continuity test, the CQA Consultant must confirm segments of the seam are not passed over and that each test is conducted for the full 10-second duration.

VACUUM BOX TESTING			
Material	**Test**	**Standard**	**Min. Test Frequency**
HDPE	Seam Continuity	Vacuum Box Test	100% of Extrusion Weld Seams

3.3.3.3 Destructive Testing

The non-destructive seam testing procedures presented in Section 3.3.3.2 only establish seam continuity and not seam strength, they do not provide for a quantitative comparison with specified seam qualities. As a result, samples of completed seams must be collected and subjected to laboratory examination. At a minimum, one seam sample must be taken, at random, every 500 feet of seam length. If field conditions warrant, or the CQA Consultant suspects that a seam may not have been constructed properly, samples shall be collected at a greater frequency.

Sample Collection

One seam sample shall be collected, at random, a minimum of every 500 feet of seam. Each sample shall be cut from the seam by the Geosynthetics Contractor. The CQA Consultant will:

- Specify locations for the test samples.
- Observe the collection of samples.
- Identify the sample with a number and verify that it is marked accordingly.
- Note the sample location, the date, the reason for sampling (e.g., random sample, previous failure) and other pertinent information in the project log.
- Confirm that the sample location is repaired as soon as practicable following sample collection.

Sample Size & Failure Response

Destructive samples shall be twelve (12) inches wide, centered over the seam, and fifty (50) inches long, along the seam. Ten 1-inch wide by 12-inch long strips shall be cut from each sample. Each strip shall be tested by the Geosynthetics Contractor for peel and sheer strength (five in peel, five in shear) using a field tensiometer. When peel testing is performed, both welds of double fusion welds shall be tested to provide an indication of the quality of the weld. All specimens shall exhibit a film tear bond <u>and</u> meet or exceed the minimum seam strength requirements. If the sample passes the field peel and shear tests, the remaining sections are cut and distributed as follows:

- One 12 inch by 12 inch section for the Owner's archives.
- One 12 inch by 12 inch section for shear and peel testing by the Contractor laboratory.
- One 12-inch by 18-inch section for shear and peel testing by an independent laboratory.

If the sample fails the field peel and shear tests by the Geosynthetics Contractor or that of the independent laboratory, then the Contractor has the following options:

- Reconstruction of the seam between the failed location and any passed test section, which includes cap stripping of the seam, replacing the failed seam with a new one foot wide panel which is welded over the seam or extrusion welding of the failed seam.
- Retrace the failed seam in both directions by taking additional destructive samples and conducting field peel and shear tests until the length of the poor quality seam is established. Additional destructive samples shall be collected at minimum intervals of ten (10) feet from the location of the failed sample. Upon attaining passing results from the destructive samples, the seam shall be reconstructed between the passing location and the original failed location.

All passing seams must be bounded by two locations from which passing laboratory destructive tests have been taken. Large reconstructed seams of over 50 feet or more are under the same requirements as smaller failed seams in which a sample must be taken from the reconstructed seam to pass the destructive testing.

Laboratory Testing

An independent testing laboratory will perform all material conformance testing and confirmation of the field destructive seam testing. Samples shall be collected, packaged and sent to the independent laboratory on the same day that the samples are obtained.

All independent laboratory testing shall be in accordance with the requirements of the project specifications. Conformance testing shall conform to the standards listed and destructive seam samples will be tested for peel and shear strength. For each destructive sample submitted, five (5) specimens shall be tested under each test method. When peel testing is performed, both welds of double fusion welds shall be tested to provide an indication of the quality of the weld. For the sample to pass, four (4) of the five (5) specimens must meet the minimum test values presented in the project specifications and exhibit a film tear bond and the fifth sample must achieve at least 80% of the required strength. Laboratory results shall become available in a timely manner to allow the Design Engineer or CQA Consultant time to notify the Geosynthetics Contractor of any failures. No areas of the geomembrane may be covered prior to receiving test results from the independent laboratory.

DESTRUCTIVE TESTING			
Material	**Test**	**Standard**	**Min. Test Frequency**
HDPE	Peel Strength*	ASTM D6392	1 Test/500 LF
	Shear Strength	ASTM D6392	1 Test/500 LF

* Both welds shall be tested on samples of double-track welds.

3.3.4 Detail and Repair Work

Once the geomembrane has been deployed, the panels are examined for flaws, holes, defects and tears. Each location shall be repaired using the following procedures:

- Patching - A patch is used to repair defects in the geomembrane which are 1/8-inch or larger.
- Abrading and Re-welding - This procedure is used to repair small seam sections.
- Spot Welding - Spot welding is used to repair small tears, pinholes and/or other small defects.
- Capping - Used to repair large lengths of failed seams.

Patches or caps shall extend at least six inches beyond the edge of the defect. The edges of the patch or cap shall be extrusion welded to the existing geomembrane after the liners are abraded by a disc grinder with an abrasive disc to remove the sheen of the surface of the geomembrane and to provide a surface which is more conducive to accepting the weld. Welding of the repair patch is completed by extrusion welding the geomembrane. The repairs shall be non-destructive tested using the vacuum-box method.

3.4 Drainage/Protection Layer

3.4.1 Observation Requirements

The drainage/protection layer includes a network of perforated subdrains placed on the surface of the geomembrane and covered by a permeable drainage layer. The drainage layer materials are used to convey water from the surface of the geomembrane barrier into the run-off control system where it can be properly managed. Before the drainage layer is installed, the CQA Consultant will:

- view the geomembrane barrier prior to the installation of the drainage layer;
- view incoming loads of the drainage layer material; and
- ensure that geomembrane testing and drainage soil testing has been performed and results have been reviewed by the Design Engineer.

During installation of drainage layer, the CQA Consultant will:

- observe the placement of the drainage layer material on the surface of the geomembrane; and
- confirm that the thickness of the drainage layer conforms with the project specifications.

3.4.2 Pre-Construction Testing

Prior to any material placement, the Contractor shall submit results of pre-construction testing conducted on representative samples of the Contractor's source of drainage soil material. In addition, the Contractor must submit results for geomembrane interface friction testing in accordance with the table below. The CQA Consultant will review all test results with the Design Engineer.

The Contractor must also submit representative samples of the drainage soil material for independent pre-construction testing by the Owner or CQA Consultant.

DRAINAGE MATERIAL PRE-CONSTRUCTION TESTING			
Material	**Test**	**Standard**	**Min. Test Frequency**
Drainage Sand	Grain Size	ASTM D-422	1 Test/Each Source
	Permeability	ASTM D-2434	1 Test/Each Source
	Interface Shear w/ Geomembrane *	ASTM D-5321	1 Test/Each Source

* An interface shear test will be performed on the drainage layer/40-mil textured HDPE geomembrane only if the borrow source is different from the sub-grade/gas venting layer source. Refer to Section 3.3.2 Conformance/Acceptance Testing for testing conditions.

3.4.3 Construction Testing

The Design Engineer and CQA Consultant must confirm that the necessary grain size and hydraulic conductivity tests have been performed. The Contractor is responsible for taking one sample of the drainage layer material during placement every 1,500 cubic yards (see table below). The Contractor will be responsible for collecting, packaging, and sending all samples to the laboratory.

The Owner and CQA Consultant reserve the right to collect additional samples for testing by the project's independent laboratory.

DRAINAGE MATERIAL CONSTRUCTION TESTING			
Material	**Test**	**Standard**	**Min. Test Frequency**
Drainage Sand	Grain Size	ASTM D-422	1 Test/1,500 CY
	Permeability	ASTM D-2434	1 Test/3,000 CY

3.5 Vegetative Layer

3.5.1 Observation Requirements

The vegetative cover material is used as the top layer in a final cover system and will be topsoil material and/or soil capable of providing the proper base for establishing surficial grasses for erosion control. Before the vegetative layer is installed, the CQA Consultant will:

- view the drainage layer prior to the installation of the vegetative layer;
- view incoming loads of the vegetative layer material; and
- ensure that drainage layer testing has been performed and results reviewed by the Design Engineer.

During installation of vegetative support layer, the CQA Consultant will:

- observe the placement of the vegetative layer material over the drainage layer; and
- confirm that the thickness of the vegetative layer conforms with the project specifications.

3.5.2 Pre-Construction Testing

Prior to any construction, the Contractor shall submit results of pre-construction testing conducted on representative samples of the Contractor's source of vegetative support material. The CQA Consultant will review all test results with the Design Engineer.

The Contractor must also submit representative samples of the vegetative support material for independent pre-construction testing by the Owner or CQA Consultant.

VEGETATIVE SUPPORT MATERIAL PRE-CONSTRUCTION TESTING			
Material	**Test**	**Standard**	**Min. Test Frequency**
Vegetative Support	Grain Size	ASTM D-422	1 Test/Each Source
	pH	ASTM D-4972	1 Test/Each Source
	Organic Content	ASTM D-2974	1 Test/Each Source

3.5.3 Construction Testing

The Contractor is responsible for taking one sample of the vegetative layer material during placement every 1,000 cubic yards (see table below). The Contractor will be responsible for collecting, packaging, and sending all samples to the laboratory.

The Owner and CQA Consultant reserve the right to collect additional samples for testing by the project's independent laboratory.

VEGETATIVE SUPPORT MATERIAL CONSTRUCTION TESTING			
Material	**Test**	**Standard**	**Min. Test Frequency**
Vegetative Support	Grain Size	ASTM D-422	1 Test/1,000 CY
	pH	ASTM D-4972	1 Test/1,000 CY
	Organic Content	ASTM D-2974	1 Test/1,000 CY

3.5.4 Seeding Requirements

The CQA Consultant will observe the Contractor's operations regarding the application of lime, fertilizer and seed and shall verify compliance with the specified mixtures and application rates.

3.6 Storm Water Controls

3.6.1 Observation Requirements

Storm water controls such as run-off diversion berms, swales, channels and storm water basins will be installed to control run-off from the final cover system. The Contractor will confirm the location and grades of the structures, along with confirming that materials conform to the project specifications and the design drawings.

4.0 DOCUMENTATION AND RECORD-KEEPING

The effectiveness of a CQA plan is largely dependent on the ability to properly monitor and document all activities. It is the responsibility of the CQA Consultant to observe and document the activities of the Contractors in sufficient detail and with sufficient continuity to provide a high level of confidence and to produce sufficient documentation that the work product complies with the design drawings and specifications. Documentation to be provided by the CQA Consultant shall include daily work summaries of construction activities, all laboratory test results, design and specification revisions and construction photographs. The CQA Consultant shall maintain a complete file of plans and specifications at the site, a CQA manual, test procedures, daily reports and other pertinent documents.

4.1 Daily Record-keeping

The CQA Consultant will compile daily logs, which detail the construction activities, observation and testing data sheets, meetings and/or discussions, the names of site visitors and any construction problems along with the actions taken to alleviate the problem. Examples of CQA record keeping forms are provided in Appendix A.

4.2 Observation and Testing Reports

The CQA Consultant will compile and maintain a complete record of material test results. All applicable test results will be included in the certification report.

4.3 Changes to Specifications/Drawings

In the event that any design and/or specification changes are required, the CQA Consultant shall notify the Design Engineer. Design and/or specification changes shall be made only with the agreement of the Design Engineer and shall take the form of an addendum to the specifications or design drawings.

4.4 Photographic Documentation

The CQA Consultant will maintain a detailed photographic record of the construction activities to provide a pictorial record of the progress of work, any problems that may arise and the mitigation activities related to those problems. The photographic record will be included in the certification report.

4.5 Deficiencies/Corrective Measures Reports

In the event that problems or work deficiencies arise, the CQA Consultant shall determine the nature and extent of the deficiency, notify the Contractors and properly document the situation. The procedure for handling such a situation is to define and discuss the problem/deficiency, review any alternative solutions and implement a plan to resolve the problem/deficiency. In the event that the issue is not resolved, the CQA Consultant shall notify the Design Engineer. All discussions and meetings related to the problem/deficiency shall be documented by the CQA Consultant. A corrective measures report shall be prepared, if necessary, and shall include the location, description and probable cause of the problem, along with any recommended corrective measures to ensure that the problem/deficiency does not occur again.

4.6 Record Drawings

Once the project has been completed, record drawings shall be prepared to document the as-built conditions of the site. The record drawings shall be prepared by the Contractor's registered professional land surveyor and shall present the limits and elevations of the components of the base liner system and the overall constructed work product. The Contractor shall also prepare a record drawing showing all geosynthetics installed including the approximate locations of panels, field seams, destructive tests and repairs.

4.7 Final Report

After completion of the construction work, the Design Engineer and CQA Consultant will prepare a final certification report in accordance with 310 CMR 19.106. The purpose of this report is to certify that the work has been performed in general compliance with the plans and specifications, and includes supporting documentation. The report must include a summary of all construction activities, observations and test results, construction problems and their solutions, changes in design and/or material specifications, photographs of the construction activities, record drawings and any other pertinent information.

5.0 MEETINGS

5.1 Pre-Construction Meetings

A pre-construction meeting shall be held before any construction activity commences. This meeting shall be attended by the Owner and/or Operator, the Design Engineer, the CQA Consultant and the Contractors. The intention of this meeting will be to review the design plans and specifications, delineate each party's responsibilities, designate a contact person for each party, discuss site rules and safety related issues and discuss how to address any problems which may arise during construction.

5.2 Progress Meetings

Progress meetings shall be held on a routine basis. These meetings may be necessary to solve problems, improve lines of communication and discuss the status of the project to date.

5.3 Final Viewing of Work

At the completion of the project, a final viewing of the work shall be performed. The Owner and/or Operator, the Design Engineer and CQA Consultant shall walk the site to view the construction.

APPENDIX A

SAMPLE C. Q. A. RECORD KEEPING FORMS

DAILY FIELD REPORT

Date:	
Project No.:	
Project:	
Location:	
Client:	
General Contractor:	
Sub-Contractor:	

SITEC

ENVIRONMENTAL

Hazardous and Solid Waste Consultants

GENERAL INFORMATION

SITEC CQA Personnel Present:	***Arrival Time:*** ***Departure Time:***
Contractor Personnel Present:	***Equipment Used:***
Weather: ***Temperature:***	

SERVICES PERFORMED & OBSERVATIONS:

SITEC

ENVIRONMENTAL
Hazardous and Solid Waste Consultants

TRIAL WELD LOG

Project No:
Project:
Location:
Client:
Contractor:
Sub-Contractor:
Product Type:

Date	***Time***	***Machine No.***	***Tech.***	***Hot Shoe Temp/Speed***	***Extrustion Gun Temp/Preheat***	***Peel***					***P/F***	***Shear***	***P/F***	***Comments***
						In/Out	***In/Out***	***In/Out***	***In/Out***	***In/Out***				

SITEC

ENVIRONMENTAL

Hazardous and Solid Waste Consultants

Geomembrane Panel Placement Log

Project No:
Project:
Location:
Client:
Contractor:
Sub-Contractor:
Product Type:

Panel No.	*Date*	*Roll No.*	*Panel Length (ft.)*	*Panel Width (ft.)*	*Square Footage*	*Comments*

SITEC

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Hazardous and Solid Waste Consultants

Seaming & Air Testing Log

Project No:
Project:
Location:
Client:
Contractor:
Sub-Contractor:
Product Type:

Seam No.	*Seam Length (ft.)*	*Date Seamed*	*Time Seamed*	*Tech.*	*Machine No.*	*Start Time*	*Start PSI*	*End Time*	*End PSI*	*P/F*	*Date Tested*	*Comments*

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Destructive Testing

Project No:	
Project:	
Location:	
Client:	
Contractor:	
Sub-Contractor:	
Product Type:	

Sample No.	***Seam No.***	***Date Welded***	***Date Tested***	***Tech.***	***Machine No.***	***Peel***					***P/F***	***Shear***	***P/F***	***Comments***
						In/Out	***In/Out***	***In/Out***	***In/Out***	***In/Out***				

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Geomembrane Repair Log

Project No:
Project:
Location:
Client:
Contractor:
Sub-Contractor:
Product Type:

Seam No.	*Repair No.*	*Repair Description*	*Repair Date*	*Vacuum Test Date*	*P/F*	*Failed Test Date*

PART F

TECHNICAL SPECIFICATIONS
PHASE 9 LANDFILL EXPANSION
BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY

BWP SW 26 - APPLICATION FOR AUTHORIZATION TO CONSTRUCT PHASE 9 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY BOURNE, MASSACHUSETTS

PART F TECHNICAL SPECIFICATIONS

Prepared For:

TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT
24 Perry Avenue
Bourne, Massachusetts 02532

Prepared By:

SITEC Environmental, Inc.
769 Plain Street, Unit C
Marshfield, Massachusetts 02050

December 6, 2022

BWP SW 26 - APPLICATION FOR AUTHORIZATION
TO CONSTRUCT
PHASE 9 LANDFILL EXPANSION

BOURNE INTEGRATED SOLID WASTE MANAGEMENT FACILITY
BOURNE, MASSACHUSETTS

PART F
TECHNICAL SPECIFICATIONS FOR
LINER CONSTRUCTION

SECTION 01036

HEALTH AND SAFETY

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall submit to the Owner prior to beginning the work a written "Health and Safety Plan" for review and approval. Partial payments will not be made to the Contractor by the Owner until the "Health and Safety Plan" has been submitted.

B. The Contractor shall provide such equipment and medical facilities as are necessary to supply first aid to anyone who may be injured in connection with the Work and shall provide for the capability for immediate removal and hospitalization if required.

C. The Owner may stop the Work if in his sole judgement safety laws, or safe work practices are not being observed; provided, however, that none of the foregoing shall relieve the Contractor from being fully responsible and liable for meeting all safety laws and safe work practices in connection with the Work, nor should the failure of such persons to stop the Work be construed to mean that all safety laws and safe work practices are being met. Notwithstanding the above, the Contractor is solely responsible for the compliance with safety laws and maintaining safe work practices.

1.02 HEALTH AND SAFETY PLAN

A. Prior to construction commencement, the Contractor shall prepare a site specific health and safety plan (the "HASP"). If the Contractor does not have the capability to prepare the HASP, the Contractor shall contract for the preparation of the HASP. The Contractor is solely responsible for the preparation, monitoring, management, and enforcement of the HASP.

B. The Contractor is encouraged to include any information that the Contractor believes is relevant. Contractor shall submit a copy of the HASP to the Owner prior to starting construction. Submission of the Contractor's HASP to the Owner is to inform the parties of the details of the program. Submission of the HASP does not, in any way, impose a responsibility on the Owner for adequacy of the program nor does it relieve the Contractor from full responsibility to comply with, and liability for, the appropriate laws, rules or regulations regarding health and safety of on-site personnel.

C. The Health and Safety Plan shall, as a minimum, address the following:

1. Description of work to be completed.

2. Identification of possible site chemical exposure hazards, including but not limited to gases and leachate typically found in landfills, refuse and ash.

3. Identification of possible explosion hazard from methane released from the landfill.

4. Monitoring equipment and procedures for use on site (eg. explosimeter, oxygen meter, photoionization detector).

5. Site operating procedures and safety guidelines.

6. Emergency procedures and information for personnel injury, fire, explosion, or equipment failure.

D. The Health and Safety Plan shall as a minimum be consistent with the requirements of the latest versions of:

1. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29, Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 1926), including amendments, or current amendments at the time of contract performance as stated in Fed Reg December 19, 1986: 45654-45675 (Interim Final Rule, 29 CFR 1910.120 "Hazardous Waste Operations and Emergency Response").

2. United States Environmental Protection Agency (USEPA) Standard Operating Safety Guidelines, Office of Emergency and Remedial Response, Hazardous Response Support Division, Edison, New Jersey.

3. Corps of Engineers Accident Prevention and Safety and Health Requirements Manual, EM 385-1-1.

4. NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Site Activities, October 1985, DHHS (NIOSH) Publ. No. 85-115.

1.03 GENERAL SAFETY CONSIDERATIONS

A. Workers shall be advised of the presence of methane or hydrogen sulfide gas emanating from the natural decomposition of refuse buried at or near the job site and take precautions to ensure the safety of workers and the public.

B. A person shall be designated as Safety Monitor who is trained in the use of gas detection instruments and safety equipment. He shall be present at all times with appropriate instruments to test for oxygen deficiency and the presence of methane or hydrogen sulfide gas. An Emmet CGS-10 Gas Detector, or similar unit, shall be available for this purpose. The Safety Monitor shall periodically test the excavation areas, utility vault, structure, etc., for safe working conditions and be responsible for the appropriate safety equipment being available at the site.

C. Workers shall not be allowed to work alone at any time in an excavation. Work parties of at least two shall be mandatory, with one worker outside of possible gas effects. Access to the open trench shall be via ladders spaced no further than 30 yards apart. Trenches shall be shelved to prevent possible caving in on workers.

D. No welding shall be permitted in trenches, enclosed areas, or over refuse filled areas unless performed over ground mats or in areas of the site approved by the Safety Monitor.

E. Workmen shall not be permitted to enter excavations where there is an oxygen deficiency or a combustible mixture of methane or other explosive gases, without taking precautionary measures.

F. As construction progresses, all valves, pipe and other conduit openings shall be closed as soon as installed to prevent the migration of gases through the pipeline system, unless they are so intended, and to prevent extraneous matter from entering the system.

G. Smoking shall be prohibited in or near open excavations and in the vicinity of excavation activities. No excavation or drilled hole greater than 2 feet deep shall be left unattended or left open overnight unless securely covered in a manner acceptable to the Owner. Precautions shall be taken to prevent open excavation from the introduction to stormwater.

H. Entrance into utility access manholes shall be done with extreme caution. Sparks can occur from metal manhole covers and rings. Always test the air in a manhole or enclosed space with a detector before entering. Positive ventilation should be considered when working in any underground structure. All enclosed entries will be performed under full mask and suit conditions (pursuant to OSHA requirements) by certified personnel.

I. Fire extinguishers shall be available and be rated at least A, B and C.

1.04 PRECAUTIONS WHEN WORKING ON OR NEAR REFUSE LANDFILLS

A. Workers shall be cautioned regarding the potential unstable soil and refuse material and the strong possibility of caving during excavation operations. All workers entering open excavations shall be secured with a safety belt, harness, or short rope to enhance rescue operations in the event of accidents.

B. Workers in the excavation area shall have access to acid vapor masks for temporary protection in the event hydrogen sulfide (H_2S) gas is present and triggers the H_2S alarm on the gas detector. Vacate the area immediately when H_2S is detected.

C. Construction equipment shall be equipped with vertical exhaust and spark arresters.

D. Motors utilized in refuse excavation areas shall be explosion-proof.

E. Start-up and shutdown of equipment shall not be done in areas of exposed refuse.

F. Soil shall be stockpiled adjacent to operations in areas of exposed refuse for fire fighting purposes. Probably the most effective way to extinguish landfill fires is to smother the fire with soil (which eliminates available combustion oxygen).

G. The use of explosives is not permitted.

H. Any refuse exposed during construction activities shall be covered as soon as possible after exposure with at least a 6-inch layer of earth or deposited into approved containers. In no event shall the refuse remain exposed overnight.

I. All refuse excavated during construction activities shall be disposed of in an appropriate disposal manner.

J. Inhalation of landfill gases shall be avoided as much as possible. Such gases (or oxygen deficient air) may cause nausea and dizziness, which could lead to accidents.

K. Workers shall avoid contact with exposed refuse where possible. Irritants or hazardous materials may be present.

L. Workers shall not leave open wells or excavations unattended. Open boreholes must be covered to prevent accidental entry. Wells must be barricaded, flagged, and protected sufficiently to prevent entry of dirt and run off water.

M. Landfill gas (LFG) is comprised of approximately equal portions of carbon dioxide (CO_2) and methane (CH_4) with other trace constituents. It is a product formed by the anaerobic decomposition of refuse. Methane gas is the primary component of natural gas, and is combustive when the methane concentration in air is between 5 and 15 percent by volume. The 5 percent level is called the lower explosive limit (LEL). Below 5 percent, there is insufficient methane for combustion. Above 15 percent, called the upper explosive limit (UEL), there is insufficient oxygen for combustion. However, it is important to note that a concentration of methane above 15 percent is considered at least as dangerous as a concentration between 5 and 15 percent, because as the methane dilutes with air, it will pass through the explosive range. When gas concentrations are low, it is common to express methane concentration as a percentage of the LEL. For example, 100 percent LEL is 5 percent methane in air, and 50 percent LEL is 2.5 percent methane in air.

N. Because the decomposition of buried refuse typically produces methane at concentrations ranging from 40 to 55 percent, methane will always pass through the combustible range as it vents to the atmosphere and dilutes with air. Methane is lighter than air, and will rise in the absence of a typical barriers. LFG, being a mixture of methane and carbon dioxide, may be heavier than or lighter than air depending on the specific mixture. LFG may escape from the refuse, both vertically through the landfill cover, and laterally through surrounding soils. LFG moves in response to the pressure buildup within the landfill and through diffusion in the absence of a pressure differential. Diffusive movement nearly always produces explosive range concentrations of methane.

O. The Contractor shall consider any concentration of methane at or above 10% LEL as one to cease construction activities or operations.

END OF SECTION

SECTION 01562

DUST CONTROL

PART I - GENERAL

1.01 GENERAL PROVISIONS

A. Furnish all labor, materials, tools, and equipment to apply water or calcium chloride on roads, other traveled surfaces or the Landfill surface within the construction site when directed by the Owner and/or as necessary to control dust.

B. When dust control is not included as a separate item in the Contract, the work shall be considered incidental to the appropriate items of the Contract.

PART 2 - PRODUCTS

2.01 WATER

Water for sprinkling shall be clean, free of salt, oil, and other injurious materials.

2.02 CALCIUM CHLORIDE

Calcium chloride shall meet the requirements of ASTM Specification D98-48 and as amended.

PART 3 - EXECUTION

3.01 WATER APPLICATION

A. Water shall be applied by equipment approved by the Owner. As a minimum it shall consist of a tank, a spray bar, and a gauge equipped pump. Water shall be dispersed through nozzles at a minimum pressure of 20 psi.

3.02 CALCIUM CHLORIDE APPLICATION

A. Calcium chloride shall be properly applied where directed by the Owner and distributed at the rate specified or ordered. Method of application shall be by hand or approved spreading device. The number and frequency of applications shall be determined by the Owner.

B. Whenever calcium chloride is applied, the Contractor shall take every precaution necessary to prevent calcium chloride from entering and contaminating surface waters on and around the job site. Any damage resulting to property or surface and ground waters, including public and private water supplies, from the use of calcium chloride shall be the Contractor's liability. The Owner's direction or approval for calcium chloride application shall not release the Contractor from responsibility for protection of property or water resources. Any reparations required as a result of the misuse of calcium chloride shall be at the Contractor's expense.

END OF SECTION

SECTION 01566

EROSION AND SEDIMENTATION CONTROL

PART I - GENERAL

1.01 SCOPE

A. Furnish all labor, materials, tools and equipment, and perform all operations necessary for erosion control work indicated on Drawings and specified.

1.02 PROJECT CONDITIONS

A. Earthmoving activities-shall be conducted in such a manner as to prevent accelerated erosion and the resulting sedimentation.

B. The Contractor shall design, implement and maintain erosion and sedimentation control measures which effectively prevent accelerated erosion and sedimentation. The Contractor shall be totally responsible for all damages resulting for failure to prevent erosion and sedimentation.

1.03 EROSION AND SEDIMENTATION CONTROL PLAN

A. The Contractor shall submit an Erosion Control Plan within 10 days of Notice to Proceed. The plan shall be prepared by a person trained and experienced in erosion and sedimentation control methods and techniques, to the Owner for approval. The plan shall detail the Contractor's proposed schedule and methods for implementing the requirements of the Contract Documents, including this Section.

1.04 GENERAL METHODOLOGY

A. Erosion and sedimentation control methods shall consider all factors which contribute to erosion and sedimentation including, but not limited to, the following:

1) Topographic features of the Project area.

2) Types, depth, slope and areal extent of the soils.

3) Proposed alteration of the area.

4) Amount of run-off from the Project area and the upstream watershed area.

5) Staging of earthmoving activities.

6) Temporary control measures and facilities for use during earthmoving.

7) Permanent control measures and facilities for long term protection.

8) Maintenance program for the control facilities including disposal of materials removed from the control facilities or Project area.

PART 2 - PRODUCTS

2.01 SEDIMENT BARRIERS

A. Sediment barriers shall be hay or straw bales, brush, stone, geotextile fabrics, or other approved materials that will prevent sedimentation.

2.02 MULCH AND SEEDING

A. Mulch and seeding shall be in accordance with requirements of Tables 1 and 2 attached to this Section.

PART 3 - EXECUTION

3.01 DIVERSION TERRACES

A. Diversion terraces shall be used as a temporary measure installed on the uphill side of the disturbed areas to divert surface runoff away from unstabilized slopes, and the Project area.

B. Recommended Minimum Dimensions:

Height	1.5 feet
Top Width	2 feet
Side Slopes	2:1 or flatter
Material	Soil

3.02 INTERCEPTOR CHANNELS

A. Interceptor channels shall be used across disturbed areas where the slope is running parallel to the direction of trenches.

B. Interceptor channels reduce erosion by intercepting storm runoff and diverting it to outlets on the lower side of the disturbed area where it can be disposed of having minimum erosion impact.

C. Recommended Dimensions and Materials:

Depth	0.5 feet
Width	2 - 4 feet
Side Slopes	2:1 or flatter
Spacing	Where required
Material	Stable on-site material

3.03 TRENCH BARRIERS

A. Trench barriers shall be used where the disturbed area is sloped in the direction of the pipeline, when the slope exceeds 15 percent or when the Owner deems necessary.

B. Trench barriers shall be earth-filled sacks or piled stone, stacked to the top of the trench prior to backfill, if backfill is delayed.

C. Trench barriers shall act as an erosion check by preventing the washout of the trench.

D. Recommended Dimensions and Materials:

Height	To top of trench
Spacing	Approximately every 150 feet
Material	Earth-filled sacks or piled stones

3.04 SEDIMENT BARRIERS

A. Sediment barriers shall be used at storm drain inlets; across minor swales and ditches; and at other applications where the structure is of a temporary nature and structural strength is not required. Sediment barriers are temporary berms, diversions, or other barriers that are constructed to retain sediment on-site by retarding and filtering storm runoff.

B. Recommended Materials and Dimensions:

1) Hay or Straw Bales:

a) Bales should be bound with twine.

b) Bales should be anchored to the ground with fence posts, wood pickets, or any naturally decomposable material. Two anchors per bale are required.

c) Bales shall be installed so that runoff cannot escape freely under the bales.

d)

Height:	1.5 feet
Width:	1.5 - 3.0 feet
Cross-Sectional area required per tributary acre:	50 square feet

2) Stone:

a)	Height:	1.5 - 2 feet (uniform top elevation)
b)	Material:	Coarse rock or stone

c) Side Slopes: 3:1 or flatter

Cross-Sectional area required tributary acre: 20 square feet

d) Top Width: 3 - 5 feet

3) Brush:

a) Brush should be bound with twine.

b) Brush should be anchored such that it does not move and runoff cannot escape freely under the barrier.

c) Height: 1.5 - 2.0 feet

d) Cross-Sectional area required per tributary acre: 15 square feet

3.05 MULCH

A. Used alone or in conjunction with other structural or vegetative erosion control measure, mulch is applied on any disturbed area which is subject to erosion, for protection of disturbed soil or newly reseeded areas.

B. Recommended Methods and Materials:

Material: Hay, straw, wood chips

Methods: Spread by hand tools on small plots and by mechanical blower on larger areas. Tacked by passing a tracked construction vehicle over the mulched area.

Rates: See Table 1

3.7 VEGETATION

A. Temporary Vegetation:

1) The planting of temporary vegetative cover shall be performed on disturbed areas where the earthmoving activities will be ceased for a period of more than 45 days. The vegetation shall provide short-term rapid cover for the control of surface runoff and erosion, until permanent vegetation can be established or earthmoving activities can resume.

2) Table 2 gives recommended types of temporary vegetation, corresponding rates of applications, and planting seasons.

B. Permanent Vegetation:

1) Planting of various permanent vegetative covers shall be performed on disturbed areas where the earthmoving activities have ceased. The

vegetation shall reestablish ground cover for the control of surface runoff and erosion.

TABLE 1

MULCH MATERIALS, RATES AND USES

Mulch Material	Quality Standards	Application Rates		Depth of Application	Remarks
		per 1,000 sq ft	per acre		
Straw or Hay	Air-dried Free from coarse materials	75-100 lbs 2 - 3 bales	1.5 - 2.5 tons 90 - 120 bales	Lightly cover 75 to 90% of surface.	Use straw where mulch effect is to be maintained for more than 3 months. Subject to wind blowing unless kept moist or tied down. Most common and widely used mulching material. Good for erosion control in critical areas.
Wood Chips	Green or air-dried	500 - 900 lbs	10 - 20 tons	2" - 7"	If intensive foot or vehicle traffic is anticipated, the application rate may be increased. Resistant to wind blowing. Decomposes slowly.

TABLE 2

TEMPORARY SEEDING FOR EROSION CONTROL ON CONSTRUCTION SITES

Species Or Mixture For Temporary Cover	Percent By Weight	Seeding Rates In Pounds		Recommended Seeding Dates
		per 1,000 sq ft	per acre	
Annual Ryegrass	100%	1	20 to 40	April 1 to June 1 August 15 to October 15
Field Bromegrass	100%	1	20 to 40	March 1 to June 15 August 15 to September 15
Sundangrass	100%	1	30 to 40	May 15 to August 15

END OF SECTION

SECTION 02130

LANDFILL GAS EXTRACTION WELLS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for installation of landfill gas extraction wells (EW) as specified herein and as shown on the Drawings.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02714 - HDPE Pipe and Fittings

1.03 CONTRACTOR QUALIFICATIONS

A. Contractor shall have completed at least five successful operating landfill gas collection system installations with similar wells, and condensate traps within the last five years.

B. All extraction wells (EW) shall be installed under the direction of a qualified construction superintendent with direct experience of conducting landfill gas extraction well boring and construction work. All final EW collection well drilling logs and construction diagrams shall be signed by the construction superintendent.

1.04 SUBMITTALS

A. The Contractor is responsible for implementing a Health and Safety Plan for the protection of its employees working at the site. The plan shall be reviewed by the Owner prior to construction start-up. Refer to Section 01036 – Health and Safety.

B. Prior to construction, Contractor shall meet with the appropriate representatives of the Bourne Police Department and Fire Department to discuss public safety, site access, traffic safety and emergency response requirements.

C. Prior to construction, the Contractor shall submit to the Owner a detailed Odor Control Plan describing procedures to control odors from the waste excavation and Contractor's procedures for responding to odor complaints.

D. Prior to construction, the Contractor shall submit to the Owner a detailed Spoils Management Plan for the handling of spoils removed from the borehole and trenches during gas collection system construction.

E. Prior to construction, the Contractor shall submit to the Owner shop drawings detailing the dimensioning and technical specifications for all the gas collection pipe and fittings. Also, submit certified test reports that the pipe was manufactured and tested in accordance with the ASTM standards specified herein.

F. The Contractor shall submit testing results of pre-construction quality control tests conducted on representative samples of the Contractor's source of the washed stone. Such test results must document compliance with these specifications.

G. The Contractor shall submit to the Owner representative samples of washed stone prior to delivery of the washed stone to the project site. Owner may elect to conduct the tests of said sample.

H. Submit one copy of the following Landfill Gas Extraction Well (EW) Data upon completion of drilling:

1. Daily driller's report. During the drilling of the well, maintain daily driller's report that includes at a minimum, but not limited to:

    a. Date, Location, Boring identification number, Weather conditions, Daily activities, Equipment used, Drilling crew, Time (rig time, down time, stand-by, etc.), Footage, Materials used, Well construction (materials used, type, quantity, etc.), Relevant notations and Verification of activities.

2. Well Log. During the drilling of the well the Contractor will complete a well log report that includes at a minimum, but not limited to:

    a. Logger's Name, Date Begun, Date Completed, Location, Boring identification number, Weather conditions, Equipment used, Drilling crew, Time (time to depth, down time, stand-by, etc.), Footage (Total Depth, Well depth), General descriptions of strata encountered, Depth and thickness of intermediate covers/soil layers, General soils descriptions, Estimates of moisture content, Notation of wet or saturated zones, Ambient air monitoring results, Materials used, Well construction (materials used, type, quantity, etc.), Relevant notations and Verification of activities.

3. Well Installation Log. Upon completion of the well the Contractor will complete a well instillation report that includes at a minimum, but not limited to:

    a. Installer's Name, Date Begun, Date Completed, Location, Boring identification number, Equipment used, Installation crew, Time (time to depth, down time, stand-by, etc.), Footage (Total Depth, Well depth), Materials used, Size and depth of pipe, Length of perforated and solid casing, Depth and type of gravel pack, Depth and thickness of bentonite seal(s), Depth and thickness of backfill materials(s), Type and thickness of surface seal, Casing elevation, Relevant notations and Verification of activities.

4. Contractor will provide copies of Driller's Reports, Well Logs and Well Installation Logs for review and approval by the Owner prior to requesting payment for that work.

5. Contractor will provide copies of proposed EW Installation procedures for review and approval by the Owner prior to initiation of well construction.

PART 2 - PRODUCTS

2.01 GAS EXTRACTION WELLS (EW)

A. All pipe and fittings are to be high density polyethylene (HDPE) per Specification Section 02714, HDPE Pipe and Fittings and as shown on the Drawings.

2.02 WASHED STONE

A. Washed stone shall be non-calcareous gravel, 1-inch to 1½-inch for gas collection gas wells. Washed stone shall be free of debris, organic matter, vegetation, frozen earth and any other materials considered unsuitable by the Owner. Washed stone shall be clean with no more than 5 percent of the material being finer than a #200 sieve as determined by ASTM D422.

2.03 SOIL BACKFILL

A. Soil: backfill shall be of a fine material that has good compaction characteristics and shall conform with cover materials on-site or as designated in Section 02200, Earthwork and as approved by the Owner.

2.04 BENTONITE SEALS

A. Bentonite shall be medium bentonite chips or 3/8-inch round bentonite pellets.

2.05 LANDFILL GAS WELLHEADS

A. The landfill gas collection system wellheads shall be a CES-Landtec Accu-Flo™ wellhead assembly and shall consist of well head piping, flow control gate valve, gas temperature gauge port, quick connect gas sampling, static and impact pressure ports, flexible hose connector, PVC union disconnect and dust cap. Wellhead piping and fittings shall be Schedule 80 PVC. Adapters shall be Elastomeric Polyvinyl Chloride.

B. Volumetric Flow Rating

1. The nominal flow capacity of the wellhead shall be:

Wellhead Nom. Size (in.)	Min. Flow (CFM)	Max. Flow (CFM)
1.5	0	50
2.0	5	150
3.0	25	300

C. The equipment shall be capable of withstanding the rigors of landfill gas recovery application including internal high vacuum, weathering, gas constituent and ultraviolet light exposure.

D. The wellhead shall be air tight and leak free and shall be height adjustable in the field using adapter bushings.

E. The wellhead assembly shall be capable of being used with the CES-Landtec GEM-500™ and GEM-2000™ Gas Extraction Monitor incorporating all GEM™ monitoring functions.

F. It is the intent of this Specification that the wellhead assembly shall be supplied as a complete manufactured unit.

PART 3 - EXECUTION

3.01 GAS EXTRACTION WELLS (EW)

A. The Contractor shall install landfill gas extraction wells, piping, headers, valves etc. at the locations and as shown on the Drawings.

B. The EW well boring will be a minimum 24-inch diameter hole drilled to the bore hole depth listed on the Drawings, which is intended to be 10 feet above the bottom of waste/top of sand drainage layer elevations as noted on the Drawings. The depth to the bottom of the waste is approximated from construction information. Due to placement of fill and/or settling, actual depths to the bottom may be different than the values presented. The Contractor shall provide actual elevation and location information of proposed EW locations to the Owner. The Contractor shall not begin boring operations at an EW location until the Owner has approved the boring depth for that location. In no instance will well borings be advanced and/or completed into the liner system beneath the landfill. Wells shall be constructed in accordance with the details shown on the Drawings and as noted in the Specifications.

C. Contractor shall fabricate the well casings in accordance with Drawings and Specifications. The well casing shall be perforated in accordance with the Drawings and Specifications. All perforations and casing assembly shall be as stipulated in the Drawings and Specifications. The bottom of the casing shall be capped with a cap of appropriate material, size and schedule. Slip couplings shall allow for landfill settling, while providing a seal between changing pipe sizes, as shown on the Drawings. Well casings shall be capped at the surface connection prior to installation to prevent gas from escaping and backfill material from entering the pipe.

D. No pressure check is necessary for the extraction wells.

E. Contractor shall drill the gas extraction well bores using an appropriate truck mounted or Caisson (crane-mounted bucket auger) type drilling unit capable of boring to the depths indicated in the Drawings and Specifications.

F. Contractor shall preform no boring unless the Owner is present to approve the well location and to witness operations.

G. Boring depths shall be completed to within 10 feet of the bottom of the refuse as identified on the Drawings for each well location. These depths are based on available knowledge of liner construction. In no case shall the borings be advanced into the liner system beneath the refuse. Should the liner system be encountered during drilling, all drilling operations on that hole will cease and the Owner immediately notified. The Contractor shall submit a Verbal Remedial Plan by the end of the day of the incident, and a written plan, by the following day, to repair the damaged liner, so as to meet the design performance standards for the impacted liner system. Final casing depths shall be adjusted at the completion of drilling to accommodate any deviation from identified depths.

H. Well casings shall be set and the annular space backfilled in accordance with contract Drawings and Specifications. Well casings shall be installed immediately after completion of the holes by lifting the casing with the drill rig cable hoist, in sections if required, and lower the casing into the hole. The casing shall be installed above the bottom of the boring, as shown on the Drawings. The flanged surface connection, or the cap, shall terminate 6 feet above the existing landfill surface. The casing shall be suspended at the surface and centered in the boring at all times during backfilling. Suspension and centering equipment shall allow for safe manipulation of the well casing in and over the open boring and provide a stable working surface for personnel completing section couplings and/or final removal of well supporting equipment. Initial washed stone backfilling operations shall be completed while the well casing is suspended at the depth shown on the Drawings above the bottom of the boring hole. When the pipe is "supported" by the washed stone in the hole, and the drill rig can be moved to the next location. Wells shall then be completely backfilled with the designated amounts and levels of materials as shown on the Drawings. Washed stone backfill shall be placed to the depths shown on the Drawings. A minimum two feet thick seal of hydrated bentonite chips shall be installed above the gravel pack and well washer, as shown on the Drawings. This seal will be allowed to hydrate thoroughly prior to addition of clean backfill. Clean backfill shall be installed, as shown on the Drawings.

I. The drilling schedule must be reviewed daily to insure that all wells started can be completed and sealed by the end of each work day. No wells are to be left incomplete overnight.

J. At no time are open well borings to be left uncovered and/or unattended during the course of the workday.

K. Contractor shall be responsible for any grading, leveling, towing and/or restoration which may be necessary for movement of the drill rig on the landfill property. No extraction well drilling shall occur on slopes that cannot safely support the drilling operations.

L. Any settlement shall be backfilled within 3 weeks after placement of backfill from the level of the subsidence to 6 inches above existing grade with the appropriate cover materials.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary to perform all related work as specified, herein, as shown on the Drawings.

B. The work of this Section shall include, but not necessarily be limited to: excavating, separating, hauling, stockpiling, backfilling, compacting and grading of soils. The work of this Section may pertain in whole or in part to construction of the following: landfill cap subgrade preparation, gas collection system piping, leachate interceptor piping, drainage structures and swales and general site grading.

The Contractor is advised that related sections contain additional detailed specifications and testing requirements for the various layers of the landfill cap to be constructed under this Contract.

C. The Contractor shall conform to the dimensions, lines and grades indicated on the Drawings.

D. Excavations into the landfill may create hazardous conditions due to the presence of methane gas and other organic compounds. The Contractor shall be responsible for continuously monitoring conditions associated with the excavation and shall employ appropriate health and safety protocol for the protection of the Contractor's employees and all subcontractors. The Contractor shall implement all applicable provisions of his Health and Safety Plan as required under Section 01036 of these specifications.

1.02 RELATED SECTIONS

A. Section 02130 - Landfill Gas Extraction Wells

B. Section 02210 - Sand

C. Section 02250 - Plastic Pipe & Appurtenances

D. Section 02500 - HDPE Geomembrane Liner

E. Section 02714 - HDPE Pipe and Fittings

1.03 PROTECTION

A. The Contractor shall protect trees, shrubs, lawns and other features remaining as part of final landscaping.

B. The Contractor shall protect benchmarks, survey markers, fences, roads, sidewalks, paving, curbs and other existing structures from damage due to the Contractor's activities.

C. The Contractor shall repair damage caused by the construction operations at his cost.

D. Erosion control must be maintained. Erosion control measures shall be implemented in conformance with the Contractor's Erosion Control Plan required under Section 01566 of these specifications and the minimum guidelines presented on the Drawings.

1.04 REFERENCES

A. Latest version of American Society for Testing and Materials (ASTM) Standards:

1.	ASTM D 422	Standard Test Method for Particle-Size Analysis of Soils
2.	ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
3.	ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil In Place By the Sand-Cone Method.
4.	ASTM D 1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
5.	ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
6.	ASTM D 2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
7.	ASTM D 2922	Standard Test Methods for Density of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth).
8.	ASTM D 2937	Standard Test Method for Density of Soil In Place By the Drive-Cylinder Method.
9.	ASTM D 3017	Standard Test Method for Water Content of Soil and Rock In Place By Nuclear Methods (Shallow Depth).
10.	ASTM D 4220	Standard Practices for Preserving and Transporting Soil Samples.
11.	ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.05 EXISTING UTILITIES, STRUCTURES AND FACILITIES

A. The locations of existing underground structures as shown on the Drawings are approximate only and are shown only for the convenience of the Contractor, who must verify the information to his own satisfaction. The Owner disclaims any responsibility for the accuracy or completeness of the information shown on the Drawings with regard to existing underground utilities or structures, and the Contractor shall not be entitled to any additional compensation because of inaccuracy or incompleteness of such information.

B. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, the Contractor shall inform the Owner of such piping or utility immediately. The Contractor shall make modifications as approved by the Owner.

C. The Contractor shall be held responsible for the cost of repairing all utilities, structures and subsurface drains which become damaged due to his construction operations, whether or not they appear on the Drawings. The notification of all utility companies before the start of work and the locating of underground structures which may be encountered during the course of construction are the responsibilities of the Contractor. All costs, including the costs of services of representatives of the affected utilities, incurred in such location operations shall be included in the work to be done under this Contract.

D. Furnish all the necessary equipment and assume the entire cost of handling any water from storm, surface and flood flows which may be encountered at any time during construction of the work. The manner of providing for these flows shall meet with the approval of the Owner, and the entire cost of said work shall be included in the work to be done under this Contract.

E. Should it become necessary to permanently or temporarily move any conduits, pipes, wires or structures in order to permit the Contractor to execute the work, the Contractor shall notify the Owner of the location and circumstances, and shall cease work if necessary, until satisfactory arrangements have been made by the owners of said obstructions to properly care for the same. No claims for damages shall be allowed on account of any delay occasioned thereby. The entire cost of the changes or temporary removal shall be included in the work to be done under this Contract.

F. The Contractor shall, at his own expense, shore up and protect any poles, or other public or private structures which may be encountered or endangered in the prosecution of the work, and that may not be otherwise provided for, and he shall repair and make good any damages caused to any such property by reason of his operations. All existing structures which due to the prosecution of the work are removed shall be replaced by the Contractor. No extra payment will be made for said work or material.

1.06 SUBMITTALS

A. Submit an Excavation Plan to the Owner for review and approval. The Excavation Plan shall include detailed description of the Contractor's proposed methods of construction, including dewatering, excavation, filling, compaction, and backfilling for the various portions of the work. The Contractor shall remain responsible for the adequacy and safety of the methods. The Plan shall be approved prior to the Contractor conducting any excavation work.

B. The Contractor shall submit to the Owner the required information and samples for all proposed fill materials a minimum of 14 days prior to delivery of the material to the Site, unless otherwise approved by the Owner.

C. The Contractor shall notify the Owner in writing at least 7 days in advance of intention to perform the work of this Section.

D. If work is interrupted for reasons other than inclement weather, the Contractor shall notify the Owner a minimum of 24 hours prior to the resumption of work.

1.07 SOURCE QUALITY CONTROL

A. All fill and backfill materials shall be procured from off site sources unless otherwise approved or allowed in these specifications. Approval of materials will be based on tests performed by the Contractor's independent testing laboratory.

B. Testing laboratory will determine maximum dry density and optimum water content of fills in accordance with ASTM D 1557. Provide samples of each fill material from proposed source of supply. Allow sufficient time for testing and evaluation of results before material is needed. Submit samples from alternate source(s) if required.

1.08 PRODUCT DELIVERY AND HANDLING

A. Handling Materials: Keep public roads clear of all spillage from trucks hauling earthwork materials either from or to project site.

1.09 SOIL TESTING

A. The Owner will select areas within the limits of the fill for testing the degree of compaction obtained. The Contractor shall cooperate fully in obtaining the information desired.

B. Testing shall be conducted by an independent laboratory hired by the Contractor and approved by the Owner. If test results do not meet the specified requirements, all costs involved in correcting deficiencies in compacted materials and retesting shall be borne by the Contractor.

C. Field density tests of the compaction of subgrade and each layer of fill shall be performed for every 5,000 square feet of embankment or fill areas. The tests shall be in accordance with one of the following: ASTM D1556, ASTM D1557, ASTM D2167, ASTM D2922, or ASTM D2937. Contractor shall allow time for the performance of the tests upon completion of each layer of fill in a designated area. The Contractor shall provide equipment to cut out smooth-surfaced spot locations designated by the Owner on which to perform the test. When the tests indicate that density or moisture content does not meet requirements specified herein, the particular layer or portion thereof, as determined by the Owner, shall be reworked by rolling or by scarifying, wetting, or drying and recompacting until the required density has been obtained.

1.10 JOB CONDITIONS

A. Contractor shall examine the site prior to submitting his Bid, taking into consideration all conditions that may affect his work. The Owner will not assume responsibility for variations of subsoil quality or conditions.

B. Contractor shall barricade open excavations occurring as part of this work, and shall post and operate warning lights as recommended by authorities having jurisdiction.

C. Contractor shall protect structures, utilities, sidewalks, pavements, and other facilities, not designated to be demolished, from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

PART 2 - PRODUCTS

2.01 GENERAL

A. This section specifies those classes of soils most commonly used or encountered in earth work construction. The Contractor shall use or furnish such types as are called for on the Drawings and/or in the Specifications.

2.02 SELECT GRANULAR FILL

A. Select granular fill shall be natural mineral soil consisting of durable granular aggregates. The gradation of the soil shall conform to the limits specified below. The material shall be obtained from approved sources.

1. Granular Fill: Clean granular fill for use under footings and slabs-on-grade, subbase or subgrade soils and elsewhere as specified or indicated shall conform to the following gradation requirements:

Square Sieve Size	Percent Finer By Weight	
	Borrow	Subgrade Borrow
6-inch	100	--
3-inch	--	100
2-inch	90-100	--
1 ½-inch	--	70-100
½-inch	--	50-85
No. 4	20 to 65	30-60
No. 200	0 to 12	0-10

Excavated material falling within the above requirements may be stored in segregated stockpiles for use as granular fill.

2.03 PIPE BEDDING MATERIAL

A. Fine Gravel Bedding: Clean gravel for pipe bedding and elsewhere as specified or indicated shall conform to the following gradations requirements:

Square Sieve Size	Percent Finer By Weight
3/4-inch	100
3/8-inch	40 to 85
No. 4	15 to 60
No. 10	0 to 20
No. 200	5 maximum

2.04 PROCESSED AGGREGATES

A. Processed aggregates shall be obtained or produced from approved sources and shall consist of granular mineral soils having gradations as specified below:

1. Washed Sand

Sieve Size	Percent Finer by Weight
3/8-inch	100
No. 4	70 to 100
No. 200	0 to 5

2. Crushed Stone

Sieve Size	Percent Finer by Weight				
	Peastone (1/4")	Grad. A (3/4")	Grad. B (1-1/4")	Grad. C (1-1/2")	Grad. D (Dense Grade)
6 inch	---	---	---	---	---
3 inch	---	---	---	---	---
2-inch	---	---	---	100	100
1-1/2-inch	---	---	100	95-100	70-100
1-1/4-inch	---	---	85-100	---	---
1-inch	---	100	---	35-70	---
3/4-inch	---	90 - 100	10 - 40	0-25	50-85
1/2-inch	100	10-50	0-8	---	---
3/8-inch	85 - 100	0-20	---	---	---
No. 4	20 - 50	0-5	---	---	30-55
No. 8	0 - 15	---	---	---	---
No. 16	0 - 5	---	---	---	---
No. 50	---	---	---	---	8-24
No. 100	---	---	---	---	3-10

a. For crushed gravel, at least 50 percent of the materials retained on the 1-inch sieve shall have a fractured face.

3. Screened or Crushed Gravel

Sieve Size	Percent Finer by Weight		
	Type A Aggr.	Type B Aggr.	Type C Aggr.
1/2 inch	45 to 70	35 to 75	
No. 4	30 to 55	25 to 60	25 to 70
No. 40	0 to 20	0 to 30	0 to 30
No. 200	0 to 5	0 to 5	0 to 5

a. Type A aggregates for base shall not contain particles of rock which will not pass the 2-inch square mesh sieve.

b. Type B aggregate for base shall not contain particles of rock which will not pass the 4-inch square mesh sieve.

c. Type C aggregate for base shall not contain particles of rock which will not pass the 6-inch square mesh sieve.

PART 3 - EXECUTION

3.01 PREPARATION

A. Remove all unsuitable material including topsoil, fill, organic soils and waste within areas upon which granular fill is to be placed.

B. In cross country areas within which excavations are to be made, cover material, loam and topsoil shall be carefully removed and separately stored to be used again as directed.

C. The Contractor shall make excavations in such manner and to such widths as will give suitable room for building the structures or laying and joining pipe; shall furnish and place all sheeting, bracing, and supports; shall do all pumping, and draining; and shall render the bottom of the excavation firm and dry and in all respects acceptable.

D. In no case shall the earth be plowed, scraped, or dug by machinery so near to the finished grade at the bottom of the excavation as to result in disturbance of material below said grade. All loose material shall be removed from the bottom of the excavation so that the bottom shall be in an undisturbed condition. If removal of the loose material results in excavation beyond the limits shown on the Drawings and over excavation has not been ordered, the restoration of the excavation to grade shall be done at no additional cost to the Owner.

3.02 LANDFILL SURFACE PREPARATION

A. The existing landfill surface is presently covered with intermediate cover soils material placed as part of facility operations. The quality and thicknesses of these materials may vary, however, portions of these soils may be suitable to act as the subgrade layer for the landfill liner. The requirements of this layer are that it be a compactable, inorganic soil material, a minimum of 12 inches thick after compaction and that it not contain stones, rubble or other deleterious materials that could damage the liner components that are to be installed above it.

B. The Contractor shall conduct landfill surface preparation with the intent of utilizing existing cover soils as much as possible. Owner provided Subgrade Borrow material will be used to bring areas to grade, as directed by the Owner. Organic or vegetative support soils shall be striped from the landfill surface and stockpiled on site, in a location directed by the Owner.

C. The Contractor shall not damage the existing geomembrane cap and double composite liner systems and shall repair all damage to the existing systems in accordance with the requirements of Section 02500 - HDPE Geomembrane Liner.

D. Should it be determined by the Owner, through test pits and observation, that the existing intermediate cover soils are of insufficient quantity and quality to obtain the uniform 12 inch layer, supplemental Subgrade Borrow provided by the Owner from on-site sources shall be placed and compacted as approved by the Owner.

E. Layers shall not exceed 6 inches in thickness (compacted) and shall be compacted to a dry density at least 90 percent of the maximum dry density as determined by ASTM D1557at a moisture content between 2% less than and 3% more than optimum moisture.

F. The Contractor shall rough grade the landfill liner subgrade surface and adjacent areas to required levels, profiles, contours and elevations ready for finish subgrading.

G. Grading shall be done by bulldozer or other appropriate means. Areas adjacent to structures and other areas unaccessible to heavy grading equipment shall be graded by hand.

H. The landfill surface, including sideslopes of the existing landfill areas shall be fine graded to a smooth and uniform surface free from depressions and high spots conforming generally to the slopes indicated on the Drawings. The surface shall then be thoroughly compacted. Landfill surface compaction shall be provided by a minimum of four complete passes of a 10 ton vibratory smooth compaction equipment traveling at a speed of not greater than 5 miles per hour.

I. Upon completion of vibratory compaction the prepared area shall be rolled smooth free of ruts and depressions to a dense and uniform surface.

J. The prepared landfill surface shall be proof rolled in order to demonstrate that the compaction effort has been successful and that no soft spots remain.

K. Proof rolling shall be conducted by the Contractor utilizing an articulated dump truck or equivalent which has been loaded to maximum capacity with soils material, (total weight 60 tons ±).

L. Proof rolling shall be conducted in the presence of the Owner. The intent of the proof roll is to identify soft or yielding areas within the existing landfill surface areas.

M. Should the Owner determine that soft spots or yielding areas remain after the compaction effort is completed, corrective measures shall be taken. These measures shall include the excavation of the yielding materials and backfill and compaction with gravel borrow soils to suitable subgrade elevations. The affected area shall be re-tested to ensure adequate stabilization.

N. The horizontal and vertical extent of all excavation shall be determined by the Owner.

3.03 COVER SUBGRADE PREPARATION

A. The Contractor shall grade the landfill cover's subgrade surface and adjacent areas to required levels, profiles, contours and elevations ready for finish grading and cap construction. Subgrade slopes on the top of the landfill shall be no less than 5% and side slopes no greater than three horizontal to one vertical (3:1). Materials containing organics or having a moisture content of greater than 20% within one foot (1') of the surface shall be removed and replaced with select granular fill (Subgrade Borrow), which is to be provided by Owner.

B. Grading shall be done by bulldozer or other appropriate means. Areas adjacent to structures and other areas unaccessible to heavy grading equipment shall be graded by hand.

C. The Landfill cap's subgrade shall be fine graded to a smooth and uniform surface, free from depressions and high spots conforming to the grades indicated on the Drawings. Remove all stones with sharp edges or points and stones greater than three inches (3") in diameter from the subgrade surface.

D. Where filling is required, materials shall be select granular fill (Subgrade Borrow). Layers shall not exceed 6 inches in thickness (compacted) and shall be compacted by proof rolling to a dry density at least 90 percent of the maximum dry density as determined by ASTM D1557 at a moisture content between 2% less than and 3% more than optimum moisture.

E. Proof rolling shall be conducted by the use of vibratory compaction equipment or rollers or other means to achieve the specified maximum dry density

F. Upon completion of compaction the prepared area shall be fine graded to the elevations shown on the plans. The surface shall be rolled smooth free of ruts and depressions to a dense and uniform surface.

3.04 EXCAVATION NEAR EXISTING STRUCTURES

A. Attention is directed to the fact that there are existing pipes, drains, and other utilities in certain locations. An attempt has been made to locate all utilities on the drawings, but the completeness or accuracy of the information given is not guaranteed. Where such structures are not to be demolished, unless otherwise approved by the Owner, excavation work shall be conducted in accordance with this section.

B. As the excavation approaches pipe, conduits, or other underground structures, digging by machinery shall be discontinued and the excavation shall be done by means of hand tools, as required. Such manual excavation when incidental to normal excavation shall be included in the work to be done under items involving normal excavation.

C. Where determination of the exact location of a pipe or other underground structure is necessary for doing the work properly, the Contractor may be required to excavate test pits to determine such locations. When such test pits may be properly considered as incidental to other excavation, the Contractor shall receive no additional compensation, the work being understood to be included as a part of the excavation.

3.05 PROTECTION OF PROPERTY

A. All surfaces which have been injured by the Contractor's operations shall be restored to a condition at least equal to that in which they were found immediately before work was begun. Suitable materials and methods shall be used for such restoration.

3.06 PROTECTION OF EXISTING STRUCTURES

A. All existing pipes, poles, wires, fences, curbings, property line markers, perimeter gas ventilation trenches, monitoring wells and other structures not designated for demolition, unless otherwise approved by the Owner, which the Owner decides must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from injury by the Contractor. Should such items be injured, they shall be restored by the Contractor, without compensation therefore, to at least as good of a condition as that in which they were found immediately before the work was begun.

3.07 CARE AND RESTORATION OF PROPERTY

A. The Contractor shall enclose the trunks of trees adjacent to his work and not to be cut, with substantial wooden boxes of such height as may be necessary to protect them from injury from piled material, from equipment, from his operations, or otherwise due to his work. Excavating machinery and cranes shall be of suitable type and be operated with care to prevent injury to trees not to be cut and particularly to overhanging branches and limbs.

B. Branches, limbs, and roots shall not be cut except by permission of the Owner. All cutting shall be smoothly and neatly done without splitting or crushing. In case of cutting or unavoidable injury to branches, limbs, and trunks of trees, the cut or injured portions shall be neatly trimmed and covered with an application of grafting wax or tree healing paint as directed.

C. Cultivated hedges, shrubs, and plants which might be injured by the Contractor's operations shall be protected by suitable means or shall be dug up, balled and temporarily replanted and maintained. After the construction operations have been substantially complete, they shall be replanted in their original positions and cared for until growth is re-established. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced by items of kind and quality at least equal to the kind and quality existing at the start of the work.

D. On paved surfaces the Contractor shall not use or operate tractors, bulldozers, or other power-operated equipment the treads or wheels of which are so shaped as to cut or otherwise injure such surfaces.

E. All surfaces which have been injured by the Contractor's operations shall be restored to a condition at least equal to that in which they were found immediately before work was begun. Suitable materials and methods shall be used for such restoration.

F. The restoration of existing property and structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

3.08 SHEETING AND BRACING

A. The Contractor shall furnish, put in place, and maintain sheeting, bracing, etc., as may be necessary to support the sides of the excavation and to prevent any movement of earth which could in anyway diminish the width of the excavation to less than that necessary for safe and proper construction, or could otherwise injure or endanger adjacent structures or human life. If the Owner is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports put in at the expense of the Contractor.

B. The Contractor shall leave in place to be embedded in the backfill, or concrete, all sheeting, bracing, etc., in which the Owner may direct him in writing to leave in place.

C. The Owner may direct that timber used for sheeting and bracing may be cut off at any specified elevation.

D. Wherever possible, sheeting shall be driven ahead of the excavation to avoid loss of material from behind the sheeting. If it is necessary to excavate below the sheeting, care shall be taken to avoid trimming behind the face along which the sheeting shall be driven. Care shall be taken to prevent voids outside the sheeting; but, if voids are formed, they shall be filled immediately with sand and compacted.

E. All sheeting and bracing not to be left in place shall be carefully removed in such manner as to not endanger the construction or other structures. All voids caused or left by the withdrawal of sheeting shall be backfilled immediately with approved material and compacted.

F. The right of the Owner to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work as a result of negligence or other causes growing out of the Contractor's failure to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.

3.09 TRENCH EXCAVATION - GENERAL

A. Trench excavation, backfill and compaction shall be conducted in general accordance with these specifications and the Drawings.

B. Trenches shall be excavated to such depths as will permit the pipe to be laid at the elevations, slopes, or depths of cover indicated on the drawings.

C. Where pipe is to be laid in crushed stone bedding or concrete cradle, the trench may be excavated by machinery to, or to just below the designated subgrade, provided that the material remaining at the bottom of the trench remains undisturbed.

D. Where pipe is to be laid directly on the trench bottom, the lower part of the trench in earth shall not be excavated to subgrade by machinery, but just before the pipe is to be placed, the last of the material to be excavated shall be removed by hand tools to form a flat or shaped bottom, true to grade, so that the pipe will have a uniform bearing and support on firm and undisturbed material between joints except for limited areas where the use of pipe slings may have disturbed the bottom.

3.10 TRENCH EXCAVATION IN FILL

A. If pipe is to be laid in embankments or other recently filled material, the material shall first be placed to the top of the fill or to a height of at least l foot above the top of the pipe whichever is the lesser. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench shall be excavated as though in undisturbed material. Material under the pipe location shall be compacted to 90 percent maximum density according to ASTM Dl557, Method C.

3.11 TRENCH AND OPEN EXCAVATION IN LANDFILL

A. The gas collection system and leachate interceptor pipeline routing, condensate drain and well locations shall be surveyed and staked by the Contractor from baseline and coordinate information provided by the Owner. Contractor shall preserve construction survey stakes, elevations and marks for the duration of their usefulness.

B. Following layout of the collection system the Owner and the Contractor will review the system in the field. System location and routing shall be strictly adhered to by Contractor unless authorized by the Owner to deviate from the design locations. Changes in the design locations may be required based upon actual field conditions.

C. Contractor shall excavate pipe trenches to the dimensions shown on theDrawings. The trench width shall allow for a minimum clearance of 12 inches on each side of the pipe.

D. Bottom-of-the-trench grade shall maintain a continuous slope at a minimum of five percent (5%) or as shown on the Drawings. The slope shall be continuous from high points to low points. Grade shall be verified and recorded at 10-foot intervals by Contractor during trenching, for inclusion on as-built plans.

E. Owner retains the right to check all grades and pipe placement prior to backfilling.

F. If unapproved low points are determined to exist from the Contractor's or Owner's verification, the pipe grades shall be corrected by the Contractor or additional condensate drains shall be required at these low points. This work shall be conducted at the expense of the Contractor, unless the Owner determines that such changes are required by field conditions.

G. Refuse encountered during drilling or trenching work shall be handled and removed in accordance with Owner requirements and hauled to the active face of the Landfill for disposal, as approved by the Owner. Contractor shall not be assessed for landfill disposal fees. All refuse shall be removed from the work site as necessary to prevent odor conditions and no less frequent than at the end of each work day. Any excavated refuse that is temporarily stockpiled shall be covered with lime or other odor controlling material. Trenches shall be shored in accordance with OSHA rules and regulations and as necessary.

H. Any water which may be encountered or may accumulate in any excavation shall be pumped out or otherwise removed as necessary to keep the bottom of the excavation free and clear of water during the progress of the work. All pumped water must either be recharged into the Landfill or discharged to the leachate collection system.

I. Contractor shall be aware of the presence of existing landfill gas collection wells and lines, landfill cap components and pipes, culverts and swales, some of which are noted on the plans. All reasonable precautions shall be taken to preserve and protect all such items. Where it is necessary to remove, replace or relocate any pipelines or drainage fixtures, in order to complete the Contract work, the Contractor shall perform this work at his expense.

3.12 WIDTH OF TRENCH

A. Pipe trenches shall be made as narrow as practicable and shall not be widened by scraping or loosening materials from the sides. Every effort shall be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.

B. Trenches shall be excavated with approximately vertical sides between the elevation of the center of the pipe and elevation l foot above the top of the pipe.

3.13 EARTH EXCAVATION AND BACKFILL BELOW NORMAL GRADE

A. If, in the opinion of the Owner, existing material below trench grade is unsuitable for properly placing bedding material and laying pipe, the Contractor will excavate and remove unsuitable material to the required width and depth and replace it with granular fill as directed by the Owner.

3.14 UNAUTHORIZED EXCAVATION

A. If the bottom of any excavation is taken out beyond the limits indicated or prescribed, the resulting void shall be backfilled at the Contractor's expense with thoroughly compacted specified borrow for pipeline not having a concrete encasement or cradle. For concrete structures and pipelines having concrete encasement or cradle, the void shall be filled with concrete with a minimum compressive strength of 3000 psi.

3.15 COMPACTION REQUIREMENTS

A. The requirements for compaction of backfill shall conform to the following guidelines based on ASTM Dl557 Method C:

Location	Percent Maximum Density
Below pipe midline	92
Above pipe midline	92
Below pipe in embankments	92
Below pavement (upper 3 feet)	95
Embankments	92
Adjacent to structures	92
Below structures	95
Landfill Liner Subgrade	90

B. The Owner reserves the right to perform additional tests on any area.

3.16 STRUCTURAL EXCAVATION

A. Excavate areas to the elevation indicated on Drawings or as may be required for the Contractor's selected equipment. Extend excavations a sufficient distance from structures to allow for placement and removal of forms, installation of services, and inspection.

B. Slope sides of excavation maximum of 45 degrees from horizontal,except adjacent to existing structures.

C. Final excavations shall be hand trimmed. Do not disturb soil below final excavation grades.

D. Excavation shall not interfere with normal 45 degree bearing splay of foundations.

E. Proof roll entire excavation.

F. Remove soft areas of excavation discovered during proof rolling and backfill with granular fill as specified.

G. Backfill excavation to required subgrade with suitable excavated materials or granular fill as specified.

3.17 BACKFILLING

A. In general, and unless other material is indicated on the Drawings or specified or classified as unsuitable material by the Owner, excavated material removed in the course of the construction excavation shall be suitable material for backfilling trenches, waste removal areas, or filling to final subgrades.

B. Care shall be exercised in placing fill adjacent to piers, walls, grade beams, footings, and other structures to prevent lateral movement. Fill on opposite sides of such items shall be kept at approximately the same elevation to prevent an unbalanced earth pressure, and shoring shall be used as necessary. Foundation walls and footings will not withstand unbalanced earth or equipment loadings.

C. Frozen material shall not be placed in the backfill nor shall backfill be placed upon frozen material. Previously frozen material shall be removed or shall be otherwise treated as required, before new backfill is placed.

D. All backfill shall be compacted to the specified percent of maximum density at optimum moisture as determined by ASTM Dl557.

E. Previously placed or new materials shall be moistened by sprinkling, if required, to ensure proper bond and compaction. No compacting shall be done when the material is too wet, from either rain or too great an application of water, to compact it properly; at such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions shall be taken as may be necessary to obtain proper compaction.

F. Material used for backfilling trenches or around structures shall be brought up to the grades as indicated on the drawings.

3.18 BACKFILLING PIPE TRENCHES

A. As soon as practicable after pipes have been laid, backfilling shall be started. Pipeline cover shall be as indicated on the Drawings or directed by Owner.

B. Pipe bedding shall be placed with hand shovel up to a level of 12-inches above the top of pipe. This area of backfill is considered the zone around pipe and shall be thoroughly compacted before the remainder of the trench is backfilled. Compaction of the zone around pipe shall be done by use of power-driven tampers weighing at least 20 pounds and approved by the Owner. Care shall be taken that material close to the bank, as well as in all other portions of the trench, is thoroughly compacted.

C. Granular fill shall be placed from the top of the select backfill to grade. Backfill and compaction in the remainder of the trench shall be done in layers not exceeding 12 inches in depth and by use of power driven tampers weighing at least 20 pounds and approved by the Owner. Water jetting and puddling will not be permitted.

D. The Contractor shall maintain the trench surface as work progresses. If settlement takes place he shall immediately deposit additional material to restore the level of the ground.

3.19 BACKFILL GRADES

A. Material used for backfilling trenches or around structures shall be brought up to normal grades.

3.20 FILL SUPPORTING STRUCTURES AND REQUIRED COMPACTION

A. Material to be used as fill for supporting structures shall be Fine Gravel Bedding as directed and approved in advance by the Owner. Where fill is required to support proposed footings, wall, slabs, and any other structure, the material shall be placed and compacted in layers not to exceed 8 inches. Compaction of each lift shall be to a dry density of 95 percent of the maximum dry density determined by ASTM Dl557 and shall be by hand-guided vibratory equipment or mechanical tampers.

B. Following the placement and compaction of the fill material, crushed stone, if required, shall be placed immediately below the structures as detailed on the drawings.

3.21 BACKFILLING AROUND STRUCTURES

A. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads to which they will be subjected. Excavated material approved by the Owner shall be used in backfilling around structures and shall be compacted. Backfilling material shall be spread in horizontal layers not exceeding 9 inches in thickness (loose) and thoroughly compacted to at least 92 percent of the maximum dry density as determined by ASTM Dl557.

B. Tree stumps or roots more than 12 inches long or more than l/2-inch in diameter and stones or rocks larger than 6 inches in greatest dimension shall not be considered suitable material for backfill around structures.

C. Should an insufficient quantity of suitable material, as determined by the Owner, be available for backfill around structures, the Contractor shall use gravel borrow, as approved by the Owner at no additional cost to the Owner.

3.22 ADDITIONAL GRANULAR FILL

A. Should the Owner classify material above the trench bottom as unsuitable for backfill, and there is no available backfill material stockpiled, then the Owner shall order additional granular fill to be furnished and installed by the Contractor.

B. Backfilling and compaction requirements for the granular fill shall otherwise conform to the trench details.

3.23 ADDITIONAL CRUSHED STONE

A. Should the Owner order additional crushed stone for utility supports or for other purposes, the Contractor shall furnish and install the crushed stone as directed.

3.24 RESTORING TRENCH SURFACE

A. Where the trench occurs adjacent to paved streets in shoulders or sidewalks, the Contractor shall compact as specified elsewhere in these specifications the backfill and shall maintain the surface as the work progresses. If settlement takes place he shall immediately deposit additional fill to restore the level of the ground.

B. Adjacent to streets and highways the top 12-inch layer of trench backfill shall consist of compacted gravel base course. If in the opinion of the Owner, the existing top 12-inch layer is unsuitable for use as subgrade or shoulder material, he may order the Contractor to remove this layer and to backfill with gravel borrow compacted to at least 95 percent of maximum dry density as determined by ASTM Dl557, Method D.

3.25 MATERIAL FOR FILLING AND EMBANKMENTS AND REQUIRED COMPACTION

A. Surplus, uncontaminated, as determined by the Owner, excavated material available from the excavations and other on-site areas may be used for filling and building embankments, except as otherwise specified.

B. Material needed in addition to that available from construction operations shall be furnished by the Contractor at his own expense, and shall conform to granular fill as specified. The Owner may provide suitable on site material for embankment and subgrade fill.

C. The Contractor shall remove loam and topsoil, loose vegetable matter, stumps, large roots, etc., from areas upon which embankments will be built or material will be placed for grading. The subgrade shall be shaped as indicated on the drawings and shall be so prepared by forking, furrowing, or plowing so that the first layer of the new material placed there on will be well bonded to it.

D. After the subgrade has been prepared as herein before specified, the material shall be placed thereon and built up in successive layers until it has reached the required elevation.

E. Layers shall not exceed 12 inches in thickness (loose) and shall be compacted to at least 92 percent of the maximum dry density as determined by ASTM Dl557, Method D. In embankments the layers shall be slightly dished toward the center.

F. Each layer of material shall be compacted by the use of vibratory compaction equipment or rollers or other means to achieve at least 92 percent of maximum dry density as determined by ASTM Dl557, Method D. At such points as cannot be reached by mobile mechanical equipment, the materials shall be thoroughly compacted by the use of suitable power-driven tampers.

3.26 SURPLUS EXCAVATED MATERIALS

A. No excavated material shall be removed from the site of the work or disposed of by the Contractor except as directed or approved by the Owner. All surplus material removed from the site shall be disposed of by the Contractor at the Contractor's expense.

B. Surplus, uncontaminated, excavated materials shall, with the approval of the Owner, be used to backfill normal excavations in rock or to replace other materials unacceptable for use as backfill; shall be neatly deposited and graded so as to make or widen fills, flatten side slopes, or fill depressions; or shall be neatly deposited for other purposes indicated by the Owner, within its jurisdictional limits; all as directed or approved and without additional compensation.

C. Surplus, uncontaminated, excavated material, other than that suitable for backfill, shall be neatly deposited for other purposes as indicated by the Owner, within its jurisdictional limits, as directed or approved and without additional compensation.

D. Surplus, uncontaminated, excavated material not needed as specified above shall be hauled away and dumped by the Contractor; at his expense, at appropriate locations, and in accordance with arrangements made by him.

E. Refuse and debris excavated during these operations shall be disposed of by the Contractor at a location within the limits of the Landfill, as approved and directed by the Owner. The Contractor shall limit the disposal area to as small a section of the Landfill as is possible.

3.27 DITCHES AND GUTTERS

Excavation of ditches, and gutters shall be accomplished by cutting accurately to the cross sections, grades, and elevations required. Excessive open ditch or gutter excavation shall be backfilled with satisfactory thoroughly compacted material or with suitable stone or cobble to grades shown at the Contractor's expense. Material excavated shall be disposed of as directed, except that in no case shall material be deposited less than 4 feet from the edge of a ditch. The Contractor shall maintain all excavations free from detrimental quantities of standing water, leaves, brush, sticks, trash and other debris until final acceptance of the work.

3.28 PAVEMENT SUBGRADE PREPARATION

A. General

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 6 inches below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade and cross section and compacted as specified. The elevation of the finished subgrade shall not vary more than 0.05 foot from the established grade and cross section.

B. Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment well suited to the type of material being compacted.

Subgrade for pavements shall be compacted to at least 95 percent laboratory maximum density (ASTM D1557) for the depth below the surface of the pavement shown on the Contract Drawings.

3.29 FINISHING

A. The surface of all excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for all graded areas shall be within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in Paragraph Subgrade Preparation above.

Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be seeded shall be finished to a smoothness suitable for the application of seeding materials.

B. Provide as-built survey plan of finished sub-grade elevations at change of grade and intermediate locations, at distances no greater than on a fifty foot (50') grid. Survey locations shall be reproduced for low permeable soil liner and drainage layer finished grades.

3.30 TESTING

A. Contractor shall retain the services of a qualified geotechnical laboratory to conduct construction tests on all earthwork, including general site work and landfill subgrade work, as specified.

B. The Contractor shall conduct construction testing on earthwork as the material is delivered to the site or as on-site materials are incorporated into the work.

C. Grain size test (ASTM D422) shall be performed on borrow source samples as the material is transported on-site or as on-site materials are incorporated into the work, at a minimum frequency of one test every 2,000 cubic yards, or when material changes. The results of such testing shall be submitted to the Owner.

D. Modified proctor test (ASTM D1557) shall be performed on borrow source samples as the material is transported on-site or as on-site materials are incorporated into the work, at a minimum frequency of one test every 10,000 cubic yards, or when material changes. The results of such testing shall be submitted to the Owner.

E. Prior to the placement of landfill liner materials, all unsuitable materials shall be excavated, the subgrade shall be rolled smooth and thoroughly compacted. In-place testing shall be conducted on each 6 inch compacted lift and on the finished landfill subgrade and other finished surfaces. This testing shall be conducted on both gravel borrow from off-site sources and on excavated materials reused as part of the subgrade.

F. Additional testing shall be performed if the material does not meet specifications at the Contractor's expense.

3.31 SUBGRADE AND EMBANKMENT PROTECTION

A. During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained in such a manner as to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until subgrade, subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subgrade, subbase, base course, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subgrade, subbase, base surfacing or pavement be placed on a muddy, spongy, or frozen subgrade.

END OF SECTION

SECTION 02210

SAND

PART I - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the construction of the gas venting and sand drainage layer components of the landfill cap construction as specified herein and as shown on the Drawing.

B. The Contractor shall coordinate the construction of the sand layers with other construction activities at the site.

C. The Owner will allow the Contractor to use on site sources for materials. It shall be the sole responsibility of the Contractor to satisfy himself as to the quality and quantity of the on site material to meet this specification. It shall also be the sole responsibility of the Contractor to test the material as well as to process and/or amend the on site source material so as to meet the requirements of this specification.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02500 - HDPE Geomembrane Liner

1.03 REFERENCES

A. Latest version of American Society for Testing Materials (ASTM) standards:

1. ASTM D 422, Standard Method for Particle-Size Analysis of Soils.

2. ASTM D 2434, Standard Test Method for Permeability of Granular Soils (Constant Head).

3. ASTM D5321, Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method.

1.04 SUBMITTALS

A. The Contractor shall submit the following information and samples to the Owner a minimum of 14 days prior to the start of construction of the gas ventilation and sand drainage layer:

1. the proposed material source or sources;

2. the results of particle size-analysis in accordance with ASTM D 422;

3. the results of the laboratory permeability test in accordance with ASTM D 2434;

4. the results of the laboratory interface shear test in accordance with ASTM D 5321;

5. the results of the laboratory direct shear test in accordance with ASTM D 3080; and

6. a 10-pound bag sample of each proposed soil and authorization to access the borrow source or sources for sampling.

B. The Contractor shall conduct interface shear tests (ASTM 5321) to determine the strength of the interface between each source of the gas vent layer and drainage layer sand and the geomembrane cap to be used for the project. Each test shall determine interface strength at normal stresses of 1 pound per square inch (psi), 2 psi and 3 psi. Additional testing shall be required if the material's source has changed or the characteristics of the source have changed. Additional samples shall be collected and tested if the material does not meet specifications.

C. The Contractor shall conduct direct shear tests (ASTM D-3080) to determine the internal shear strength of the sand materials. Each test shall determine internal strength at normal stresses of 1 pound per square inch (psi), 2 psi and 3 psi.

D. The Contractor shall notify the Owner in writing a minimum of 7 days prior to starting construction. The notice shall state the source of the material to be used, the equipment to be used, the date and time that placement operations will start, and the name of the person in the field who will be in charge of the construction.

E. If work is interrupted for reasons other than inclement weather, the Contractor shall notify the Owner immediately and provide a plan schedule for resumption of work.

PART 2 - PRODUCT

2.01 MATERIAL

A. The sand materials shall be free of any metals, roots, trees, stumps, concrete construction debris, or any other organic matter or deleterious material that are not compatible with landfill leachate.

B. The sand materials shall conform to Washed Sand as specified in Section 02200 with a maximum particle size of 3/8 inch diameter and shall be smooth and rounded.

C. Each of the sand layers materials shall have a minimum hydraulic conductivity (k) as indicated on the Drawings, based on laboratory permeability testing conducted in accordance with ASTM D 2434.

D. The interfaces shall have minimum peak shear strength (Friction Angle) of 27°, under saturated conditions.

PART 3 - EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the work described in this Section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all the portions of the work falling within this Section and related Sections specified elsewhere.

B. Inspection:

  1. Prior to implementing any of the work described in this Section, the Contractor shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of this Section may properly commence without adverse impact.

3.02 FIELD QUALITY CONTROL

A. The minimum frequency of quality control testing shall be:

  1. Sieve analysis (ASTM D 422) at 1 per 1,500 cubic yards.

  2. Hydraulic conductivity (ASTM D 2434) at 1 per 3,000 cubic yards.

B. The Contractor shall take this testing frequency into account in planning his construction schedule.

C. The frequency of conformance testing shall apply to all material delivered to the site.

D. The Contractor shall provide necessary personnel, tools and equipment for the purpose of conducting layer thickness verification. Thickness verification will be performed by hand digging shallow test pits for direct measurement. Layer thickness verification shall be conducted at a frequency no less than 5 tests per acre or more often as directed by the Owner. All tests will be conducted in the presence of the Owner.

3.03 GAS VENTING LAYER AND DRAINAGE LAYER PLACEMENT

A. The Contractor shall construct the gas vent and the drainage layers to the grades, slope and depths shown on the Drawings and as specified in this Section.

B. The gas venting layer shall be placed directly on prepared subgrade as shown on the Drawings to a full 6 inch thickness. The drainage layer shall be placed directly on top of the HDPE geomembrane liner as shown on the Drawings to a full 12 inch thickness. Thickness verification will be conducted in the presence of the Owner at a minimum frequency of 5 tests/acre or more often as directed by the Owner.

C. In the event of damage to prior work or work completed as specified in this Section, the Contractor shall immediately make all repairs and replacements necessary, to the approval of the Owner and at no additional cost to the Owner.

D. Sand placement will be performed by the Contractor with extreme caution. Any damages caused to the geomembrane liner or other appurtenant features will be repaired and retested if necessary to original or better conditions. Repair work will be performed to the satisfaction of the Owner at no additional cost to the Owner.

E. The integrity of the geomembrane cannot be jeopardized during any part of these operations. Therefore, dump trucks and spreading equipment will not be allowed to operate in direct contact with geomembrane. Placement of the sand will be by such means as to cause no ballooning of the membrane, ahead of the sand placement work.

F. The placement of the sand drainage layer shall be performed using low ground pressure equipment. The equipment shall exert no more than 5 psi ground pressure.

3.04 SURVEY CONTROL

A. The Contractor shall provide survey control necessary for establishing proper grade, slope and thickness when constructing each sand layer.

3.05 PROTECTION OF WORK

A. The Contractor shall use all means necessary to protect all prior work, including all materials and completed work specified in this and other Sections.

B. In the event of damage to prior work or work completed as specified in this Section, the Contractor shall immediately make all repairs and replacements necessary, to the approval of the Owner and at no additional cost to the Owner.

END OF SECTION

SECTION 02220

RIP RAP

PART 1 - GENERAL

1.1 SCOPE

Furnish all labor, materials, tools, and equipment and perform all operations necessary for the placement of a protective covering of stone of the size, type, and location shown on the Drawings or as directed by the Owner.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 - Earthwork

B. Section 02596 - Geotextile Fabric

PART 2 - PRODUCTS

2.1 STONE

A. Stone used for rip rap shall be hard, durable angular shaped stones which are the product of the primary crushing of a stone crusher. Rounded stone, boulders, sandstone and similar soft stone or relatively thin slabs will not be acceptable.

B. The quality of the rip rap shall be approved by the Owner.

C. Rip rap shall comply with the following gradation criteria:

Size of Stone	Passing Percentages
8 in.	95-100
4 in.	0-25
2 ½ in.	0-5

2.2 GRAVEL BLANKET

Gravel blanket material shall consist of a mineral soil meeting the specifications for Subgrade Borrow, Select Granular Fill, as defined in Section 02200, or the Owner may direct the Contractor to utilize Owner provided material, commonly called "Emulsion Mix", which is a low grade asphalt mix produced by the remediation of soils contaminated with low levels of petroleum constituents.

PART 3 - EXECUTION

3.1 RIP RAP STONES

A. Rip rap stones shall be placed on the prepared area in a manner which will produce a well graded mass with a minimum practical percentage of voids and a minimum thickness of one foot.

B. The stone shall be placed to its full thickness in one operation and in such a manner as to avoid displacing the underlying material.

C. The placement of the stone shall produce a compact rip rap protected surface in which all sizes of stone are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to achieve the specified result.

3.2 GRAVEL BLANKET

A. Where a gravel blanket is shown on the plans or ordered by the Owner, the gravel shall be placed in layers not exceeding 6 inches compacted depth.

B. The finished surface shall be reasonable uniform in appearance, approximately parallel to and within 6 inches of the lines and grades shown on the Drawings.

C. Non-woven geotextile shall be placed below and on top of the gravel blanket, upon which the rip rap stones will be placed, as shown on the Drawings.

END OF SECTION

SECTION 02250

PLASTIC PIPE AND APPURTENANCES

PART I GENERAL

1.01 SCOPE

A. The Contractor shall furnish all labor, materials, tools, and equipment necessary for the satisfactory installation of plastic pipe and fittings as shown on the Drawings and as specified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 - Earthwork

B. Section 02130 - Landfill Gas Extraction Wells

1.03 INSPECTION AND TESTING

A. The quality of all materials, the process of manufacture and piping in place shall be subject to inspection and approval of the Owner. Pipe may be inspected at the place of manufacture and on the Work. Pipe shall be subject to rejection at any time even though submitted samples may have been approved. In addition, the Owner reserves the right to have any or all pipe or fittings inspected tested, or both, by an independent inspection service at either the manufacturer's plant or elsewhere. Such inspection and/or tests shall be at the Owner's expense.

B. All pipe, fittings and appurtenances shall be carefully inspected in the field before installation. All pieces found to be defective, as determined by the Owner, shall be pulled out and not installed. Such rejected pipe shall be clearly tagged in such a manner as not to deface or damage it, and the pipe shall then be removed, from the job site by the Contractor at his own expense. Results of shop tests which are required in the Specifications shall be submitted to the Owner prior to installation of the pipe for which such tests were ordered.

1.04 SUBMITTALS

A. Product Data: Contractor shall provide a list of materials and manufacturers of all materials to be used in the completion of work under this specification. Manufacturer specifications shall be included as part of this submittal.

1.05 HANDLING OF PIPE AND FITTINGS

A. All pipe and fittings shall be carefully handled by equipment of sufficient capacity and proper design to avoid damage to the pipe and fittings. Under no circumstances shall materials be dropped or dumped. Pipe and fittings shall be stored in such a manner as to be protected and kept clean and dry.

1.06 QUALITY ASSURANCE

A. Each length of pipe shall be marked by manufacturer with the trade name, nominal size, material designation, and class.

B. Couplings and fittings shall be marked by the manufacturer with the trade name, nominal size, material designation and class.

PART 2 - PRODUCTS

2.01 GENERAL

A. Plastic pipe shall meet the minimum strength requirements for the type and/or class specified. Pipe and fittings shall conform to the specifications of the latest ASTM standards.

2.02 PLASTIC PRESSURE PIPE, FITTINGS AND JOINTS

A. Plastic pipe is intended for use as landfill gas extraction well casing material.

B. Plastic pipe shall be manufactured from rigid, unplasticized polyvinyl chloride and chlorinated polyvinyl chloride compounds meeting ASTM D1784, Class 12454-B and Class 23447-B, respectively. The pipe shall be manufactured in accordance with ASTM D1785, PVC 1120 and ASTM F441, CPVC 4120. The pipe shall have a hydrostatic design stress rating of 200 psi at 73° F and shall be suitable for field cutting and solvent welding. Pipe shall be of the material, sizes and class, as shown on the Drawings.

C. Plastic fittings shall be the socket type for solvent-welded joints conforming to ASTM D2467 and D2466, for PVC and ASTM F439 and F438 for CPVC. Solvent shall be as specified in ASTM D2564 except where threaded or flanged connections are shown on the Drawings. Joints shall be flanged where shown on the Drawings. Flanges shall be furnished with 1/8- inch thick full-faced natural rubber gaskets which shall be of a material suitably resistant to the fluid within the respective pipelines, and shall be subject to the approval of the Owner.

D. Fittings, specials, unions and flanges shall be of the same schedule number and manufactured of the same materials as the pipe.

E. Plastic pipe shall be furnished perforated as indicated on the Drawings. The perforations shall be drilled into the pipe after manufacture, prior to delivery to the site.

PART 3 - EXECUTION

3.01 GENERAL

A. Pipe and fittings shall be jointed in accordance with the recommendations of the latest ASTM standards.

3.02 PREPARATION

A. Pipe and fittings shall be thoroughly cleaned before they are placed. Ends of pipe, the inside of sleeves and any rubber rings shall be wiped clean and any burrs removed immediately before jointing the pipes.

B. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. The entrance of earth into pipe will not be permitted, and the Owner may require the placing of a heavy canvas bag of suitable size over each end of the pipe before it is lowered into the trench. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

3.03 INSTALLATION

A. Pipe and fittings shall be laid accurately to the lines and grades indicated on the Drawings or as directed by the Owner. Care shall be taken to ensure alignment both horizontally and vertically and to provide a firm bearing for the pipe along its entire length. It will be permitted to disturb the trench subgrade over a maximum length of twelve inches near the middle of each length of pipe due to the withdrawal of pipe slings or other lifting equipment. Pipes shall not be laid in water, nor shall water be allowed to flow through them. The Contractor shall take all necessary precautions to prevent flotation of the pipe in the trench.

B. After placing a length of pipe, the joint shall be made per manufacture's instructions and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with hangers or approved backfill material tamped under and around it. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, the amount of deflection allowed shall not exceed that required for making a satisfactory joint and shall be subject to the approval of the Owner.

C. Plastic pipe shall be installed according to ASTM D 2321 and in accordance with the requirements of the specification for the applicable item of work.

D. Plastic pipe being installed as Landfill Gas Extraction Wells shall be installed in accordance with Section 02130 of the specifications.

3.04 ADAPTERS

A. Where it is necessary to join pipes of different types, the Contractor shall furnish and install the necessary adapters as indicated on the Drawings. Adapters shall have ends conforming to specifications for the appropriate type of joint to receive the adjoining pipe.

END OF SECTION

SECTION 02290

TOPSOIL AND SEED

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work covered by this section consists of furnishing all labor, equipment and material as necessary to apply topsoil, seed and fertilizer to the landfill surface and adjacent disturbed areas and to establish a healthy, robust growth of perennial grasses upon these areas.

B. This section also covers the furnishing and placement of erosion control matting within grass lined diversion berms and swales.

C. The Owner will allow the Contractor to use on site sources of materials for topsoil. It shall be the sole responsibility of the Contractor to satisfy himself as to the quality and quantity of the on site material to meet this specification. It shall also be the sole responsibility of the Contractor to test the material as well as to process and/or amend the on site source material so as to meet the requirements of this specification.

1.02 QUALITY ASSURANCE

A. The Contractor shall have samples of topsoil tested by an independent testing laboratory for pH, organic concentration and grain size.

B. The above referenced testing shall be done at a frequency of 1 set of tests for every 1,000 cubic yards of material to be used on this project.

C. The results of all laboratory testing shall be submitted to the Owner.

PART 2 - PRODUCTS

2.01 TOPSOIL

A. Topsoil shall be a natural, fertile, friable soil, typical of productive soils in the vicinity, obtained from naturally well-drained areas, neither excessively acid nor alkaline (pH within 6.5 to 7.5), and containing no substances harmful to grass growth.

B. Topsoil shall not be delivered to the site in frozen or muddy condition and shall be reasonably free of stumps, roots, heavy or stiff clay, stones larger than 2 inches in diameter, lumps, coarse sand, noxious vegetation, sticks, brush or other litter.

C. The topsoil shall contain not less than 8 percent nor more than 20 percent organic matter as determined by the loss of weight by ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 230 degrees F ±9 degrees.

2.02 LIME

Lime shall be standard commercial ground limestone containing at least 50 percent total oxides (calcium oxide and magnesium oxide), and 50 percent of the material must pass through a No. 100 mesh sieve with 98 percent passing a No. 20 mesh sieve.

2.03 FERTILIZER

Fertilizer shall be commercial fertilizer, 15-30-15 fertilizer mixture. At least 40 percent of the nitrogen content shall be derived from organic material. The fertilizer shall be delivered to the site in the original sealed containers each showing the manufacturer's guaranteed analysis. Store fertilizer so that when used it shall be dry and free flowing.

2.04 SEED

A. Seed shall be of an approved mixture, new crop, clean, high in germinating value, a perennial variety, and low in weed seed. Seed shall be obtained from a reliable seed company and shall be accompanied by certificates relative to mixture purity and germinating value.

B. The grass seed shall conform to the following requirements:

	Proportion by Weight	Germination Minimum	Purity Minimum
Creeping Red Fescue	50%	85%	95%
K.31 Tall Fescue	30%	85%	95%
Domestic Rye	10%	90%	98%
Red Top	10%	85%	92%
Ladino Clover	5%	85%	96%

2.05 MULCH AND STRAW

A. Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogenous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air dry weight content and not contain in excess of 10 percent moisture.

B. Straw mulch shall consist of cured straw. When air-dried in the loose state, the contents of a representative bale shall lose not more than 15 percent of the resulting air dry weight of the bale. It shall be free from primary noxious weed seed and rough woody materials.

2.06 EROSION CONTROL BLANKETS

A. Erosion control blankets shall be installed to protect grass lined diversion berm swales, as indicated on the Drawings. The erosion control blankets shall consist of a rolled erosion control product manufactured from natural fibers mechanically attached to or woven into two continuous degradable synthetic netting structures. Erosion control blankets shall meet the following minimum standards:

1. Grass Lined Diversion Berm Swales - Double Net Straw/Coconut Fiber Erosion Control Blanket (North American Green SC150 or Approved Equal).

    (a) Matrix: 70% agricultural wheat straw, 30% coconut fiber, minimum weight (.5 lbs/sy)
    (b) Netting: Top, UV stabilized polypropylene with .6-inch openings. Bottom, lightweight photodegradable polypropylene with .5-inch openings.
    (c) Stitching: Degradable thread on 1.5 inch centers
    (d) Roll Size: 6.5' x 83.5', 60 sys
    (e) Roll Weight: 30 lbs ±10%

B. The erosion control material(s) shall be anchored with "U" shaped 11 gauge wire staples or wooden stakes with a minimum top width of one inch and length of six inches. Fastener type (metal or wood) shall be designated by the Owner.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Topsoil placement shall not begin until the Owner has approved the placement and grading of the subgrade work performed under other sections. Topsoil placement shall be conducted utilizing equipment and methods that will not cause damage or disruption to the layers below. Unacceptable disruptions include the pushing of sand, tracking through the topsoil into the sand, or causing an intermixing of topsoil and sand. Successful topsoil placement will produce distinct layers.

B. Topsoil shall be placed and spread to a depth sufficiently greater than the depths required on the Drawings so that after natural settlement and compaction, the completed work will conform to the lines, elevations and grades indicated on the Drawings. Topsoil shall be placed to the limits indicated on the Drawings or as directed by the Owner. After topsoil has been placed and spread, prepare the topsoil's surface by carefully scarifying or harrowing and hand raking. Remove and dispose large stiff clods, brush, roots, litter, stones greater than 2-inch diameter and other foreign material.

C. Lime shall be applied to bring the pH to 6.5 or, without a soil test, at the rate of 2-3 tons of lime per acre.

D. When dry fertilizer is used, it shall be applied uniformly to the seeding areas at the time of seeding, at the rate of 1,000 pounds of 15-30-15 fertilizer, or an equivalent quantity of 1-2-1 fertilizer, per acre. The method of application shall be approved by the Owner before fertilizer is applied.

E. When applied in liquid form or mixed with water, fertilizer shall provide the same value of nutrients per acre as specified for dry fertilizer. Fertilizer applied in liquid form shall be agitated during application.

F. The seed bed shall be harrowed or raked a minimum of 3 inches deep, to thoroughly incorporate the lime and fertilizer into the soil. The topsoil shall then be raked until the surface is finely pulverized and smooth and shall be compacted with rollers, weighing not over 100 pounds per linear foot of tread, to even the surface to conform to the prescribed lines and grades.

3.02 SEEDING

A. Seeding shall be done when weather conditions are approved as suitable, in the periods between April 1 and May 31 or August 15 to October 15, unless otherwise approved by the Owner.

B. If there is a delay in seeding, during which weeds grow or soil is washed out, the Contractor shall remove the weeds or replace the soil before sowing the seed, without additional compensation. Immediately before seeding is begun, the soil shall be lightly raked.

C. Seed shall be applied at the rate of 100 pounds per acre, on a calm day by machine. The preferred method of application is by hydroseeding unless approved otherwise by the Owner.

D. One-half the seed shall be sown in one direction and other half at right angles. Seed shall be raked into the soil to a depth of 1/4 inch and rolled with a roller weighing not more than 100 lbs. per linear foot of tread.

E. Hydroseeding equipment shall be designed specifically for this work. Mix seed, fertilizer, wood cellulose fiber mulch and non asphaltic-fiber binder in required amounts of water to produce a homogeneous slurry. Add fiber mulch after seed, water, and fertilizer have been thoroughly mixed and apply at the rate of 200 lbs per acre dry weight. The slurry shall be applied within 30 minutes of mixing to prevent burning of the seed by the fertilizer. Immediately following the application of the slurry mix, make separate application of fiber mulch and fiber binder at the rate of 1,000 lbs, dry weight, per acre except where erosion control blanket is applied immediately. When hydraulically sprayed on the ground, material shall form a blotter-like cover impregnated uniformly with grass seed. Cover shall allow rainfall or applied water to percolate to underlying soil.

F. The Contractor shall be responsible for maintenance of the grassed area including watering, weeding, fertilization, mowing and replanting as necessary to establish a uniform stand of the specified grasses and until final acceptance. Scattered bare spots, none of which are larger than 72 square inches, will be allowed in seeded areas up to a maximum of 2 percent of any grassed area. After the grass has started, all areas and parts of areas which fail to show a uniform stand of grass, for any reason, shall be reseeded and such areas and parts of areas shall be reseeded repeatedly until all areas are covered with a satisfactory growth of grass. Prior to acceptance, any damage resulting from erosion, gullies, washouts, or other causes shall be repaired by filling with topsoil, tamping, refertilizing, and reseeding.

G. Grass areas shall be protected against trespassing and damage as required to insure satisfactory growth acceptable to the Owner. Any means of protection shall require the approval of the Owner prior to its erection.

3.03 EROSION CONTROL BLANKETS

A. Channel or Swale Applications:

1. Prepare soil before installing blankets, including application of lime, fertilizer, and seed.

2. Begin at the top of the channel by anchoring the blanket in a 6-inch deep by 6-inch wide trench. Backfill and compact the trench after stapling.

3. Roll center blanket in direction of water flow on bottom of channel.

4. Place blankets end over end (shingle style) with 6-inch overlap. Use a double row of staggered staples 4 inches apart to secure blankets.

5. Full length edge of blankets at top of side slopes must be anchored in a 6-inch deep by 6-inch wide trench. Backfill and compact the trench after stapling.

6. Where necessary, blankets on side slopes must be overlapped 4 inches over the channel blanket and stapled.

7. A staple check slot shall be installed at 30 to 40 foot intervals. Use a row of staples 4 inches apart over entire width of channel. Place a second row 4 inches below the first row in a staggered pattern.

3.04 TEMPORARY COVER

A. If there is insufficient time in the planting season to complete the fertilizing and seeding, permanent seeding may be left until the following planting season, at the option of the Contractor or on order of the Owner. In that event, a temporary cover crop shall be sown.

B. This cover crop shall be cut and watered as necessary until the beginning of the following planting season, at which time it shall be plowed or harrowed into the soil, the area shall be fertilized and the permanent seed crop shall be sown as specified.

3.05 INSPECTION AND ACCEPTANCE

A. At the beginning of the next planting season after that in which the permanent grass crop is sown, the seeded areas will be inspected. Any section not showing dense, vigorous growth at that time shall be promptly reseeded by the Contractor at his own expense. The seeded areas shall be watered, weeded, fertilized, cut and otherwise maintained by the Contractor until the end of that planting season, when they will be accepted if the sections show a dense, vigorous growth.

END OF SECTION

SECTION 02500

HDPE GEOMEMBRANE LINER

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, supervision, and equipment to install the HDPE geomembrane cap including, but not limited to panel layout, seaming, patching, and testing, and all necessary and incidental items required to complete the Work, in accordance with the Drawings and these Specifications. The Contractor shall also furnish all labor, materials, supervision, and equipment to excavate and backfill the anchor trench for the Geomembrane, as shown on the Drawings.

B. The Contractor is responsible for conducting compliance testing on representative geomembrane rolls and conducting destructive sample testing from representative field seams. The Contractor shall retain the services of a Geosynthetics Accreditation Institute – Laboratory Accreditation Program (GAI-LAP) certified laboratory to conduct the tests indicated in Parts 2.01 and 3.03 of this Section.

C. The Contractor shall coordinate geomembrane installation work with the subgrade, sand drainage layer and work of others.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02210 - Sand

1.03 REFERENCES

A. Latest version of the American Society for Testing and Materials (ASTM) standards:

1. ASTM D 638, "Standard Test Method for Tensile Properties of Plastics."

2. ASTM D 746, "Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact."

3. ASTM D 751, "Standard Methods for Coated Fabrics."

4. ASTM D 792, "Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement."

5. ASTM D 1004, "Standard Test Method of Initial Tear Resistance of Plastic Film and Sheeting."

6. ASTM D 1204, "Standard Plastics Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature."

7. ASTM D 1238, "Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer."

8. ASTM D 1505, "Standard Test Methods for Density of Plastics by the Density-Gradient Technique."

9. ASTM D 1603, "Standard Test Method for Carbon Black in Olefin Plastics."

10. ASTM D 1693, "Standard Test Method for Environmental Stress Cracking of Ethylene Plastics."

11. ASTM D 3015, "Recommended Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds."

12. ASTM D 3895, "Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis."

13. ASTM D 4218, "Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Techniques."

14. ASTM D 4437, "Standard Test Methods for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Geomembranes."

15. ASTM D 4833, "Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products."

16. ASTM D 5199, "Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes."

17. ASTM D 5321, "Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method."

18. ASTM D 5397, "Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test."

19. ASTM D 5596, "Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics."

20. ASTM D 5641, "Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber."

21. ASTM D 5721, "Practice for Air-Oven Aging of Polyolefin Geosynthetics."""

22. ASTM D 5820, "Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes."

23. ASTM D 5885, "Test Method for Oxidative Induction Time of Polyolefin Geosyntetics by High Pressure Differential Scanning Calorimetry."

24. ASTM D 5994, "Test Method for Measuring Core Thickness of Textured Geomembranes."

25. ASTM D 6392, "Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods."

26. ASTM D 6693, "Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Polypropylene Geomembranes."

27. D6747, "Selection of Techniques for Electrical Detection of Potential Leak Paths in Geomembrane."

B. Latest version of the Geosynthetic Research Institute (GRI) standards:

1. GM-5 (b), "Single Point Notched Constant Tensile Load (SP-NCTL) Test for Polyolefin Resin or Geomembranes."
2. GM-6, " Pressurized Air Channel Test for Dual Seamed Geomembranes."
2. GM-9, "Cold Weather Seaming of Geomembranes."
3. GM10, "Specifications for the Stress Crack Resistance of Geomembrane Sheet."
4. GM11, "Accelerated Weathering of Geomembranes Using a Florescent UVA-Condensation Exposure Device."
5. GM12, "Measurement of the Asperity of Textured Geomembranes Using a Depth Gage."
6. GM13, "Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes."

C. FTMS 101/2065, "Federal Test Method Standard for Puncture Resistance and Elongation Test."

D. Daniel, D.E. and R.M. Koerner, (1993), *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities*, EPA/600/R-93/182.

E. U.S.E.P.A., (1991), *Technical Guidance Document: Inspection Techniques for the Fabrication of Geomembrane Field Seams*, EPA/530/SW-91/051.

F. U.S.E.P.A., (1993), *Technical Guidance Document: Quality Control Assurance and Quality Control for Waste Containment Facilities*, EPA/600/R-93/182.

G. NSF Joint Committee on Flexible Membrane Liners, (1993), *Standard 54, Flexible Membrane Liners*, NSF International.

H. Geosynthetic Research Institute Test Method GM-5 (b), "Single Point Notched Constant Tensile Load (SP-NCTL) Test for Polyolefin Resin or Geomembranes."

I. Geosynthetic Research Institute Test Method GM-6, "Pressurized Air Channel Test for Dual Seamed Geomembranes."

1.04 LINE AND GRADE CONTROL

A. Contractor is responsible for line and grade control for all aspects of the work in accordance with the Contract Drawings and these Specifications.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle and store geomembrane rolls and associated materials in such a manner as to ensure a sound, undamaged condition. Procedures shall be in conformance with manufacturer's recommendations.

1.06 QUALIFICATIONS

A. The geomembrane manufacturer must have at least five years experience in the manufacture of such geomembrane. In addition, the geomembrane manufacturer shall have produced at least 10 million square feet of similar material.

B. The geomembrane installer must have at least three years experience in the installation of such geomembrane. Also, the geomembrane installer must have installed at least 10 projects involving a total of 5 million square feet of similar material within the last three years.

C. The geomembrane installer's supervisor must be on-site and be in responsible charge throughout the geomembrane installation. The supervisor must have supervised the installation of at least 2.5 million square feet of geomembrane.

D. The geomembrane installer must establish a Quality Control (QC) representative who must be responsible in the field for the quality and integrity of the geomembrane installation, including all testing, inspections and documentation. The QC representative must have performed these duties on at least 2.5 million square feet of geocomposite.

1.07 SUBMITTALS

A. The Contractor shall submit to the Owner representative samples of the geomembrane liners and extrudate rod. The Owner may elect to conduct tests on said samples.

B. The Contractor shall submit quality control certificates provided by the manufacturer on each roll of the geomembrane barrier to the Owner. Test results must document compliance with the specifications in Part 2.01 of this Section.

C. The Contractor shall submit testing results of pre-construction tests conducted on representative samples of the geomembrane barriers. Such test results must document compliance with the specifications in Part 2.01 of this Section.

D. The Contractor shall submit geomembrane panel layout drawings to the Owner at least 10 days prior to beginning the installation of secondary geomembrane liner. The panel layout drawings shall be prepared at scale not less than 1" = 50'. The drawings shall show the location of geomembrane roll numbers, geomembrane panels, panel numbers, seam locations, geomembrane penetrations and anchor trench.

E. The Contractor shall submit an "As-Built" panel layout to the Owner within 10 days of completion of the project.

1.08 WARRANTY

A. A written Warranty shall be provided to the Owner for materials and workmanship of the HDPE Geomembrane liners.

B. The manufacturer shall warrant the membrane against manufacturing defects and material degradation for the design conditions for a period of 20 years. The manufacturer shall provide for the replacement of any material that fails for the above stated reasons.

C. The installer shall warrant the membrane against any defects in the installation or workmanship for a period of 2 years. The installer shall provide for the replacement of any material that fails for the above stated reasons.

PART 2 - PRODUCTS

2.01 GEOMEMBRANE LINERS

A. Geomembrane cap shall be made of textured, 40 mil thick, high density polyethylene (HDPE) as noted and to the limits shown on the Drawings.

B. Geomembrane used shall meet the minimum standards included in Table 02500-1.

C. The chemical resistance of the Geomembrane material and seams shall be in keeping with typical properties of high quality polyethylene products currently available through commercial sources.

D. Geomembrane shall be shipped rolled with no seams in the roll.

E. Extrudate rod shall be manufactured of the same resin type as the geomembrane and shall have the same properties.

F. Geomembrane materials shall be manufactured by Agru America, GSE Lining Technology, Inc., Poly-Flex, Inc. or approved equal and shall be tested to the frequencies and physical properties as specified in this Section.

G. No reclaimed material (that is, material that has seen previous service) shall be allowed in the Geomembrane sheet.

H. Regrind material (that is, material that has been previously processed by the same manufacturer but has never seen previous service) shall be allowed in the Geomembrane sheet if approved by the Owner.

I. The Geomembrane shall be free of pinholes and reasonably free from surface blemishes, scratches and other defects as judged by the Owner.

J. As part of the Contractor's pre-construction testing, interface shear testing shall be performed on each interface of the cap system in accordance with ASTM D5321 or ASTM D6243 for those interfaces involving Geomembrane. Each test shall determine the interface shear strength at normal stresses of 1 psi, 2 psi and 3 psi. The geomembrane interfaces shall have the following shear strengths:

1. Geomembrane Cap/Liner and each of the Sand Gas Venting/Drainage Layers (under saturated conditions): $\geq$27° peak friction angle.

PART 3 - EXECUTION

3.01 CONSTRUCTION - GENERAL

A. The Geomembrane cap shall be constructed as soon as practical after completion of the cap subgrade installation. No Geomembrane placement shall take place without specific approval from the Owner. Each sequential section of geomembrane shall be secured in an anchor trench or continuously welded to the adjacent sections as shown on the Drawings and details.

B. The geomembrane installer shall issue geomembrane subgrade acceptance forms to the Owner prior to the installation of the geomembrane.

C. All geomembrane compliance testing must be completed and passed before placing the geomembrane barrier.

3.02 GEOMEMBRANE INSTALLATION

A. Surfaces to receive liner installation shall be smooth and even, and free of ruts, voids, protrusions, and deleterious material. Vehicles leaking contaminants or causing ruts, pumping, cracking or deformation of surface or otherwise unacceptable to the Owner are not permitted on final dressed surfaces unless authorized by the Owner. Any damage to the surface caused by the Contractor's vehicles shall be repaired at the Contractor's expense.

B. An anchor trench (as illustrated on the Drawings) will be required at locations indicated along the cap perimeter to secure the Geomembrane. The Contractor shall take precautions to minimize loose soil underlying the Geomembrane in the anchor trenches. The time schedule for excavation and backfilling of the anchor trench is to be approved by the Owner so that the anchor trench remains open for the shortest possible time.

C. Installation of the Geomembrane shall be as follows:

1. Unroll only those sections which are to be seamed together or anchored in one day. Panels should be positioned with the overlap recommended by the manufacturer, but not less than 6 in. (114 mm), after the necessary alignment and cutting. Seams shall run parallel with the slope, not across it, wherever possible. If seams must run across a slope, the edge of the upslope sheet shall be positioned above the edge of the downslope sheet. The Geomembrane sections will be placed in an anchor trench which is then backfilled by the Contractor with suitable excavated materials in accordance with the Drawings.

2. After panels are initially in place, remove as many wrinkles as possible. Unroll several panels and allow the material to relax before beginning field seaming.

The purpose of this is to make the edges which are to be bonded as smooth and free of wrinkles as possible.

3. Once panels are in place and smooth, commence field seaming operations.

4. At the end of each day or installation segment all unseamed edges shall be anchored by rope, sand bags, or other approved device. Sand bags securing the Geomembrane on the side slopes should be connected by rope fastened at the top of the slope section by a temporary anchor. Staples, U-shaped rods or other penetrating anchors shall not be used to secure the Geomembrane. Any damage to the Geomembrane due to wind, rain, hail, other weather predicaments or negligence shall be the sole responsibility of the Contractor.

D. Field seaming may be extrusion or fusion welding or a combination of these methods. Solvent welding is not acceptable. The Owner reserves the right to reject any proposed seaming method believed to be unacceptable. Additional requirements of proper field seaming include the following:

1. All foreign matter (dirt, water oil, etc.) shall be removed from the edges to be bonded. For extrusion-type welds, the bonding surfaces must be thoroughly cleaned by mechanical abrasion or alternate methods approved by the Owner to remove surface cure and prepare the surfaces for bonding. All abrasive buffing shall be performed using No. 80 grit or finer sandpaper. The grinding shall be performed so that grind marks are generally perpendicular to the edge of sheet. No solvents shall be used to clean the Geomembrane materials.

2. As much as practical, field seaming shall start from the top of the slope and proceed down slope. This will minimize the development of wrinkles which may occur due to having people working on the side slopes behind the area being seamed. Tack welds (if used) shall use heat only; no double sided tape, glue or other method will be permitted.

3. The completed cap shall not exhibit any "trampolining" at the time protective cover or other materials are being placed over the Geomembrane.

4. The seams should be oriented as shown by the approved panel layout drawing, generally parallel to the line of maximum slope. In corners and odd shaped geometric locations, the number of field seams should be minimized.

5. No horizontal seams should be within 5 ft (1.5m) of the toe of a slope greater than 5%.

6. No seaming should be attempted above 104°F (40°C) ambient air temperature.

7. Below 41°F (5°C) ambient air temperature, preheating of the Geomembrane will be required. Preheating may be achieved by natural and/or artificial means (shelters and heating devices). Ambient temperature is measured 6 in. (150mm) above the liner surface. The membrane installation contractor shall supply instrumentation for measurement of ambient temperature. Trial welds shall be performed at double the specified frequence. Trial welds shall be made under the same conditions as will be experienced in the work-area. All trial testing will be conducted in a heated area after the samples have been

allowed to warm to at least 40°F or more. The lowest temperature at which seaming may take place shall be the lowest temperature at which consistent passing trial seams can be produced under simulated work-area conditions. No seaming will be conducted below 20°F.

8. A moveable protective layer of plastic may be required to be placed directly below each overlap of Geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded. The protective layer must be removed after seaming is complete unless approved by the Owner. It shall be the Contractor's responsibility to determine the need for such a protective layer.

9. Seaming will extend to the outside edge of panels to be placed in anchor trenches.

10. If required, a firm working surface should be provided by using a flat board or similar hard surface directly under the seam overlap to achieve proper support. The surface must be removed after seaming is complete.

11. No excessive grinding prior to welding shall be permitted. Overground or improperly ground areas shall be replaced at the Contractor's expense.

12. Seams at panel corners of 3 or 4 sheets shall be completed in a fully leak-proof manner. Open ends of all air channels must be welded closed. A patch having a minimum dimension of 24 in. (610mm), extrusion welded to the parent sheet or other approved techniques may be used. The Contractor shall submit a drawing of its proposed seam completion detail and obtain approval from the Owner.

3.03 GEOMEMBRANE TESTING

All Geomembrane sheet and seams will be tested and evaluated prior to acceptance. In general, testing of the sheet will be conducted by the manufacturer. Testing of the seams will be conducted by the Contractor under observation of the Owner. The Owner or a designated, independent geosynthetics laboratory may perform additional testing, as required by these Specifications or as required in the judgement of the Owner to verify that the HDPE sheet and seams meet the specifications. Discretionary testing shall be paid for by the Owner. Testing requirements are detailed in the following subsections:

A. Pre-shipping Sheet Tests

The Contractor or supplier (manufacturer) will be required to submit his Quality Control program to the Owner for approval prior to the shipment of material to the site. As a minimum, the Contractor shall perform the tests at the frequencies given in Table 02500-2 on the HDPE sheet prior to shipping HDPE material to the site. Test results shall be submitted to the Owner 14 days prior to shipping the HDPE rolls unless otherwise approved by the Owner.

B. The Owner may, at his discretion, conduct conformance testing on the HDPE sheet in order to verify that it meets the minimum standards specified on Table 02500-1. All conformance tests shall be performed by an independent geosynthetics testing laboratory in accordance with the methods presented on Table 02500-1. All conformance test results shall be reviewed by the Owner and accepted or rejected, prior to the placement of the geomembrane. In case of failing test results, the manufacturer may request that another sample be retested by the independent laboratory with the manufacturer's technical representative present during the testing procedures. This retesting shall be paid for by the manufacturer. The manufacturer may also have the sample retested at two different laboratories approved by the Owner. If both laboratories report passing results, the material shall be accepted. If both laboratories do not report passing results, all geomembrane material from the lot representing the failing sample will be considered out of specification and rejected. The manufacturer shall obtain additional samples from rolls immediately before and after the failing roll and test it by the independent laboratory at his/her own expense. If these rolls pass, then only the failing roll will be rejected. If they fail, then the entire lot is rejected. Discretionary testing shall be paid for by the Owner.

C. Trial Test Seams

The Contractor shall maintain and use equipment and personnel at the site to perform testing of test seams. Test seams will be made each day prior to commencing field seaming. These seams will be made on fragment pieces of Geomembrane to verify that seaming conditions are adequate. Such test seams will be made at the beginning of each seaming period; at changes of equipment, equipment settings, weather, or sheet temperature; at the Owner's direction; and at least once every four to six hours during continuous operation of each welding machine. Also, each seamer will make at least one test seam each day. Requirements for test seams are as follows:

1. The test seam sample will be at least 3 ft (0.9m) long by 1 ft (0.3m) wide with the seam centered lengthwise. Ten adjoining specimens 1 in. (25mm) wide each will be die cut from the test seam sample. These specimens will be tested in the field with a tensiometer for both shear (5 specimens) and peel (5 specimens) for single-track fusion welds or extrusion welds. For dual-track fusion welds, the Contractor shall test each track as if it was a single-track weld. Test seams will be tested by the Contractor under observation of the Owner. The specimens should not fail in the weld. The Contractor shall supply qualified personnel and testing equipment. No strain measurements need to be obtained in the field. A passing fusion or extrusion welded test seam will be achieved when the criteria described in Table 02500-1A are satisfied with the exclusion of any strain requirements. If a test seam fails, the entire operation will be repeated. If the additional test seam fails, the seaming apparatus or seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. Test seam failure is defined as failure of any one of the specimens tested in shear or peel.

2. The Owner will observe all test seam procedures. The remainder of the successful test seam sample will be assigned a number and marked accordingly by the Contractor, who will also log the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. In addition, at least one tested specimen from each test as selected by the Owner will be retained by the Owner.

D. Non-Destructive Testing

Production seams will be tested by the Contractor continuously using non-destructive techniques. Requirements for non-destructive testing are as follows:

1. Single Weld Seams - the Contractor shall maintain and use equipment and personnel at the site to perform continuous vacuum box testing on all single weld production seams. The system shall be capable of applying a vacuum of at least 4 psi (28 kPa). The vacuum shall be held for a minimum of 10 seconds for each section of seam.

2. Double Weld Seams - The Contractor shall maintain and use equipment and personnel to perform air pressure testing of all double weld seams. The system shall be capable of applying a pressure of at least 30 psi (207 kPa) for not less than 5 minutes. The Contractor shall perform all pressure and vacuum testing under the observation of the Owner. Pressure loss tests shall be conducted in accordance with the procedures outlined in "Pressurized Air Channel Test for Dual Seamed Geomembranes," Geosynthetic Research Institute Test Method GM-6. As outlined by the test method, following a 2 minute pressurized stabilization period pressure losses over a measurement period of 5 minutes shall not exceed 3.0 psi.

E. Destructive Testing

Destructive testing will be performed on an average of every 500 linear ft (150m) of production seam but not less than 2 times per day. The locations will be selected by the Owner. Sufficient samples will be obtained by the Contractor to provide one sample to the archive, one sample to the Owner for discretionary, independent laboratory testing, and one sample to be retained by the Contractor for field or laboratory testing. Testing requirements are as follows: Each sample shall be large enough to test five specimens in peel and five specimens in shear. For the sample to pass, four (4) of the five (5) specimens must meet the minimum test values presented in the project specifications and exhibit a film tear bond and the fifth sample must achieve at least 80% of the required strength. Specimens must fail in film tear bond (FTB) and meet the strain or separation requirements of Table 02500-1A. Samples which do not pass the shear and peel tests will be re-sampled from locations at least 10 ft (3 m) on each side of the original location. These two re-test samples must pass both shear and peel testing. If these two samples do not pass, then additional samples will continue to be obtained until the questionable seam area is defined. Requirements for each destructive test are as follows:

1. The Contractor shall test samples in the field or in a laboratory. All tests shall be performed using a calibrated, motor-driven, strain-controlled tensiometer approved by the Owner. The Contractor shall supply certification records demonstrating that the tensiometer has been calibrated by a qualified agency within the past 6 months.

   a. Peel shall be measured for one sample (that is, five specimens). Peel tests will be evaluated for the criteria described in Tables 02500-1 and 02500-1A.

b. Shear shall be measured for one sample (that is, five specimens). Strain measurements are required for the shear specimens. Laboratory tests will be evaluated for the criteria described in Table 02500-1 and 02500-1A.

2. The Owner will observe all production seam field test procedures. Testing for both peel and shear will be evaluated in accordance with Tables 02500-1 and 02500-1A.

3. The Contractor will be responsible for the archive specimen. He will assign a number to the archive sample and mark the sample with the number. He will also log the date, seam number, approximate location in the seam, and field test pass-or-fail description, if applicable. Following completion of the installation of the liner, the archive specimens will be submitted to the Owner.

4. For double-weld seams, all destructive testing shall be performed for each weld to ensure a continuous good weld.

3.04 REPAIR OF DAMAGED, SAMPLED, AND FAILED SEAM AREAS

A. Damaged and sample coupon areas of Geomembrane shall be repaired by the Contractor by construction of liner strips. No repairs shall be made to seams by application of an extrusion bead to a seam edge previously welded by fusion or extrusion methods. Repaired areas will be tested for seam integrity. Damaged materials are the property of the Contractor and will be removed from the site at the Contractor's expense. The Contractor will retain all ownership and responsibility for the Geomembrane until acceptance by the Owner.

B. Once the geomembrane has been deployed, the panels must be examined for flaws, holes, defects and tears. Each location requiring a repair shall be repaired using the following procedures:

Patching - A patch shall be used to repair defects in the geomembrane which are 1/8-inch or larger.
Abrading and Re-welding - This procedure may be used to repair seam sections which are less than 10 feet in length.
Spot Welding - Spot welding may be used to repair small tears, pinholes and/or other small defects which are 1/8-inch or smaller.
Capping – Capping shall be used to repair failed seams that are greater than 10 feet in length.

C. Patches or caps shall extend at least six inches beyond the edge of the defect. The edges of the patch or cap shall be extrusion welded to the in place geomembrane after both the liners are abraded to remove the surface sheen of the geomembrane and to provide a surface that is more conducive to accepting the weld. Welding of the repair patch or cap shall be completed by extrusion welding the geomembrane. The repairs shall be non-destructive tested using the vacuum-box method as described in this Section.

D. The Contractor shall not conduct repairs without prior notification of the Owner.

3.05 POTENTIALLY DAMAGING ACTIVITIES

A. No support equipment shall be allowed on the Geomembrane unless the equipment and protective measures are approved by the Owner. Light-weight portable generators must be placed on protective rub sheets, and stands or supports shall be adequately padded to prevent potential damage to the rub sheet or Geomembrane. All-terrain-vehicles (ATVs) shall not be operated on the Geomembrane. Personnel working on the Geomembrane shall not smoke, wear damaging shoes, or engage in any activity which damages the Geomembrane.

3.06 ANCHOR TRENCH BACKFILLING

A. The anchor trench will be backfilled and compacted by the Contractor to a dry unit weight not less than 95 percent of standard proctor density determined by ASTM D 698 or 90 percent of the modified proctor density determined by ASTM D 1557. Care should be taken when backfilling the trench to prevent any damage to the Geomembrane. Anchor trench spoil shall be used as backfill material, wherever possible.

TABLE 02500-1
REQUIRED PHYSICAL PROPERTIES
OF HDPE GEOMEMBRANE LINER AND SEAMS
per
GRI Test Method GM13 Standard Specification for
"Test Methods & Testing Frequency for HDPE Smooth & Textured Geomembranes"

PROPERTY	TEST METHOD	40-MIL (1.5mm)
Thickness	ASTM D5994	36 mil (min.)
Asperity Height	GM 12/ASTM D7466	10 mil (min.)
Density	ASTM D1505/D792	0.940 g/cc (min.)
Tensile Properties	ASTM D6693	Strgth @ Yld = 84 ppi Strgth @ Brk = 60 ppi Elngtn @ Yld = 12% Elngtn @ Brk = 100%
Tear Resistance	ASTM D1004	28 lbs.
Puncture Resistance	ASTM D4833	60 lbs.
Stress Crack Resistance	ASTM D5397	300 hrs.
Carbon Black Content	ASTM D4218	2%-3%
Carbon Black Dispersion	ASTM D5596	Category 1 or 2
Melt Flow Index	ASTM D1238	<1.0 g/10 minutes (max.)
Oxidative Induction Time	ASTM D3895/D5885	100 min./400 min.
Oven Aging @85°C	ASTM D5721 - D3895/D5885	55% (min.)/80% (min.)
U.V. Resistance	GRI GM11 - ASTM D3895/D5885	N.R./50%
Minimum Peel Strength, lb/in., Fusion Extrusion	ASTM D6392	 60 52
Minimum Bonded Shear Strength, lb/in.,	ASTM D6392	80

(Continued on Table 02500-1A)

TABLE 02500-1A

HDPE WELDED SEAM REQUIREMENTS

(CONTINUED FROM TABLE 02500-1))

Type of Seam	Peel Requirements	Shear Requirements
Fusion	1) Film Tearing Bond failure, 2) Peel separation no greater than 25%, and 3) Achievement of required strength	1) Film Tearing Bond failure, 2) Elongation at break no greater than 50%, and 3) Achievement of required strength
Extrusion	1) Film Tearing Bond failure, 2) Peel separation no greater than 25%, and 3) Achievement of required strength	1) Film Tearing Bond failure, 2) Elongation at break no greater than 50%, and 3) Achievement of required strength

FILM TEARING BOND: A failure in the ductile mode of one of the bonded sheets by tearing prior to complete separation of the bonded area.

TABLE 02500-2
REQUIRED TESTING METHODS & FREQUENCIES
OF HDPE GEOMEMBRANE PRIMARY AND SECONDARY LINERS
per
GRI Test Method GM13 Standard Specification for
"Test Methods & Testing Frequency for HDPE Smooth & Textured Geomembranes"

PROPERTY	TEST METHOD	MINIMUM FREQUENCY
Thickness	ASTM D5994	Each Roll
Asperity Height	GM 12/ASTM D7466	Every Second Roll
Density	ASTM D1505/D792	Every 200,000 lb.
Tensile Properties	ASTM D6693	Every 20,000 lb.
Tear Resistance	ASTM D1004	Every 45,000 lb.
Puncture Resistance	ASTM D4833	Every 45,000 lb.
Stress Crack Resistance **	ASTM D5397	Every 200,000 lb.
Carbon Black Content	ASTM D4218	Every 20,000 lb.
Carbon Black Dispersion	ASTM D5596	Every 45,000 lb.
Melt Flow Index	ASTM D1238	Every 200,000 lb.
Oxidative Induction Time **	ASTM D3895/D5885	Every 200,000 lb.
Oven Aging @85°C **	ASTM D5721 - D3895/D5885	Each Formulation
U.V. Resistance **	GRI GM11 - ASTM D3895/D5885	Each Formulation
Coefficient of Friction	ASTM D-5321 (Detailed test conditions specified by the Owner)	Once per critical interface

* Or at least once per railcar for railcars containing less than 180,000 lb (81.6 Mg).

** Contractor shall obtain testing data from geomembrane manufacturer and submit to Owner with geomembrane roll certifications.

END OF SECTION

SECTION 02596

GEOTEXTILE FABRICS

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall furnish all labor, materials, tools, and equipment and perform all operations necessary for the installation of geotextile fabrics, as indicated on the Drawings and as specified herein.

B. The materials supplied shall be products designed and manufactured specifically for the purpose of this work and which have been satisfactorily demonstrated by prior use to be suitable and durable for such purposes.

C. Geotextile filter fabrics shall be used as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 - Earthwork

B. Section 02220 - Rip Rap

1.03 SUBMITTALS

A. Shop Drawings shall be submitted in accordance with Section 01340.

B. Certification test results showing that the fabric meets the specifications shall be submitted to the Owner prior to installation.

PART 2 - PRODUCTS

2.01 GEOTEXTILE FABRICS

A. The fabric shall be non-woven consisting of continuous chain polymer filaments or yarns of polyester, formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew and rot resistant, resistant to ultraviolet light exposure, insect and rodent resistant, and conform to the properties specified below.

Physical Properties	Specification	
Weight (ounces per square yard)	8	16
Grab Tensile Strength ASTM D4632 (lbs)	220	390
Grab Strength Elongation ASTM D4632	50	50
Puncture Strength ASTM D4833	120	240
Permittivity ASTM D4491 (sec.$^{-1}$)	1.30	0.60
Water Flow Rate ASTM D4991 (gpm/ft^2)	95	45
Equivalent Opening Size ASTM D4751 (U.S. Standard Sieve No.)	80	100
Trapezoid Tear Strength ASTM D4533 (lbs)	90	150

PART 3 - EXECUTION

3.01 SITE PREPARATION

A. Site grade preparation shall conform to the requirements of this Section, and Section 02200 - Eartwork.

B. The surface to receive geotextile shall be cleared of sharp objects, boulders, stumps, or any materials that may contribute to fabric punctures, shearing, rupturing or tearing.

3.02 INSTALLATION

A. The geotextile shall be placed in the manner and at the locations shown. Geotextile shall be laid smooth and free of tension, stress, folds, wrinkles, or creases.

B. During the placement of rip rap or other stone materials over the geotextile, care shall be taken so as not to damage the geotextile. Dozer blades shall not be in direct contact with the geotextile.

C. All materials located on top of geotextiles shall be deployed in such a manner as to ensure:

1. The geotextile materials are not damaged.
2. Minimal slippage of the geotextile on underlying layers occurs.
3. No excess tensile stresses occur in the geotextile.

D. If geotextile is damaged during any step of installation, a piece of geotextile material shall be cut and placed over the damaged area and overlap the undamaged material a minimum of 3 feet in each direction.

END OF SECTION

SECTION 02714

HDPE PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for installation of all high density polyethylene (HDPE) pipe, fittings and appurtenances in conjunction with landfill gas extraction well and collection systems and the leachate interceptor pipe system, as specified herein and as shown on the Drawings.

1.02 RELATED SECTIONS

A. Section 02130 - Landfill Gas Extraction Wells

B. Section 02200 - Earthwork

1.03 REFERENCES

A. Latest version of the American Society for Testing and Materials (ASTM) standards:

1. ASTM D 1248, Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

2. ASTM F 1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

3. ASTM D 1603, Standard Test Method for Carbon Black in Olefin Plastics

3. ASTM D 1693, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

4. ASTM D2513, Thermoplastic Gas Pressure Pipe, Tubing and Fittings.

5. ASTM D 2657, Standard Practice for Heat-Joining for Polyolefin Pipe and Fittings

6. ASTM D2683, Socket Type Polyethylene Fittings For Outside Diameter Controlled Polyethylene Pipe and Tubing.

7. ASTM D 2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

8. ASTM D3261, Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

9. ASTM D 3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

10. ASTM F 714, Standard Specification for Polyethylene (PE) Plastics Pipe (SDR-PR) Based on Outside Diameter.

1.04 WARRANTY

A. The Contractor shall furnish the Owner written warranties obtained from the manufacturer and the installer against defects in materials and workmanship in accordance with ASTM D 3350 and ASTM F 714. Warranty conditions proposed by the manufacturer or installer concerning limits of liability will be evaluated and must be acceptable to the Owner.

1.05 SUBMITTALS

A. The Contractor shall submit shop drawings and manufacturers catalog data for all piping system components in accordance with Section 01340 - Shop Drawings, Samples and Product Data.

B. The Contractor shall submit to the Owner for approval, a list of materials to be furnished, the names of the suppliers and the proposed dates of delivery of the materials to the site.

C. The Contractor shall submit to the Owner the pipe Manufacturer's certification of compliance with this Section for all materials delivered to the site, and shall comply with the pipe Manufacturer's recommendations for handling, storing, and installing HDPE pipes and fittings.

D. The Contractor shall submit to the Owner in writing the following documentation from the HDPE pipe Manufacturer on the raw materials used to manufacture the HDPE pipe and fittings prior to transporting any HDPE pipe or fittings to the site.

1. Certificate stating the specific resin, its source and the information required by ASTM D 1248.

2. Certification that no recycled compound has been added to the resin except that generated in the Manufacturer's own plant from resin of the same specification from the same raw material.

PART 2 - PRODUCTS

2.01 HIGH DENSITY POLYETHYLENE (HDPE) COMPOUND

A. The HDPE pipe and fittings shall be manufactured from new, high performance, high molecular weight, high density polyethylene resin conforming to ASTM D 1248 (Type III, Class C Category 5, Grade P 34), ASTM D 3350 (Cell Classification PE 345444C), and having a Plastic Pipe Institute (PPI) Rating of PE 3408. Material specifications for the HDPE pipe and fittings are presented in Table 02714-1.

B. The resin shall be pre-compounded. In plant blending of non-compounded resins shall not be permitted. The polyethylene compound shall contain a minimum of 2% carbon black.

C. The polyethylene compound shall have a minimum resistance of 125 hours when tested for environmental stress crack in accordance with requirements of ASTM D 1693, Procedure B.

2.02 HIGH DENSITY POLYETHYLENE (HDPE) PIPES AND FITTINGS

A. All HDPE pipe and fittings shall comply with the ASTM F 714.

B. All HDPE pipe and fittings shall have a minimum Standard Diameter Ratio (SDR) of 17.

C. HDPE pipe shall be supplied in standard laying lengths not exceeding 50 feet.

D. HDPE pipe shall be furnished perforated as indicated on the Drawings. The perforations shall be drilled into the pipe after manufacture, prior to delivery to the site.

E. HDPE pipes and fittings shall be homogeneous throughout and free of visible cracks, holes (other than intentional manufactured perforations), foreign inclusions, or other deleterious effects, and shall be uniform in color, density, melt index and other physical properties.

F. Fittings at the ends of pipes shall consists of HDPE end caps and fused elbows as indicated on the Drawings.

G. Polyethylene fittings and joints shall be molded by means of thermal butt-fusion. The ends of the fabricated fittings shall be trimmed to match the pipe section to which they are going to be joined. All polyethylene fittings shall have the same or higher pressure rating as the pipe when installed in accordance with the latest technical specifications.

H. Flanges shall be ASTM A 240, Type 304 stainless steel backing flanges with 125-pound, ANSI B16.1 standard drilling. Flanges shall be complete with one-piece, molded polyethylene stub ends. Flanged connections shall have the same pressure rating as the pipe or greater.

I. Gaskets shall be flat ring, 1/8-inch ethylene propylene rubber (EPR).

J. Bolting shall be type 304 stainless steel, ASTM A 193, Grade B8 hex head bolts; and ASTM A 194, Grade 8 hex head nuts. Bolts shall be fabricated in accordance with ANSI B18.2 and provided with washers of the same material as the bolts.

K. The following shall be continuously indent printed on the pipe, or spaced at intervals not exceeding 5 feet:

1. Name and/or trademark of the pipe manufacturer.
2. Nominal pipe size.
3. Standard dimension ratio (SDR).
4. The letters PE followed by the polyethylene grade per ASTM D 1248, followed by the Hydrostatic Design basis in 100's of psi (e.g., PE 3408).

5. Manufacturing Standard Reference (e.g., ASTM F-714-1).

6. A production code from which the date and place of manufacture can be determined.

2.03 BUTTERFLY VALVES

A. Provide butterfly valves at locations on the landfill gas collection system as shown on Drawings as specified.

B. Service conditions:

1. Material handled: Landfill gas (55% CH_4, 40% CO_2, 5% other) saturated, corrosive.

2. Temperature gas: 100 to 150°F.

3. Average pressure: 1 to 5 inches mercury vacuum.

4. Location: Outdoor (-20 to 100°F).

C. Valves

1. Butterfly valves of indicated sizes are to be installed at each wellhead and at locations within the gas collection system as shown on the Drawings.

2. Valves shall have PVC bodies and polypropylene discs, be flanged, short body type and have stainless steel shafts.

3. Valve seats shall be of the resilient type, mounted in the body or on the disc. Seats and seals shall be of Teflon® or Viton.

4. Exposed valves, 4" and less in size, shall be hand lever activated with infinite adjustable setting capability.

5. Exposed valves greater than 4" in size and buried valves are to be gear box actuated with handwheels. Buried valve actuators are to include inner and outer extension shafts, as indicated on the Drawings.

2.04 BALL VALVES

A. Provide ball valves at locations shown on Drawings as specified.

B. Service conditions:

1. Material handled: Leachate and landfill gas condensate.

2. Temperature: 35 to 90 °F.

3. Average operating pressure: 50 psi

C. Thermoplastic ball valves shall be rated 150 psi at 75 °F, with ASTM D 1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem. Valves shall be flanged. Valves shall have replaceable Teflon seats and Viton or Teflon O-ring stem seals.

D. Exposed valves, 4" and less in size, shall be hand lever activated with infinite adjustable setting capability.

2.05 FLEXIBLE HOSE

A. Provide flexible hose at locations shown on Drawings and specified.

B. Specifications - wellhead flexible hoses:

1. Diameter of the hose shall be as shown on the Drawings and shall be constructed airtight by adapters to the HDPE piping system, as approved by the Owner.

2. Description: PVC suction hose (Kanaflex, Series 101 PS or Equal).

3. Ratings at 72 F
   Working Pressure: 30 psig.
   Vacuum Rating: 28.0 inches of mercury.

4. Minimum bending radius: 6.5 inches

C. Service conditions - wellhead flexible coupling:

1. Product flow: Landfill gas (approximately 55% CH_4, 40% CO_2, 5% other), saturated, corrosive.

2. Product temperature: 100 to 150°F.

3. Product pressure: 1 to 5 inches water vacuum.

4. Location: Exterior service.

D. Connections to flanged stub ends shall be by stainless steel hose clamp or manufacturer's standard, as approved by Owner.

2.06 TRACER TAPE

A. The tracer tape shall be constructed of a metallic core bonded between layers of plastic. The tape shall be a minimum 3 inches wide. The plastic shall be coated with the corrosion-resistant yellow color and the legend shall say "Gas Line Below".

PART 3 - EXECUTION

3.01 FAMILIARIZATION

A. Prior to implementing any of the work described in this Section, the Contractor shall become thoroughly familiar with all portions of the work falling within this Section.

B. Prior to implementing any of the work in this Section, the Contractor shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of this section may properly commence without adverse impact.

3.02 HANDLING AND PLACEMENT

A. The Contractor shall exercise care when transporting, handling and placing HDPE pipe and fittings, such that they will not be cut, kinked, twisted, or otherwise damaged.

B. Ropes, fabric or rubber-protected slings and straps shall be used when handling HDPE pipe. Slings, straps, etc. shall not be positioned at butt-fused joints. Chains, cables or hooks shall not be inserted into the pipe ends as a means of handling pipe.

C. Pipe or fittings shall not be dropped onto rocky or unprepared ground. Under no circumstances shall pipe or fittings be dropped into trenches, or dragged over sharp and cutting objects.

D. HDPE pipe shall be stored on clean level ground, preferably turf or sand, free of sharp objects which could damage the pipe. Stacking shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary, due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports. The pipes should be stored out of direct sunlight.

E. The maximum allowable depth of cuts, gouges or scratches on the exterior surface of HDPE pipe or fittings is 10 percent of the wall thickness. The interior of the pipe and fittings shall be free of cuts, gouges and scratches. Sections of pipe with excessive cuts, gouges or scratches shall be removed and the ends of the pipe rejoined at no cost to the Owner.

3.03 PIPE INSTALLATION

A. General

1. All HDPE pipe and fittings shall be installed in accordance with the manufacturer's instructions.

2. The Contractor shall carefully examine all pipe and fittings for cracks, damage or defects before installation. Defective materials shall be immediately removed from the site and replaced at no cost to the Owner.

3. The interior of all pipe and fittings shall be inspected, and any foreign material shall be completely removed from the pipe interior before it is moved into final position.

4. Field-cutting of pipes, where required, shall be made with a machine specifically designed for cutting pipe. Cuts shall be carefully made, without damage to pipe or lining, so as to leave a smooth end at right angles to the axis of the pipe. Cutter ends shall be tapered and sharp edges filed off smooth. Flame cutting will not be allowed.

B. Gas Extraction Wells

1. The Contractor shall install vertical sections of perforated piping at each of the well locations shown on the Drawing. This pipe shall be set in a boring into the waste, supported vertically and backfilled as specified.

2. The perforated pipe shall be topped with the 8" x 6" slip coupling and 6" solid wall pipe with blind flange, as indicated on the Drawings. The solid wall HDPE riser pipe shall extend from the pipe connections to a height of six (6) feet above the existing grade of the landfill.

3. The Contractor shall secure the gas wells with the indicated well washer.

C. The piping shall be installed as indicated on the Drawings and in accordance with Section 02200 of these Specifications.

3.04 JOINTS AND CONNECTIONS

A. HDPE pipe, fittings and flange connections shall be joined with thermal butt-fusion joints. All joints shall be made in strict compliance with ASTM D 2657 and the manufacturer's recommendations, and shall be performed by manufacturer's authorized, trained personnel. Pipe lengths, fittings, and flanged connections to be joined by thermal butt-fusion shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.

B. Mechanical connections of the polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through flanged connections unless noted otherwise, which shall consist of the following:

1. A polyethylene "stub end" shall be thermally butt-fused to the ends of the pipe.

2. Provide ASTM A 240, Type 304 stainless steel backing flange, 125-pound, ANSI B16.1 standard. Insulating flanges shall be used where shown.

3. Bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to the manufacturer's standard. Retorque the nuts after 4 hours.

4. Gaskets as specified.

C. Butt-fusion of pipes and fittings shall be performed in accordance with the pipe manufacturer's recommendations as to equipment and technique. Depending on site conditions, butt-fusion joining shall be performed in or outside of the excavation at the Contractor's option.

D. Each joint shall be swabbed and visually inspected inside and outside for damage, dirt, or moisture inside the joint prior to fusing. All open pipe ends will be capped at the end of the work day to prevent foreign material from entering the pipe.

E. Pipe ends shall be wiped clean and ends squared with the facing tool of the fusion machine. Alignment shall be checked to see that the pipe ends meet squarely over the entire surface to be fused. The heater plate shall be applied so as to achieve a melt pattern to a depth of 3/16 inches. The pipe ends shall be carefully removed from the ends. The pipe shall be brought together under sufficient pressure to form a double roll-back bead of 3/16-inch minimum width. After the joint has cooled, the pressure shall be released and the pipe shall be removed from the clamps.

F. Polyethylene pipe connected to heavy fittings, manholes, and rigid structures shall be supported in such a manner that no subsequent relative movement between the polyethylene pipe at the flanged joint and the rigid structures is possible.

3.05 PRODUCT PROTECTION

A. The Contractor shall use all means necessary to protect all prior work and materials and completed work of other Sections.

B. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary, to the approval of the Owner and at no additional cost to Owner.

3.06 FIELD QUALITY CONTROL

A. General

1. Upon completion of piping, but prior to covering concealed/buried piping, test all piping systems.

2. Utilize pressures, media and pressure test durations as specified.

3. Isolate equipment which may be damaged by the specified pressure test conditions.

4. Perform pressure test using calibrated pressure gages. Select each gage so that the specified test pressure falls within the upper half of the gage's range. Notify the Owner 24 hours prior to each test.

5. Unless otherwise specified, completely assemble and test new piping systems prior to connection to existing pipe systems.

6. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

B. HDPE Collection System Testing

1. Backfilling over installed piping shall not be done until a successful pressure test of all piping has been completed to the satisfaction of Owner.

2. All piping shall be pressure tested in accordance with ASTM F 1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air. All testing shall be done in the presence of Owner. After test approval by the Owner, the trench will be backfilled.

3. The pipeline may be tested in sections at the discretion of or with the approval of the Owner.

4. Contractor shall furnish and install all required vents, purges, plugs and blind flanges and make all necessary connections and all other required preparations required for the tests. Contractor shall provide all pressurizing equipment, furnish and install temporary piping supports required for the entire length of the pneumatic tests.

5. Contractor shall repair any leaks found in fusion joints which he has made cutting/removing defective joint and fusing pipe ends together using proper polyethylene fusion procedures.

6. No pipe installation will be accepted until it meets all pressure test requirements.

7. No pipe installation will be accepted should there be evidence of exterior surface damage to the pipe, that in the opinion of the Owner, may compromise the integrity of the system, even though it may pass the pressure test requirements.

8. Pipe with exterior surface damage greater than 10 percent of the pipe diameter will not be accepted.

9. All costs associated with the pressure testing of pipe and any repair of damaged pipe shall be borne by the Contractor.

3.07 CLEANING

A. Clean interior of piping systems thoroughly before installing.

B. Maintain pipe in clean condition during installation.

C. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.

3.08 LOCATION OF CONSTRUCTED SYSTEM

A. The Contractor shall furnish an As-Built Plan showing exact horizontal and vertical locations and description of the constructed facilities. The As-Built Plan shall indicate the location of all wells, tees, connections, valves, header pipe at 50 foot intervals and at elbows and any other pertinent information which will be required by future contractors for replacement servicing, or adjacent construction around any buried facility.

TABLE 02714-1
HDPE PIPE AND FITTINGS PROPERTIES

PROPERTIES	UNITS	SPECIFIED VALUES	TEST METHOD
Density	g/cm^3	0.941 - 0.955	ASTM D 1505
Melt Flow	g/10 min	< 0.15	ASTM C 1238 Condition E
Flex Modulus	psi	110,000 - 160,000	ASTM D 790
Tensile Strength at Yield	psi	3,000 - 5,000	ASTM D 638
Environmental Stress Cracking	hrs	> 5,000	ASTM D 1693 Condition C
Hydrostatic Design Basis	psi	1,500 @ 23°C	ASTM D 2837

END OF SECTION

SECTION 02715

PERFORATED CORRUGATED POLYETHYLENE PIPE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation and installation equipment necessary for the installation of heavy duty corrugated polyethylene tubing, fittings and appurtenances in conjunction with the drainage layer subdrains and toe drains, as specified herein and as shown on the Drawings.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02210 - Sand

1.03 REFERENCES

A. Latest version of the American Society for Testing and Materials (ASTM) standards:

1.	ASTM D 618	Method for Conditioning Plastics and Electrical Insulating Materials for Testing
2.	ASTM D 883	Definition of Terms Relating to Plastics
3.	ASTM D 1248	Specifications for Polyethylene Plastics Molding and Extrusion Materials
4.	ASTM D 1693	Test Method for Environmental Stress Cracking of Ethylene Plastics
5.	ASTM D 2122	Method of Determining Dimensions of Thermoplastics Pipe and Fittings
6.	ASTM D 2412	Test Method for External Loading Properties of Plastic Pipe by Parallel-Plate Loading
7.	ASTM F 412 D	Definitions of Terms Relating to Plastic Piping Systems

1.04 SUBMITTALS

A. The Contractor shall submit to the Owner for approval, a list of materials to be furnished, the names of the suppliers and the results of physical testing performed by the Manufacturer.

B. The Contractor shall submit to the Owner the PE pipe Manufacturer's certification of compliance with this Section for all materials delivered to the site, and shall comply with the pipe Manufacturer's recommendation for handling, storing, and installing PE pipes and fittings.

C. The Contractor shall submit to the Owner, in writing, the following documentation from the PE pipe Manufacturer on the raw materials used to manufacture the PE pipe and fittings prior to transporting any PE pipe or fittings to the site.

1. Certificate stating the specific resin, its source and the information required by ASTM D 1248.

2. Certification that no recycled compound has been added to the resin except that generated in the Manufacturer's own plant from resin of the same specification from the same raw material.

PART 2 - PRODUCTS

2.01 POLYETHYLENE (PE) COMPOUND

A. The PE pipe and fittings shall be made of virgin PE compound which conforms with the requirements of Type III, Category 4 or 5, Grade P33, Class C or Grade P34 Class C as described in ASTM D 1248.

2.02 CORRUGATED POLYETHYLENE (PE) PIPE AND FITTINGS

A. All corrugated PE pipe and fittings shall comply with ASTM F 405.

B. All corrugated PE pipe and fittings shall have a nominal inside diameter as shown on the Drawings and shall be rated for heavy duty commercial use.

C. Corrugated PE pipe shall be supplied in standard laying lengths which facilitate handling and placement and minimize joint connections.

D. Corrugated PE pipe shall be furnished in perforated and non-perforated sections.

1. Perforations shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the pipe.

2. Circular perforations shall not exceed 3/16 inch in diameter. Width of slots shall not exceed 1/8 inch. The length of individual slots shall not exceed 10 percent of the pipe inside nominal circumference.

3. Slots shall be centered in the valleys of the corrugation. The water inlet area shall be a minimum of 1 square inch per linear foot of piping.

E. PE fittings shall not reduce or impair the overall integrity or function of the pipe. All inline fittings, such as couplings shall be "spin-on" type. All other assembly fittings such as tees, wye's and end caps shall be "snap-on" type. All fittings shall provide for a strong connection to the main piping and shall be resistant to pull-out.

2.03 PIPING PROTECTIVE WRAP

A. Where indicated on the Drawings corrugated perforated PE piping shall be wrapped with geotextile fabric to prevent the movement of fine soil particles and clogging of the pipe.

B. Geotextile pipe wrap shall be installed by the pipe manufacturer prior to shipment to the site.

C. Geotextile pipe wrap shall conform to the following criteria:

Physical Properties	Nominal Values
Weight, Oz. Per Sq. Yd. (ASTM D 3776)	2.5 to 3.5
Fiber Size, Denier Per Filament	100 to 200
Burst Strength, PSI (ASTM D 3786)	100 to 135
Air Permeability CFM Per Sq. Ft. (ASTM D 737)	700
Equivalent Opening Size (EOS) (U.S. Standard Sieve Size)	30 to 40

PART 3 - EXECUTION

3.01 DRAINAGE LAYER INTERCEPTOR

A. Four (4) inch inside diameter, heavy duty, perforated, corrugated polyethylene piping with a geotextile wrap shall be installed where shown on the Drawing. The intent of this piping is to intercept stormwater which has infiltrated the topsoil layer of the landfill cap into the sand drainage layer and to provide discharge of this water to the adjacent drainage channel network.

B. The perforated interceptor piping shall be fitted with solid wall outlet tees and extension piping at the locations shown on the Drawings.

C. All piping connections shall be made in accordance with manufacturer's recommendations and shall be secure and resistant to separation.

D. All piping and appurtenances are intended for placement on top of the impermeable HDPE geomembrane layer and installed within the sand drainage layer of the landfill cap, as shown on the Drawings.

E. The Contractor shall protect and maintain the integrity of the impermeable layer during all construction activities.

F. The Contractor shall be responsible for developing a construction sequence and procedure that will ensure the protection of the lateral drainage interceptor piping system during the placement of subsequent soil layers against pipe crushing or buckling.

G. The open ends of the interceptor outlet piping shall be fitted with polyethylene mesh screens to prevent rodent access.

H. Small crushed stone aprons shall be constructed at each outlet pipe for erosion protection.

END OF SECTION

PART G

DRAWINGS

No.	Date	Revision Description	Chkd. by	Appvd. by

scale: AS SHOWN
date: DEC. 6, 2022
drawn: TBD
checked: ARQ
approved: ARQ
drawing number: 1

project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title: EXISTING SITE CONDITIONS AND PROPOSED PHASE 9 STAGING PLAN

SITEC ENVIRONMENTAL
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Land Use Planning and Surveying
Hazardous and Solid Waste Consultants

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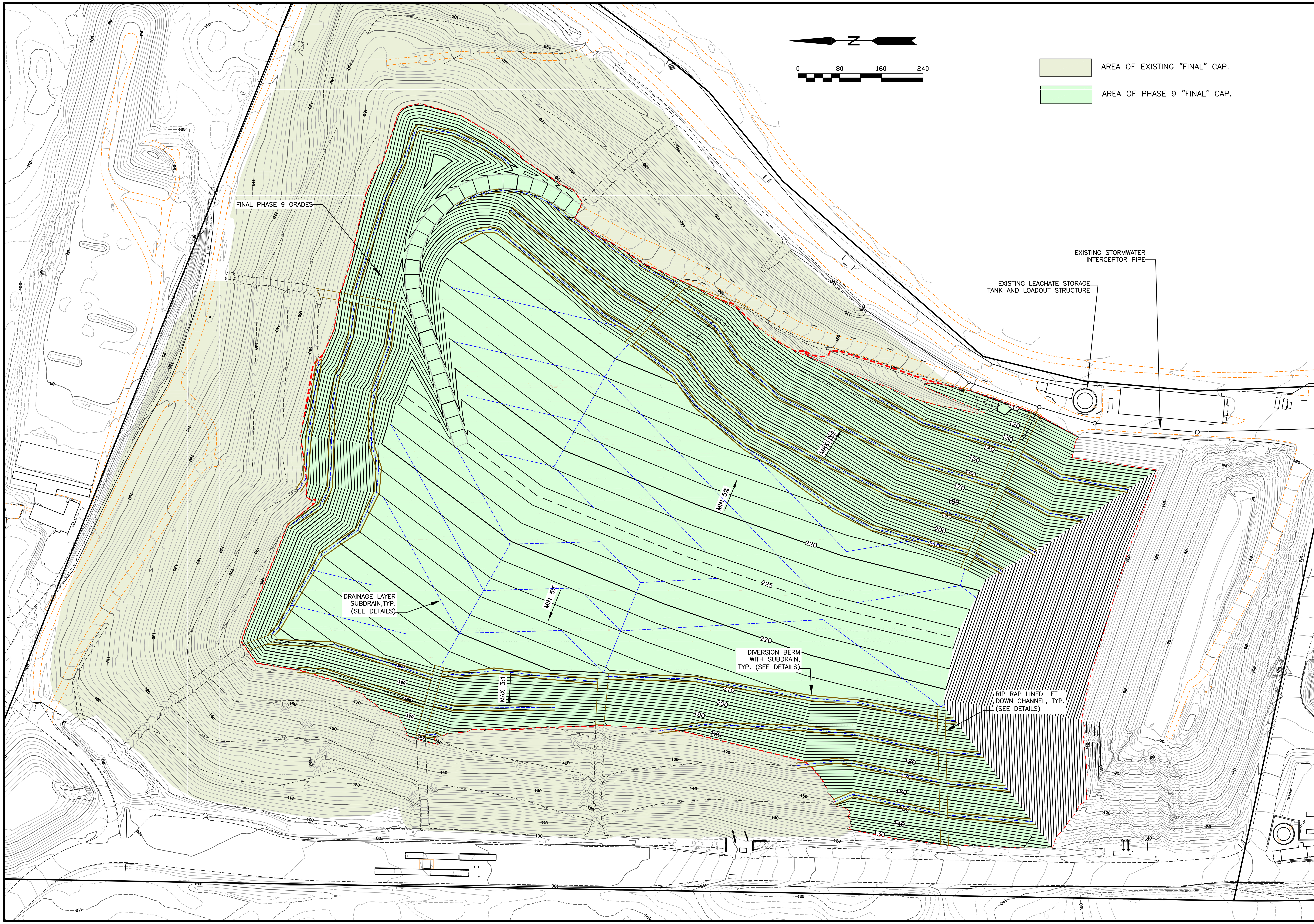
Acad No. PHASE 9 ATC PLAN.dwg
SE01-456-13



No.	Date	Revision Description	Chkd. by	Appvd. by

project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title: FINAL GRADING SITE PLAN

scale: AS SHOWN
date: DEC. 6, 2022
drawn: TBD
checked: ARQ
approved: ARQ
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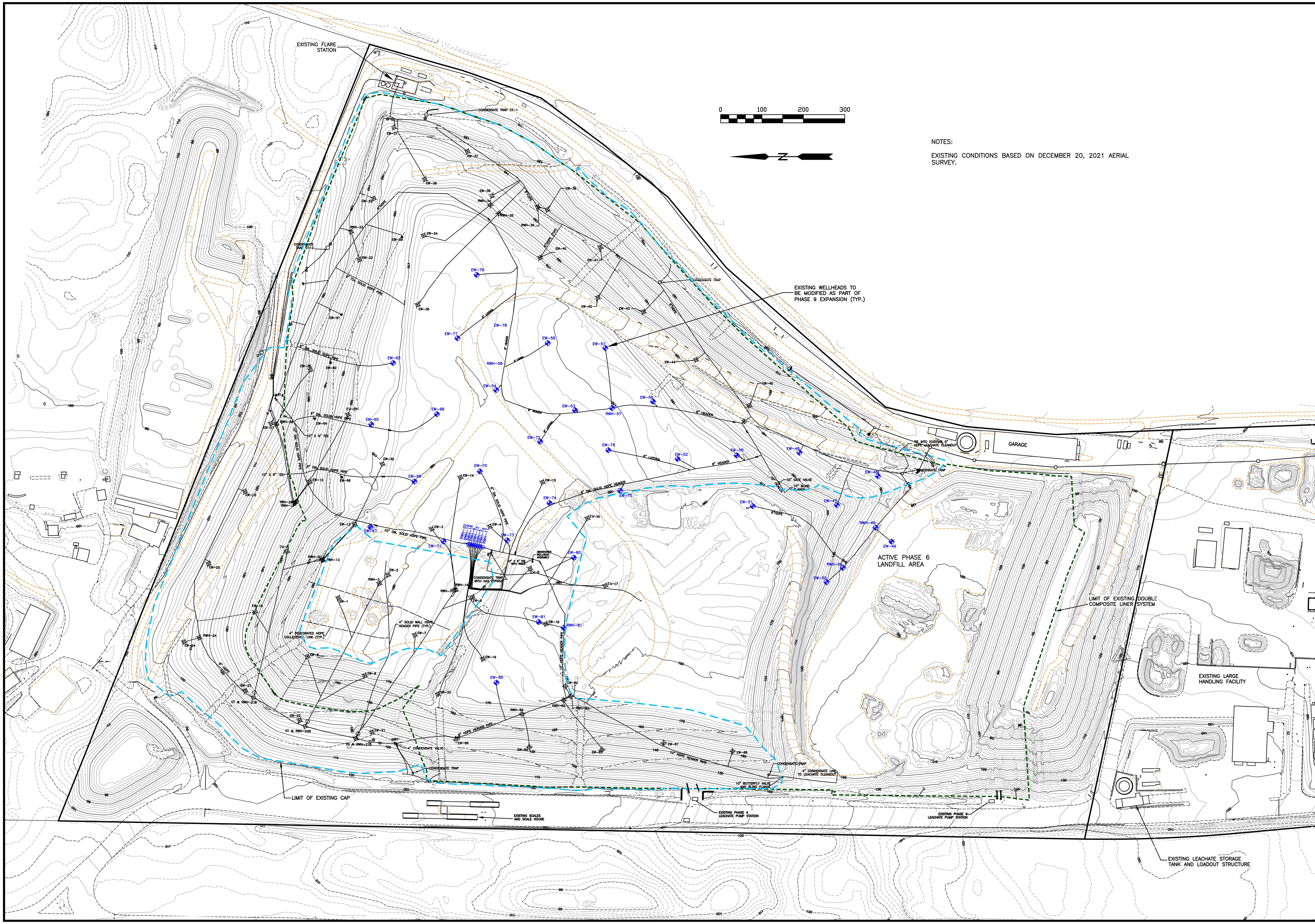

NOTES:

EXISTING CONDITIONS BASED ON DECEMBER 20, 2021 AERIAL SURVEY.

No.	Date	Revision Description	Chkd. by	Appvd. by

scale: AS SHOWN
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approved: ARQ
drawing number: 3

project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title: EXISTING GAS COLLECTION SYSTEM PLAN

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SE01-456-13

0 60 120 180
N
GARAGE
EW-51
8" HDPE
RWH-49
EW-49
VERTICALLY EXTEND EXTRACTION WELLS EW-49, EW-50 AND EW-51 AND REMOTE WELLHEADS OR REPLACE WITH TEMPORARY HORIZONTAL COLLECTION SYSTEM
RWH-50
EW-50
PHASE 6 INTERIM SUBGRADES (TYP.)
INV. = +/- 155.0
6" PERF. HDPE LEACHATE COLLECTION LINE, MIN SLOPE = 5%
INV. = +/- 149.0
PHASE 9, STAGE 1 FILL
LIMIT OF EXISTING CAP
EXISTING SCALES AND SCALE HOUSE
EXISTING PHASE 4 LEACHATE PUMP STATION
6" SOLID HDPE LEACHATE LINE CONNECTED TO PHASE 6 8" LEACHATE CLEANOUT LINE
EXISTING PHASE 6 LEACHATE PUMP STATION
No.
Date
Revision Description
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project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION
client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT
drawing title: PHASE 6 INTERIM AND PHASE 9, STAGE 1 GRADING SITE PLAN
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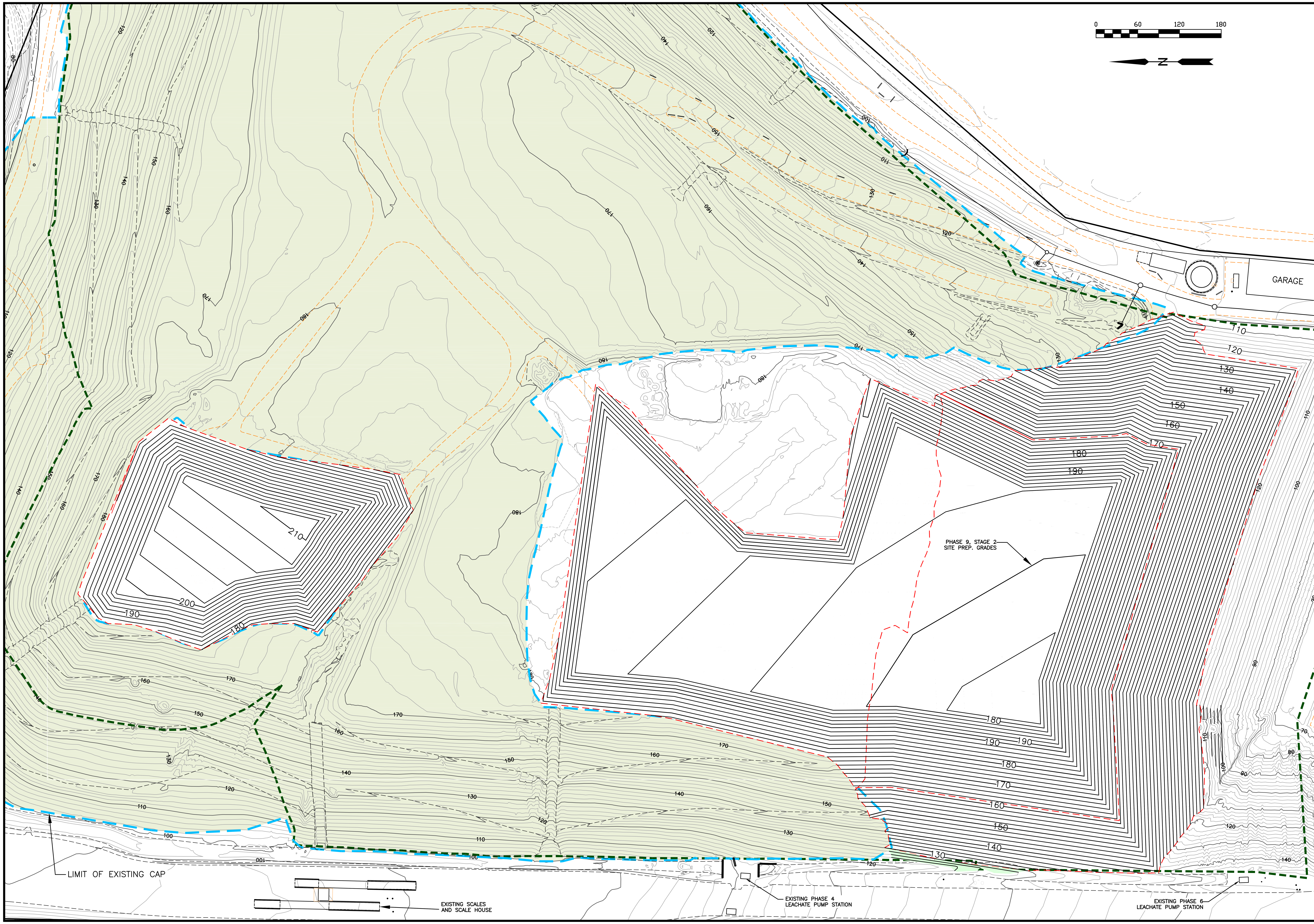
SE01-456-13



No.	Date	Revision Description	Chkd. by	Appvd. by

project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title: PHASE 9, STAGE 2 PREPARATION
GRADING SITE PLAN

scale: AS SHOWN
date: DEC. 6, 2022
drawn: TBD
checked: ARQ
approved: ARQ
drawing number: 5

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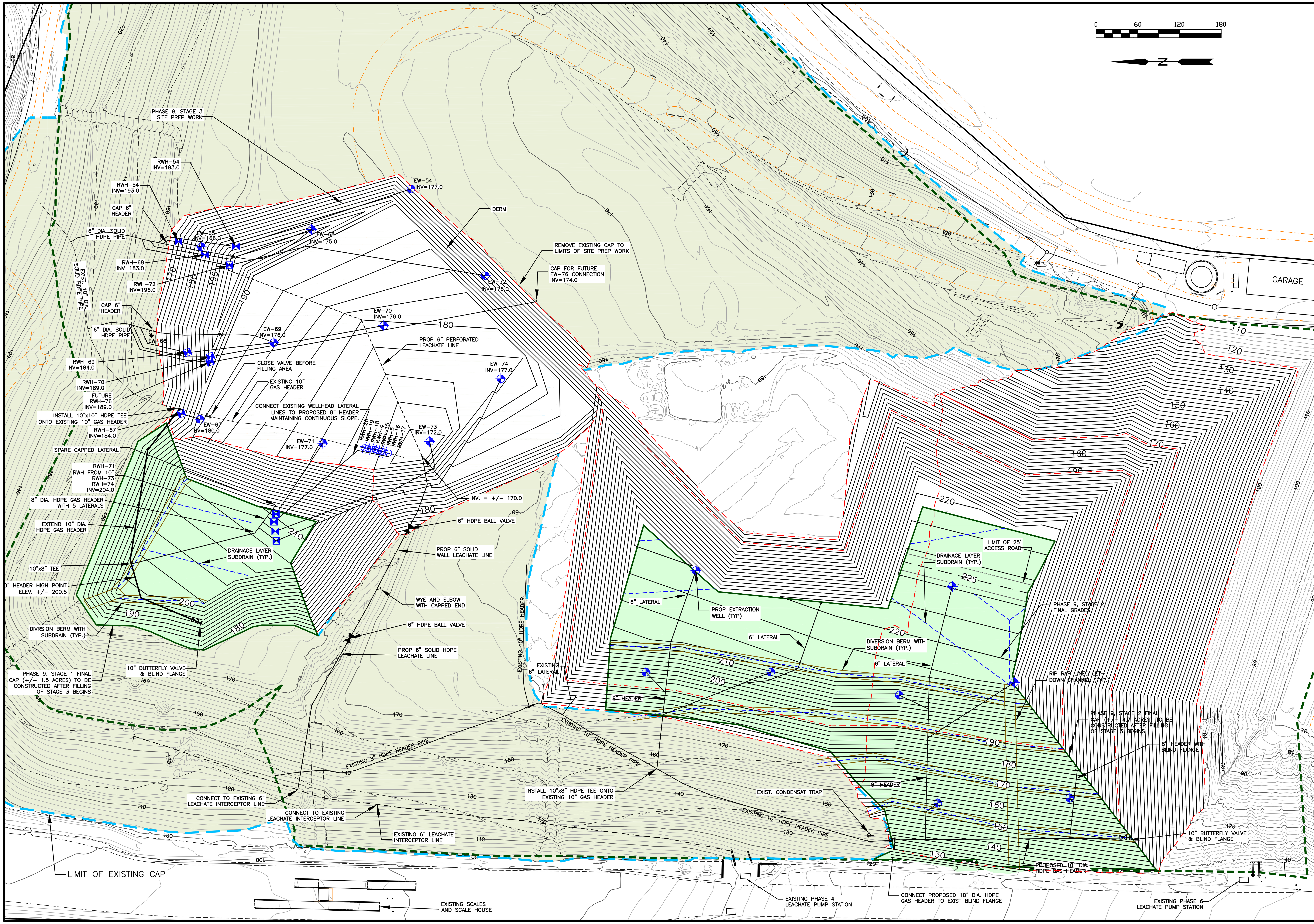
SE01-456-13



No.	Date	Revision Description	Chkd. by	Appvd. by

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approved: ARQ
drawing number: 6

project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title: PHASE 9, STAGE 2 FILLING AND STAGE 3 PREPARATION GRADING SITE PLAN

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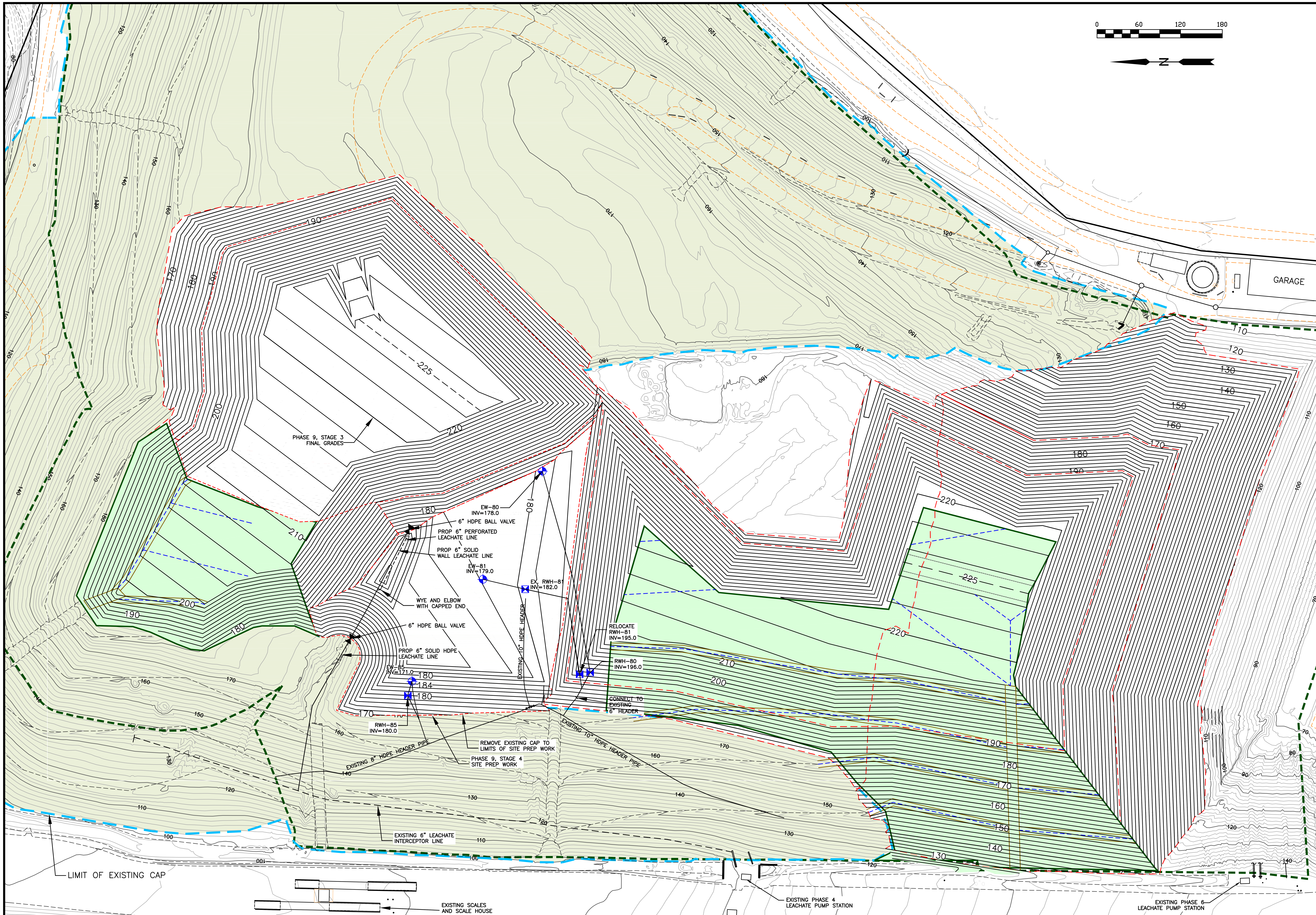

No.	Date	Revision Description	Chkd. by	Appvd. by

project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title: PHASE 9, STAGE 3 FILLING AND STAGE 4 PREPARATION GRADING SITE PLAN

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date: DEC. 6, 2022
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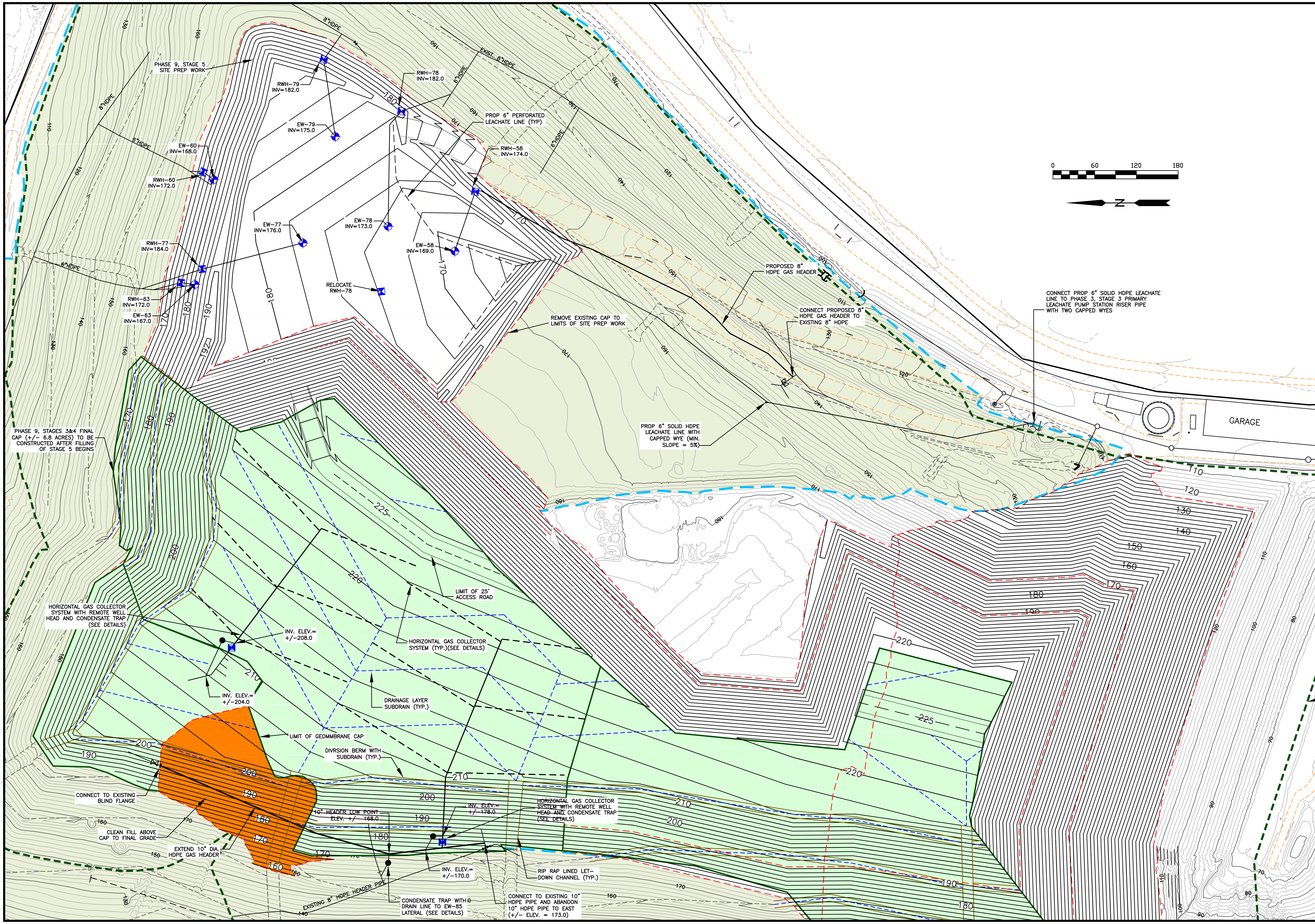
SE01-456-13



No.	Date	Revision Description	Chkd. by	Appvd. by

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drawn: TBD
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approved: ARQ
drawing number: 8

project:
BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client:
TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title:
PHASE 9, STAGE 4 FILLING AND STAGE 5 PREPARATION GRADING SITE PLAN

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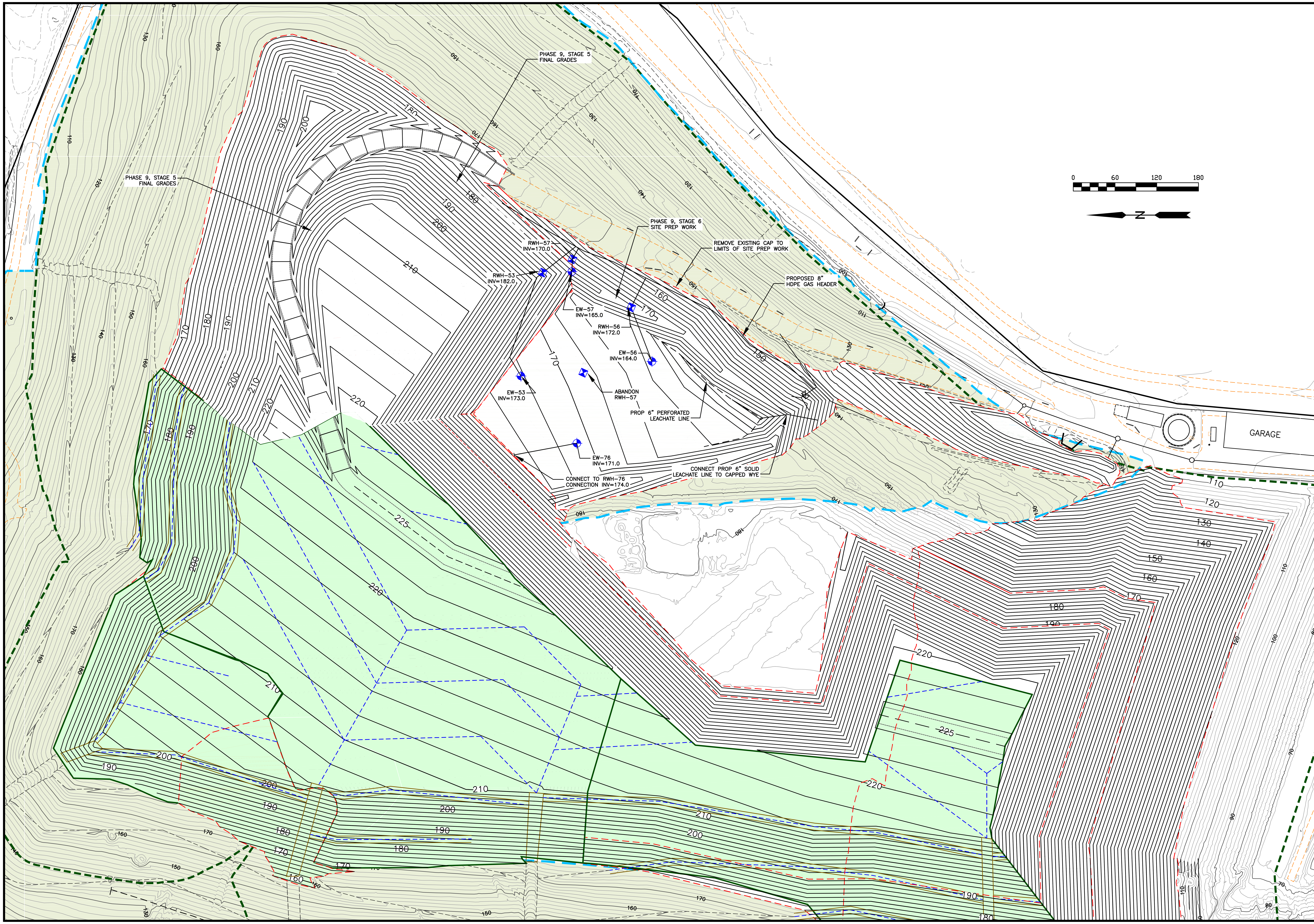
PHASE 9 CONCEPT PLAN.dwg
SE01-456-13



Revision Description

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project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title: PHASE 9, STAGE 5 FILLING AND STAGE 6
PREPARATION GRADING SITE PLAN

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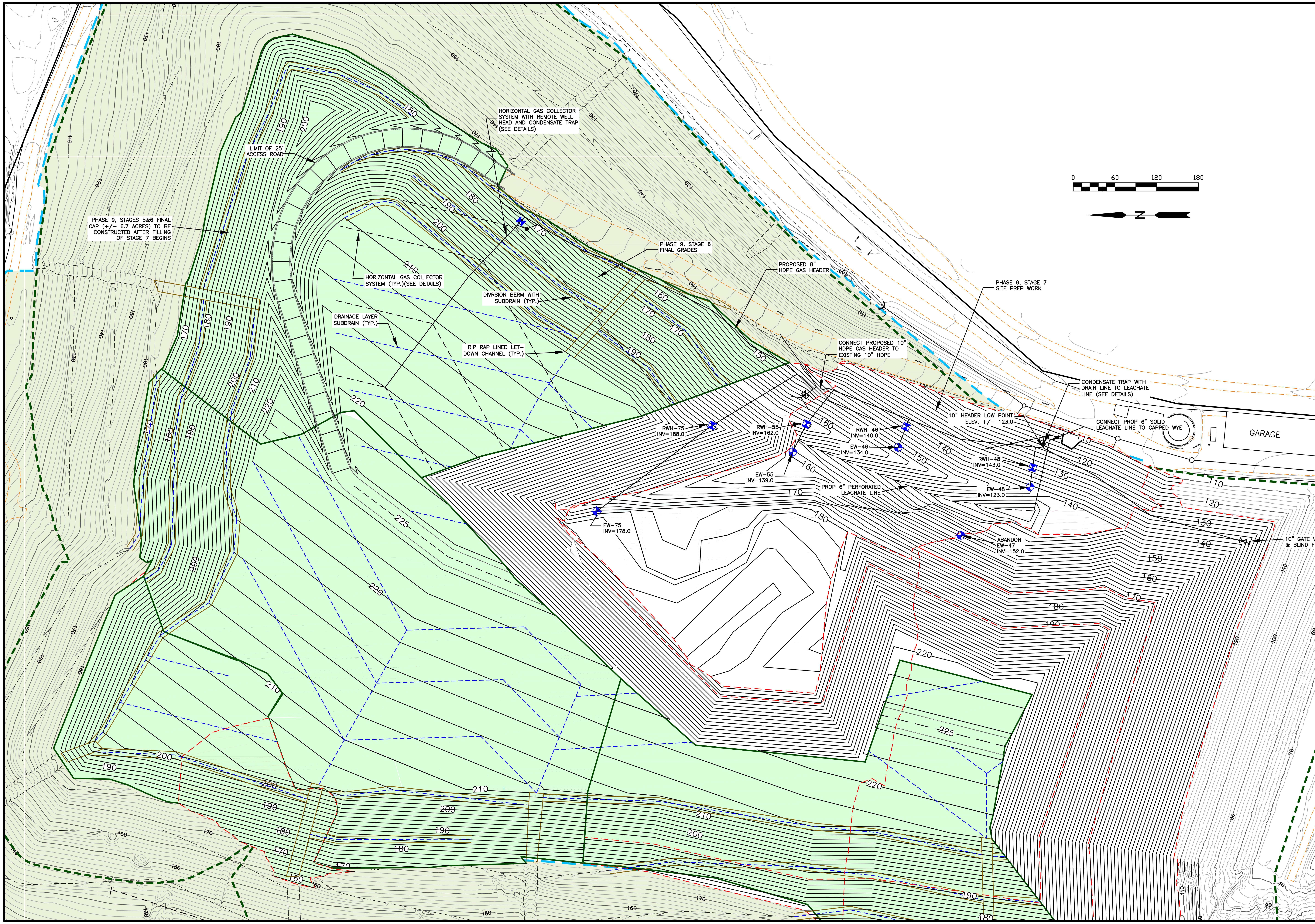
SE01-456-13



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date:	DEC. 6, 2022
drawn:	TBD
checked:	ARQ
approved:	ARQ
drawing number:	10

project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title: PHASE 9, STAGE 6 FILLING AND STAGE 7 PREPARATION GRADING SITE PLAN

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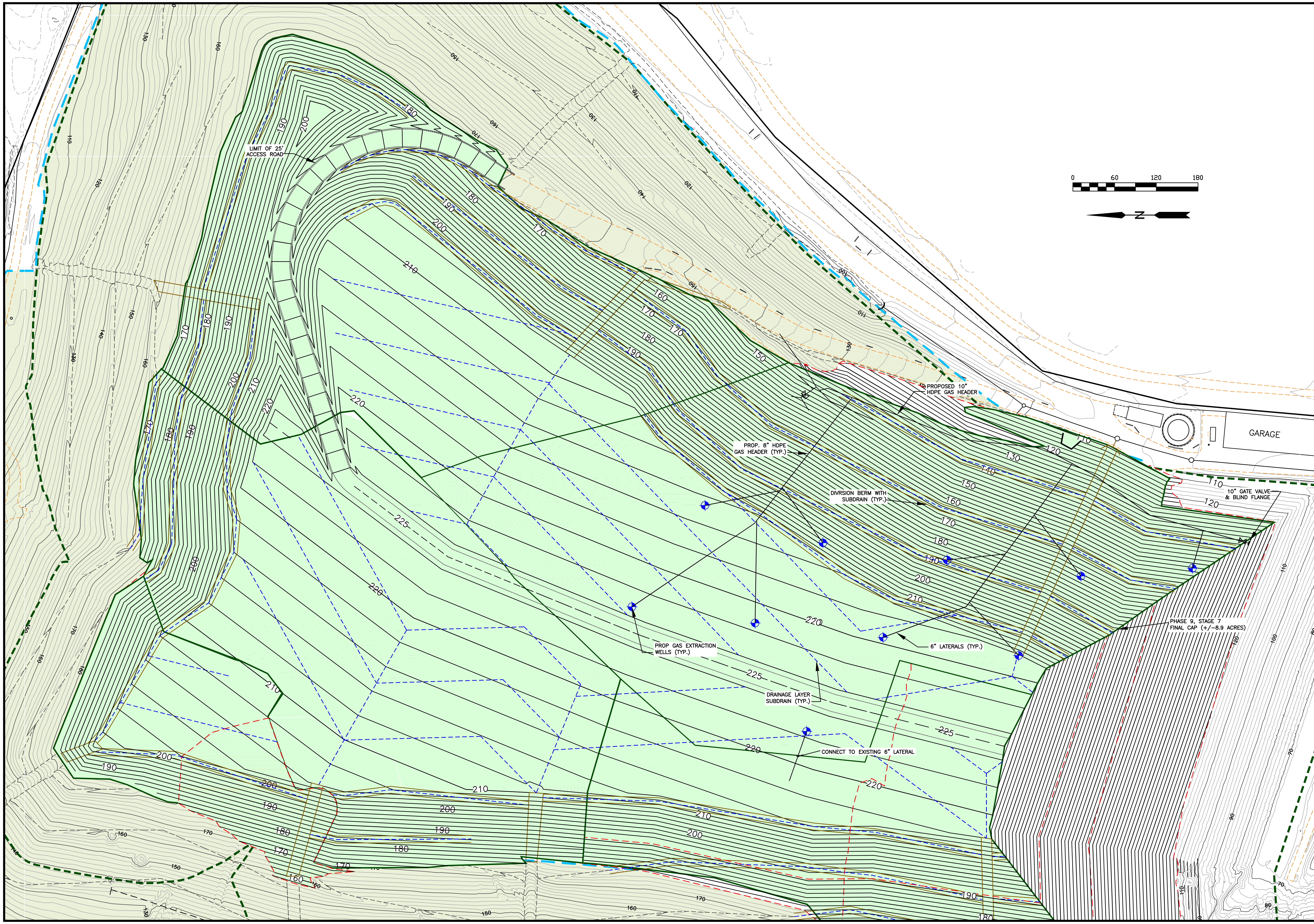
SE01-456-13



No.	Date	Revision Description	Chkd. by	Appvd. by

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approved: ARQ
drawing number: 11

project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title: PHASE 9, STAGE 7 FILLING AND FINAL GRADING SITE PLAN

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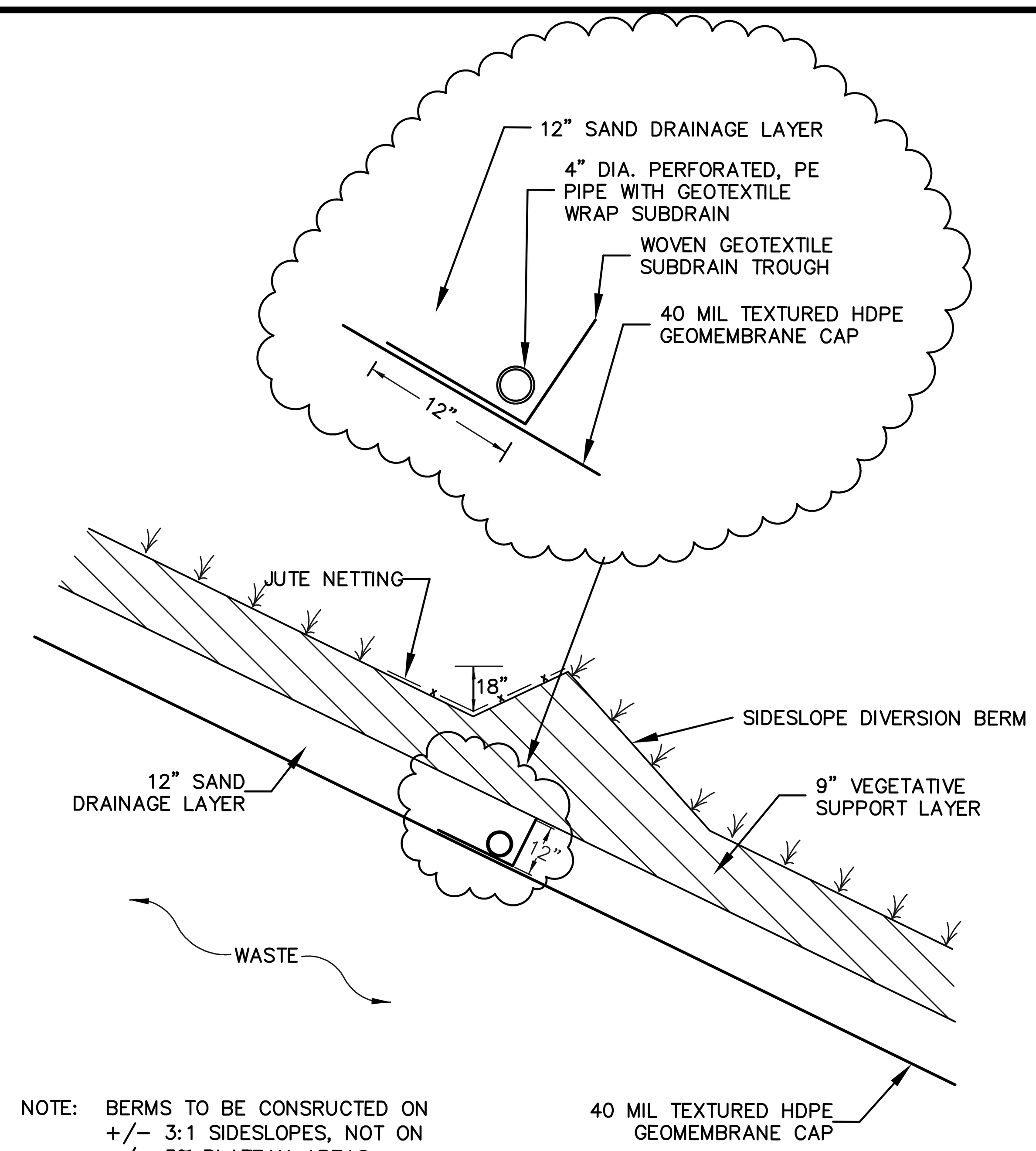
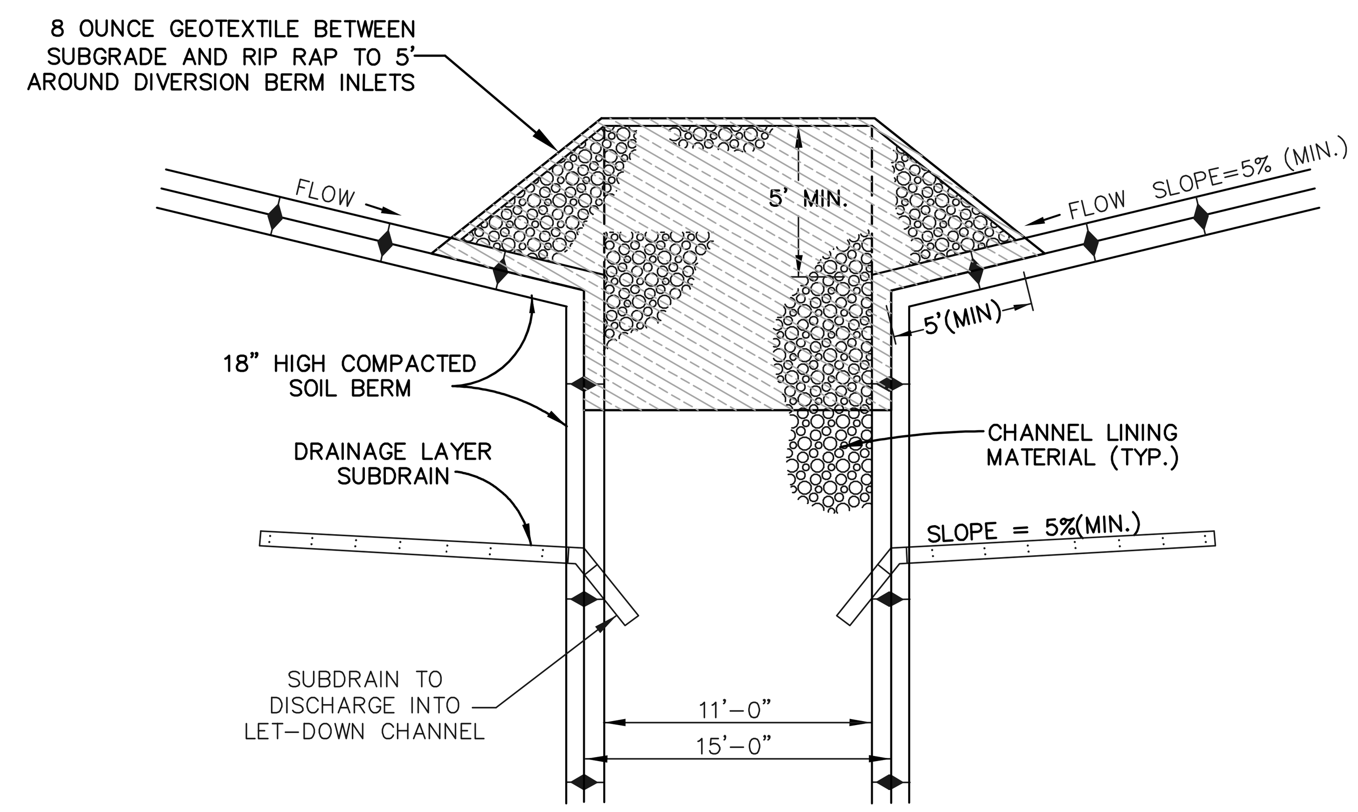
Acad No.
PHASE 9 CONCEPT PLAN.dwg
SE01-456-13

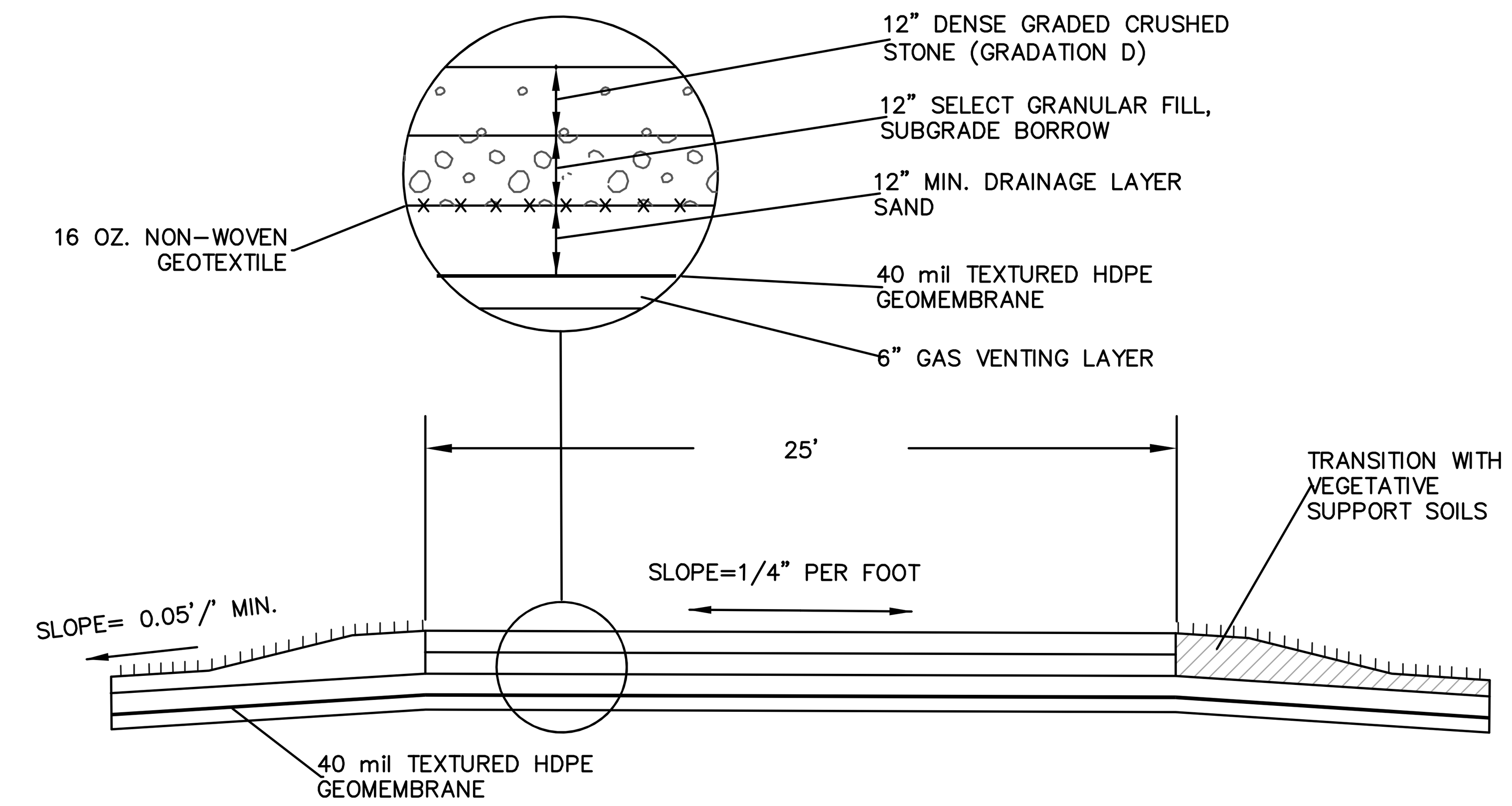


NOTE: BERMS TO BE CONSRUCTED ON +/- 3:1 SIDESLOPES, NOT ON +/- 5% PLATEAU AREAS.

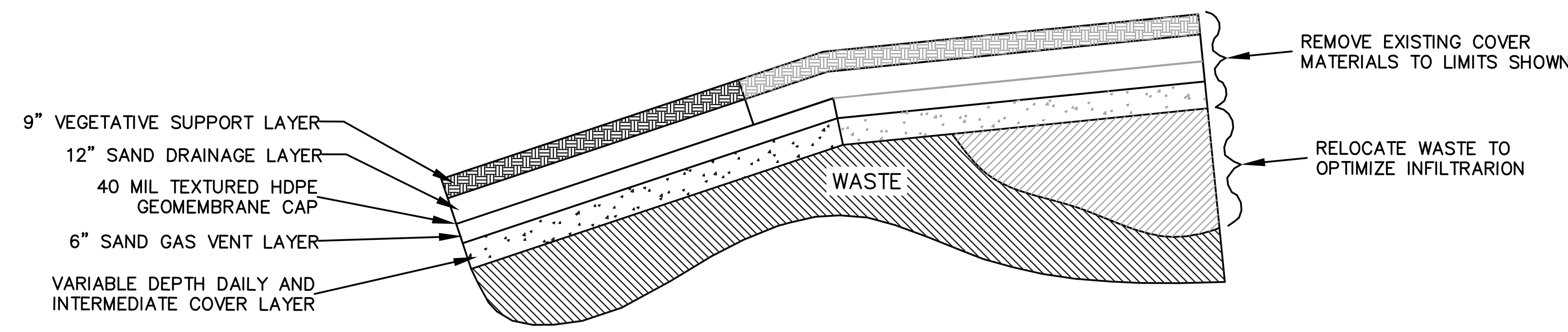
DIVERSION BERM/SUBDRAIN
GEOMEMBRANE FINAL COVER
NOT TO SCALE



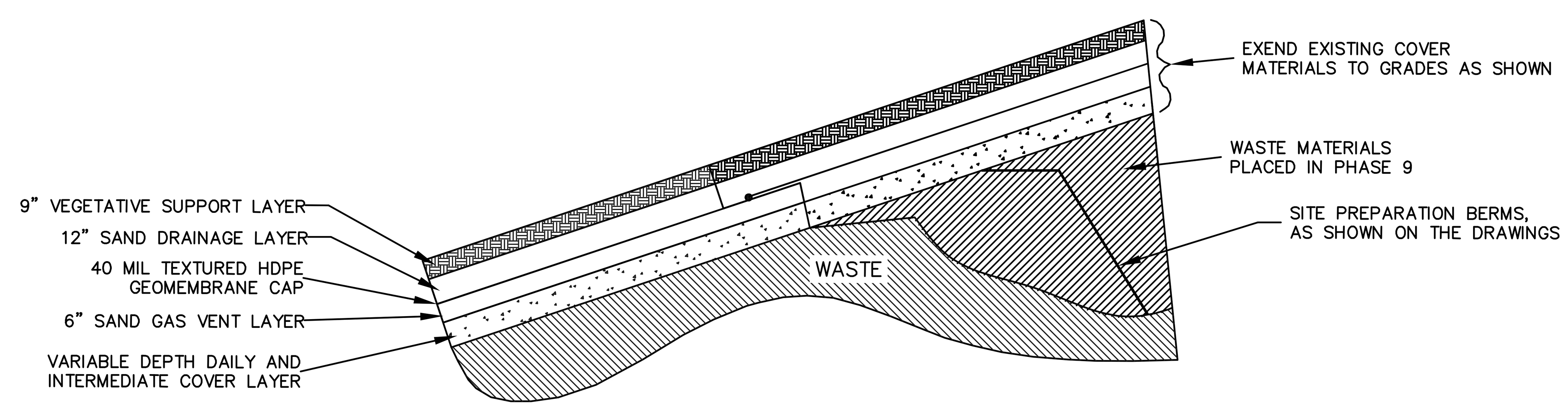
LET-DOWN CHANNEL INLET
NOT TO SCALE



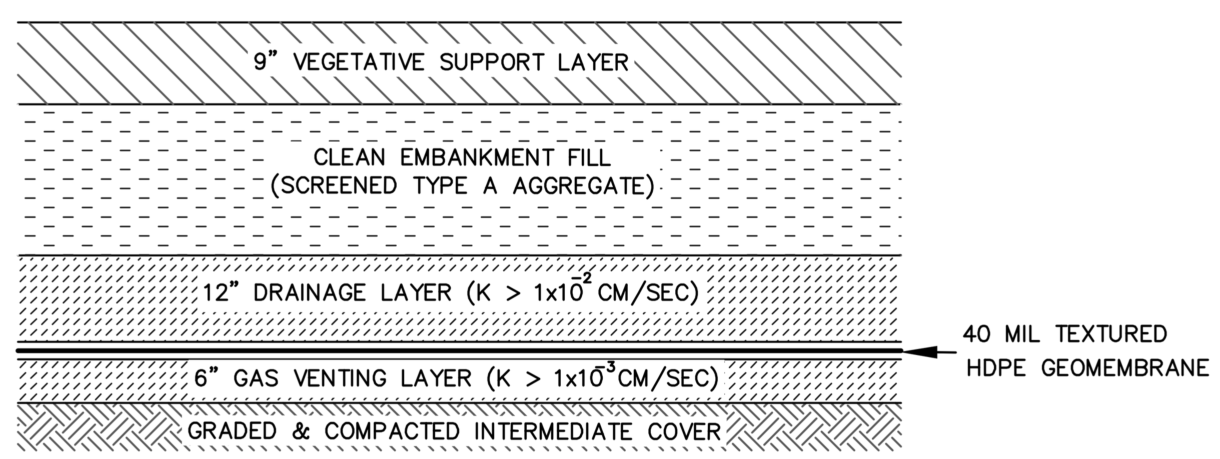
ACCESS ROAD - TOP OF LANDFILL
NOT TO SCALE



SITE PREPARATION - MODIFICATION OF
EXISTING FILL AND COVER MATERIALS
NOT TO SCALE

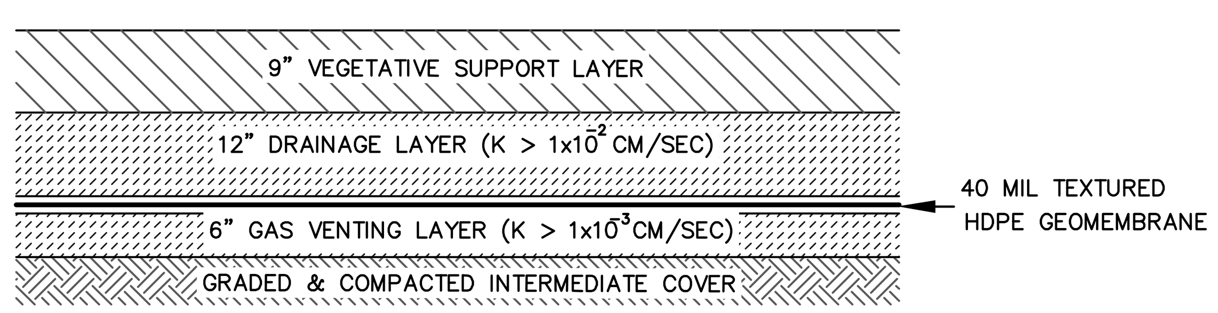


PHASE 9 FILLING AND CONNECTION
TO EXISTING AND EXTENDING CAP
NOT TO SCALE

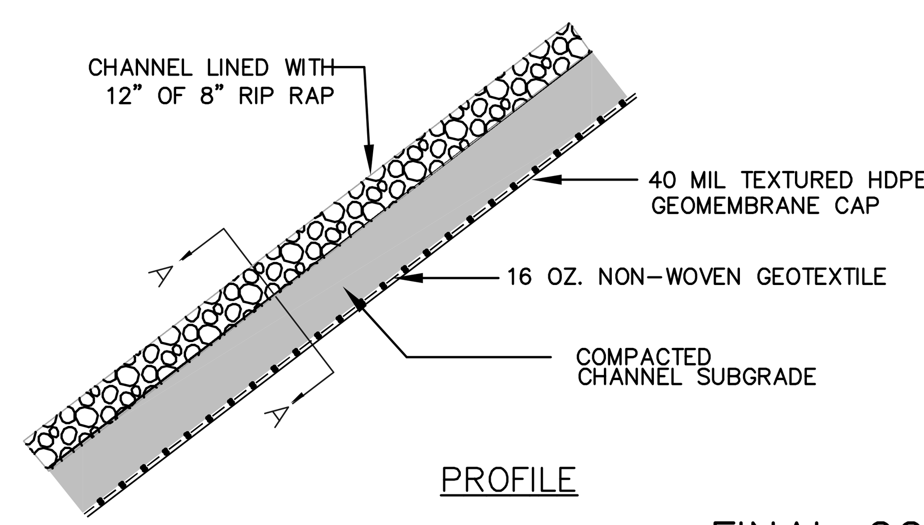


TYPICAL FINAL COVER DETAIL
WITH CLEAN FILL

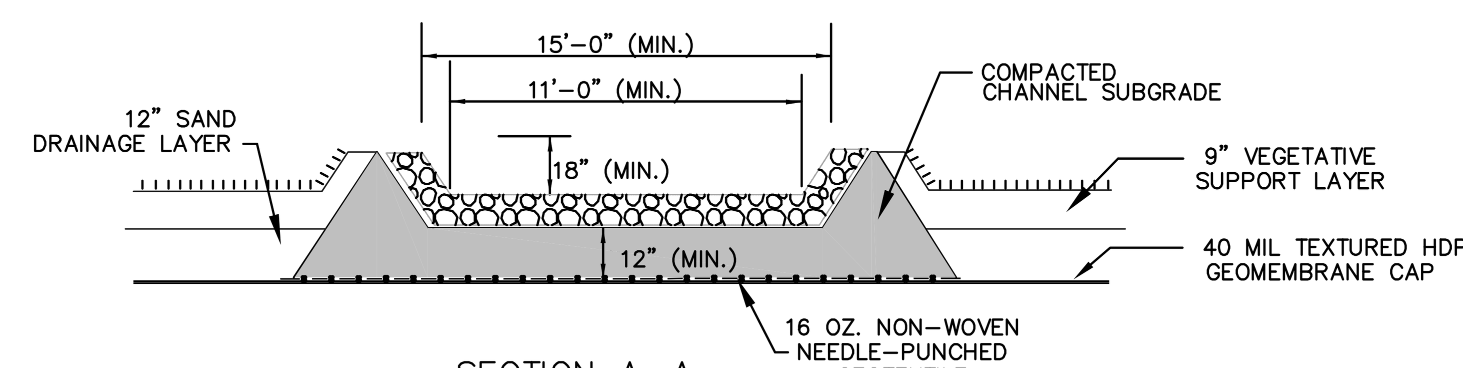
NOT TO SCALE



TYPICAL FINAL COVER DETAIL
NOT TO SCALE



PROFILE



SECTION A-A

FINAL COVER
LET-DOWN CHANNEL
NOT TO SCALE

NOTES: CHANNEL LINING MATERIAL WILL CONSIST OF A 6 INCH LAYER OF WELL-GRADED RIP-RAP.
RIP RAP CHANNEL LINING SHALL BE TAMPED TO SET STONE INTO CHANNEL SUBGRADE MATERIAL TO FORM A STABLE MASS.

No.	Date	Revision Description	Chkd. by	Appvd. by

scale: AS SHOWN
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approved: ARQ
drawing number: 12

project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title: CAPPING DETAILS

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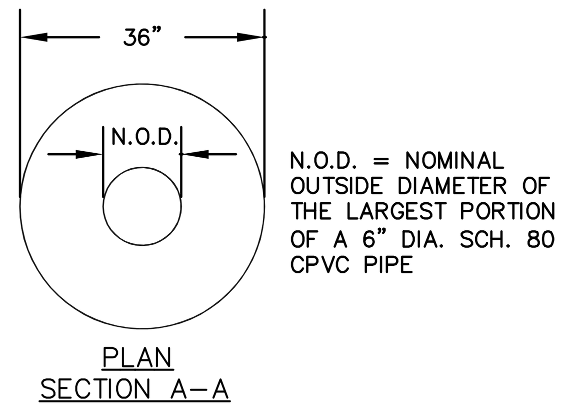
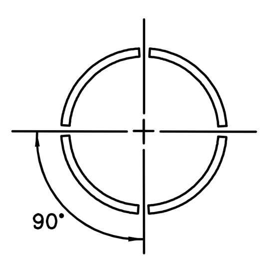
File No. SE01-456-13



HDPE WELL WASHER DETAIL

NOT TO SCALE



SECTION B–B

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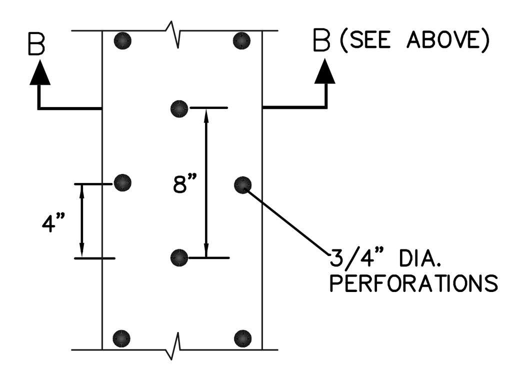

PERFORATED WELL PIPE DETAIL

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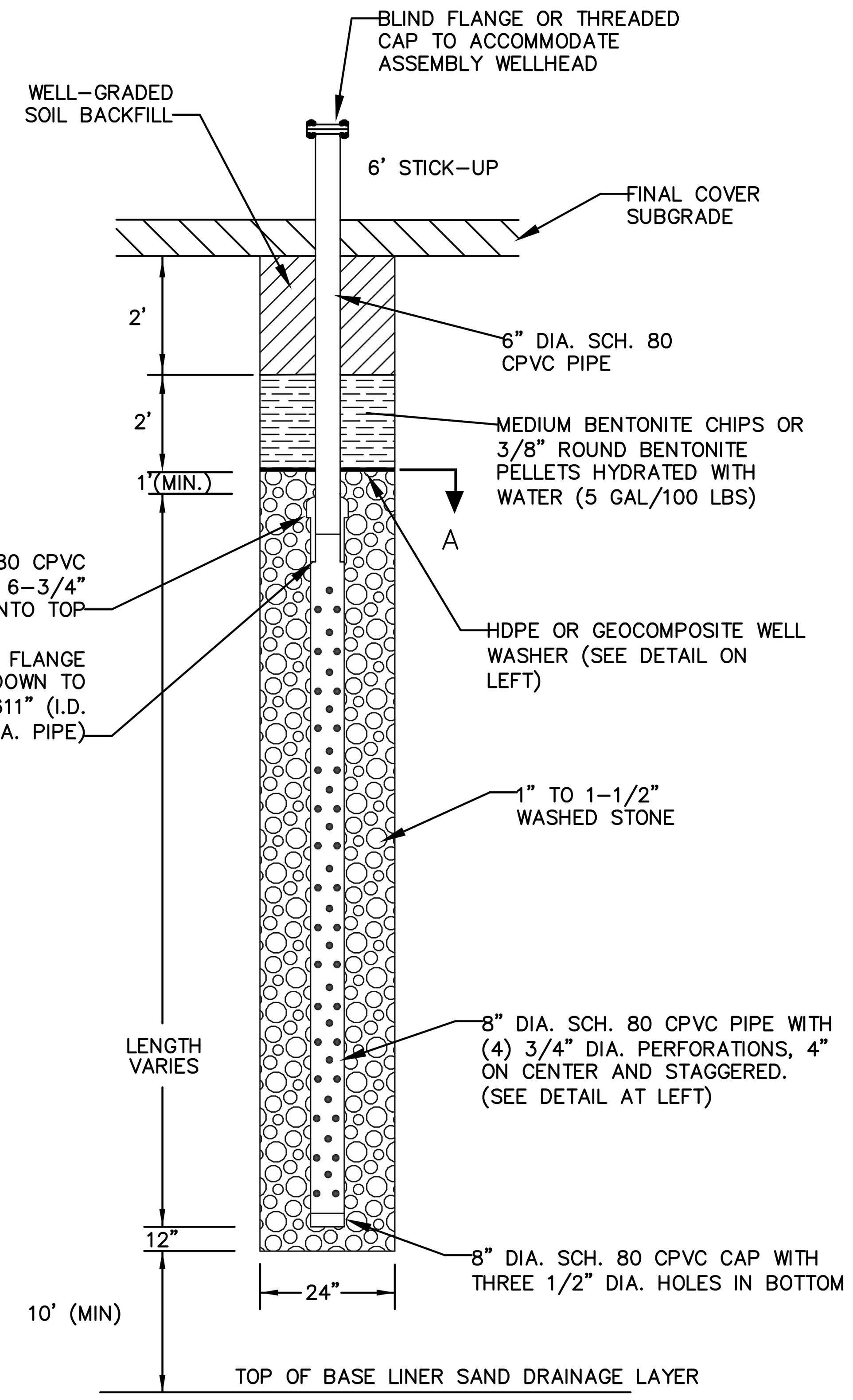

GAS EXTRACTION WELL DETAIL

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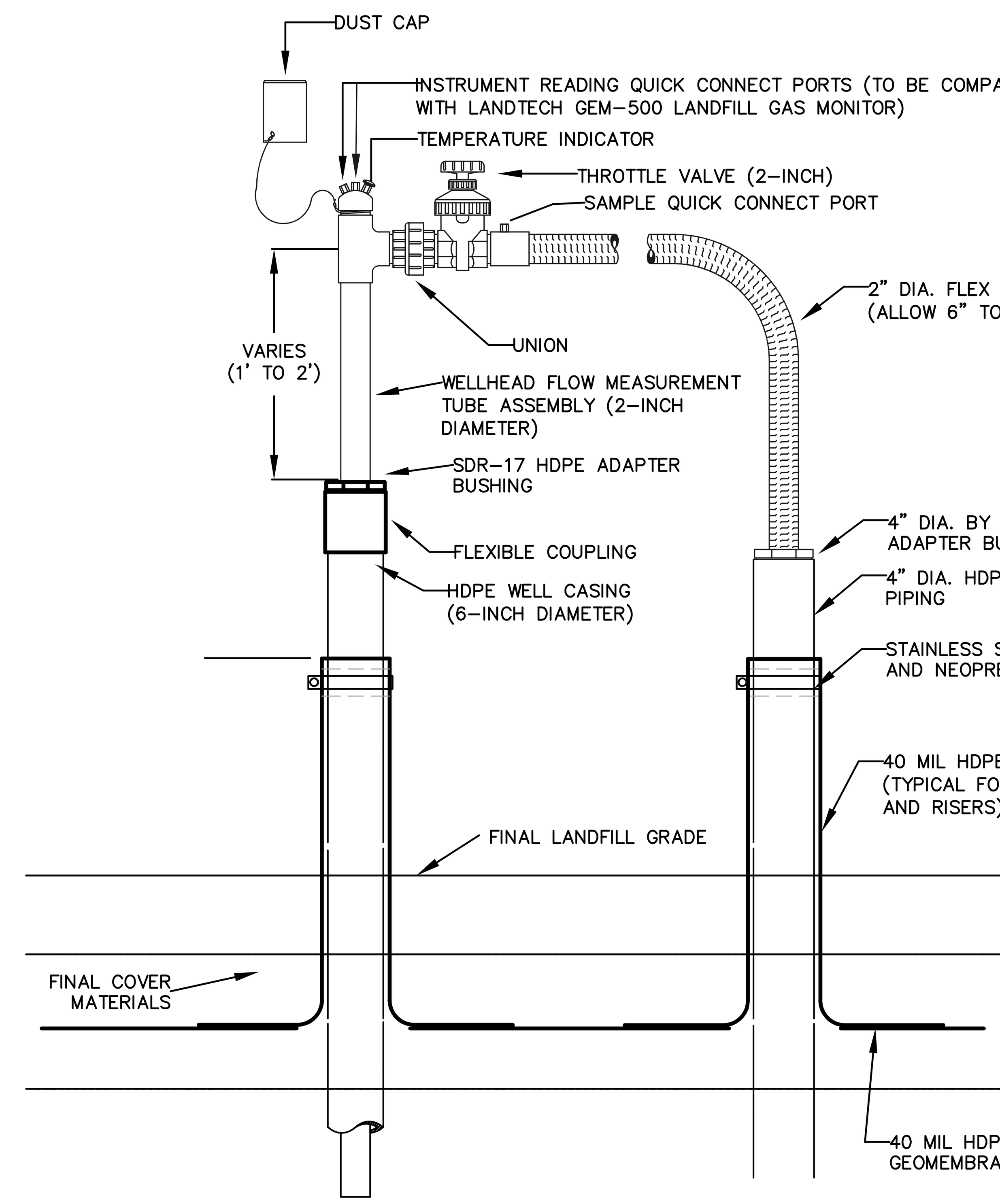
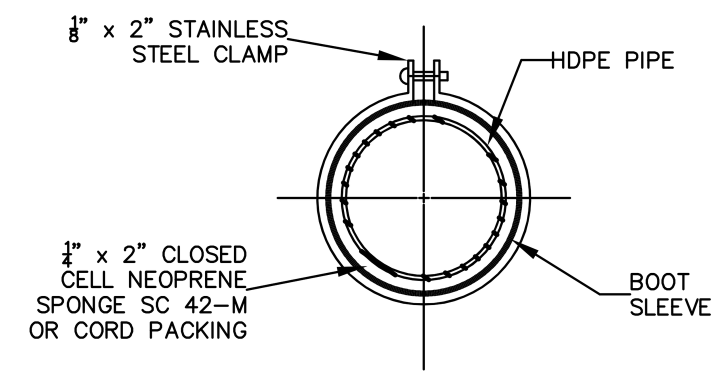


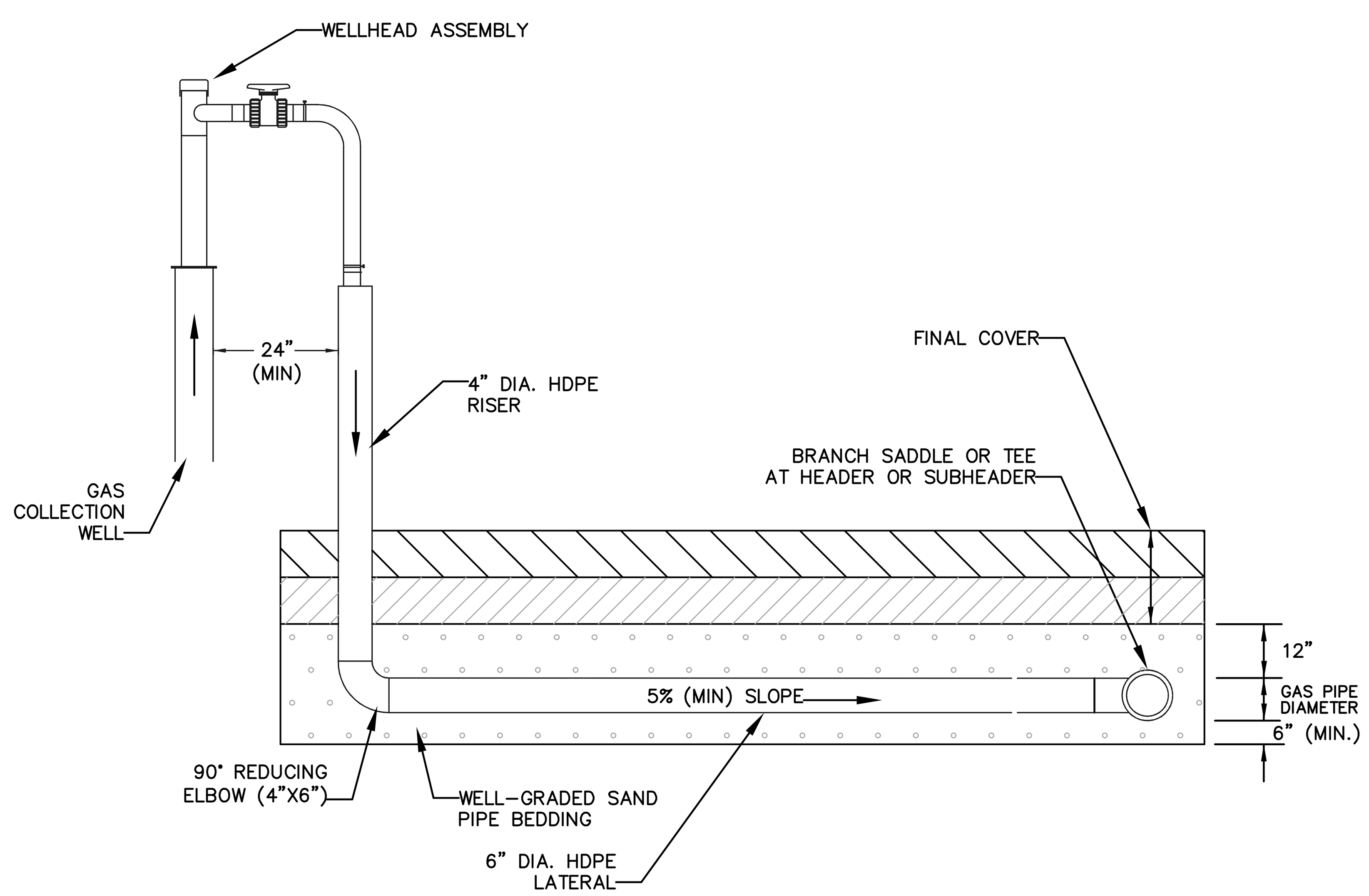
LANDFILL WELLHEAD ASSEMBLY

NOT TO SCALE



PIPE BOOT SEAL (TYP.)

NOT TO SCALE



WELL LATERAL DETAIL

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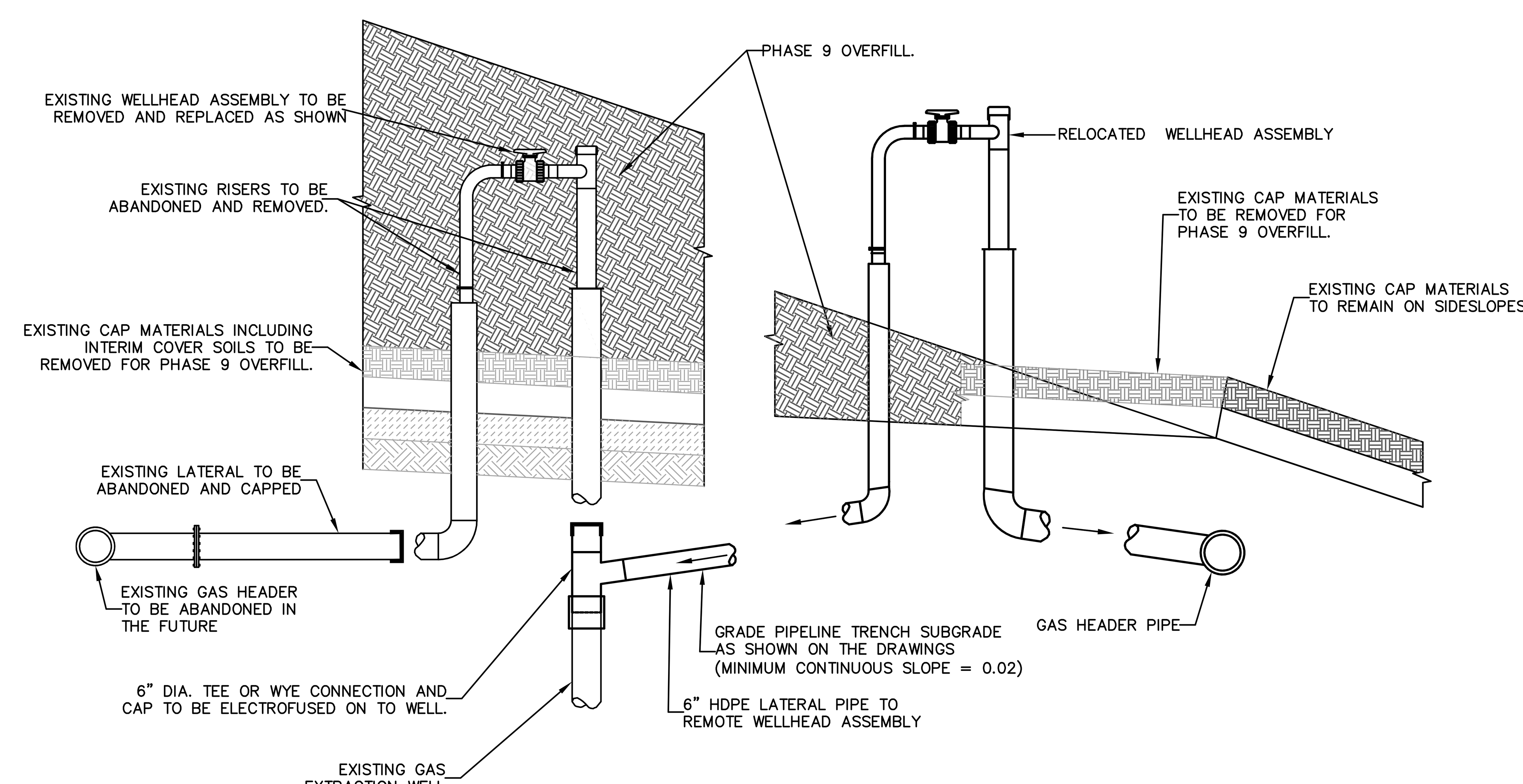
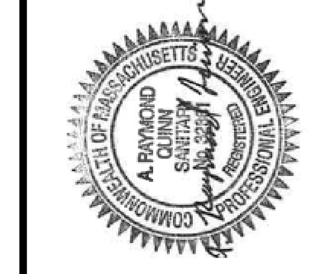


DETAIL OF MODIFICATION TO EXISTING EXTRACTION WELLS TO REMOTE WELLHEADS

NOT TO SCALE



No.	Date	Revision Description	Chkd. by	Apprvd. by

scale: AS SHOWN
date: DEC. 6, 2022
drawn: HB
checked: ARQ
approved: ARQ
drawing number: 13

project: BOURNE LANDFILL
PHASE 9 LANDFILL EXPANSION

client: TOWN OF BOURNE
DEPARTMENT OF INTEGRATED SOLID WASTE MANAGEMENT

drawing title: GAS COLLECTION SYSTEM DETAILS – 1

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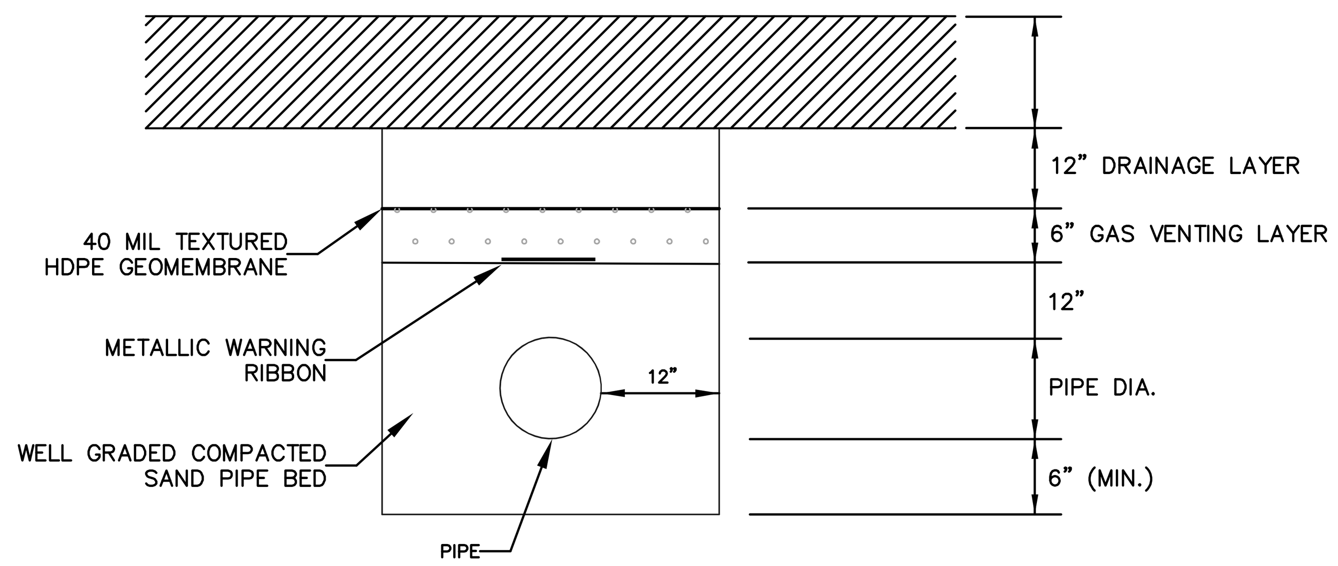
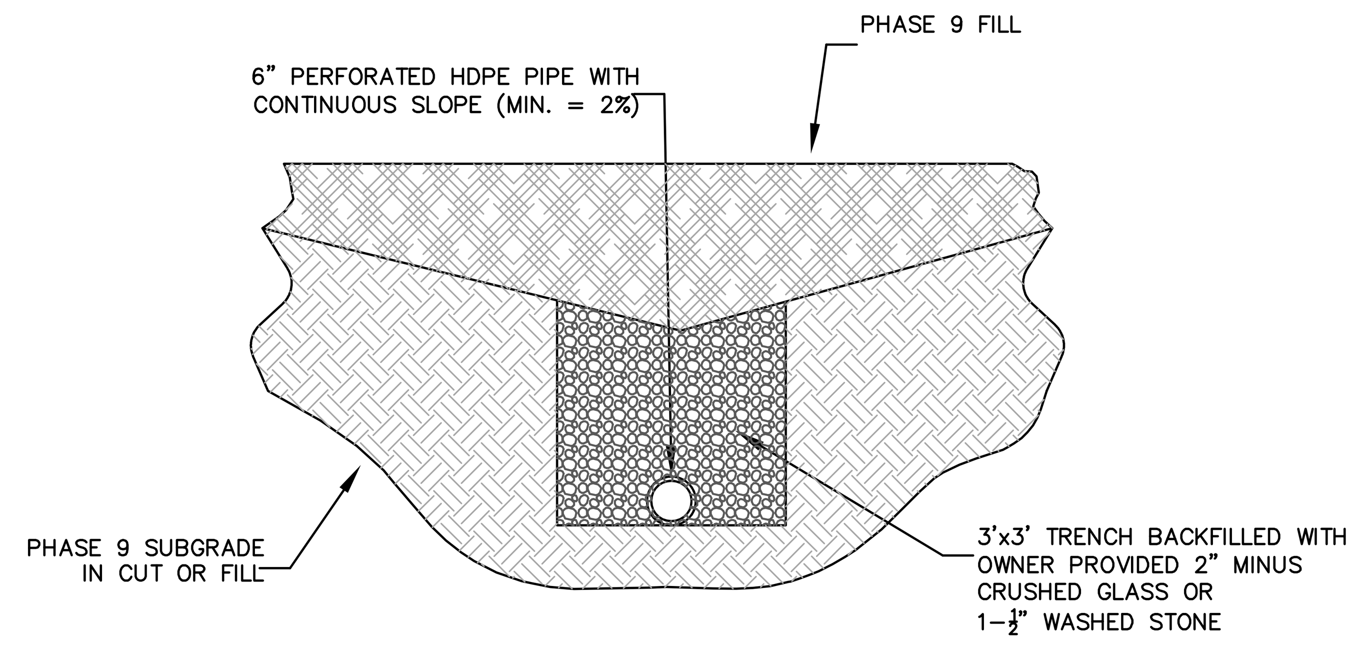


PIPELINE TRENCH DETAIL

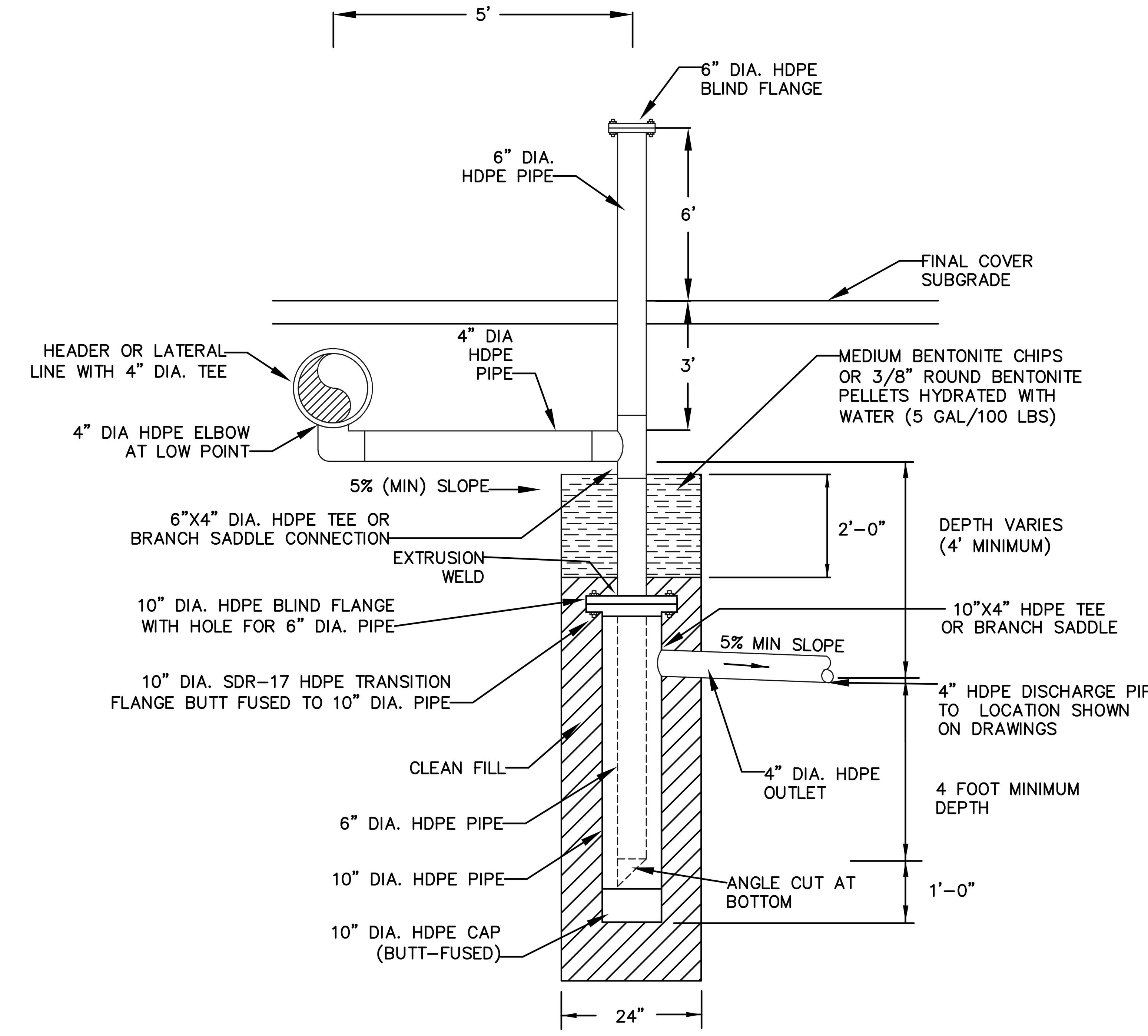
NOT TO SCALE

NOTES:
1. STATE AND FEDERAL REGULATIONS REQUIRE HEALTH AND SAFETY PLANS FOR WORK IN CONFINED SPACES SUCH AS THOSE WHICH WILL BE ENCOUNTERED DURING GAS MANAGEMENT STRUCTURE INSTALLATIONS.
2. ALL UNDERGROUND FLANGES TO BE COVERED AND SEALED IN 5 MIL POLYETHYLENE WRAP OR COATED WITH AUTOMOTIVE UNDERCOATING MATERIAL.
3. ALL BOLTS & NUTS TO BE 316 STAINLESS STEEL, OR CARBON STEEL COATED WITH COLD TAR EPOXY EMULSION OR EQUAL, LUBRICATED WITH NEVERSEEZE OR APPROVED EQUIVALENT.
4. METALLIC WARNING RIBBON TO BE PLACED ON TOP OF SAND BEDDING.



LEACHATE COLLECTION PIPE TRENCH DETAIL

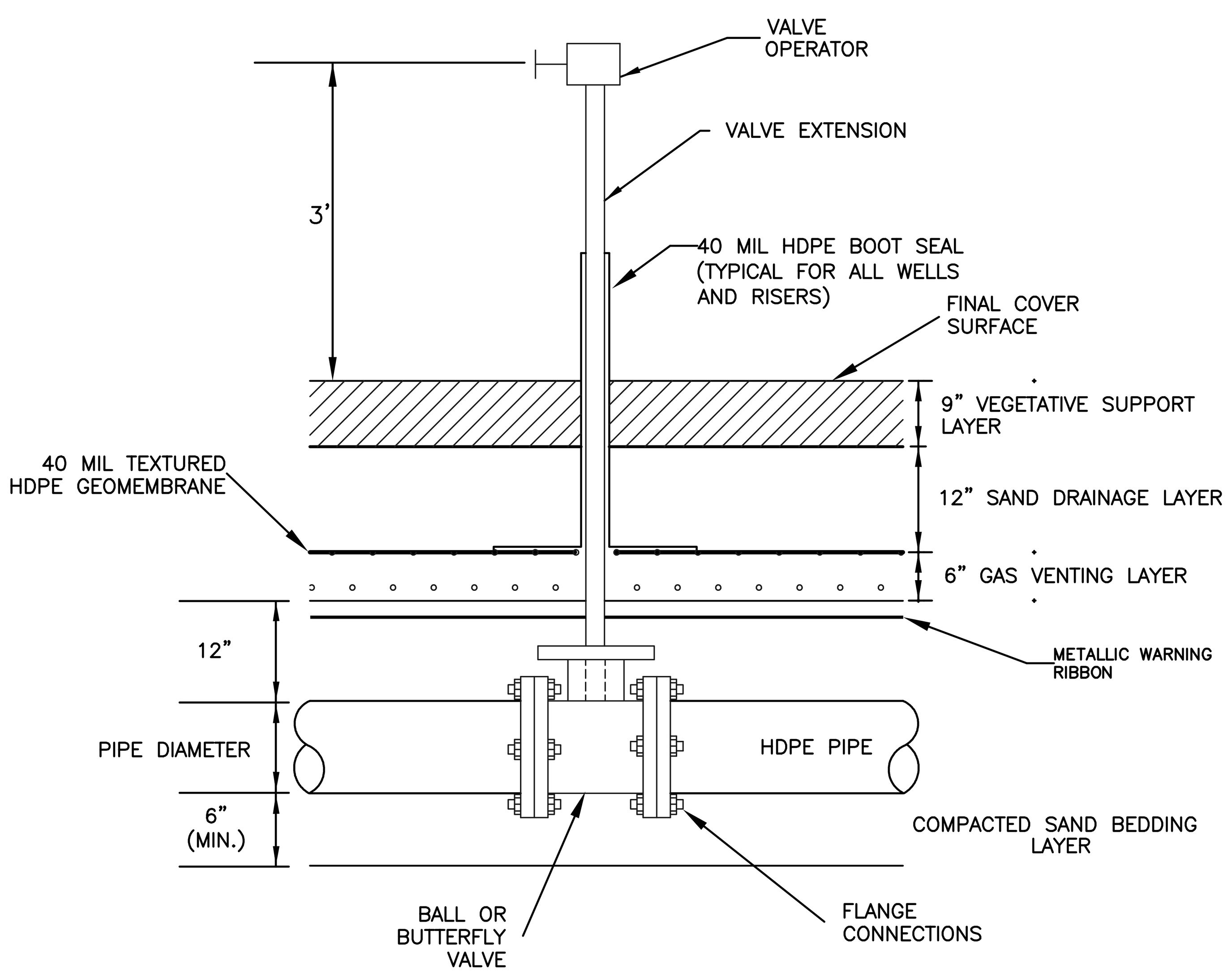
NOT TO SCALE



CONDENSATE TRAP DETAIL

NOT TO SCALE

NOTES:
1. CONDENSATE TRAPS TO BE INSTALLED AT LOW POINT IN THE GAS COLLECTION PIPELINE.
2. FILL TRAP WITH WATER PRIOR TO OPERATION.



TYPICAL VALVE INSTALLATION

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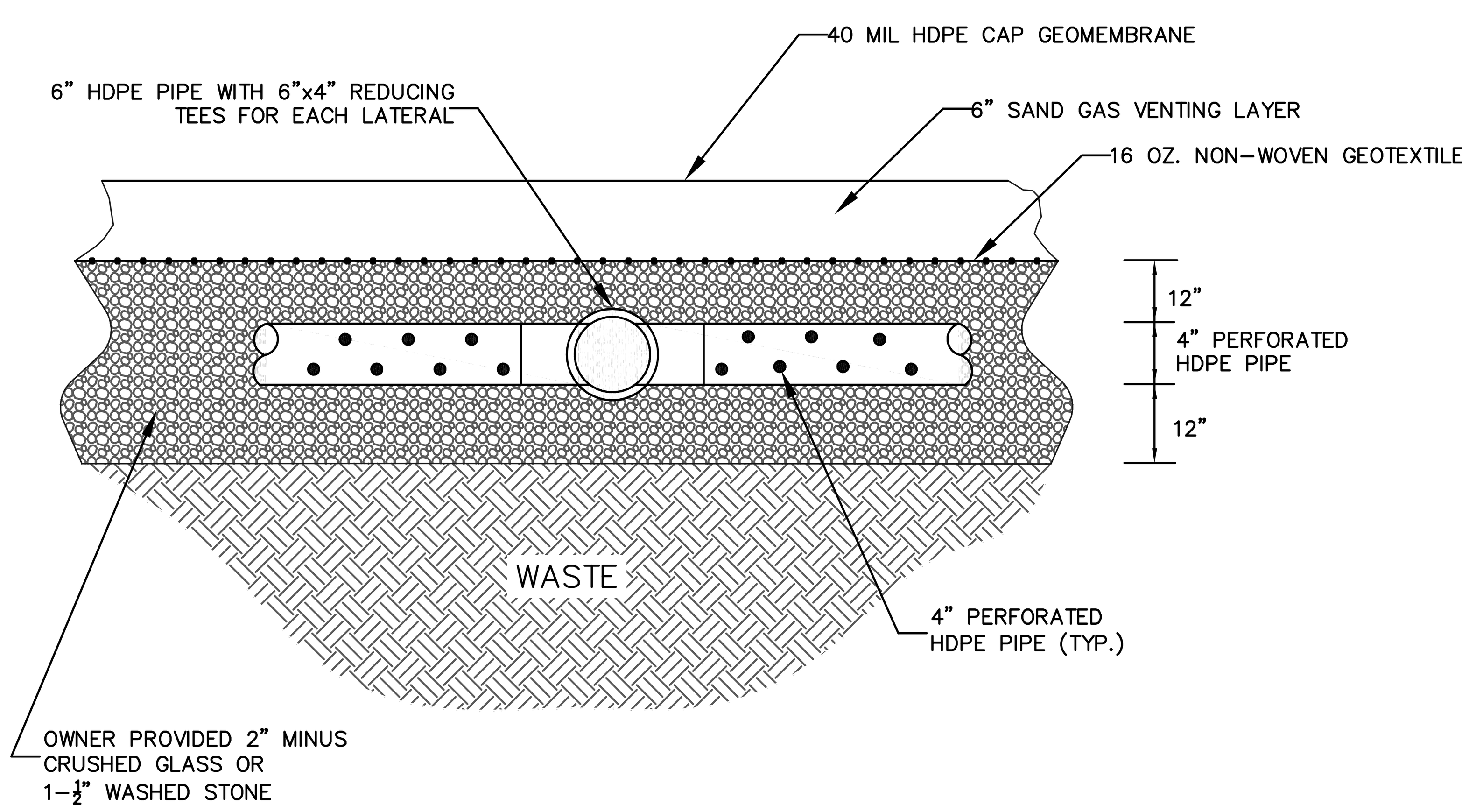
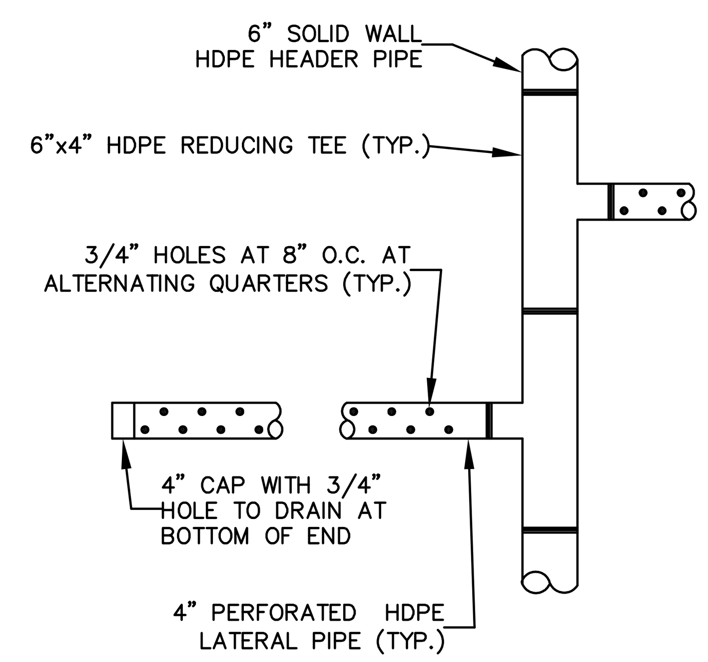


HORIZONTAL GAS COLLECTOR LATERAL/HEADER SECTION DETAIL

NOT TO SCALE



HORIZONTAL GAS COLLECTOR LATERAL/HEADER JUNCTION DETAIL

NOT TO SCALE

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