REPORT

Design Report

Tazewell County Sanitary Landfill - SWP No. 564

Submitted to:

Tazewell County Sanitary Landfill
2475 Lynn Hollow Road
North Tazewell, VA 24630

Submitted by:

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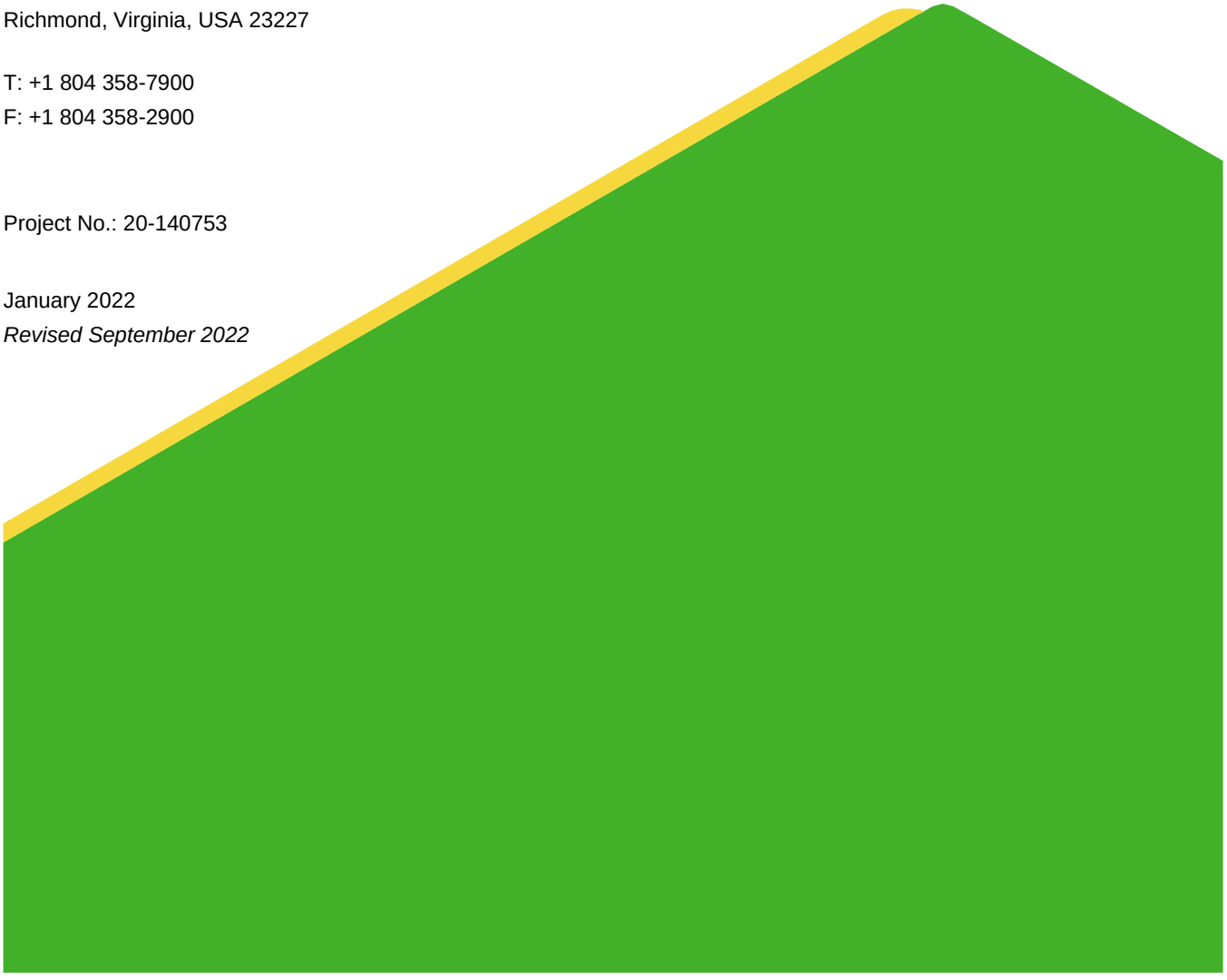

Table of Contents

Tables

Attachments

1.0 INTRODUCTION

This Design Report (Report) has been prepared for the Tazewell County Sanitary Landfill (Facility) located in North Tazewell, Virginia. The Facility operates as a municipal solid waste (MSW) landfill under the Virginia Department of Environmental Quality (DEQ) Solid Waste Permit No. 564. Golder Associates Inc. (Golder) has prepared this report for Santek of Virginia, LLC. (Santek, Operator) on behalf of the Tazewell County Board of Supervisors (County).

1.1 Site Description

The Facility is located at 2475 Lynn Hollow Road (State Route 649) in North Tazewell, Virginia (N37° 11' 06" latitude and W81° 26' 39" longitude). The Facility is owned by the County and is operated by Santek. The Facility includes a lined disposal area; support facilities including a scalehouse/office trailer, truck scale, maintenance shop building, stockpile areas for tires, scrap metal, and brush; and the environmental controls and monitoring systems required for a MSW landfill.

The Facility property consists of approximately 202 acres, of which approximately 126 acres are designated for facility activities, with a permitted disposal area of approximately 22 acres (i.e., Phases 1 through 4A). Disposal activities have been ongoing since the landfill permit was issued.

1.2 Permit Amendment Information

The existing lined disposal area, Phases 1 through 4A, is nearing capacity and approaching its end-of-life. Phase 5, an approximately 14-acre lateral expansion to the existing disposal area, is being proposed to increase the life of the landfill. This area was previously identified in the original permit application as an area for future development and is located within the Facility property boundary. No off-site construction or land acquisition is required.

The Facility currently receives MSW from Tazewell, VA; Bland, VA; Buchanan, VA; Dickenson, VA; Giles, VA; Montgomery, VA; Pulaski, VA; Smythe, VA; Monroe, WV; Wythe, VA; Logan, WV; McDowell, WV; Mercer, WV; Raleigh, WV; Summers, WV; Washington, VA; Wise, VA; Scott, VA; Wyoming, WV; and Watauga, NC. To accommodate an increased service area and waste stream, the County is requesting an increase in their maximum daily disposal limit from 300 tons per day (tpd) to 900 tpd with an anticipated annual maximum disposal of approximately 120,000 tons per year (tpy). Without these modifications, waste from the area currently serviced by the Facility would require transport to the New River Resource Authority Landfill, which is located approximately 55 miles away.

Additionally, in accordance with 9VAC20-81-130.J.1.b, as part of this Major Permit Amendment, the County desires to change the bottom liner system of Phase 5 to replace the 24-inch-thick compacted soil liner with a 12-inch-thick controlled subgrade layer and geosynthetic clay liner (GCL), making the bottom liner system a “pre-approved alternate” per 9VAC20-81-130.J.1.b. Additional components are included with the alternate system, as described in this Report.

Lastly, two alternate final cover systems are being proposed for Phase 5 and existing Phases 1 through 4A; two alternates for side slopes in accordance with 9VAC20-81-160.D.2.f and two pre-approved alternates for the top deck in accordance with 9VAC 20-81-160.D.2.d. The proposed final cover system is discussed in the Closure Plan (Attachment IV of this Part B Major Permit Amendment).

1.3 General Facility Information

Operator: Santek of Virginia, LLC.
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Tazewell County Sanitary Landfill
2475 Lynn Hollow Road
North Tazewell, Virginia 24630
(314) 302-3634

Permittee: Tazewell County Board of Supervisors
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(276) 385-4246

Owner/Lessor: Tazewell County Board of Supervisors
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1.3.1 Site Acreage

The Facility property is approximately 202 acres, of which approximately 126 acres are designated for facility activities, with an existing lined landfill area of approximately 22 acres (i.e., Phases 1 through 4A). The Phase 5 Waste Management Boundary (WMB) consists of an approximately 20-acre area adjacent to the active landfill, located within the existing Facility property boundary. Within the proposed WMB, approximately 14 acres will be used as the disposal area and the remaining area will be cleared and graded for drainage and access.

1.3.2 Landfill Capacity and Life Expectancy

Phases 1 through 4 of the landfill provides approximately 3.8 million cubic yards (cy) of gross disposal volume (i.e., waste and daily and intermediate cover volume). The landfill, as currently constructed (Phase 1 through 4A), is reaching its constructed capacity. The remaining constructed capacity and life expectancy was calculated in August 2020 by others to be approximately 420,000 cy and 3 years and 2 months, respectively, and was based on the currently permitted maximum daily disposal limit of 300 tpd.

A Part A Permit Application, prepared by others, was submitted to the DEQ's Southwest Regional Office in August

2020 requesting an increase to the maximum daily disposal limit as well as a lateral expansion to the landfill. Phase 5, the requested lateral expansion adjacent to the existing disposal area, would increase the gross disposal volume of the landfill by approximately 1.5 million cy. The life expectancy of the landfill would be extended by approximately 13 years and 6 months, assuming an average waste intake rate of 250 tpd and a landfill density of 0.72 tons per cy.

1.4 Prior Approvals

The landfill has previously received Part A and Part B approvals. The Facility serves as an MSW landfill and accepts MSW materials in compliance with 9VAC20-81-10 et seq. The existing permit covers waste disposal in Phases 1 through 4A.

In August 2020, a Part A Permit Application prepared by others for the proposed maximum daily disposal limit increase and lateral expansion area was submitted to the DEQ Southwest Regional Office. The Part A Permit Application is included as Attachment 1 to this Design Report amendment. Conditions of the DEQ Part A Permit Application approval for the lateral expansion to the Facility and increase to the maximum daily disposal limit are listed in the section below.

1.4.1 DEQ Part A Permit Conditions

Included in this section are the conditions included in the DEQ Part A Permit Application approval letter, included as Attachment 2 to this Design Report amendment, with each condition followed by discussion of how the condition is met by the design.

[DEQ PART A APPROVAL CONDITIONS TO BE INCLUDED ONCE APPROVAL IS RECEIVED]

2.0 SITE FEATURES

2.1 Security

The Facility is accessed by the existing entrance road off State Route 649. This entrance also serves as the emergency access route into and out of the Facility. Access to the Facility is limited to working hours which are from 8 a.m. to 4 p.m. The Facility is closed on Sundays and observed holidays (i.e., New Year's Day, Presidents Day, Memorial Day, July 4, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day and the day following, as well as Christmas Day).

The existing entrance and access to the disposal area is secured by a lockable security gate across the road. The Facility attendant is stationed at the building located adjacent to the scale area. The attendant's responsibilities are to monitor incoming vehicles and waste loads and to maintain records of incoming waste loads and general landfill operations. Visitors are required to check in with the Facility attendant upon arrival at the site. Unless an attendant is on duty, the gate is closed and locked during all non-operating hours to prevent entry and illegal disposal of wastes.

Operators will be equipped with mobile radios or cellular phones to maintain contact with the office personnel. Fencing, gates, and locks will be inspected and maintained. Other site security features include fencing, vegetation, and topography which limit access around the perimeter of the site.

2.2 Roads

Existing and proposed all-weather access and perimeter roads within the Facility are shown on the Design Drawings (Attachment III of this Part B Major Permit Amendment). The existing 30-ft wide, 350-ft long entrance road provides access to the Facility from State Route 649 and is paved up to the scale house area. Beyond the paved portion, the permanent access roads are constructed with subbase consisting of a minimum 12-inch-thick layer of compacted soil and a minimum 12-inch-thick layer of stone. The subbase is overlaid by a base course consisting of a 9-inch-thick layer of Virginia Department of Transportation (VDOT) No. 3 stone, which is overlaid by a wearing course of a 3-inch-thick layer of VDOT No. 57 stone to provide an all-weather travel surface and minimize dust generation from vehicles. Design criteria for access roads are generally a maximum sustained grade of 10 percent or less and a minimum width of 24 feet for two-way traffic. The base course and wearing course are crowned from the center of the road or sloped to one side to promote drainage from the road surface. The fill slope of perimeter access roads is a maximum of two feet horizontal to 1 foot vertical (2H:1V). The access road follows the perimeter of the permitted disposal cells for approximately 2,350 feet until it reaches the proposed lateral expansion area. The perimeter access road is the primary interior access road for waste haulers to reach the working face of the landfill and is used for both incoming and outgoing vehicles. All other Facility roads will be gated, and the route will be marked with appropriate signage to prevent waste haulers from accessing unauthorized areas.

The working face of the landfill is accessed by temporary roads, which will be constructed by the landfill operator atop previously filled wastes. The roads will be maintained for all-weather access and have a maximum fill slope of 3H:1V in Phase 5 and 4H:1V in Phases 1 through 4A.

Access roads are maintained by site personnel through periodic maintenance that includes fugitive dust control, removal of mud deposited on the surface, surface regrading, surface re-compaction, placement of additional stone, and cleaning of ditches and other drainage structures along the road as needed to maintain drainage and ensure all-weather access to the active areas of the Facility. Consideration for standard vehicles will be made when constructing and maintaining all internal roads.

2.3 Traffic Routing

Vehicles enter and exit the Facility though the entrance off of State Route 649. The existing 30-ft wide, 350-ft long entrance road has sufficient width to allow safe passage of users. All vehicles are required to stop at the Facility attendant building at the scale area to be inspected and weighed. Beyond the entrance road, the access road follows the perimeter of the permitted disposal cells for approximately 2,350 feet until it reaches the active working face. Currently, commercial loads are being routed to the active working face by the main access road, which is the access route for all weather conditions, and small loads are routed to the convenience area near the attendant

building and scale to prevent congestion along the access road and working face.

Processing incoming vehicles and inspecting loads typically takes about 2 to 5 minutes on average, depending on vehicle size and whether the vehicle is a returning customer. Processing activities are conducted by the Facility attendant. The Facility currently receives approximately 121 vehicles per day on average, which includes commercial vehicles.

A traffic queuing analysis was completed by others for the proposed increase in tonnage and submitted to VDOT for approval. VDOT completed a traffic study in March 2019 to determine the impacts of the additional vehicles associated with the requested increase in the maximum daily disposal limit to the existing transportation infrastructure and traffic patterns to the Facility. The VDOT Adequacy Report and Approval Letter, which outlines the required improvements to routes leading to the Facility, is included as Attachment 3.

2.4 Shelter

Shelter is provided for site personnel in the attendant building, located near the Facility entrance at the scale area. Site personnel have access to heat, air conditioning, lighting, sanitary facilities, and communication utilities (e.g., telephone, two-way, radio, and internet) at the attendant building. Portable sanitation facilities will be provided near the active portion of the landfill.

2.5 Aesthetics

The site is located within a mostly rural residential and agricultural area along State Route 649. The Facility is partially wooded, and visual screening is generally provided by the existing perimeter tree line, as shown on the Design Drawings, and the exterior slopes of the existing facility. A fire break of at least 100 feet is maintained between the tree line and the disposal unit boundary. Landfill slopes are seeded and maintained with adequate vegetation to minimize erosion and provide site aesthetics. Areas not used for landfill operations will remain undisturbed.

Noise at the Facility boundary should not be of concern, as most Facility operations will take place at a distance of over 100 feet from the Facility boundary. As can be seen in the table below, the average noise level[1] for the anticipated types of construction equipment is below the 80 decibels (dBA) threshold at 100 feet. Proper maintenance of equipment, selective clearing, and the presence of a mixed tree buffer surrounding the site will act to further attenuate noise generated during Facility operations.

Table 1: Construction Noise Activity Table

Equipment Type	Average A-Weighted Noise Level at 100 feet (dBA, Leq)
Water Truck	78
Bulldozer	79
Haul Truck	78

Notes: Field-measured construction equipment noise data were found in Appendix N of the 2007 *Draft Environmental Impact Report for the Port of Los Angeles Container Terminal Project* (http://www.portoflosangeles.org/EIR/TraPac/DEIR/Appendix_N_Noise.pdf).

2.6 Site Benchmarks

There are seven established site benchmarks, which are shown on Drawing 2 of the Design Drawings (Attachment III of this Part B Major Permit Amendment). In the event that the benchmarks are damaged, destroyed, or removed for future development, new permanent benchmarks will be re-established, if necessary, to maintain at least three permanent benchmarks on site.

Table 2: Site Benchmarks

ID	Northing	Easting	Ground Elevation (ft AMSL)
5000	3605311.83	10627352.62	3081.21
5001	3604858.93	10626314.98	3066.04
5002	3604150.46	10627737.02	3018.01
5003	3603769.58	10626908.52	2907.66
5004	3602809.09	10625280.67	2822.15
5006	3604291.74	10624472.62	3002.54
5007	3604446.35	10624964.04	3007.27

3.0 SITE DEVELOPMENT

The majority of the 20-acre WMB area, as defined in the Part A Permit Application by others, was previously disturbed in mid-2017 during the construction of the maintenance shop. The area is currently used to stockpile soil for daily cover material, brush, tires, and scrap metal. The stockpiles will be removed or relocated as needed elsewhere within the Facility boundary to allow for the lateral expansion development. Phase 5, which consists of approximately 14 acres, will be excavated and lined for disposal activities. Excavated soils will be stockpiled onsite for use as daily and final cover material. Vegetation and approximately 4 acres of woodlands will be removed from the remaining 8 acres of the WMB to allow for site grading, construction of a 100-foot fire break from the disposal area, and extensions to the existing access roads. Drainage will be diverted away from the disposal area to the Facility's existing sediment basin. The existing maintenance shop will remain in its current location. Areas where bedrock is encountered during excavation will be over-excavated and backfilled with a minimum 1-foot-thick layer of compacted soil for the controlled subgrade layer.

The County or Operator will be responsible for the baseline stake-out prior to construction activities for the project in accordance with the Design Drawings (Attachment III of this Part B Major Permit Amendment). The County or Operator will utilize subcontractors and subconsultants, as deemed appropriate, for specific functions related to the construction of Phase 5.

The County or Operator will employ a Professional Engineer licensed in the Commonwealth of Virginia to provide quality assurance services during construction. As-built drawings will be prepared during construction of newly constructed roads, site infrastructure, the disposal unit, and related utilities. Construction Quality Assurance (CQA) documentation and record drawings will verify that the site's facilities were constructed in substantial accordance with the plans and specifications upon which the permit was issued.

3.1 Landfill Phase/Cell Development

The operational phasing of Phase 5 is designed to allow for flexibility in construction scheduling of the site with uninterrupted landfill operations. The phasing requires the stockpiling of soil and geosynthetic materials at the site. The stockpiling of geosynthetic materials will be near the site infrastructure area or as designated by the Operator. The disposal areas for Phase 5 operations are shown in Table 3 below. Details of the Phase 5 construction sequence are included in Drawings 4 through 8 of the Design Drawings. For the purpose of determining remaining life in Table 3, an assumed average daily intake rate of 250 tpd and a landfill density of 0.72 tons per cy were used.

Table 3: Landfill Phasing Table

Phase	Lined Area (ac)	Gross Capacity (cy)	Life (years)
Phase 5A	10.3	418,600	3.7
Phase 5B	3.9	1,085,900	9.9

Note: Supporting calculations for the capacity and estimated life of each phase were determined by computer-aided drafting (CAD) software.

3.2 Borrow and Stockpile Estimates

The landfill, including the lateral expansion, is not expected to have a soil deficit through closure. The anticipated volume of soil required over the life of the landfill is expected to come from readily available on-site soils from the proposed excavation of Phase 5, which is estimated to be approximately 424,000 cy.

Approximately 401,800 cy are estimated to remain after the construction of the Phase 5 base grades. This material will be stockpiled on-site for operational, site construction, and closure needs. The location of stockpile areas may vary, as determined by the County and Operator.

The volume of soil required through closure of Phase 5 is estimated to be 215,800 cy for daily, intermediate, and final cover, leaving a soil surplus of approximately 186,000 cy for other site uses and closure of the remaining portion of the facility. As noted in the Part A Permit Application, the County owns a reserve of soil of up to one million additional cubic yards on adjacent County-owned properties for use in facility closure activities.

4.0 LANDFILL UNIT DESIGN

4.1 Liner Foundation

Phase 5 has been designed and will be constructed as a waste containment area incorporating a composite liner system and leachate collection and removal. The Phase 5 liner will tie into the existing liner system of Phases 1 and 3.

Construction of the liner foundation for Phase 5 will require both cut and fill of existing soils to achieve the base grades. The Phase 5 area currently consists of bare, wooded, and uneven terrain, with a portion of the area used as a source of daily cover material. Areas where existing soils have been subjected to standing water will be excavated and undercut as necessary to provide a suitable subgrade for placement of clean soil structural fill. The excavated subgrade in these areas shall be inspected in accordance with the CQA Plan prior to placing structural

fill. Clean soil structural fill will be placed, compacted, and tested in accordance with the Technical Specifications and CQA Plan.

In addition, this section presents the analyses and results to evaluate the settlement, bearing capacity, and stability for Phase 5 for construction and operational loads. The following subsections present summary information and conclusions from current evaluations as well as previous evaluations by others, which have been relied upon to determine the following:

- Slope and veneer stability of the proposed base and final grades;
- Bearing capacity of the Phase 5 foundation soils;
- Foundation settlement, including predicted strains in the Phase 5 liner system;
- Potential for bottom heave or blow-out, and;
- Liner performance under construction and operational loads.

4.1.1 Subsurface Exploration Data

A subsurface investigation was completed, by others, for the Phase 5 area to provide an adequate representation of the soil stratigraphy and mechanical properties. Although the site is located within a Virginia Department of Conservation and Recreation (DCR) Karst Bedrock Predictive Model, no evidence of karst or karst development is documented or was observed within the lateral expansion area. Additionally, the Phase 5 area is not known to contain geologically unstable soils, sink holes, caverns, or underground mines. Subsurface information is included in the Part A Permit Application by others and was relied upon for the design of Phase 5 and the calculations and analyses contained herein.

4.1.2 Laboratory Data

Material properties' testing was performed on the samples of soil obtained from the Phase 5 area during the subsurface investigation in support of the Part A Permit Application. The results of these tests were presented in the Part A Permit Application by others and were relied upon for the design of Phase 5 and the calculations and analyses contained herein.

4.1.2.1 Settlement Potential

A settlement analysis was completed to estimate the potential post-development settlement of the foundation soils below the proposed lateral expansion assuming maximum waste elevations and final cover conditions. Potential settlement was calculated at points along two leachate collection header alignments where Phase 5 will experience the greatest differential overburden pressures from the proposed overlying waste and final cover. Total settlement was calculated at each point, and the change in the liner floor grade slope, or leachate collection header, was calculated using the differential settlements between each point.

The maximum total settlements of the base grade at the points analyzed were estimated to be approximately 0.30 feet, 0.16 feet, and 0.24 feet. Based on the expected total settlements, the differential settlement would reduce the

floor grades from 3.75% to 3.72% in the east-west direction and from 2.00% to 1.97% in the north-south direction. A leachate pipe capacity calculation is included in the Leachate Management Plan (Attachment VIII of this Part B Major Permit Amendment) to demonstrate the leachate collection pipes can convey the maximum expected leachate flows at the post-consolidation leachate collection pipe slopes. The anticipated differential settlement will not adversely impact the leachate collection system or liner system components.

This settlement is expected to occur over an extended period of time (the life of Phase 5) as loading to the area occurs with fill operations. The settlement analysis is included in Attachment 4 of this Design Report amendment.

4.1.2.2 Bearing Capacity and Stability

A bearing capacity analysis was completed to demonstrate that the bearing capacity of the underlying soils will not be exceeded by the expected loading by the lateral expansion. The ultimate bearing capacity of the subsurface soils is estimated to be 240,977 pounds per square foot (psf) and the loading of Phase 5 is expected to be approximately 8,890 psf. These values yield a factor of safety against bearing capacity failure of 27.1. The calculations for bearing capacity are included in Attachment 4 of this Design Report amendment.

The global stability of Phase 5 was also evaluated. A single cross-section considered to be the most critical was selected and analyzed with the proposed design parameters. The critical section was evaluated for circular, non-circular, and block slip surfaces. The calculated factor of safety (FS) of 1.7 for static conditions and 1.1 for seismic conditions meet the required minimum FS and indicate that the FS against slope failure is satisfactory in a static and seismic case for the evaluated section. The stability analysis is included in Attachment 4 of this Design Report amendment.

4.1.2.3 Bottom Heave or Blow-out

Bottom heave is upward movement of the *in-situ* soils resulting in the rise of the ground surface. In clay soils this is generally the result of unloading due to the excavation, which allows an intake of water by the underlying soil. The clay and silt layers underlying the foundation are significantly above the groundwater table and will be covered by a relatively impermeable liner system. Furthermore, the in-situ pressures currently experienced by these soils are significantly lower than the pre-consolidation pressure (historical maximum pressure experienced by these materials), indicating that a substantial unloading of the soil relative to the proposed excavation has already occurred. Thus, bottom heave is not anticipated in the underlying soils.

Blow-out of the bottom or sides of an excavation can be caused by excessive hydrostatic pressure acting upward against a soil layer or particle. Blow-out will occur when the effective stress in the soil is equal to the neutral stress. When blow-out occurs, the hydraulic gradient must be approximately equal to 1.0. Bottom heave and/or blow out is not anticipated to occur within Phase 5, as hydrostatic conditions necessary for bottom heave and/or blow out are not present in the Phase 5 area. The water table will be sufficiently below bedrock and the bottom liner system. The absence of a water table within the Phase 5 area eliminates the threat of damaging hydrostatic pressures; therefore, blow-out of the bottom of the excavation is not a concern.

4.1.2.4 Construction and Operational Loading

The calculation titled *Base Grade Stress During Construction*, contained in Attachment 5 to this Design Report amendment, indicates that there will be adequate protection from installation and operation activities.

As demonstrated in the preceding section of this report, the foundation of Phase 5 adequately supports the anticipated ultimate load of the disposal unit. Construction and operational loads are considered to have a negligible effect on the foundation when compared to the ultimate load of the disposal unit; therefore, further analysis on the underlying foundation due to construction and operational loads is not warranted under the foundation section of this report. Construction and operational loads are however evaluated for the liner system in Section 4.4 of this Report and for the leachate collection system in the Leachate Management Plan (Attachment VIII of this Part B Major Permit Amendment), where a discussion of the anticipated construction and operational loads is presented along with supporting calculations.

4.2 Limiting Site Characteristics

4.2.1 Presence of Springs, Seeps, or Other Groundwater Intrusion

No springs, seeps, or other groundwater intrusions have been identified in the Part A Permit Application, and none are anticipated that would affect Phase 5 based on the hydrogeologic study of the site. Therefore, no controls for these items are proposed.

4.2.2 Presence of Gas, Water, Sewage, or Electrical or Other Utilities

No utilities under the Phase 5 area have been identified in the Part A Permit Application, and none are known that would affect Phase 5. Adjacent utilities for leachate conveyance have been identified to the east of the lateral expansion area and are indicated on the Design Drawings (Attachment III of this Part B Major Permit Amendment). Utility locations for existing, water, sewer, and electrical services will be performed prior to construction, as required by state law.

4.2.3 Prior Existence of Open Dump, Unpermitted Landfill, or Lagoons

No prior existence of open dumps, unpermitted landfills, or lagoons have been identified in the Part A Permit Application and none are known to exist in the Phase 5 area.

4.3 Liner System

Landfilling is currently underway at the site under Solid Waste Permit No. 564. The lateral expansion at the Tazewell County Sanitary Landfill is being constructed as a municipal solid waste disposal facility incorporating a composite bottom liner system that meets or exceeds the requirements of 9VAC20-81-130.J.1. The proposed bottom liner system for Phase 5 will be constructed as an approved alternate liner as described in 9VAC20-81-130.J.1.b and consists of the following components (from top to bottom):

Cell Floor

- 18-inch-thick granular leachate drainage layer with a hydraulic conductivity greater than or equal to $2x10^{-2}$ centimeters per second (cm/s)
- 60-mil double-sided textured high-density polyethylene (HDPE) geomembrane
- GCL with a hydraulic conductivity less than or equal to $5x10^{-9}$ cm/s
- 12-inch-thick controlled subgrade

Cell Sideslopes

- 18-inch-thick protective soil cover layer
- 275-mil double-sided geocomposite
- 60-mil double-sided textured HDPE geomembrane
- GCL with a hydraulic conductivity less than or equal to $5x10^{-9}$ cm/s
- 12-inch-thick controlled subgrade

Details for the bottom liner system are shown on the Design Drawings (Attachment III of this Part B Major Permit Amendment).

4.3.1 Leachate Drainage Layer

The granular leachate drainage layer consists of an 18-inch-thick, non-carbonate (less than or equal to 5%), granular material with a hydraulic conductivity greater than or equal to $2x10^{-2}$ cm/s. A network of 6-inch perforated HDPE leachate collection laterals drain leachate to 8-inch perforated HDPE leachate collection mains, which drain by gravity into the leachate collection sump.

4.3.2 275-mil Drainage Geocomposite

On the sideslopes of the cell, a 275-mil double-sided geocomposite will serve as the drainage layer for landfill sideslopes and convey leachate under an 18-inch-thick protective cover soil layer to the leachate collection system on the cell floor.

4.3.3 60-mil HDPE Geomembrane

The bottom liner geomembrane is constructed from double-sided textured HDPE material, and shall conform to the standards contained in the Technical Specifications. Geomembrane installation shall conform to the practices outlined in the Technical Specifications and the CQA Plan.

4.3.4 Geosynthetic Clay Liner (GCL)

The GCL consists of bentonite encapsulated between two stitched geosynthetic fabrics. The GCL will have a hydraulic conductivity less than or equal to $5x10^{-9}$ cm/s. Prior to placing the GCL, the liner subgrade must be certified by the installer and inspected by the CQA consultant. Care shall be taken during installation of the GCL to prevent exposure to excessive moisture that may damage the material.

4.3.5 Controlled Subgrade

The controlled subgrade layer will be a minimum of 12 inches, consist of soils classified as SC, SM, ML, CL, MH, or CH, and compacted to a minimum of 95% of the maximum dry density (standard Proctor).

4.4 Liner Slopes

The minimum base liner slope is 3.7%, post-settlement, and the maximum base liner slope is 33% (3H:1V). The liner subgrade shall conform to the requirements of 9VAC20-81-130.J.1.b(2) and the Technical Specifications.

Based on the results of the settlement calculations, included in Attachment 4 of this Design Report amendment, the base liner slope is anticipated to effectively remain at the as-constructed slope (3.8%) and function as designed after settlement occurs.

Engineering analyses for the Phase 5 liner foundation include the following:

- Settlement Potential
- Bearing Capacity and Stability
- Bottom Heave or Blow-Out

These analyses are discussed in Section 4.1 and attached to this Design Report amendment.

In addition, calculations for veneer stability, liner self-weight, and base liner system run-out were performed to ensure an adequate factor of safety for each. These calculations are discussed in the sections below.

4.4.1 Slope Stability

A sideslope veneer stability calculation was performed to analyze the bottom liner system slope stability. Veneer stability of the base liner system was evaluated for the 3H:1V sideslopes for the longest liner section, approximately 210 feet. The stability was evaluated as a series of interfaces where the liner system materials overlay one another. The permitted liner system must have a minimum peak interface friction angle of at least 26.1 degrees with no adhesion. The veneer stability calculation is provided in Attachment 5 of this Design Report amendment.

4.4.2 Liner Stress Calculations

An evaluation was performed to determine the anticipated stresses on the geosynthetic components of the liner system and to compare these stresses to the tensile strengths of the materials. The calculation titled *Base Grade Liner Self Weight*, found in Attachment 5, indicates that the 60-mil HDPE would not pull out of the anchor trench or be stressed beyond its yield strength.

4.4.3 Liner Anchor Trench

The base liner system geosynthetics will be installed with a perimeter anchor trench to secure the geosynthetics in place during construction. Due to the anticipated friction angle between the subgrade and the geosynthetic layer immediately above, an anchor trench or horizontal liner run-out is not required for stability since the geosynthetic

materials are not in tension; however, one has been included for construction convenience. Supporting calculations are provided in Attachment 5 of this Design Report permit amendment.

4.5 Prevention of Exposure

During construction of the base liner system, the system will be protected from damage and degradation through careful construction sequencing and monitoring. Although protection techniques vary, some or all of the following techniques for liner protection can be employed.

For protection of the liner subgrade, the soil grade can be constructed approximately 0.2 feet higher, to serve as a wearing surface prior to geosynthetics deployment. Immediately prior to deployment of geosynthetics, weather depending, the surface can be fine-graded and smooth drum rolled. The resulting subgrade will then be visually inspected in accordance with the CQA Plan.

The geomembrane component of the liner system will not be left exposed more than 30 days prior to placement of the geocomposite or leachate drainage layer. The geocomposite will not be left exposed more than 30 days prior to placement of the protective cover soil layer.

As detailed in the CQA Plan, the GCL will not be exposed to excessive moisture and it will be protected from premature hydration by covering it with geomembrane liner on the same day it is deployed, if possible.

After placement and survey of the leachate drainage layer, the drainage layer will be protected through maintenance until the Certificate to Operate (CTO) is received. Inspection of the surface after rainfall events will be conducted and should any damage be found (i.e., rills, washouts, slides, etc.), repairs will be made by placing additional drainage layer material in the damaged areas and re-grading those areas to achieve the minimum uniform thickness. Since the drainage material is relatively porous, it is anticipated that rainfall events of small intensity or volume will infiltrate directly into the drainage layer material and will not cause runoff or drainage layer material damage. If a large rain event cause drainage layer damage (i.e., rills, washouts, slides, etc.), additional drainage layer material will be placed and the area re-graded to achieve the uniform minimum thickness. Should the expected duration between construction completion and CTO receipt by unusually long or should the cell be operated in subphases, consideration for a temporary rain cover to protect the constructed drainage layer will be made. If employed, the rain cover will be removed prior to placement of MSW.

5.0 RUN-ON AND RUN-OFF CONTROL SYSTEMS

The stormwater management and storm drain systems for Phase 5 and existing Phases 1 through 4A were designed to meet or exceed the Virginia Solid Waste Management Regulations (VSWMR), Virginia Department of Conservation and Recreation Division of Soil and Water Conservation Erosion and Sediment Control Regulations, and Local Ordinances at the time of the original permit. The design and analysis of the systems were prepared using the U.S. Army Corps of Engineers Hydrologic Engineering Center's Modeling System (HEC-HMS) model and calculation methodology from the Natural resource Conservation Services (NRCS) Technical Release 55 (TR-55).

The lateral expansion is bounded by woods to the north and west, the existing landfill to the east, and a neighboring property to the south. Stormwater run-off from undisturbed areas off-site will be controlled by natural drainage features and perimeter ditches or diversion berms. Stormwater runoff from the property drains to the south to an existing stormwater retention pond, which discharges into an unnamed tributary to the North Fork Clinch River approximately 900 feet from the southern edge of the property.

5.1 Run-On Control System

A small undisturbed wooded area to the north of the lateral expansion area runs-on to the limits of the property and will be conveyed by the perimeter drainage channel. Run-on control within the waste management area is controlled by a series of drainage benches, tack-on berms, slope drains, and perimeter conveyance channels.

5.1.1 Design and Performance

The lateral expansion design incorporates the use of standard erosion control measures such as conveyance channels and diversion berms to direct surface run-on away from the active portions of the Phase 5 area. Only water falling directly on the working face or fill areas reaches the active cells. Stormwater controls are shown on the Design Drawings (Attachment III of this Part B Major Permit Amendment).

5.1.2 Construction

All drainage structures and channels are to be constructed in accordance with current Virginia Erosion and Sediment Control Standards, Virginia Department of Transportation (VDOT) Drainage Manual, and the CQA Plan. Designs for non-standard structures should follow current Federal Highway Administration (FHWA) or American Society for Testing and Measurement (ASTM) standards.

5.2 Run-Off Control System

Included in this report are stormwater calculations that demonstrate the adequacy of the proposed stormwater management systems to effectively handle post-development stormwater events in accordance with the VSWMR. Supporting calculations for this demonstration are included in Attachment 6 of this Design Report amendment.

5.2.1 Design Rates

Run-off rates for the 2-, 25-, and 100-year, 24-hour storm events were determined using the Technical Release No. 55 (TR-55) methodology and were modeled in HEC-HMS.

5.2.2 Stormwater System Design

Run-off from the intermediate and final phases of the lateral expansion will be collected in a series of drainage benches or tack-on berms. The run-off from the benches and berms is collected in slope drainpipes that will safely convey the stormwater to the perimeter stormwater channels, which drain to the site's existing sediment basin for attenuation and discharge through its outfall.

Drainage benches measure at least three feet in height and tack-on berms measure at least two and half feet in

height. Both form a V-ditch channel with a minimum longitudinal slope of a half percent. The drainage benches and tack-on berms divide the drainage area into areas so that the runoff flow rates remain non-erosive during sheet and shallow concentrated flow conditions. The slope drainpipes receive stormwater from the drainage benches and tack-on berms and convey it down the sideslopes of the landfill to the perimeter stormwater channels. The slopedrains will be buried within the final cover soil to facilitate mowing and to prevent water traveling along the axis of the pipe, causing erosion. Water will enter the pipes through engineered drop inlets at the low point of each drainage bench and tack-on berm. Grouted riprap and gabion baskets will be located at the discharge end of the slopedrains to reduce the water velocity upon entering the perimeter stormwater channel.

The perimeter channels are trapezoidal or triangular and are lined with riprap or with erosion control matting that provides adequate erosion protection and supports the development of vegetative lining.

The existing sediment basin is capable of receiving and attenuating the additional stormwater flow from the lateral expansion, as well as provide trapping and storage for conveyed sediment. The basin is unlined and constructed partly by excavation and partly by compacted soil berms. The spillways and receiving channels will release run-off at non-erosive velocities. The basin is able to contain the 100-year storm event and does not engage the emergency spillway.

5.2.3 Drainage Structure Maintenance

Maintenance of the site's drainage structures will include routine inspections as per the Operations Plan to identify areas of erosion, undercutting, or other maintenance needs. Additional inspections may be required after large storm events to check for damage. Specific items to be inspected include:

- Culvert inlets for accumulated sediment or debris
- Diversion benches for erosion, sediment buildup, and establishment of vegetation
- Slope drainpipes for proper anchorage, leaking joints, undercutting
- Vegetation in other areas for proper establishment, need of mowing
- Perimeter stormwater channel for erosion and establishment of vegetation
- Energy dissipation and drop inlet structures for integrity and accumulated sediment
- Other temporary controls (e.g., silt fence) for proper function and sediment control

Activities to correct or repair identified deficiencies will be initiated as soon as practical by site operations. Additional time may be required to correct larger deficiencies or if additional drainage structure construction is required. Sediment removed during maintenance or repair activities will be dewatered and used as cover soil on the landfill. For the sediment basin, the level of accumulated sediment will be monitored on a regular basis through visual inspection. The removal of accumulated sediment can be performed as necessary.

Attachment 1

Part A Permit Application (By Others)