January
Monthly Compliance Report

Solid Waste Permit #498
Bristol Integrated Solid Waste Management Facility
2655 Valley Drive
Bristol, VA 24201
(276) 645-7233

SCS ENGINEERS

02218208.05-18 | February 10, 2023

15521 Midlothian Turnpike Suite 305
Midlothian, VA 23113
804-378-7440

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Appendices

INTRODUCTION

On behalf of the City of Bristol, Virginia (City), SCS Engineers has prepared this report to the Virginia Department of Environmental Quality (VDEQ) in accordance with item 8 in Appendix B of the Consent Decree between the City and VDEQ. This report covers the Solid Waste Permit (SWP) #498 Landfill during the month of January.

1.0 LEACHATE PUMP STATION

The City is in the process of repairing the pumps and addressing other concerns related to the leachate pump station. The steps taken by the City are outlined in the following sections.

1.1 FLOATING MATERIAL

On July 6, 2022 SCS received the results of samples taken from the Solid Waste Permit 498 Wet Well on May 25, 2022. Based on SCS' review of the data, the data indicated the liquid is non-hazardous. SCS submitted a letter to the City on July 7, 2022 with SCS' review of the data and the underlying lab analysis. A copy of this letter was included in the October Monthly Compliance Report for the SWP #498 Landfill

As described in the October Monthly Compliance Report for the SWP #498 Landfill, the floating material in the wet well was resolved.

1.2 PUMP REPLACEMENT

The City contracted with Buchanan Pump Service (Buchanan) to complete repairs to the pumps and infrastructure at the 498 pump station. Buchanan completed repairs to one pump (in addition to the pump currently operating at the pump station. Buchanan delivered a third pump to the site, however the electrical requirements of the pump exceeded what could be supported with existing infrastructure. Buchanan is now in the process of procuring another pump that will operate utilizing the existing electrical infrastructure.

1.3 ALARM/NOTIFICATION SYSTEM

The City's Information Technology (IT) department has inspected, diagnosed, and repaired the existing pump station alarm/notification system. The alarm system is now functional and sending alerts to landfill staff via text message.

2.0 COVER INTEGRITY AND EXPOSED WASTES

The sections below describe steps taken by the City to address cover integrity and exposed wastes.

2.1 INTERMEDIATE COVER

The City continued hauling soil to the landfill to install an intermediate cover across the entire landfill. The City has completed intermediate cover installation on large portions of the landfill. City staff estimate that intermediate cover has been placed on more that 85 percent of the landfill area. The slopes of the landfill continue to present challenging conditions for the City. Inclement weather

has continued to prevent the City from safely placing cover on the slopes. In addition, placement of intermediate cover on the slopes has been slowed by the presence of thick vegetation that must be removed prior to placement. The City intends to complete soil placement on the Solid Waste Permit #498 landfill during the month of February if weather permits.

2.2 SURFACE EMISSIONS MONITORING

On December 19, 2022, SCS performed surface emissions monitoring (SEM) on the landfill. During the monitoring event no exceedances were detected on the serpentine route or at pipe penetrations. Details of the SEM were included in the December Monthly Compliance Report for the SWP #498 Landfill.

SCS understands that the Solid Waste Permit #498 Landfill is subject to quarterly SEM and therefore SEM was not required to be performed this month. The first quarter SEM for the SWP #498 landfill will occur in February or March.

3.0 GAS COLLECTION

The City has taken steps to optimize gas collection and minimize air intrusion as outlined in the sections below.

3.1 SYSTEM OPTIMIZATION

The City and its contractor completed repairs to the SWP #498 LFG header and restored vacuum to EW-20 and EW-21. These wells were monitored and adjusted by SCS Field Services (SCS-FS) on January 25, 2023. SCS-FS also replaced the orifice plate on EW-19 to improve control of the flow rate from that well.

3.2 OPTIMIZATION PLAN AND REPORTING

3.2.1 Optimization Plan

On December 1, 2022, on behalf of the City, SCS submitted a plan that provides for means and methods for optimizing the performance of the existing gas extraction system in the Solid Waste Permit #498 landfill. Additional details about that plan were included along with a copy of the plan in the November Monthly Compliance Report for the SWP #498 Landfill.

3.2.2 Optimization Actions

During the month of January actions were taken to implement the submitted Optimization Plan. The following actions were taken at the SWP #498 Landfill in accordance with the plan:

- As outlined in Section 3.1 the existing landfill gas collection and control system (LFGCCS) was repaired
- A liquid level measurement event was performed.
- A concept LFGCCS expansion design was developed in conjunction with the closure plans developed for the landfill as described in Section 4.0

SCS prepared a report that detailed the results of each of these activities and recommendations for further optimization of the well field. The report was submitted to VDEQ on February 1, 2023 and a copy is included in Appendix B.

3.2.3 Monthly Wellhead Monitoring

On January 6, 2023 and January 25, 2023, SCS-FS visited the landfill and performed monitoring of the landfill gas wells. The results of the monthly monitoring were submitted to VDEQ on February 1, 2023 and are included in Appendix A.

4.0 GRADING, GEOMETRIC CONFIGURATION AND GAS EXPANSION

The City has taken the steps outlined in the sections below to grade the surface of the SWP #498 Landfill to an appropriate geometric configuration to allow for final closure.

4.1 CLOSURE AND LFGCCS PLAN

SCS prepared plans on the City's behalf for closing and installing final cover on the Solid Waste Permit #498. The plans also include a comprehensive gas collection and control system and comprehensive stormwater management plan. The design addressed the gas collection infrastructure, grading work to be completed prior to installation, estimates of stormwater volumes, stormwater calculations, and construction materials to be used.

The drawings (16 sheets) titled "SWP #498 Final Closure System Permit Modification Design Plans" were submitted to VDEQ on January 31, 2023. Supporting documentation was also included for the purposes of the modification to the facility's Solid Waste Permit. The drawings included the layout and details of the proposed final cover installation and are included in Appendix C.

4.2 FINAL COVER AND LFGCCS INSTALLATION

The drawings described in Section 4.1 will be used as the basis of bid drawings used for procurement of a contractor to complete final cover and LFGCCS installation. The drawings used for the purposes of bidding, procurement and construction of the final closure, gas collection system, and stormwater controls will generally conform to the layout and details in the attached drawings. In addition to the drawings SCS will prepare a detailed project manual including technical specifications. SCS will also continue to work with VDEQ to complete the permit modification incorporating the revised closure design into the facility's solid waste permit.

5.0 LEACHATE SEEPS AND PONDING

The sections below outline the steps taken by the City to address leachate seeps and ponding.

5.1 PERIODIC INSPECTIONS

The City initiated a process of tracking precipitation events that have the potential to create ponding and leachate seeps. Inspections are made following events that exceed 0.25 inches as recorded by the on-site weather station. For the purposes of these inspections, if precipitation is continuous for at

least 8 hours during a storm that lasts multiple days, that storm will be considered a single event requiring a single inspection. After each such event, City personnel will inspect the landfill for ponding and leachate seeps. Locations of ponding and seeps will be marked in the field.

The City performed inspections as appropriate during the month of January. Section 6 describes the self-inspection logs that were used to record observations during the inspections. Inspection forms will be scanned and stored on the landfill computer server in a folder designated for the purpose of storing environmental records. Completed inspection forms are available for VDEQ to review upon request.

5.2 COMPLETION OF WORK ACTIVITIES

During the month of January, the City began the process of addressing the conditions, identified in the inspections described in Section 5.1, as requiring remediation. These actions are performed as part of intermediate cover placement and grading activities. The City will also address any conditions that require remedial actions identified in future inspections.

6.0 STORMWATER DRAINAGE AND MANAGEMENT

The sections below outline the steps by the City to improve stormwater management and drainage.

6.1 STORMWATER MANAGEMENT PLAN

As noted in Section 4.1 the plans that SCS prepared for Closure of SWP #498 included measures to address stormwater management on the landfill. The proposed grading on the landfill will promote sheet flow across the landfill surface. A series of diversion berms will direct stormwater to a central channel or the facility's perimeter channels. The central channel will discharge into a downchute pipe that discharges into a perimeter channels. The existing stormwater basin will be utilized for stormwater storage. The drawings and stormwater management calculations are included in Appendix C.

6.2 CLEANOUT OF STORMWATER DIVERSION CHANNEL/TRENCH BERM

The City has begun the process of cleaning out the stormwater diversion channel/trench berm. The efforts will continue during the month of February and the City will take steps to stabilize the channel.

7.0 SELF-INSPECTION AND RECORDKEEPING

SCS prepared two self-inspection log templates, the Stormwater Management Inspection Log and the Daily Landfill Inspection Log. SCS provided updated self-inspection logs for SWP 498 to the City and VDEQ and completed self-inspection training with facility staff on November 30, 2022.

7.1 UPDATED SELF-INSPECTION LOGS

Copies of updated self-inspection log templates were submitted to VDEQ on November 30, 2022. Details about these log and the intended inspection process were detailed in the November Monthly

Compliance Report for the SWP #498 Landfill. Copies of the log templates are also included in that report.

7.2 FACILITY TRAINING

On November 30, 2022, SCS personnel, Ryan Mahon, met members of the Facility staff to complete self-inspection training. A summary of this training and a record of attendees was included in the November Monthly Compliance Report for the SWP #498 Landfill.

7.3 SELF-INSPECTION AND RECORDKEEPING ASSIGNMENTS

Completed inspections will be held on-site at the facility office available for review by VDEQ upon request. Currently, self-inspections are being completed by Jonathan Hayes. Dave Cochran will serve as the primary alternate for inspections with the other members of the staff trained on inspection procedures filling in as needed. Inspection forms will be scanned and stored on the landfill computer server in a folder designated for the purpose of storing environmental records.

Appendix A

January Monthly Wellhead Monitoring Data

February 1, 2023
File No. 07220028.00 Task 6

MEMORANDUM

TO: Jonathan Chapman, VDEQ – SWRO

FROM: Mike Gibbons, SCS Field Services

SUBJECT: Monthly Landfill Gas System Wellhead Monitoring Data
for January, 2023 Landfill Permit Areas 221 and 498
Bristol Integrated Solid Waste Management Facility, Bristol, Virginia

SCS Field Services (SCS) is submitting this data on behalf of the City of Bristol per DEQ request for monthly landfill gas (LFG) wellhead monitoring data for Solid Waste Permit Areas #221 and #498 for the month of January, 2023.

Area 221

There are currently 15 vertical extraction wells in the SWP #221 Landfill Area (Well Nos. 1 – 15). In waste disposal units where the age of the buried wastes is greater than 40 years, as is the case at SWP #221 landfill, the rate and quantity of decomposition gas production declines significantly compared to the rate and quantity of LFG generated in more recently buried wastes. There is no historical evidence of elevated temperatures in SWP #221. Also, the #221 Landfill Area is not believed to be a significant source of fugitive LFG emissions or odors.

Adjustments are made during wellhead monitoring to optimize gas quality and applied vacuum on the Area 221 wells. All Area 221 are under vacuum. During the January monitoring event, slight valve adjustments were made at wells GW-03 and -08, wellhead. The average gas composition in the Area 221 wells is shown in Table 1. Methane and carbon dioxide concentrations decreased over the previous month while oxygen concentration increased since the previous month, this is likely attributed to the corresponding increase in applied vacuum. SCS preformed an evaluation of the wellheads in Area 221 by disassembling the wellheads and inspecting the components SCS cleaned the Pitot tubes as needed prior to reassembly. The PVC wellheads are weathered and brittle and prone to small air leaks. Pitot tubes on GW-03, -06, and -09, needed for flow rate measurements, have fallen off. SCS recommends replacing some of these wellheads with QED Precision wellheads. Details of the inspection results and recommendations are summarized in Table 2. SCS is developing a repair parts list and working with the City to make improvements to the wellheads.

Table 1. Monthly Average Wellhead LFG Composition – Area 221 Wells

Month	Average CH_4 (% Vol)	Average CO_2 (% Vol)	Average O_2 (% Vol)	Average Pressure (inches w.c.)
October '22	40.0	29.2	6.4	-14.9
November '22	47.4	33.7	3.3	-11.9
December '22	58.7	39.6	0.3	-2.7
January '23	39.8	27.0	6.0	-20.6

Table 2. Bristol Landfill Area 221 Wellhead Assessment 1/18/2023

Well#	Fernco Condition	Flex Hose Condition	Valve Condition	Pitot Tube Condition	Comments	Recommendtions
GW-1	OK	Good	OK	OK	clogged, flushed out; temp port broken	Replace port
GW-2	OK	OK	Poor	OK	Valve is bad and will not close	Replace wellhead
GW-3	OK	Poor	OK	Missing		Replace wellhead
GW-4	OK	Poor	OK	OK	flushed out debris	Replace flex hose
GW-5	OK	OK	OK	Poor	flushed out and tube is warped	Replace wellhead
GW-6	OK	OK	Poor	Missing	Valve is broken, No pitot tube	Replace wellhead
GW-7	OK	OK	OK	OK	flushed out debris	
GW-8	OK	Poor	OK	N/A	Unable to open; screws are stripped	Replace wellhead
GW-9	OK	OK	Poor	Missing		Replace wellhead
GW-10	OK	OK	OK	OK	flushed out debris	
GW-11	OK	OK	OK	OK	flushed out debris	
GW-12	Poor	Poor	OK	OK	flushed out debris	Replace 6" lateral fernco and flex hose
GW-13	OK	Poor	Poor	OK	flushed out debris, Valve broken	Replace wellhead
GW-14	OK	Poor	OK	OK	flushed out debris	Replace flex hose
GW-15	OK	Poor	Poor	OK	flushed out debris, Valve broken	Replace wellhead
GW-16	OK	Poor	OK	Good		Replace flex hose
GW-17	OK	OK	OK	OK	flushed out debris	
GW-18	OK	OK	OK	Good		

KEY:

Good	Good conition
OK	Not leaking, not new
Poor	Bad, Broken, Leaking need to be replaced
Missing	Part is missing
N/A	Unable to check

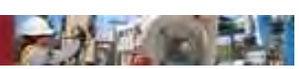
Area 498

The SWP #498 Landfill is approximately 12.0 acres and is located south of the SWP #221 Landfill and east of the SWP #588 Landfill. As of September 2022, mining in Permit #498 has concluded. The majority of the SWP #498 Landfill does not have an active LFG collection system, due to mining operations which have occurred since waste placement was completed. The current system includes four vertical wells (GW-19, GW-20, GW-21, and GW-22) and a condensate trap (CT-1) at the low point. Field reconnaissance efforts in September/October 2022 identified that the header pipe serving the four wells had been severed, blocked, or otherwise compromised. Vacuum was restored to GW-19 in November 2022. As of January 18, 2023, the blocked header piping was replaced, restoring vacuum to wells GW-20 and -21. These wells were monitored and adjusted on January 25, 2023. The buried wastes in SWP #498 Landfill Area is greater than 25 years old, thus, the rate and quantity of decomposition gas production has declined significantly compared to the rate and quantity of LFG generated in more recently buried wastes. Accordingly, the methane concentration tends to be substantially lower, the oxygen and nitrogen concentrations tend to be substantially greater, and the quantity of LFG collected declines substantially compared to the years immediately after waste placement. Furthermore, much of the organic wastes in the upper layer have likely decomposed aerobically (i.e., were composted) because of the mining operations. There is no historical evidence of elevated temperatures in SWP #498; however, the methane-to-carbon dioxide ratio measured in the wellheads can sometimes be less than 1 due to the fact that the wastes are becoming biochemically stabilized (meaning organic wastes have been more fully decomposed) and the rate of methanogenesis has declined. Also, the #498 Landfill Area is not believed to be a significant source of odors.

To better control flow rate from GW-19, SCS replaced the 1.25-inch orifice plate in the wellhead with a 1.0-inch orifice. Extraction wells GW-16, -17, -18, and -23 are perimeter migration control wells affiliated with Permit #498. These wells were monitored and adjusted as needed to control migration.

Bristol Virginia Landfill - Permit 221 and 498 Well Data - 01/01/2023 to 01/31/2023

Point Name	Record Date	CH4 (% by vol)	CO2 (% by vol)	O2 (% by vol)	Bal Gas (% by vol)	Init Static Pressure ("H2O)	Adj Static Pressure ("H20)	Temp (F)	System Pressure ("H20)	Comments
01	1/5/2023 12:28	60.3	39.7	0.0	0.0	-24.3	-24.2	67.6	-24.2	
02	1/5/2023 12:24	27.4	17.8	11.5	43.3	-24.2	-24.4	66.3	-24.2	
03	1/5/2023 12:16	13.0	9.0	15.7	62.3	-17.5	-16.9	55.9	-24.1	Closed Valve > 1 Turn
04	1/5/2023 12:11	48.2	35.3	3.1	13.4	-15.1	-15.0	64.8	-24.3	
05	1/5/2023 13:09	58.7	41.3	0.0	0.0	-24.3	-24.3	65.5	-24.2	
06	1/5/2023 13:05	14.4	8.6	16.0	61.0	-23.4	-23.2	69.0	-24.2	
07	1/5/2023 13:02	59.0	39.9	0.0	1.1	-14.0	-14.1	65.9	-24.5	
08	1/5/2023 12:58	1.9	1.6	20.3	76.2	-0.9	-0.5	67.1	-24.2	Closed Valve > 1 Turn
09	1/5/2023 12:50	56.6	38.3	1.1	4.0	-24.2	-24.1	65.4	-24.2	
10	1/5/2023 12:46	58.1	41.9	0.0	0.0	-23.1	-24.8	62.1	-24.2	
11	1/5/2023 12:36	29.5	20.2	10.7	39.6	-24.3	-24.4	60.9	-24.1	
12	1/5/2023 12:32	19.2	13.0	14.6	53.2	-24.1	-24.1	58.0	-24.1	
13	1/5/2023 12:19	59.9	40.1	0.1	0.0	-24.2	-24.2	56.9	-24.2	
14	1/5/2023 12:55	31.7	19.1	11.1	38.1	-20.6	-20.6	65.8	-24.2	
15	1/5/2023 12:41	59.5	39.0	0.0	1.5	-24.2	-24.2	56.9	-24.1	
Average Permit 221		39.8	27.0	6.9	26.2	-20.6				
16	1/5/2023 13:14	32.4	35.0	0.0	32.6	-22.8	-22.8	56.3	-24.2	
17	1/5/2023 13:16	56.3	38.1	0.0	5.6	-24.5	-24.5	63.8	-24.6	
18	1/5/2023 13:26	47.9	38.0	0.0	14.1	-17.2	-17.1	66.7	-24.2	
23	1/5/2023 13:20	0.1	0.6	20.6	78.7	-0.1	-0.1	57.9	-24.4	
Average Perimeter Migration Control Wells		34.2	27.9	5.2	32.8	-16.2				
19	1/6/2023 08:13	3.3	14.1	3.7	78.9	-17.8	-17.8	41.3	-24.1	
20	1/25/2023 11:38	8.6	10.6	6.0	74.8	-0.1	-0.4	68.4		Closed Valve > 1 Turn
21	1/25/2023 11:41	7.0	5.7	15.9	71.4	-1.4	-1.4	63.2		Closed Valve > 1 Turn
Average Permit 498		6.3	10.1	8.5	75.0	-6.4				



Appendix B

Landfill Gas Collection and Control System Optimization Results

Landfill Gas Collection and Control System Optimization Results

Bristol Integrated Solid Waste Management Facility

Solid Waste Permits #221 and 498

2655 Valley Drive
Bristol, VA 24201

SCS ENGINEERS

02218208.05 | February 1, 2023

15521 Midlothian Turnpike, Suite 305
Midlothian, VA 23113
804-378-7440

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Appendices

1.0 INTRODUCTION

Per a request by the Virginia Department of Environmental Quality (VDEQ or Department), SCS prepared a LFG Collection and Control System Optimization Plan (Plan) to assess and improve the LFG collection in the Solid Waste Permit (SWP) #221 and 498 landfills at the Bristol Integrated Solid Waste Management Facility (ISWMF) and mitigate potential for subsurface LFG migration.The report was submitted to VDEQ on behalf of the City of Bristol, Virginia (City) on December 1,2022. The Optimization Plan was divided into the following tasks for Each Landfill:

- Review and Evaluation of Existing LFG System Data
- LFG System Design and Construction Considerations
- LFG System Performance Field Activities

The results of these efforts are presented in the following two sections, with a summary and recommendations in Section 4.

2.0 PERMIT #221 LANDFILL

2.1 DEDICATED WELLFIELD BALANCING AND TUNING EVENT

A dedicated LFG wellfield balancing and tuning event by an experienced field technician to optimize the performance at each individual wellhead for the quality and quantity of LFG removal was performed by SCS staff on January 16, 2023. Methane content, carbon dioxide, oxygen, balance gas (assumed to be nitrogen), pressure, and temperature were measured at each of the wells GW-1 through GW-15. The full results are presented in Appendix A, and summarized as follows:

- All wells appear to be receiving appropriate system vacuum (~24 in. H2O)

- Eight of the 15 wells recorded oxygen concentrations greater than 5 percent, indicating excess air intrusion. Vacuum adjustments have been/will be made at these wells to reduce vacuum with the intension to reduce air intrusion.

- Only one of the 15 wells recorded methane concentrations greater than 58 percent, indicating need for additional gas extraction. Vacuum adjustments have been/will be made at this well to increase vacuum.

In addition to the dedicated tuning event, SCS-FS performed reconnaissance efforts on the wellfield to identify operations and maintenance issues with the existing wellfield infrastructure. SCS-FS flushed out debris and made observations on several broken valves, flex hoses, and other parts. In addition, it is recommended that the Facility consider replacing several wellheads with new 1" wellheads to enable fine tuning adjustments, and enable the landfill operator to measure flow rates to assist with optimization activities. SCS-FS and the City are coordinating on the replacement and repair of the wellheads.

2.2 LIQUID LEVEL MEASUREMENT AND DOWN-WELL CAMERA EVENT

SCS staff inspected and measured total depth and liquid level measurements with a camera on January 24 and 25,2023 to investigate the extent of liquid blockage and/or physical obstructions in

existing wells. Obstructions were encountered in four wells. The full results are presented in Appendix B, and summarized as follows:

- Eleven of the 15 wells had less than 10 feet of liquid in the well casing, indicating a relatively dry wellfield.

- The average depth to bottom or obstruction for the 15 wells was approximately 29 feet. This indicates relatively shallow wells in older waste

- A pump was observed in seven of the 15 wells; however these pumps are no longer active. The Facility should consider if these pumps can be reactivated, if they should be reactivated, and if they could potentially be moved to some of the wells that are experiencing higher levels of liquid blockages

2.3 VOLUNTARY SEM EVENT TO IDENTIFY FUGITIVE EMISSIONS "HOT SPOTS";

A voluntary Surface Emissions Monitoring (SEM) event was conducted on January 26,2023 to identify fugitive emissions "hot spots." SCS staff used a Thermo Scientific TVA-2020 Flame Ionization Detector (FID) to measure methane concentrations at the surface of the landfill. SCS targeted surface cover penetrations and any locations on the landfill that are potential locations of fugitive emissions (lack of vegetation, erosion rills, etc.). Most of the points exhibited methane concentrations less than 5 ppm. Surface penetrations at GW-7 and GW-15 exhibited methane concentrations of 82.4 ppm and 421 ppm, respectively. The Facility will consider general cover improvements to reduce fugitive emissions at these specific points, however these SEM results generally indicate sufficient collection of gas at the SWP 221 landfill. A map of the monitoring route and detailed results of the event are included in Appendix C.

2.4 ZONE OF INFLUENCE MAP OF THE LFGCCS

SCS developed a theoretical zone of influence at each vertical LFG well in the Permit #221 Landfill, using the current depth measured by field personnel, multiplied by a value of 3 to obtain a radius, then translating the radius into a circular area to assess the "horizontal" coverage of the LFGCCS. In order to assess the potential influence of liquids in LFG collection capacity, an adjusted radius and circle were calculated by only accounting for depth that is not structurally impaired or blocked by liquids.

A map of coverage areas based on the theoretical and adjusted zones of influence is included in Appendix D. The results of this exercise indicate that the current wellfield has been designed with appropriate coverage. Many of the zones of influence are overlapping and there are very few gaps in coverage. The adjusted zones of influence show some opportunity to increase coverage through dewatering activities.

2.5 LFGCCS EXPANSION CONCEPT DESIGN

SCS considered a design to incorporate additional wells, mostly in central areas of the landfill. Based on the data collected and reviewed, SCS is not recommending an expansion at this time.

3.0 PERMIT #498 LANDFILL

3.1 REPAIR EXISTING GCCS COMPONENTS

Site personnel have made repairs to the existing main header pipe that connects wells GW-19, GW-20, and GW-21 to the main system header as of January 19, 2022. Beginning in February 2023, these wells will be included in monthly wellfield monitoring events.

3.2 LIQUID LEVEL MEASUREMENT EVENT

Wells GW-19, GW-20, and GW-21 were inspected and total depth and liquid level were measured to determine if they should be utilized in the design of an LFG system expansion within this waste disposal unit. Sounding data indicates partial liquid blockages (less than 50 percent of total depth) in all three wells, with the wells, on average, around 31 feet deep. There were no obstructions observed at these three wells, and therefore these wells are likely suitable to continue to serve as functional extraction components.

3.3 LFGCCS EXPANSION CONCEPT DESIGN

SCS reviewed the existing LFG components as well as any available information about the waste depth and planned final cover grading, and determined that the approximately 20 feet of waste in the Permit #498 Landfill lent itself best to horizontal LFG collectors. These will also be helpful under the final cap currently in the design phase, to mitigate LFG bubbling to the surface under the geotextile. The horizontal collectors are arranged in the design drawing (Appendix E), in order to expand coverage from the minimal number of collectors on the southern boundary of the landfill to stretch into the central parts of the landfill where SCS suspects the most waste is located.

As part of the final closure Permit modification application, design drawings for a permanent GCCS were included, expanding coverage throughout the footprint of the 498 landfill with four horizontal collectors and an extension of the 8-inch header pipe to create a redundant loop. These drawings are included in the Permit Modification that was submitted to DEQ on January 31, 2023.

4.0 CONCLUSIONS/RECOMMENDATIONS

Once design plans are completed for the LFG expansion project, these action items can proceed as an extension of this Optimization Plan (***after*** the February 1, 2023 deadline).

- Reconnaissance efforts at the SWP 221 landfill indicated maintenance needs at several wellheads. See Table 2 in the January Monthly LFG System Monitoring Data for SWP 221 and 498, submitted by Mike Gibbons of SCS Engineers on January 31, 2023 for recommendations.

- Install one-inch wellheads on the wells in SWP 221. Plans to do this are already in motion, which will make it more feasible to make fine tuning to lower oxygen and lower methane at select wells. In addition, these adjustments should be performed on the extraction components in SWP 498 once monitoring begins on those components in February.

- The Facility should consider adding additional cover soil at the two locations identified in Section 2.3 (surface cover penetrations at GW-7 and GW-15), which appeared to have slightly elevated surface methane levels.

- In general, it appears that the City is appropriately addressing liquid infiltration in LFG wells via the installation of pumps, but could consider shifting pumps from drier wells to wells with higher liquid levels as measured during the sounding/camera event.

- While the existing extraction components in SWP 498 are functional, additional components are recommended to increase coverage throughout the landfill footprint. However, based on the field observations outlined above, the existing GCCS on the SWP 221 landfill appears sufficient at collecting LFG and no expansion is recommended at this time.

Appendix A

Wellfield Monitoring Data

APPENDIX A

PERMIT 221 WELLFIELD TUNING EVENT - JANUARY 16, 2023

BRISTOL LANDFILL - BRISTOL, VIRGINIA

ID	Date/Time	CH4	CO2	O2	Balance	Init. Static Press.	Sys. Press.	Temp.
		%	%	%	%	in. H2O	in. H2O	DegF
BRTLGW01	1/16/2023 12:37	37	24.7	7.5	30.8	-25.45	-24.3	56.1
BRTLGW02	1/16/2023 12:50	26.1	16.9	11.9	45.1	-25.46	-23.83	65.4
BRTLGW03	1/16/2023 13:58	18.3	12.2	14.9	54.6	-3.28	-24.52	55.9
BRTLGW04	1/16/2023 13:20	46.8	33.6	4.2	15.4	-14.96	-24.51	55.1
BRTLGW05	1/16/2023 13:24	50.8	35.6	3.3	10.3	-24.54	-24.48	60.5
BRTLGW06	1/16/2023 13:38	43.7	25.9	6.5	23.9	-21.99	-24.54	59.2
BRTLGW07	1/16/2023 11:31	56.4	38.3	0.6	4.7	-13.92	-24.53	62.4
BRTLGW08	1/16/2023 11:40	23	15.2	13.1	48.7	-1.24	-24.6	60.6
BRTLGW09	1/16/2023 11:56	51.7	35.4	2.3	10.6	-24.33	-24.05	60.3
BRTLGW10	1/16/2023 12:13	38.8	29.7	6	25.5	-24.79	-24.12	63.3
BRTLGW11	1/16/2023 12:21	17.8	12.2	14.7	55.3	-25.28	-24.33	68.1
BRTLGW12	1/16/2023 12:28	22.1	15.2	13.3	49.4	-24.75	-24.82	58.7
BRTLGW13	1/16/2023 13:49	59.9	39.7	0.3	0.1	-24.54	-24.48	54.4
BRTLGW14	1/16/2023 13:45	26	14.9	13.4	45.7	-20.11	-24.52	48.8
BRTLGW15	1/16/2023 13:53	51.7	34.8	3.1	10.4	-24.56	-24.56	55

Appendix B
Down-well Camera Event Log

APPENDIX B
PERMIT 221 WELL SOUNDING/CAMERA EVENT - JANUARY 24&25, 2023
BRISTOL LANDFILL - BRISTOL, VIRGINIA

Wellhead	Distance to Water (.ft)	Distance to Bottom (.ft)	Distance to obstruction (.ft)	Percent open casing	Pump (Y/N)	Notes:
GW-1	16.33	N/A	19.5	84%	Y	Obstruction preventing total depth measurment believed to be pump lines. Clear
GW-2	18.8	N/A	30.85	61%	Y	Obstruction preventing total depth measurment known to be pump rope. Clear
GW-3	Dry	31.58	N/A	100%	N	No Water, Well Unobstructed
GW-4	25.95	N/A	27.4	95%	Y	Obstruction preventing total depth measurment believed to be well casing
GW-5	18.95	33.68	N/A	56%	N	Well Unobstructed, Corrosion noted on well casing, Silt in water
GW-6	20.76	28.18	N/A	74%	Y	Well Unobstructed, Clear Water
GW-7	41	45.4	N/A	90%	N	Well Unobstructed, Clear water
GW-8	17.7	19.75	N/A	90%	Y	Silt in water, Well unobstructed
GW-9	N/A	N/A	15.65	--	Y	Thick black buildup around pump lines prevented camera ingress. Personnel
GW-10	19.9	29.3	N/A	68%	N	Well Unobstructed, Clear water
GW-11	13.65	29.5	N/A	46%	N	Well Unobstructed, Clear water
GW-12	15.55	27.15	N/A	57%	Y	Well Unobstructed, Clear water
GW-13	26.25	28.3	N/A	93%	N	Well unobstructed, clear water, black muddy substance found on bottom 4 feet of camera
GW-14	23.43	29	N/A	81%	N	Well Unobstructed, Clear water
GW-15	28.7	36.15	N/A	79%	N	Well Unobstructed, Clear water

Appendix C
Voluntary SEM Data

SCS ENGINEERS

SURFACE EMISSIONS MONITORING RESULTS
PERMIT 221 - TARGET ZONES - JANUARY 26, 2023
BRISTOL LANDFILL - BRISTOL, VIRGINIA

Date	Time	ID #	Methane Concentration		Compliance	Comments
1/26/23	10:24	1	1.6	PPM	OK	
1/26/23	10:25	2	1.7	PPM	OK	GW-6
1/26/23	10:27	3	1.2	PPM	OK	
1/26/23	10:27	4	1.1	PPM	OK	
1/26/23	10:28	5	82.4	PPM	OK	GW-7
1/26/23	10:29	6	1.2	PPM	OK	
1/26/23	10:29	7	1.3	PPM	OK	GW-8
1/26/23	10:30	8	1.2	PPM	OK	
1/26/23	10:30	9	1.7	PPM	OK	
1/26/23	10:31	10	2	PPM	OK	GW-9
1/26/23	10:31	11	1.7	PPM	OK	
1/26/23	10:32	12	1.3	PPM	OK	
1/26/23	10:34	13	1.4	PPM	OK	GW-10
1/26/23	10:35	14	1.3	PPM	OK	
1/26/23	10:36	15	1.8	PPM	OK	
1/26/23	10:36	16	1.4	PPM	OK	
1/26/23	10:37	17	1.5	PPM	OK	
1/26/23	10:37	18	1.7	PPM	OK	
1/26/23	10:38	19	1.5	PPM	OK	
1/26/23	10:38	20	2.3	PPM	OK	GW-11
1/26/23	10:39	21	2.6	PPM	OK	GW-12
1/26/23	10:39	22	1.7	PPM	OK	
1/26/23	10:40	23	2.1	PPM	OK	GW-1
1/26/23	10:40	24	2.5	PPM	OK	
1/26/23	10:41	25	2.1	PPM	OK	
1/26/23	10:41	26	1.7	PPM	OK	
1/26/23	10:41	27	1.7	PPM	OK	
1/26/23	10:42	28	1.4	PPM	OK	GW-2
1/26/23	10:42	29	1.4	PPM	OK	
1/26/23	10:43	30	1.5	PPM	OK	
1/26/23	10:43	31	1.6	PPM	OK	
1/26/23	10:44	32	1.5	PPM	OK	GW-3
1/26/23	10:44	33	1.9	PPM	OK	
1/26/23	10:45	34	1.5	PPM	OK	
1/26/23	10:45	35	3.1	PPM	OK	
1/26/23	10:46	36	2.8	PPM	OK	GW-4
1/26/23	10:46	37	3.1	PPM	OK	
1/26/23	10:47	38	2	PPM	OK	
1/26/23	10:47	39	1.9	PPM	OK	
1/26/23	10:47	40	1.4	PPM	OK	GW-13
1/26/23	10:49	41	2.2	PPM	OK	
1/26/23	10:49	42	1.2	PPM	OK	
1/26/23	10:49	43	1.2	PPM	OK	
1/26/23	10:50	44	1.1	PPM	OK	
1/26/23	10:50	45	1.1	PPM	OK	
1/26/23	10:51	46	421	PPM	OK	GW-15
1/26/23	10:52	47	1.1	PPM	OK	
1/26/23	10:53	48	1.1	PPM	OK	
1/26/23	10:53	49	1.2	PPM	OK	
1/26/23	10:54	50	2.2	PPM	OK	GW-14
1/26/23	10:56	51	1.4	PPM	OK	
1/26/23	10:56	52	1.3	PPM	OK	
1/26/23	10:58	53	1.2	PPM	OK	GW-5
1/26/23	11:02	54	1.2	PPM	OK	

SURFACE EMISSIONS MONITORING RESULTS
PERMIT 221 - TARGET ZONES - JANUARY 26, 2023
BRISTOL LANDFILL - BRISTOL, VIRGINIA

Date	Time	ID #	Methane Concentration	Compliance	Comments

Number of locations sampled:	54
Number of exceedance locations:	0

NOTES:
Weather Conditions: Partly Cloudy, 33˚F Wind: NW 14 MPH

Sampling Calibration: Methane - 500 ppm, Zero Air - 0.0 ppm

1/26/23	7:50	ZERO	0.0 PPM
1/26/23	7:57	SPAN	503.0 PPM

Background Reading:

1/26/23	8:00	Downwind	4.2 PPM
1/26/23	8:02	Upwind	2.0 PPM

Appendix D
Zone of Influence Maps

0 80 160 240
SCALE IN FEET

N

LEGEND

PROPOSED LFG WELL	EXISTING MAJOR CONTOUR
EXISTING WELLHEAD	EXISTING MINOR CONTOUR
EXISTING AIR RELEASE VALVE	EXISTING HORIZONTAL COLLECTOR
EXISTING ISOLATION VALVE	EXISTING 2" AIR LINE
EXISTING LEACHATE CLEANOUT	EXISTING 4" FORCE MAIN
EXISTING U-TRAP	EXISTING LFG HEADER
EXISTING CONDENSATE PUMP STATION	EXISTING 4" LFG HEADER
EXISTING HORIZONTAL COLLECTOR SUMP	EXISTING 6" LFG HEADER
EXISTING LFG LIQUIDS CONTAINMENT TANK	EXISTING 8" LFG HEADER
EXISTING GAS PROBE	EXISTING 12" LFG HEADER
EXISTING GROUNDWATER MONITORING WELL	PROPOSED 4" lfg HEADER
EXISTING MANHOLE	PROPOSED 6" HEADER
	PROPOSED 8" HEADER
	PROPOSED 12" HEADER
	BUILDING
	WASTE MANAGEMENT BOUNDARY
	FACILITY PROPERTY BOUNDARY
	APPROXIMATE LOCATION OF SIDEWALL
	EXISTING ROAD OUTLINE
	EXISTING GRAVEL ROAD

TOPOGRAPHY

GRADES SHOWN AS DASHED HALF-TONE CONTOUR LINES REPRESENT THE TOPOGRAPHY DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY NV5 GEOSPATIAL, DATED OCTOBER 7, 2022.

GENERAL NOTES

1. THE LOCATIONS OF THE EXISTING GAS PROBES AND EXISTING MANHOLES SHOWN ARE APPROXIMATE BASED ON DATA PROVIDED BY DRAPER ADEN ASSOCIATES. THE EXACT LOCATIONS OF THESE EXISTING WELLFIELD COMPONENTS MAY NEED IN-FIELD VERIFICATION.

2. THE LOCATIONS OF WELLS GW-16, GW-17, GW-19, GW-20, AND GW-21 WERE MEASURED USING MAPPING GRADE POSITIONING EQUIPMENT UTILIZING GEOGRAPHIC INFORMATION SYSTEM SOFTWARE.

3. THE LOCATION OF THE EXISTING LFG HEADER WAS MEASURED USING MAPPING GRADE POSITIONING EQUIPMENT UTILIZING GEOGRAPHIC INFORMATION SYSTEM SOFTWARE.

4. THEORETICAL RADII OF INFLUENCE BASED ON MULTIPLYING THE MEASURED WELL DEPTH TIMES A FACTOR OF 3.

5. ADJUSTED RADII OF INFLUENCE BASED ON DEPTH OF WELL CASING FREE OF LIQUIDS, TIMES A FACTOR OF 3.

BM-1
BM-2
BM-3
BM-4
GW-5
GW-6
GW-7
GW-8
GW-9
GW-10
GW-11
GW-12
GW-13
GW-14
GW-15
GW-16
GW-17
GW-19
GW-20
GW-21
GW-22
GW-30R
GW-31R
GW-32
GW-32R
GW-33
GW-34
GW-36
GW-37
GW-38
GW-48
GW-49
GW-50
GW-60
GW-61
GW-62
GW-63
GW-64
GW-65
GW-68
EW-1
EW-29
EW-33
EW-34
EW-37
EW-42
CPS-1
LCT-1
SITE TANK
CT-1
HC-2
THEORETICAL RADIUS OF INFLUENCE
ADJUSTED RADIUS OF INFLUENCE

NO.	REVISION	DATE

SHEET TITLE
RADIUS OF INFLUENCE MAP

PROJECT TITLE

CLIENT
CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS, INC.
15521 MIDLOTHIAN TPKE. MIDLOTHIAN, VA 23113
PH: (804) 379-7440 FAX: (804) 379-7453

PROJ. NO.	
DSN. BY: HGW	DWG. BY: HGW
	CHK. BY:
	Q/A RVW BY:
	APP. BY:

CADD FILE:

DATE: Jan 2023

SCALE: AS SHOWN

DRAWING NO.
1

Appendix E
Proposed Conceptual LFG Expansion Plan

N

0 40 80 120
SCALE IN FEET

LEGEND

- PROPOSED HORIZONTAL COLLECTOR
- EXISTING WELLHEAD
- EXISTING AIR RELEASE VALVE
- EXISTING ISOLATION VALVE
- EXISTING LEACHATE CLEANOUT
- EXISTING U-TRAP
- EXISTING CONDENSATE PUMP STATION
- EXISTING HORIZONTAL COLLECTOR SUMP
- EXISTING LFG LIQUIDS CONTAINMENT TANK
- EXISTING GAS PROBE
- EXISTING GROUNDWATER MONITORING WELL
- EXISTING MANHOLE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EXISTING HORIZONTAL COLLECTOR
- EXISTING 2" AIR LINE
- EXISTING 4" FORCE MAIN
- EXISTING LFG HEADER
- EXISTING 4" LFG HEADER
- EXISTING 6" LFG HEADER
- EXISTING 8" LFG HEADER
- EXISTING 12" LFG HEADER
- PROPOSED 4" lfg HEADER
- PROPOSED 6" HEADER
- PROPOSED 8" HEADER
- PROPOSED 12" HEADER
- BUILDING
- WASTE MANAGEMENT BOUNDARY
- FACILITY PROPERTY BOUNDARY
- APPROXIMATE LOCATION OF SIDEWALL
- EXISTING ROAD OUTLINE
- EXISTING GRAVEL ROAD

TOPOGRAPHY

GRADES SHOWN AS DASHED HALF-TONE CONTOUR LINES REPRESENT THE TOPOGRAPHY DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY NVS GEOSPATIAL, DATED OCTOBER 7, 2022.

GENERAL NOTES

1. THE LOCATIONS OF THE EXISTING GAS PROBES AND EXISTING MANHOLES SHOWN ARE APPROXIMATE BASED ON DATA PROVIDED BY DRAPER ADEN ASSOCIATES. THE EXACT LOCATIONS OF THESE EXISTING WELLFIELD COMPONENTS MAY NEED IN-FIELD VERIFICATION.

2. THE LOCATIONS OF WELLS GW-16, GW-17, GW-19, GW-20, AND GW-21 WERE MEASURED USING MAPPING GRADE POSITIONING EQUIPMENT UTILIZING GEOGRAPHIC INFORMATION SYSTEM SOFTWARE.

3. THE LOCATION OF THE EXISTING LFG HEADER WAS MEASURED USING MAPPING GRADE POSITIONING EQUIPMENT UTILIZING GEOGRAPHIC INFORMATION SYSTEM SOFTWARE.

PROPOSED HORIZONTAL GAS WELL

PROPOSED VERTICAL GAS WELL COLOCATED WITH HORIZONTAL COLLECTOR WELLHEAD (TYP. OF 4)

GW-72
GW-71
GW-70
GW-22
GW-19
GW-20
GW-21
GW-61
GP-2
GP-3
GP-8
GP-7
MW-108
MW-106A
MW-106B
GAS WELL GW-16
BW-2
SITE TANK
CPS-1
LCT-1
CT-1
TP-6
ROAD CROSSING
EXISTING CITY OF BRISTOL LANDFILL (PERMIT No. 498)
CITY OF BRISTOL PARCEL 425-- A-4 DB 333 PG 430
2" PNEUMATIC SUPPLY LINE / CONDENSATE DRAIN IN COMMON TRENCH
EXISTING LFG GAS COLLECTION HEADER
FIRE POND
POND OVER
PAVED AREA
6" FORCE (APPROXIMATE LOCA
SEWER LINE FROM THE BLOWER FLARE STATION AND THE INGENCO F
VALVE BOX
JUNCTION BOX
EXISTING SLOPE DRAIN
CONTACT WATER INLET
30" RCP
6" FM
6" PVC
D.I.

NO.	REVISION	DATE

SHEET TITLE
CONCEPT LFG EXPANSION

PROJECT TITLE

CLIENT
CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS, INC.
5522 MIDLOTHIAN TURNPIKE, MIDLOTHIAN, VA 23113
PH: (804) 378-7440 FAX: (804) 378-7483

PROJ. NO.
DWN. BY: HGW
D/A RVW BY:
CHK. BY:
APP. BY:
ESIK. BY: HGW

CADD FILE:

DATE: Jan 2023

SCALE: AS SHOWN

DRAWING NO.
1

Appendix C

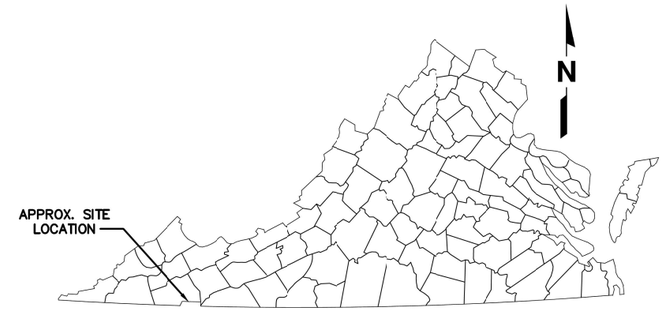
Final Closure System Permit Modification Design Plans

BRISTOL, VIRGINIA INTEGRATED SOLID WASTE MANAGEMENT FACILITY
SOLID WASTE PERMIT #498

CLOSURE DESIGN PLANS

BRISTOL, VIRGINIA

INDEX OF DRAWINGS



VIRGINIA

PREPARED FOR:

CITY OF BRISTOL, VIRGINIA
300 LEE STREET
BRISTOL, VIRGINIA 24201

INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VIRGINIA 24201

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
15521 MIDLOTHIAN TURNPIKE, SUITE 305
MIDLOTHIAN, VIRGINIA 23113-7313
PH. (804) 378-7440 FAX. (703) 471-6676
WWW.SCSENGINEERS.COM

SCS PROJECT NO. 02218208.17

JANUARY 31, 2023

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE: COVER SHEET

PROJECT TITLE: SWP #498 FINAL CLOSURE SYSTEM PERMIT MODIFICATION DESIGN PLANS

CLIENT: CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
15521 MIDLOTHIAN TNPK - MIDLOTHIAN, VA 23113
PH. (804) 378-7440 FAX. (804) 378-7433

PROJ. NO. 02218208.05 | DSN. BY: TRW/SHA | QA/A RVW BY: | APP. BY: CJW
DSK. BY: TRW | CHK. BY: CJW

CADD FILE: 02218208.05

DATE: 1/31/23

SCALE: AS SHOWN

DRAWING NO. 1 of 16

\\mid-fs01\Project\Project\02218208.05\Drawings\SWP498 LF – Permit Mod Drawings

LEGEND:

- 1850 — EXISTING CONTOUR, MAJOR (10')
- EXISTING CONTOUR, MINOR (2')
- 1850 PROPOSED CONTOUR, MAJOR (10')
- PROPOSED CONTOUR, MINOR (2')
- EXISTING 2" AIR LINE
- EXISTING 4" FORCE MAIN
- LFG EXISTING LFG HEADER
- 4G EXISTING 4" LFG HEADER
- 6G EXISTING 6" LFG HEADER
- 8G EXISTING 8" LFG HEADER
- 12G EXISTING 12" LFG HEADER
- BUILDING
- L EXISTING LEACHATE PIPE
- L PROPOSED LEACHATE PIPE
- L LEACHATE CLEANOUT
- STORMWATER PIPE
- EXISTING GRAVEL ROAD
- RIP RAP/ ROCKS
- FLEXAMAT DOWNCHUTE
- DIVERSION BERM
- SF SILT FENCE
- CELL BOUNDARY
- EDGE OF LINER
- LANDFILL GAS VENT
- LFG LANDFILL GAS PIPE
- P-2 PIEZOMETER
- MW-11 MONITORING WELL
- LOD LIMITS OF DISTURBANCE
- S SOIL TYPE BOUNDARY
- DRAINAGE AREA
- STREAM OR WATERLINE
- CENTERLINE
- (TS) TEMPORARY SEEDING
- (PS) PERMANENT SEEDING
- (DIP) CULVERT INLET PROTECTION
- (OP) OUTLET PROTECTION
- (SF) SILT FENCE
- (CE) CONSTRUCTION ENTRANCE
- (MU) MULCHING
- (B/M) BLANKETS AND MATTING
- RUNOFF FLOW DIRECTION
- LFG HEADER 6"ø

LEGEND:

- TP-3 EXISTING TEMPERATURE PROBE
- EXISTING WELLHEAD
- EXISTING AIR RELEASE VALVE
- EXISTING ISOLATION VALVE
- EXISTING LEACHATE CLEANOUT
- EXISTING U-TRAP
- EXISTING CONDENSATE PUMP STATION
- EXISTING HORIZONTAL COLLECTOR SUMP
- EXISTING LFG LIGUIDS CONTAINMENT TANK
- GP-5 EXISTING GAS PROBE
- MW-110 EXISTING GROUNDWATER MONITORING WELL
- EXISTING MANHOLE
- GW-## PROPOSED LFG COLLECTION WELLHEAD

- PROPERTY LINE
- FACILITY BOUNDARY
- WASTE MANAGEMENT UNIT BOUNDARY
- APPROXIMATE LOCATION FOR OF SIDEWALL
- EXISTING ROAD OUTLINE
- EXISTING LFG HORIZONTAL COLLECTOR
- PROPOSED LFG HORIZONTAL COLLECTOR
- LFG EXISTING LFG COLLECTION PIPING
- LFG PROPOSED LFG COLLECTION PIPING
- 8G PROPOSED 8" LFG COLLECTION PIPING
- 12G PROPOSED 12" LFG COLLECTION PIPING
- 16G PROPOSED 16" LFG COLLECTION PIPING
- 18G PROPOSED 18" LFG COLLECTION PIPING
- 24G PROPOSED 24" LFG COLLECTION PIPING
- 28G PROPOSED 28" LFG COLLECTION PIPING
- 36G PROPOSED 36" LFG COLLECTION PIPING
- PROPOSED 2" AIR LINE
- PROPOSED 4" FORCE MAIN

GENERAL NOTES:

1. OWNER/DEVELOPER: CITY OF BRISTOL, VIRGINIA
2. CONSULTING ENGINEER: SCS ENGINEERS, 15521 MIDLOTHIAN TURNPIKE #305, MIDLOTHIAN, VA 23113
3. LOCATION OF EXISTING SEWER, WATER, OR GAS LINES, CONDUITS, OR OTHER STRUCTURES ACROSS, UNDERNEATH, OR OTHERWISE ALONG THE LINE OF PROPOSED WORK ARE NOT NECESSARILY SHOWN ON THE PLANS, AND IF SHOWN ARE ONLY APPROXIMATELY CORRECT. CONTRACTOR SHALL VERIFY LOCATION AND ELEVATION OF UNDERGROUND UTILITIES SHOWN ON THE PLANS IN AREAS OF CONSTRUCTION PRIOR TO STARTING WORK. CONTACT ENGINEER IMMEDIATELY IF LOCATION OF ELEVATION IS DIFFERENT FROM THAT SHOWN ON THE PLANS, IF THERE APPEARS TO BE A CONFLICT, OR UPON DISCOVERY OF A UTILITY NOT SHOWN ON THE PLANS. THE CONTRACTOR SHALL OBTAIN FIELD UTILITY LOCATIONS BY CALLING "MISS UTILITY" FORTY EIGHT (48) HOURS PRIOR TO WORKING IN THE VICINITY OF EXISTING UTILITIES.
4. BOUNDARY INFORMATION TAKEN FROM OTHERS.
5. THESE DRAWINGS ARE NOT SUITABLE FOR CONSTRUCTION.
6. HORIZONTAL DATA IS BASED ON US STATE PLANE NAD 1983 VIRGINIA SOUTH ZONE. VERTICAL DATA BASED ON NAVD 88.
7. GRADES SHOWN AS DASHED HALF-TONE CONTOUR LINES REPRESENT THE TOPOGRAPHY DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY NV5 GEOSPATIAL, DATED OCTOBER 7, 2022.
8. EXISTING LFG HEADER WAS OBTAINED FROM SCS CONSTRUCTION DRAWINGS, LAST UPDATED JULY 6, 2022.
9. THE LOCATIONS OF THE EXISTING GAS PROBES AND EXISTING MANHOLES SHOWN ARE APPROXIMATE BASED ON DATA PROVIDED BY DRAPER ADEN ASSOCIATES. THE EXACT LOCATIONS OF THESE EXISTING WELLFIELD COMPONENTS MAY NEED IN-FIELD VERIFICATION.
10. THE LOCATIONS OF WELLS GW-16, GW-17, GW-19, GW-20, AND GW-21 WERE MEASURED USING MAPPING GRADE POSITIONING EQUIPMENT UTILIZING GEOGRAPHIC INFORMATION SYSTEM SOFTWARE.
11. HYDRAULICALLY ADEQUATE ALTERNATIVE MATERIALS FOR THE STORMWATER PIPES, CULVERTS, SEWERS, JUNCTIONS, AND DOWNCHUTES MAY BE SUBSTITUTED AT OWNER'S DISCRETION.

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE: GENERAL NOTES AND LEGEND

PROJECT TITLE: SWP #498 FINAL CLOSURE SYSTEM PERMIT MODIFICATION DESIGN PLANS

CLIENT: CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
15521 MIDLOTHIAN TNPK - MIDLOTHIAN, VA 23113
PH. (804) 378-7440 FAX. (804) 378-7433

PROJ. NO. 02218208.05 | DSN. BY: TRW/SHA | Q/A RVW BY: | DSK. BY: TRW | CHK. BY: CJW | APP. BY: CJW

CADD FILE: 02218208.05

DATE: 1/31/23

SCALE: AS SHOWN

DRAWING NO. 2 of 16

\\mid-fs01\Project\Project\02218208.05\Drawings\SWP498 LF - Permit Mod Drawings

BRISTOL VIRGINIA SOLID WASTE FACILITY CONTROL MONUMENTS 9-10-2020				
BENCHMARK	NORTHING	EASTING	ELEVATION	DESCRIPTION
BM-1	3398930.8510	10412541.7390	1945.9200	BOLT IN CONCRETE MONUMENT
BM-2	3398427.2980	10411954.6380	1880.3510	BOLT IN CONCRETE MONUMENT
BM-3	3399535.2420	10412031.2950	1864.1110	TOP OF ANCHOR BOLT FOR ROCK PROTECTION FENCING
BM-4	3399345.9430	10413587.4720	1852.0750	1/2" REBAR IN CONCRETE AT FENCE CORNER
BENCHMARK INFORMATION PROVIDED BY THE CITY OF BRISTOL, VIRGINA				

N

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SCALE IN FEET

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE
OVERALL SITE MAP

PROJECT TITLE
SWP #498 FINAL CLOSURE SYSTEM
PERMIT MODIFICATION DESIGN PLANS

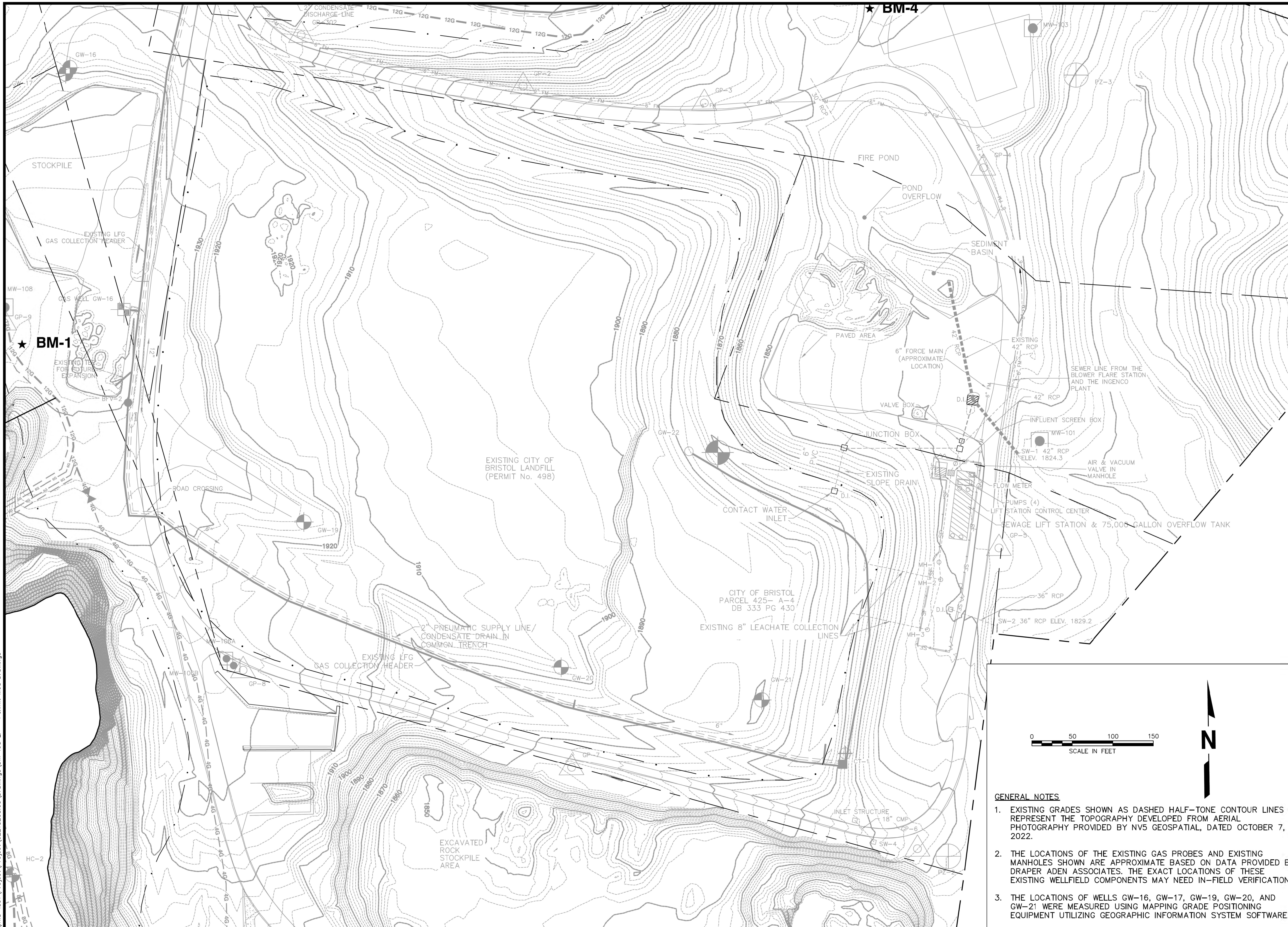
CLIENT
CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
15321 MIDLOTHIAN TNPK - MIDLOTHIAN, VA 23113
PH. (804) 378-7440 FAX. (804) 378-7433

PROJ. NO. 02218208.05
DSN. BY: TRW/SHA
CHK. BY: CJW
QA RVW BY:
APP. BY: CJW

CADD FILE: 02218208.05
DATE: 1/31/23
SCALE: AS SHOWN
DRAWING NO. 3 of 16

\\mid-fs01\Project\Project\02218208.05\Drawings\SWP498 LF - Permit Mod Drawings



GENERAL NOTES

1. EXISTING GRADES SHOWN AS DASHED HALF-TONE CONTOUR LINES REPRESENT THE TOPOGRAPHY DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY NV5 GEOSPATIAL, DATED OCTOBER 7, 2022.

2. THE LOCATIONS OF THE EXISTING GAS PROBES AND EXISTING MANHOLES SHOWN ARE APPROXIMATE BASED ON DATA PROVIDED BY DRAPER ADEN ASSOCIATES. THE EXACT LOCATIONS OF THESE EXISTING WELLFIELD COMPONENTS MAY NEED IN-FIELD VERIFICATION.

3. THE LOCATIONS OF WELLS GW-16, GW-17, GW-19, GW-20, AND GW-21 WERE MEASURED USING MAPPING GRADE POSITIONING EQUIPMENT UTILIZING GEOGRAPHIC INFORMATION SYSTEM SOFTWARE.

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE
EXISTING CONDITIONS

PROJECT TITLE
SWP #498 FINAL CLOSURE SYSTEM
PERMIT MODIFICATION DESIGN PLANS

CLIENT
CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
15521 MIDLOTHIAN TNPK - MIDLOTHIAN, VA 23113
PH. (804) 378-7440 FAX. (804) 378-7433

PROJ. NO. 02218208.05 | DWN. BY: TRW/SHA | Q/A RVW BY:
DSN. BY: TRW | CHK. BY: CJW | APP. BY: CJW

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DATE: 1/31/23
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DRAWING NO.
4 of 16

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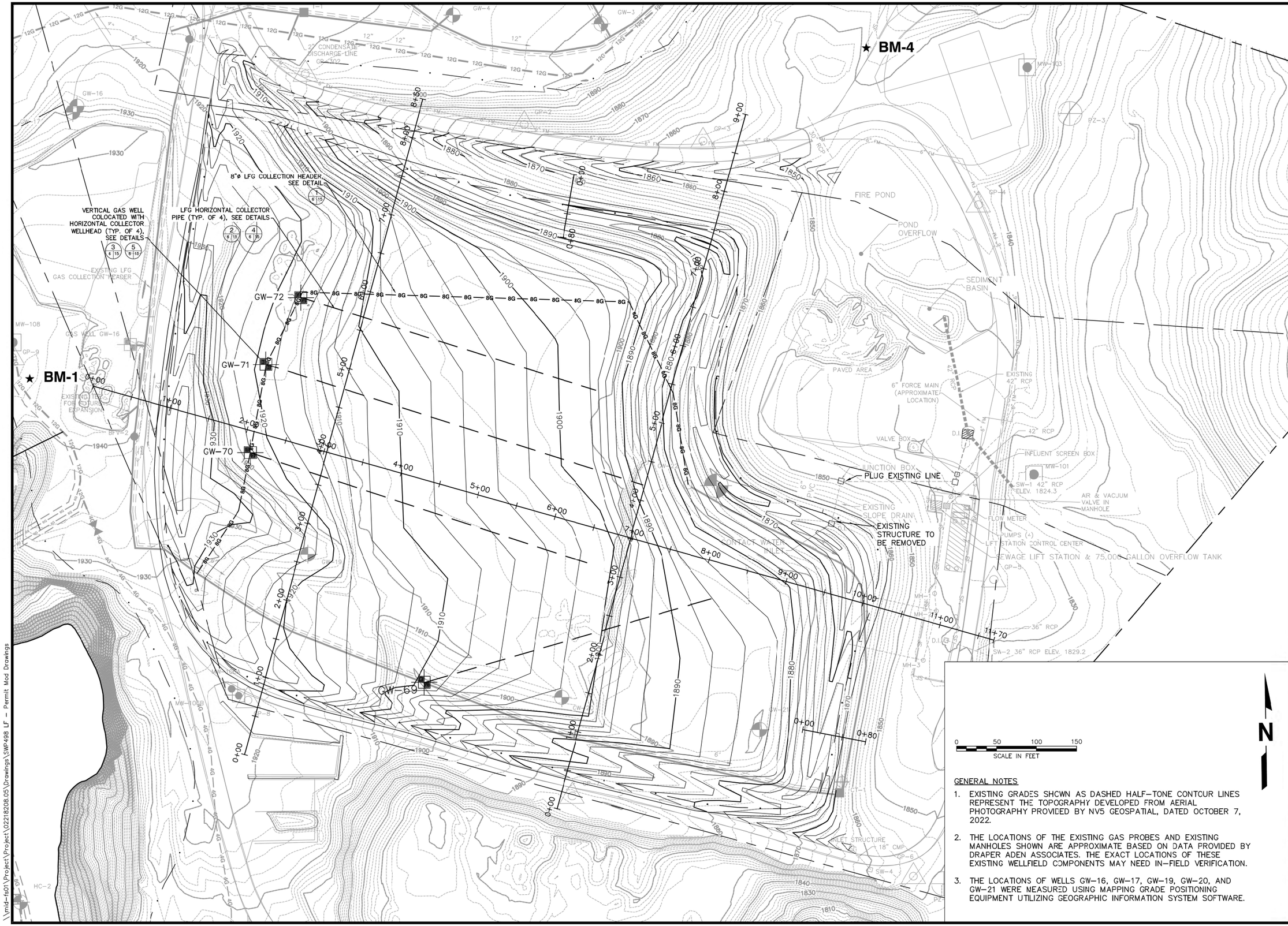

GENERAL NOTES

1. EXISTING GRADES SHOWN AS DASHED HALF-TONE CONTOUR LINES REPRESENT THE TOPOGRAPHY DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY NV5 GEOSPATIAL, DATED OCTOBER 7, 2022.
2. THE LOCATIONS OF THE EXISTING GAS PROBES AND EXISTING MANHOLES SHOWN ARE APPROXIMATE BASED ON DATA PROVIDED BY DRAPER ADEN ASSOCIATES. THE EXACT LOCATIONS OF THESE EXISTING WELLFIELD COMPONENTS MAY NEED IN-FIELD VERIFICATION.
3. THE LOCATIONS OF WELLS GW-16, GW-17, GW-19, GW-20, AND GW-21 WERE MEASURED USING MAPPING GRADE POSITIONING EQUIPMENT UTILIZING GEOGRAPHIC INFORMATION SYSTEM SOFTWARE.

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE
INTERMEDIATE COVER GRADE

PROJECT TITLE
SWP #498 FINAL CLOSURE SYSTEM
PERMIT MODIFICATION DESIGN PLANS

CLIENT
CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

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CONSULTING ENGINEERS, INC.
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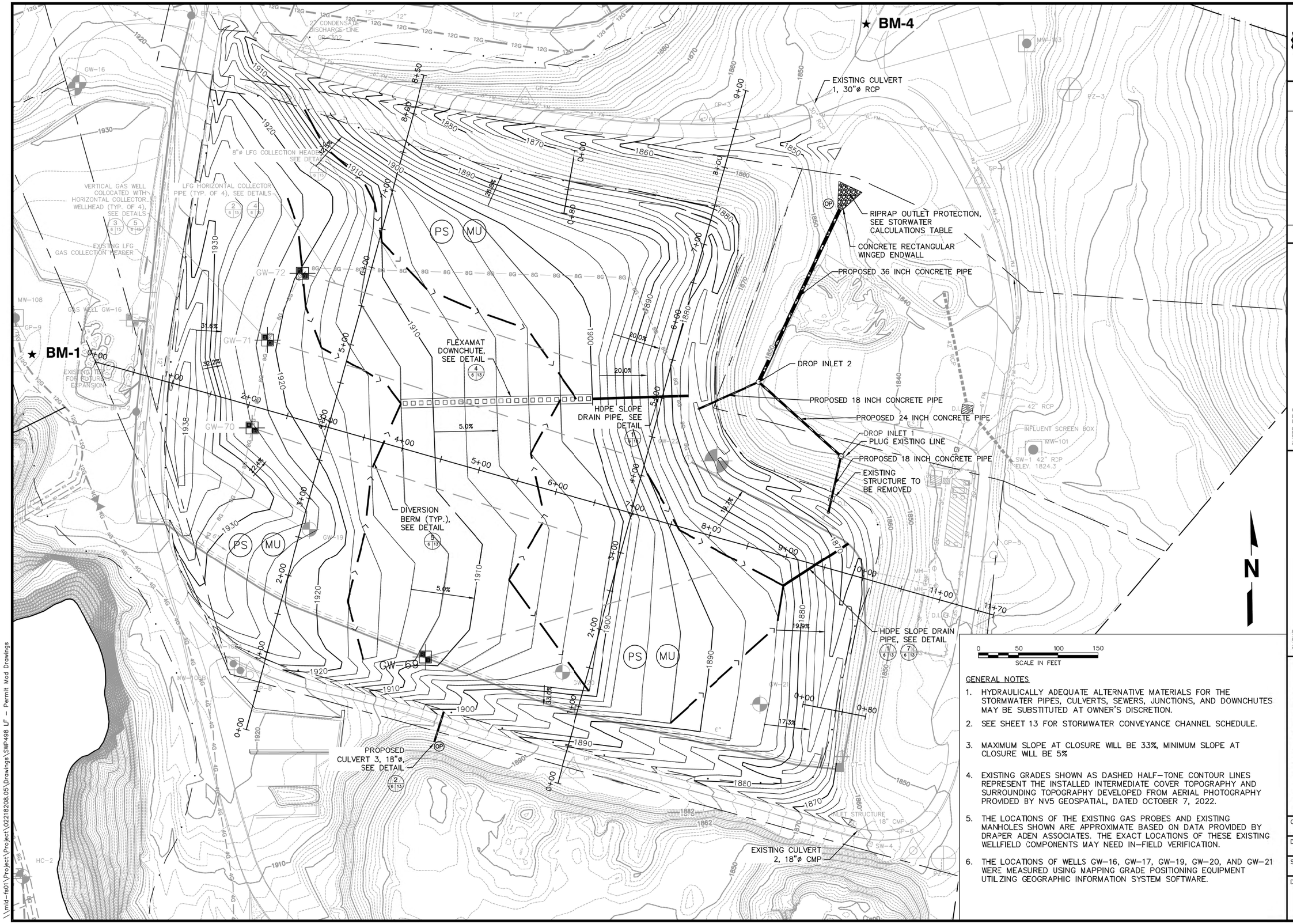
PH. (804) 378-7440 FAX. (804) 378-7433

PROJ. NO. 02218208.05
DSK. BY: TRW
DWN. BY: TRW/SHA
CHK. BY: CJW
O/A RVW BY:
APP. BY: CJW

CADD FILE: 02218208.05
DATE: 1/31/23
SCALE: AS SHOWN
DRAWING NO. **5** of 16

\\mid-fs01\Project\Project\02218208.05\Drawings\SWP498 LF - Permit Mod Drawings



GENERAL NOTES

1. HYDRAULICALLY ADEQUATE ALTERNATIVE MATERIALS FOR THE STORMWATER PIPES, CULVERTS, SEWERS, JUNCTIONS, AND DOWNCHUTES MAY BE SUBSTITUTED AT OWNER'S DISCRETION.
2. SEE SHEET 13 FOR STORMWATER CONVEYANCE CHANNEL SCHEDULE.
3. MAXIMUM SLOPE AT CLOSURE WILL BE 33%, MINIMUM SLOPE AT CLOSURE WILL BE 5%
4. EXISTING GRADES SHOWN AS DASHED HALF-TONE CONTOUR LINES REPRESENT THE INSTALLED INTERMEDIATE COVER TOPOGRAPHY AND SURROUNDING TOPOGRAPHY DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY NV5 GEOSPATIAL, DATED OCTOBER 7, 2022.
5. THE LOCATIONS OF THE EXISTING GAS PROBES AND EXISTING MANHOLES SHOWN ARE APPROXIMATE BASED ON DATA PROVIDED BY DRAPER ADEN ASSOCIATES. THE EXACT LOCATIONS OF THESE EXISTING WELLFIELD COMPONENTS MAY NEED IN-FIELD VERIFICATION.
6. THE LOCATIONS OF WELLS GW-16, GW-17, GW-19, GW-20, AND GW-21 WERE MEASURED USING MAPPING GRADE POSITIONING EQUIPMENT UTILZING GEOGRAPHIC INFORMATION SYSTEM SOFTWARE.

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE: FINAL CLOSURE GRADE

PROJECT TITLE: SWP #498 FINAL CLOSURE SYSTEM PERMIT MODIFICATION DESIGN PLANS

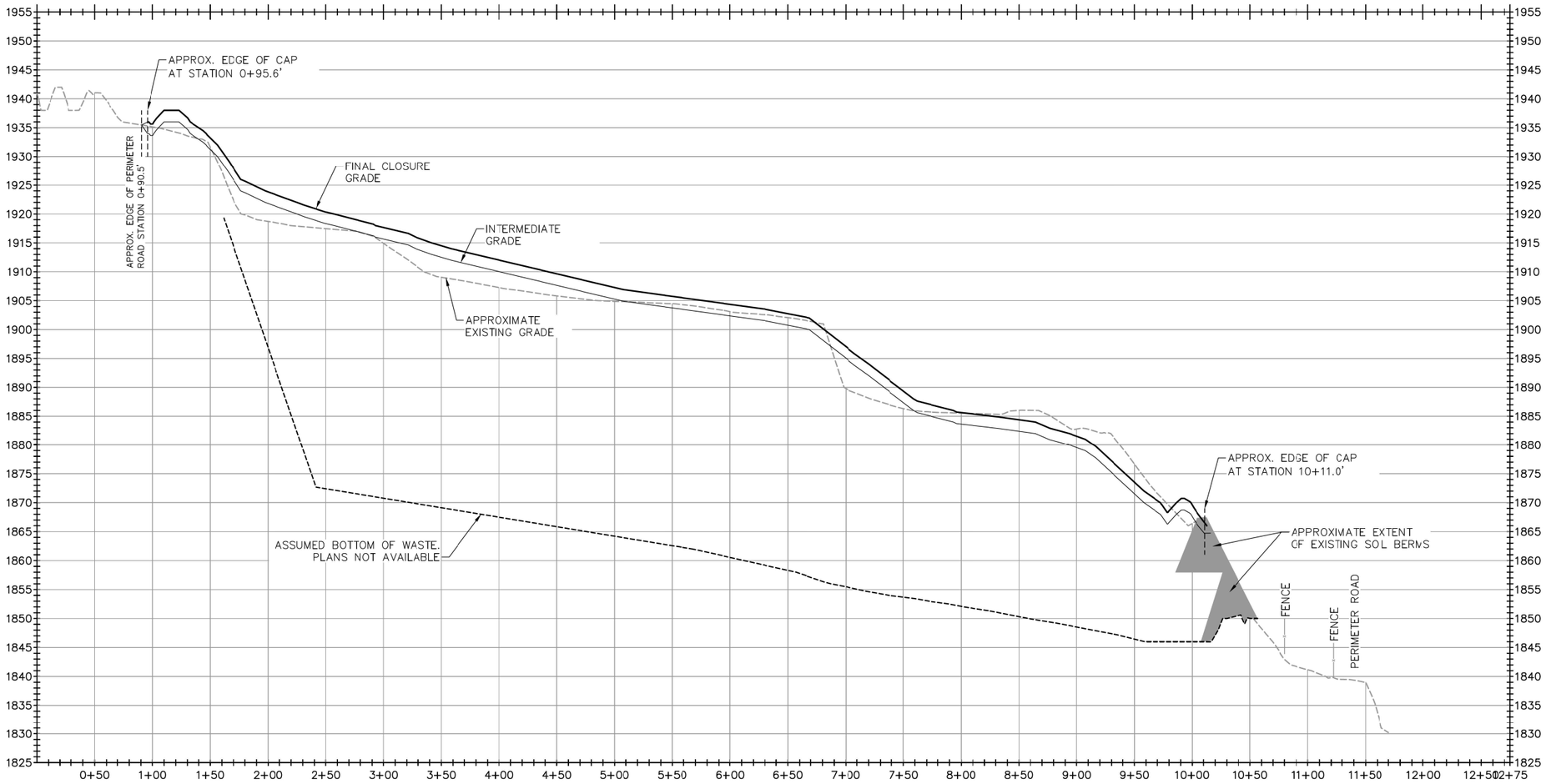
CLIENT: CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
15521 MIDLOTHIAN TNPK - MIDLOTHIAN, VA 23113
PH. (804) 378-7440 FAX. (804) 378-7433

PROJ. NO. 02218208.05 | DSN. BY: TRW/SHA | Q/A R/W BY: | APP. BY: CJW
DSK. BY: TRW | CHK. BY: CJW

CADD FILE: 02218208.05
DATE: 1/31/23
SCALE: AS SHOWN
DRAWING NO. 6 of 16

\\mid-fs01\Project\Project\02218208.05\Drawings\SWP498 LF - Permit Mod Drawings



SECTION 1
H: 1" = 50'
V: 1" = 10'

GENERAL NOTES

1. EXISTING GRADES SHOWN AS DASHED HALF-TONE CONTOUR LINES REPRESENT THE TOPOGRAPHY DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY NV5 GEOSPATIAL, DATED OCTOBER 7, 2022.
2. THE ASSUMED BOTTOM OF WASTE PROFILE IS BASED UPON DRAWINGS PREPARED BY DRAPER ADEN ASSOCIATES. THE ORIGINAL PLANS ARE NOT AVAILABLE.
3. THE WRITTEN SCALES INDICATED UNDERNEATH THE PROFILE VIEW TITLES WILL VARY DEPENDING UPON PLOT SIZE. DRAWINGS ARE INTENDED TO BE PLOTTED ON 24" X 36" SHEETS.

\\mid-fs01\Project\Project\02218208.05\Drawings\SWP498 LF - Permit Mod Drawings

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE: CROSS SECTIONS 1

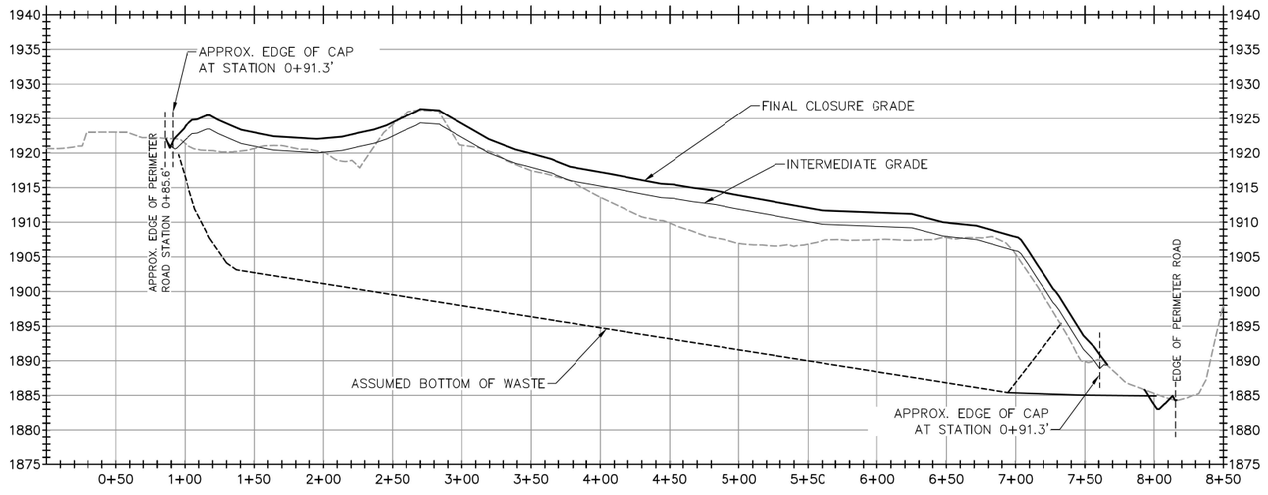
PROJECT TITLE: SWP #498 FINAL CLOSURE SYSTEM
PERMIT MODIFICATION DESIGN PLANS

CLIENT: CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

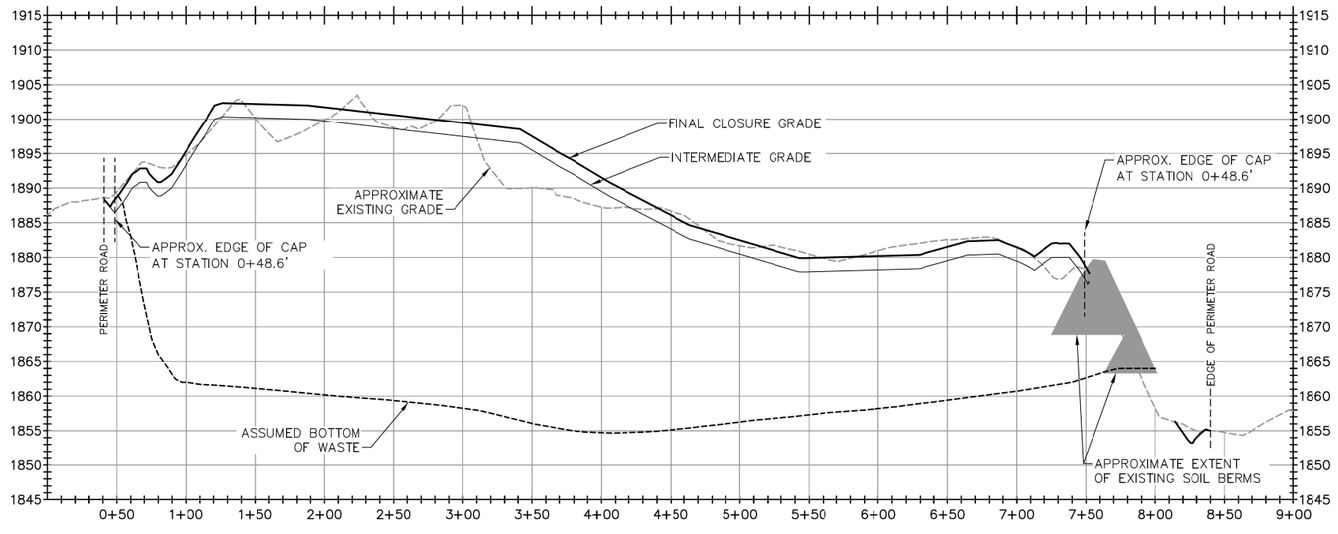
SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS, INC.
15521 MIDLOTHIAN TNPK - MIDLOTHIAN, VA 23113
PH. (804) 378-7440 FAX. (804) 378-7433

PROJ. NO. 02218208.05
DSN. BY: TRW/SHA
DRC. BY: CJW
QA/A RVW BY:
APP. BY: CJW

CADD FILE: 02218208.05
DATE: 1/31/23
SCALE: AS SHOWN
DRAWING NO. 7 of 16



SECTION 2
H: 1" = 50'
V: 1" = 10'



SECTION 3
H: 1" = 50'
V: 1" = 10'

GENERAL NOTES

1. EXISTING GRADES SHOWN AS DASHED HALF-TONE CONTOUR LINES REPRESENT THE TOPOGRAPHY DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY NV5 GEOSPATIAL, DATED OCTOBER 7, 2022.
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COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE: CROSS SECTIONS 2

PROJECT TITLE: SWP #498 FINAL CLOSURE SYSTEM
PERMIT MODIFICATION DESIGN PLANS

CLIENT: CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
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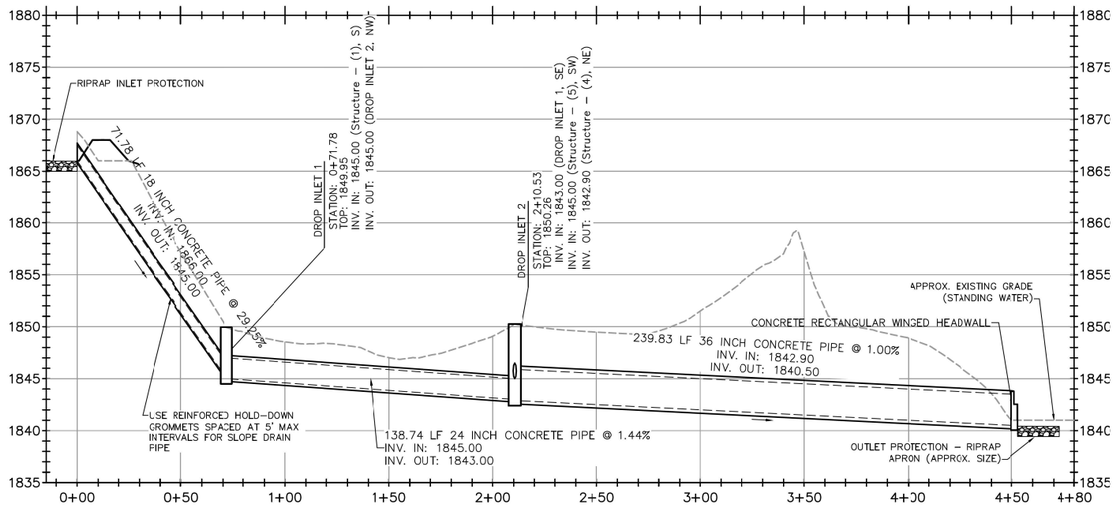
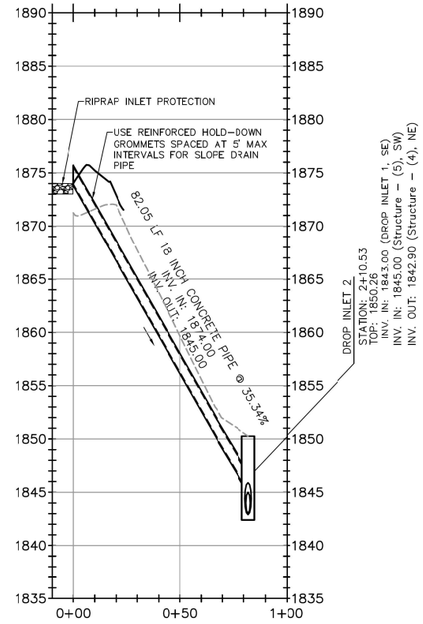
PROJ. NO. 02218208.05
DSN. BY: TRW/SHA
CHK. BY: CJW
Q/A RVW BY:
APP. BY: CJW
DSN. BY: TRW

CADD FILE: 02218208.05
DATE: 1/31/23
SCALE: AS SHOWN
DRAWING NO. 8 of 16

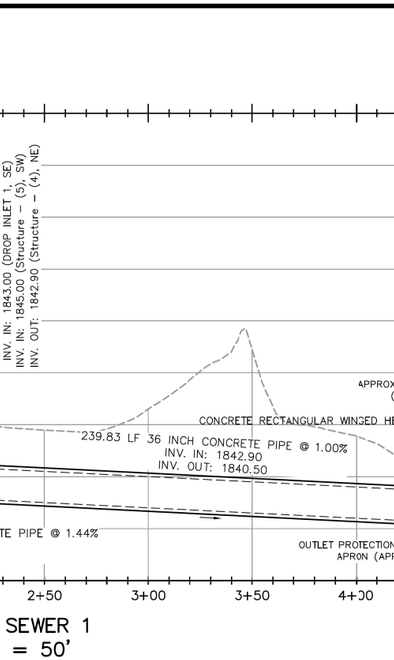


STORM SEWER 1
H: 1" = 50'
V: 1" = 10'



STORM SEWER 2
H: 1" = 50'
V: 1" = 10'

NORTH EDGE OF CAP DETAIL
H: 1" = 50'
V: 1" = 10'



EAST EDGE OF CAP DETAIL
H: 1" = 50'
V: 1" = 10'

GENERAL NOTES

1. HYDRAULICALLY ADEQUATE ALTERNATIVE MATERIALS FOR THE STORMWATER PIPES, CULVERTS, SEWERS, JUNCTIONS, AND DOWNCHUTES MAY BE SUBSTITUTED AT OWNER'S DISCRETION.
2. EXISTING GRADES SHOWN AS DASHED HALF–TONE CONTOUR LINES REPRESENT THE TOPOGRAPHY DEVELOPED FROM AERIAL PHOTOGRAPHY PROVIDED BY NV5 GEOSPATIAL, DATED OCTOBER 7, 2022.
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4. THE WRITTEN SCALE INDICATED UNDERNEATH THE PROFILE VIEW TITLES WILL VARY DEPENDING UPON PLOT SIZE. DRAWINGS ARE INTENDED TO BE PLOTTED ON 24" X 36" SHEETS

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE: CROSS SECTIONS 3

PROJECT TITLE: SWP #498 FINAL CLOSURE SYSTEM PERMIT MODIFICATION DESIGN PLANS

CLIENT: CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS, INC.
15521 MIDLOTHIAN TNPK - MIDLOTHIAN, VA 23113
PH. (804) 378-7440 FAX. (804) 378-7433

PROJ. NO. 02218208.05 | DSN. BY: TRW | C/A R/W BY: | APP. BY: CJW
DRN. BY: TRW/SHA | CHK. BY: CJW

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SCALE: AS SHOWN

DRAWING NO. 9 of 16

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EXISTING GATE/ENTRANCE

BM-1

BM-2

BM-3

BM-4

LANDFILL GAS MONITORING PROGRAM	
MONITORING NETWORK PROBES FOR SWP 498	GP-4, GP-5, GP-6, GP-9, GP-11, GP-12, GP-13, GP-14, GP-15, GP-16, GP-17, GP-18, GP-1OO, GP-200
PROBES NOT IN MONITORING NETWORK	GP-2, GP-3, GP-7, GP-8

*GROUNDWATER ELEVATIONS WERE NOT USED IN THE CREATION OF THE GROUNDWATER CONTOURS.
FT, AMSL = FEET, ABOVE MEAN SEA LEVEL

NOTES:

1. GROUNDWATER CONTOURS WERE GENERATED USING THE SURFER SURFACE MAPPING SYSTEM SOFTWARE VIA THE KRIGING GRIDDING METHOD AND ALTERED UTILIZING PROFESSIONAL JUDGEMENT. CONTOURS CORRESPOND TO SHALLOW AQUIFER – LENOIR–MOSHEIM.
2. GROUNDWATER MONITORING WELL NETWORKS FOR THE PERMIT #588 AND #498 LANDFILLS ARE PROVIDED BELOW.
   - PERMIT #498 BACKGROUND: MW–101, MW–104A, AND MW–104B
   - PERMIT #588 BACKGROUND: MW–106B AND MW–206A
   - PERMIT #588 BACKGROUND AND FERMIT #498 SENTINEL: MW–206B
   - PERMIT #588 BACKGROUND AND FERMIT #498 COMPLIANCE: MW–106A
   - PERMIT #588 BACKGROUND AND FERMIT #498 COMPLIANCE/SENTINEL: MW–205B
   - PERMIT #498 COMPLIANCE/PERFORMANCE: MW–108
   - PERMIT #588 COMPLIANCE AND PERMIT #498 SENTINEL: MW–210A, MW210B, MW211A, AND MW–211B
   - PERMIT #498 PERFORMANCE: GC OUTFALL (AKA. GRADIENT CONTROL SYSTEM)
   - PERMIT #498 SENTINEL: MW–105A, MW–105B, AND MW–109

N

0 150 300 450
SCALE IN FEET

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COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE
SITE MONITORING PLAN

PROJECT TITLE
SWP #498 FINAL CLOSURE SYSTEM
PERMIT MODIFICATION DESIGN PLANS

CLIENT
CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
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DRAWING NO. **10** of 16

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SCS ENGINEERS
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PROJ. NO.	DWN. BY:	Q/A RVW BY:
02218208.05	TRW/SHA	
DSN. BY:	CHK. BY:	APP. BY:
TRW	CJW	CJW

CLIENT
CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

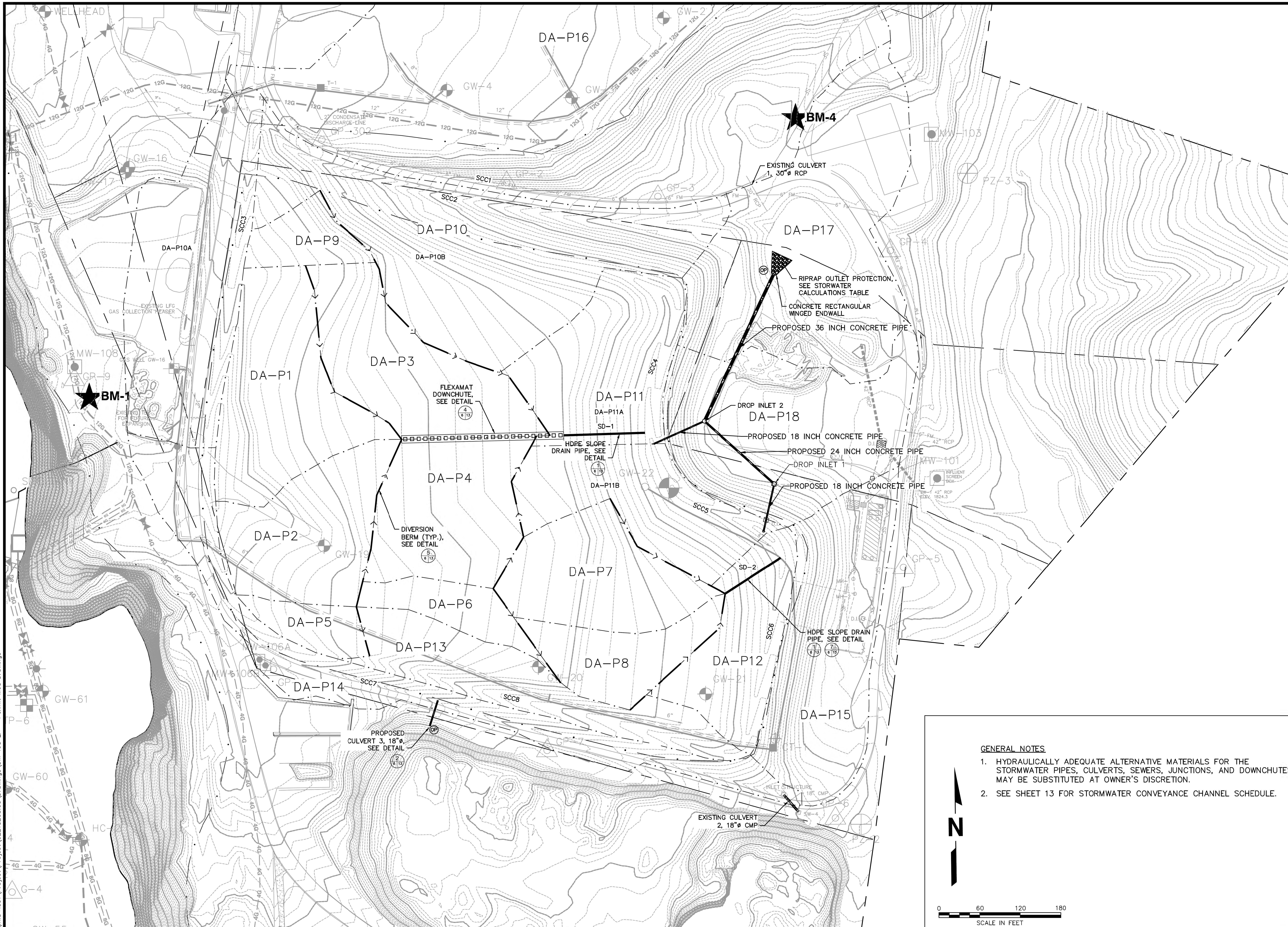
SHEET TITLE
EXISTING DRAINAGE PLAN

PROJECT TITLE
SWP #498 FINAL CLOSURE SYSTEM
PERMIT MODIFICATION DESIGN PLANS

NO.	REVISION	DATE
1		
2		
3		
4		
5		
6		

COMMONWEALTH OF VIRGINIA
CHARLES W. WARREN
#036809
PROFESSIONAL ENGINEER
1/31/23

CADD FILE: 02218208.05
DATE: 1/31/23
SCALE: AS SHOWN
DRAWING NO. 11 of 16



DA-P16
BM-4
EXISTING CULVERT 1, 30"ø RCP
DA-P17
RIPRAP OUTLET PROTECTION, SEE STORWATER CALCULATIONS TABLE
CONCRETE RECTANGULAR WINGED ENDWALL
PROPOSED 36 INCH CONCRETE PIPE
DA-P10
DA-P10A
DA-P10B
DA-P9
DA-P1
DA-P3
BM-1
FLEXAMAT DOWNCHUTE, SEE DETAIL
DA-P11
DA-P11A
SD-1
HDPE SLOPE DRAIN PIPE, SEE DETAIL
DROP INLET 2
DA-P18
PROPOSED 18 INCH CONCRETE PIPE
PROPOSED 24 INCH CONCRETE PIPE
DROP INLET 1
PROPOSED 18 INCH CONCRETE PIPE
DA-P4
DA-P11B
DA-P2
DIVERSION BERM (TYP.), SEE DETAIL
DA-P7
SD-2
DA-P6
DA-P5
DA-P13
HDPE SLOPE DRAIN PIPE, SEE DETAIL
DA-P8
DA-P12
DA-P14
DA-P15
PROPOSED CULVERT 3, 18"ø, SEE DETAIL
EXISTING CULVERT 2, 18"ø CMP
SCC1
SCC2
SCC3
SCC4
SCC5
SCC6
SCC7
SCC8
N
0 60 120 180
SCALE IN FEET
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GENERAL NOTES

1. HYDRAULICALLY ADEQUATE ALTERNATIVE MATERIALS FOR THE STORMWATER PIPES, CULVERTS, SEWERS, JUNCTIONS, AND DOWNCHUTES MAY BE SUBSTITUTED AT OWNER'S DISCRETION.
2. SEE SHEET 13 FOR STORMWATER CONVEYANCE CHANNEL SCHEDULE.

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE
STORMWATER MANAGEMENT PLAN

PROJECT TITLE
SWP #498 FINAL CLOSURE SYSTEM PERMIT MODIFICATION DESIGN PLANS

CLIENT
CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
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DRAWING NO.
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Drainage Area Discharge Calculation Summary

			Overland Flow			Shallow Concentrated Flow			Concentrated Flow					
Drainage Area No. (Dwg. 11)	Drainage Area, AC	Curve No.	% Slope	Drainage Length, ft	Tc, min.	% Slope	Drainage Length ft	Tc, min.	ΔH	Drainage Length, ft	Tc, min	Total Tc, min	2-Year Flow, cfs	25-Year Flow, cfs
P1	1.21	94	10	100	8.41	8	24	0.09	N/A			9	3.53	5.58
P2	0.97	94	10	100	8.41	7	160	0.62	N/A			9	2.83	4.48
P3	1.07	94	5	100	11.1	5	50	0.23	N/A			11	2.99	4.73
P4	1.00	94	5	100	11.1	5	172	0.79	N/A			12	2.59	4.10
P5	0.24	94	10	100	8.41	5	58	0.27	N/A			9	0.70	1.11
P6	0.33	94	5	100	11.1	5	110	0.51	N/A			12	0.85	1.35
P7	0.90	94	5	100	11.1	10*	206	0.71	N/A			12	2.33	3.69
P8	0.54	94	5	100	11.1	7*	184	0.78	N/A			12	1.40	2.22
P9	0.29	94	5	100	11.1	16*	80	0.28	N/A			11	0.81	1.28
P10A	1.69	79	5	100	11.1	5	125	0.58	N/A			12	2.02	4.27
P10B	2.54	87	5	100	11.1	25	150	0.31	N/A			11	5.22	9.32
P11A	1.09	94	5	100	11.1	12	120	0.36	N/A			11	3.04	4.82
P11B	0.96	94	7	100	9.7	20	114	0.26	N/A			10	2.80	4.43
P12	0.77	94	5	100	11.1	20	54	0.12	N/A			11	2.15	3.40
P13	0.93	94	5	100	11.1	10	127	0.41	N/A			12	2.41	3.81
P14	1.30	84	5	100	11.1	10	200	0.65	N/A			12	2.10	3.99
P15	1.46	79	10	100	8.41	8	200	0.73	N/A			9	2.00	4.19
P16	5.92	79	4	100	12.14	10	600	1.96	N/A			14	7.84	16.66
P17	2.31	79	11	100	8.1	8	210	0.77	N/A			9	3.17	6.62
P18	1.68	79	20*	100	8.28	8	250	0.91	N/A			9	2.30	4.82

Curve Number assumed as 94 within final cover area due to infiltraton layer and 79 outside final cover (Group C soil)
Concentrated flow not considered, to be conservative
Manning's n value - 0.040 for riprap, 0.030 for tall grass
Riprap is VDOT Class 1
*Slope listed is a weighted average of slopes along the flow path. Actual Tc calculations utilized individual sections for paths with significant change in slope.

Stormwater Conveyance Channel Calculation Summary

Ditch Number	Drainage Area No. (Dwg. 11)	25-Year Flow, cfs	Ave. Slope, ft/ft	Ditch Type	Base Width, ft	Side Slopes	Ditch Depth, ft	Overtopping Flow Depth D_{2y}, ft	Erosion Velocity V_{25}, ft/s	Lining
SCC-1	Partial P16	6.12	0.09	Trapezoid	2	3:1	1.5	0.48	3.71	Flexamat
SCC-2	P9 + P10	14.87	0.09	Trapezoid	2	3:1	2	0.74	4.76	Flexamat
SCC-3	P10A	4.27	0.05	Trapezoid	2	3:1	2	0.46	2.75	Flexamat
SCC-4	P1+P2+P3+P4+P11A	23.71	0.03	Trapezoid	4	3:1	2	0.97	3.54	Flexamat
SCC-5	P11B	4.43	0.03	Trapezoid	4	3:1	2	0.4	2.13	Flexamat
SCC-6	P5 + P12 + P13	8.33	0.03	Trapezoid	4	3:1	2	0.56	2.62	Flexamat
SCC-7	P14	3.99	0.08	Vee	0	3:1	1.5	0.63	3.35	Flexamat
SCC-8	P5 + P13	4.92	0.07	Trapezoid	4	3:1	2	0.33	2.99	Flexamat
SCC-9	Partial P13	2.00	0.07	VEE	0	3:1	1.5	0.4	3.5	Flexamat
FD-1*	P5 + P13	18.89	0.05	Trapezoid	2	3:1	1.5	0.95	4.1	Flexamat

*Flexamat downchute

HDPE Slope Drain Pipe Calculation Summary

Slope Drain No.	Drainage Areas	25-Year Flow, cfs	Ave. Slope, ft.ft	Pipe Dia., in	Flow Depth, in.	Flow Velocity, ft/s	Full Flow Capacity, cfs
SD-1	P1, P2, P3, P4	18.89	0.2	18	7.6	26.62	50.87
SD-2	P7, P8	5.91	0.2	18	4.2	18.78	50.87

Manning's n value - 0.025 for corrugated plastic pipe

Storm Sewer Pipe Capacities

Pipe ID	25-Year Flow, cfs	Slope, ft/ft	Pipe Dia., in	25yr Flow Depth, ft	25yr Flow Velocity, ft/s	Full Flow Capacity, cfs
36" Outlet Pipe	61.26	0.01	36	2.1	11.4	77
24" Sewer	18.66	0.014	24	1.2	9.7	31
18" Pipe to DI2	47.03	0.35	18	0.9	40.8	72

Manning's n value - 0.025 for corrugated plastic pipe

Culvert Calculations Summary

						Inlet Control , 25-yr Flow			Outlet Control								Open Channel Assumption			
Culvert Description	Pipe Diameter ft	25-Yr Pipe Flow cfs	Length, ft	Inv. In, ft	Inv. Out	HW/D	HWin	Elhi	TW,ft	Dc, ft	(Dc + D)/2	ho	ke	H	ELho	Control HW Elev	25-Yr Flow Depth, ft	Road Elev. ft	Pipe Capacity cfs	Pipe Velocity ft/s
Culvert 1	2.5	16.66	40	1847	1846	0.81	2.02	1849.02	1	1.7	1.7	1.7	0.2	0.6	1848.3	1849.2	0.83	1850	70.25	11.65
Culvert 2	1.5	2.55	32	1860	1859	0.55	0.83	1860.83	0.5	0.6	1.1	1.1	0.2	0.4	1860.45	1860.83	0.36	1861	20.13	11.39
Culvert 3	1.5	1.56	32	1897.5	1896.5	0.42	0.62	1898.12	0.4	0.7	1.1	1.1	0.2	0.4	1898	1898.12	0.29	1899	20.13	11.39

All pipe is assumed Class IV RCP
ho is larger of TW or (Dc+D)/2

Outlet Protection Summary

Structure ID	Pipe Diameter ft	25 Year Peak Flow, cfs	L_a, ft	Initial Width, ft	End Width, ft	d_{50}, min., ft
Culvert 1	2.5	16.6	30	7.5	32.5	0.9
Culvert 2	1.5	2.55	10	4.5	5.5	0.9
Culvert 3	1.5	1.56	10	4.5	5.5	0.9

L_a and widths from VESCH Plate 3.18-4
Use VDOT Class IA riprap. Discharge channels will be lined with flexamat, so additional OP is not needed

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE: **STORMWATER CALCULATIONS**

PROJECT TITLE: **SWP #498 FINAL CLOSURE SYSTEM PERMIT MODIFICATION DESIGN PLANS**

CLIENT: **CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY**
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS, INC.
15521 MIDLOTHIAN TNPK - MIDLOTHIAN, VA 23113
PH. (804) 378-7440 FAX. (804) 378-7433

PROJ. NO. 02218208.05
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DRK. BY: TRW
C/A RVW BY:
APP. BY: CJW

CADD FILE: 02218208.05
DATE: 1/31/23
SCALE: AS SHOWN
DRAWING NO. **13** of 16

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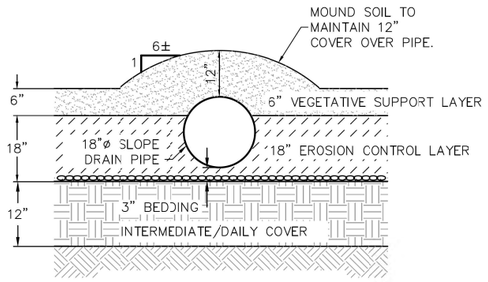
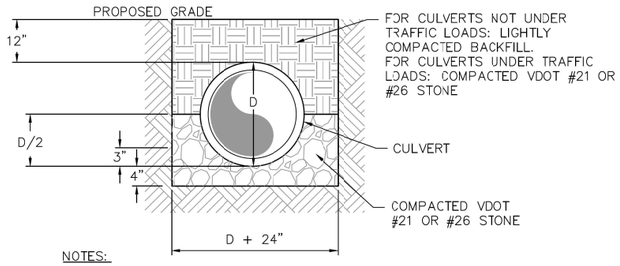


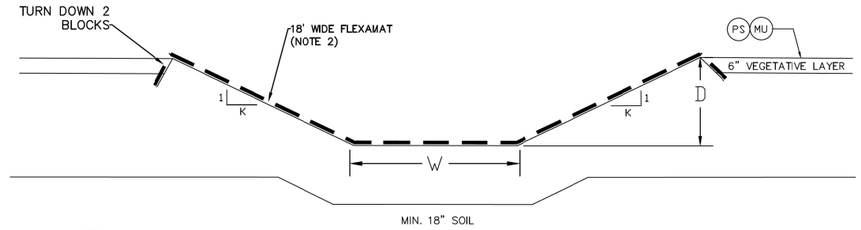
PERMANENT SLOPE DRAIN SECTION A (1 | 6 | 13)
N.T.S.



NOTES:

1. DETAIL DOES NOT APPLY TO UNDERDRAIN PIPING.
2. SHOULD GROUNDEASTE OR SATURATED SOILS BE EXPECTED, BEDDING SHALL BE VDOT #57 STONE IN LIEU OF VDOT #21 OR #26 STONE.

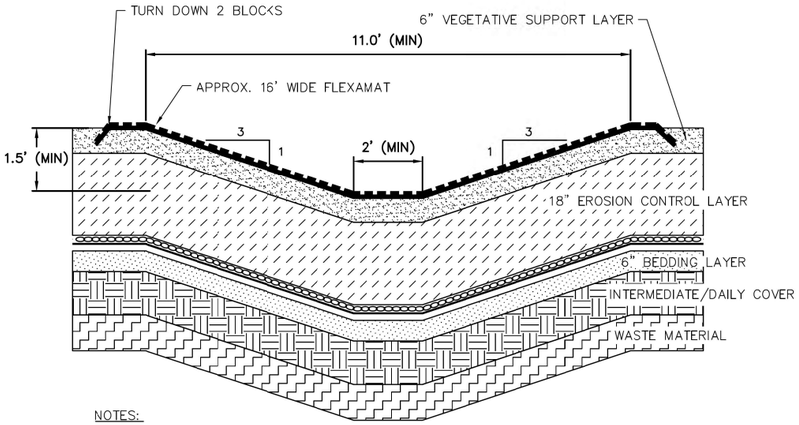
CULVERT BEDDING AND BACKFILL (2 | 6 | 13)
N.T.S.



NOTE:

1. FOR FLEXAMAT LINED STORMWATER CONVEYANCE CHANNELS (SCC), CHANNEL DIMENSIONS SHALL BE PER THE FINAL GRADING PLAN AND SCC SCHEDULE ON THE STORMWATER CALCULATIONS SHEET.
2. FLEXAMAT STANDARD WITH 8' AND 10' REQUIRED IF 18' WIDTH NOT AVAILABLE PER MANUFACTURER.

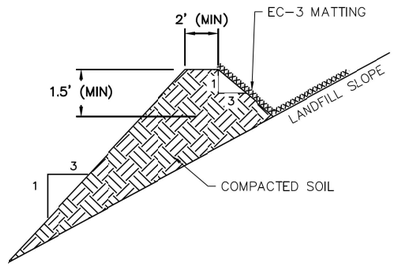
STORMWATER CONVERYANCE CHANNEL FLEXAMAT INSTALLATION DETAIL (3 | 6 | 13)
N.T.S.



NOTES:

1. WHERE DIVERSION BERMS ENTER INTO FLEXAMAT DOWN CHUTE, EXTEND FLEXAMAT 8 FEET INTO DIVERSION BERM TO CREATE TRANSITION.
2. CHANNEL DIMENSIONS SHOWN FOR DOWN CHUTE ONLY. FOR FLEXAMAT LINED STORMWATER CONVEYANCE CHANNELS (SCC), SEE CHANNEL SCHEDULE AND FINAL GRADING PLAN.

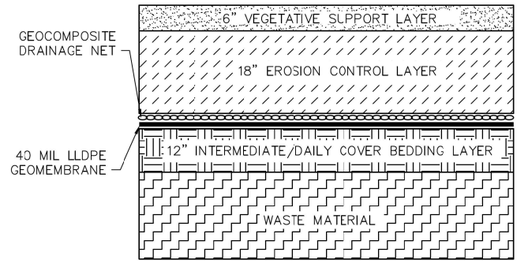
FINAL COVER FLEXAMAT DOWN CHUTE INSTALLATION DETAIL (4 | 6 | 13)
N.T.S.



NOTES:

1. FLOW SLOPE OF THE DIVERSION TO BE MAX. 5% AND MIN. 2%
2. SEE FINAL COVER DOWNCHUTE DETAIL FOR CONNECTION OF DIVERSION BERMS.
3. VESCH – STD 3.12.

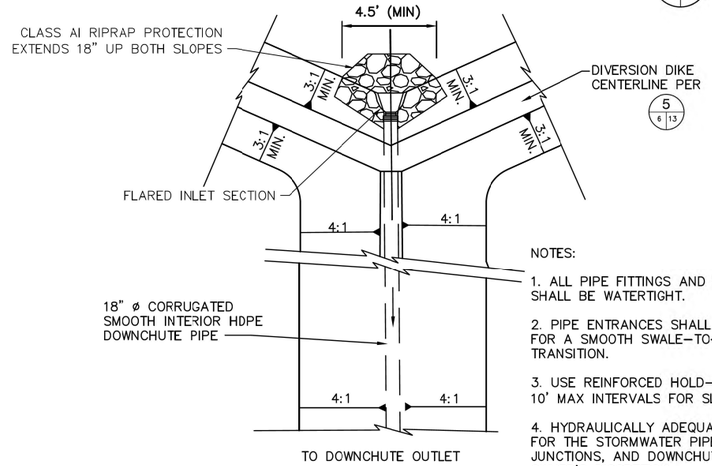
DIVERSION BERM DETAIL (5 | 6 | 13)
N.T.S.



NOTES:

1. THE TOP 6" OF INTERMEDIATE/DAILY COVER WILL FUNCTION AS A BEDDING LAYER AND IS TO BE SMOOTH AND FREE OF STICKS, ROCKS LARGER THAN 3/8 INCH, OR OTHER IREGULARITIES WHICH COULD PUNCTURE THE SYNTHETIC CAP.
2. THE SYNTHETIC CAP SHALL BE PLACED AS PER MANUFACTURER'S RECOMMENDATIONS. SEE CLOSURE SPECIFICATIONS FOR ALLOWABLE MATERIALS, INSTALLATION AND CUALITY CONTROL MEASURES.
3. EROSION CONTROL LAYER SHALL BE PLACED IMMEDIATELY AFTER THE GEOCOMPOSITE. THE GEOCOMPOSITE MAY NOT BE EXPOSED TO SUNLIGHT FOR MORE THAN THE TIME LIMITED IN THE PROJECT SPECIFICATIONS.
4. THE VEGETATIVE COVER SHALL BE PLACED AND SEEDED IMMEDIATELY AFTER INSTALLATION OF THE EROSION CONTROL LAYER. A TEMPORARY SEEDING MIXTURE MAY BE USED TO PROTECT THE AREA FROM EROSION. ONCE THE CLOSURE IS COMPLETED, FINAL SEEDING WILL OCCUR.

TYPICAL LLDPE CAP DETAIL (6 | 6 | 13)
N.T.S.



NOTES:

1. ALL PIPE FITTINGS AND CONNECTIONS SHALL BE WATERTIGHT.
2. PIPE ENTRANCES SHALL BE GRADED FOR A SMOOTH SWALE–TO–FLANGE TRANSITION.
3. USE REINFORCED HOLD–DOWN GROMMETS SPACED AT 10' MAX INTERVALS FOR SLOPE DRAIN PIPE
4. HYDRAULICALLY ADEQUATE ALTERNATIVE MATERIALS FOR THE STORMWATER PIPES, CULVERTS, SEWERS, JUNCTIONS, AND DOWNCHUTES MAY BE SUBSTITUTED AT OWNER'S DISCRETION.

HDPE DOWNCHUTE UPPER INLET, WITH DIVERSION BERMS (7 | 6 | 13)
N.T.S.

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE: DETAILS 1

PROJECT TITLE: SWP #498 FINAL CLOSURE SYSTEM PERMIT MODIFICATION DESIGN PLANS

CLIENT: CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
15521 MIDLOTHIAN TNPK - MIDLOTHIAN, VA 23113
PH. (804) 378-7440 FAX. (804) 378-7433

PROJ. NO. 02218208.05 | DSN. BY: TRW | DWN. BY: TRW/SHA | CHK. BY: CJW | QA/QC BY: | APP. BY: CJW

CADD FILE: 02218208.05

DATE: 1/31/23

SCALE: AS SHOWN

DRAWING NO. 14 of 16

(PS) LIME AND FERTILIZER APPLICATION RATES

IF POSSIBLE, DETERMINE BY SOILS TEST. WHERE NOT POSSIBLE TO OBTAIN A SOILS TEST, THE FOLLOWING SOIL AMENDMENTS WILL APPLY:

LIME

COASTAL PLAIN: 2 TONS/ACRE PULVERIZED AGRICULTURAL GRADE LIMESTONE (90 LBS./1000 FT.2)

PIEDMONT AND APPALACHIAN REGION: 2 TONS/ACRE PULVERIZED AGRICULTURAL GRADE LIMESTONE (90 LBS./1000 FT.)

NOTE: AN AGRICULTURAL GRADE OF LIMESTONE SHOULD ALWAYS BE USED.

FERTILIZER

MIXED GRASSES AND LEGUMES: 1000 LBS./ACRE 10–20–10 OR EQUIVALENT NUTRIENTS (23 LBS./1000 FT.).

LEGUME STANDS CNLY: 1000 LBS./ACRE 5–20–10 (23 LBS./1000 FT.) IS PREFERRED; HOWEVER, 1000 LBS./ACRE OF 10–20–10 OR EQUIVALENT MAY BE USED.

GRASS STANDS ONLY: 1000 LBS./ACRE 10–20–10 OR EQUIVALENT NUTRIENTS, (23 LBS./1000 FT.).

OTHER FERTILIZER FORMATIONS, INCLUDING SLOW–RELEASE SOURCES OF NITROGEN (PREFERRED FROM A WATER QUALITY STANDPOINT), MAY BE USED PROVIDED THEY CAN SUPPLY THE SAME AMOUNTS AND PROPORTIONS OF PLANT NUTRIENTS.

INCORPORATION – LIME AND FERTILIZER SHALL BE INCORPORATED INTO THE TOP 4–6 INCHES OF SOIL FROM A WATER QUALITY STANDPOINT), MAY BE USED PROVIDED THEY CAN SUPPLY THE SAMEAMOUNTS AND PROPORTIONS OF PLANT NUTRIENTS.

(MU) ORGANIC MULCH MATERIALS AND APPLICATION RATES

MULCHES:	RATES:		NOTES:
	PER ACRE	PER 1000 SQ. FT.	
STRAW OR HAY	1 1/2 – 2 TONS (MINIMUM 2 TONS OF WINTER COVER)	70 – 90 LBS.	FREE FROM WEEDS AND COARSE MATTER. MUST BE ANCHORED. SPREAD

PERMANENT SEEDING (PS) VESCH STD & SPEC 3.32

TABLE 3.32-C
SITE SPECIFIC SEEDING MIXTURES
FOR APPALACHIAN/MOUNTAIN AREA

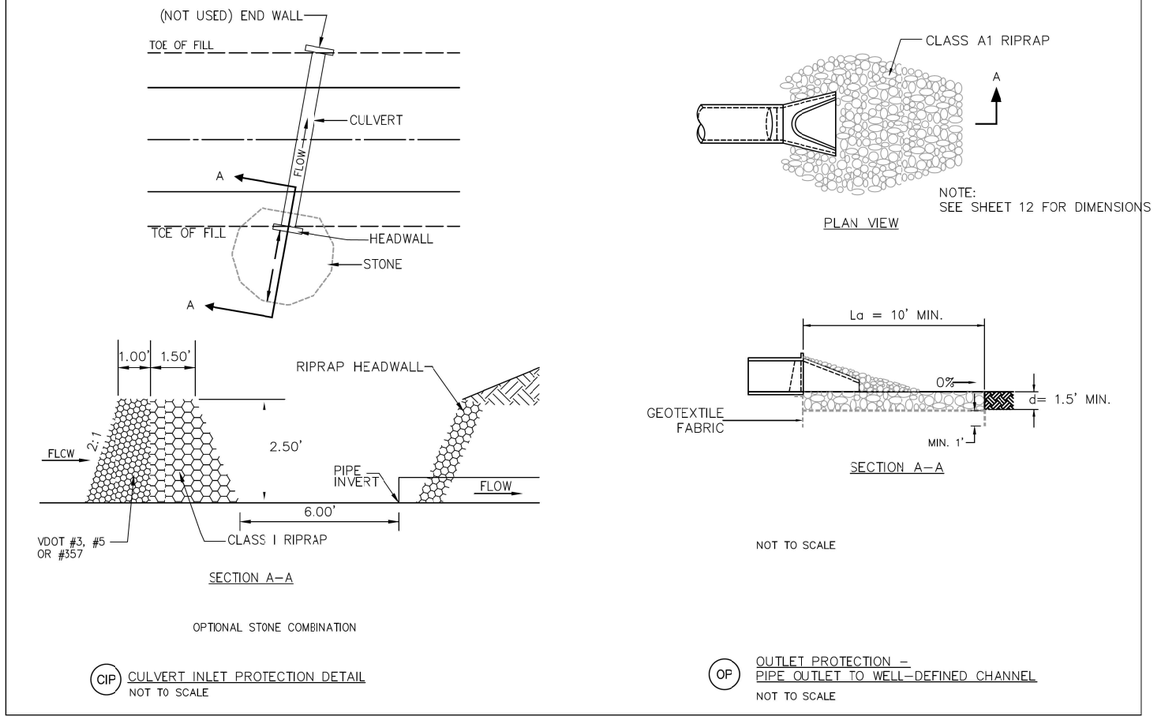
MINIMUM CARE LAWN	TOTAL LBS. PER ACRE
-COMMERCIAL OR RESIDENTIAL	200-250 LBS.
-KENTUCKY 31 OR TURF-TYPE TALL FESCUE	90-100%
-IMPROVED PERENNIAL RYEGRASS *	0-10%
-KENTUCKY BLUEGRASS	0-10%
HIGH-MAINTENANCE LAWN	
MINIMUM OF THREE (3) UP TO FIVE (5) VARIETIES OF BLUEGRASS FROM APPROVED LIST FOR USE IN VIRGINIA	125 LBS.
GENERAL SLOPE (3:1 OR LESS)	
- KENTUCKY 31 FESCUE	128 LBS.
- RED TOP GRASS	2 LBS.
- SEASONAL NURSE CROP **	20 LBS.
	150 LBS.
LOW-MAINTENANCE SLOPE (STEEPER THAN 3:1)	
- KENTUCKY 31 FESCUE	108 LBS.
- RED TOP GRASS	2 LBS.
- SEASONAL NURSE CROP **	20 LBS.
- CROWNVETCH ***	20 LBS.
	150 LBS.

* PERENNIAL RYEGRASS WILL GERMINATE FASTER AND AT LOWER SOIL TEMPERATURES THAN FESCUE, THEREBY PROVIDING COVER AND EROSION RESISTANCE FOR SEEDBED.

** USE SEASONAL NURSE CROP IN ACCORDANCE WITH SEEDING DATES AS STATED BELOW:

MARCH, APRIL THROUGH MAY 15TH	ANNUAL RYE
MAY 16TH THROUGH AUGUST 15TH	FOXTAIL MILLET
AUGUST 16TH THROUGH SEPTEMBER, OCTOBER	ANNUAL RYE
NOVEMBER THROUGH FEBRUARY	WINTER RYE

*** IF FLATPEA IS USED, INCREASE TO 30 LBS./ACRE. ALL LEGUME SEED MUST BE PROPERLY INOCULATED. WEEPING LOVEGRASS MAY ALSO BE INCLUDED IN ANY SLOPE OR LOW-MAINTENANCE MIXTURE DURING WARMER SEEDING PERIODS; ADD 10-20 LBS./ACRE IN MIXES.



(CIP) CULVERT INLET PROTECTION DETAIL
NOT TO SCALE

(OP) OUTLET PROTECTION – PIPE OUTLET TO WELL–DEFINED CHANNEL
NOT TO SCALE

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COMMONWEALTH OF VIRGINIA
CHARLES WARREN
#053809
1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE: DETAILS 2

PROJECT TITLE: SWP #498 FINAL CLOSURE SYSTEM PERMIT MODIFICATION DESIGN PLANS

CLIENT: CITY OF BRISTOL INTEGRATED SOLID WASTE MANAGEMENT FACILITY
2655 VALLEY DRIVE
BRISTOL, VA 24201

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PH. (804) 378-7440 FAX. (804) 378-7433

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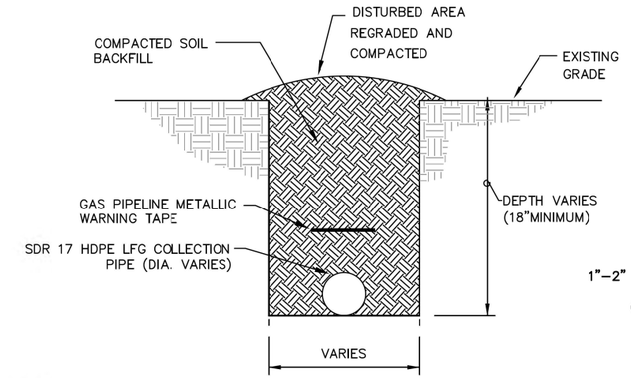
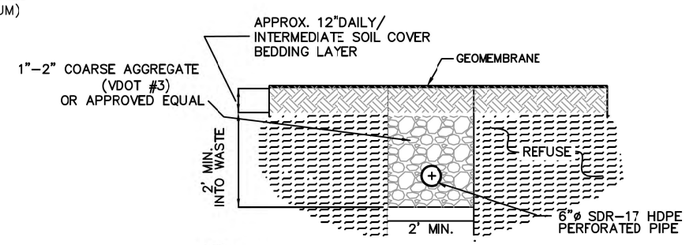


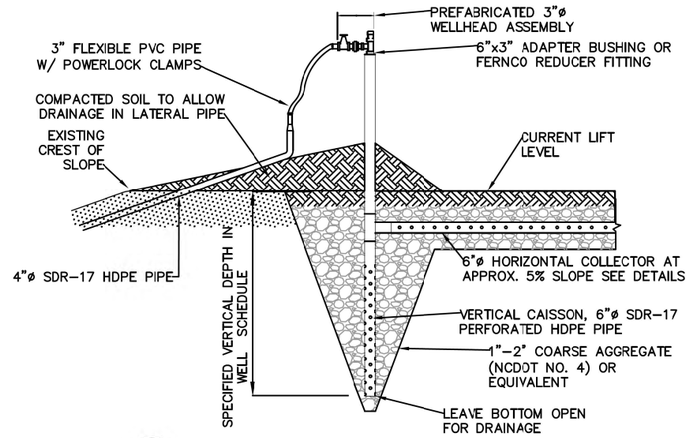
1 5,6 15 LFG COLLECTION PIPE TRENCH DETAIL
NOT TO SCALE

NOTES:

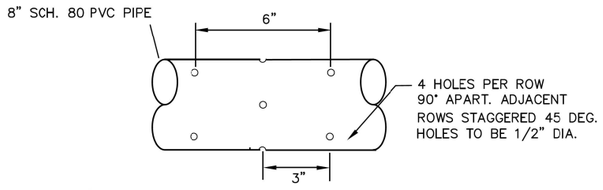
1. PNEUMATIC SUPPLY, FORCEMAIN, AND SPARE CONDUIT PIPING TO BE OMITTED FOR LFG COLLECTION PIPE WITHIN WASTE FOOTPRINT.



2 5,6 15 HORIZONTAL COLLECTOR SECTION
NOT TO SCALE



3 5,6 15 HORIZONTAL COLLECTOR WITH PIT DETAIL
NOT TO SCALE



4 5,6 15 PERFORATED PIPE DETAIL
NOT TO SCALE

Well ID	Northing	Easting	Surface Elevation (MSL)	Top of Liner System Elevation (MSL)	Total Boring Depth (ft)	Solid Wall Length (ft)	Slotted Length (ft)
GW-69	3398552.73	10413034.88	1931	1911	10	0	9
GW-70	3398839.81	10412817.39	1921	1901	10	0	9
GW-71	3398950	10412836.87	1919	1899	10	0	9
GW-72	3399033.65	10412880.61	1918	1898	10	0	9

NOTES:
1. CONTRACTOR SHALL SURVEY PROPOSED WELL LOCATIONS FOR ACTUAL GROUND ELEVATIONS BEFORE CONSTRUCTION.
2. CONTRACTOR SHALL SUBMIT SURVEY INFORMATION, INCLUDING NORTHING AND EASTING AND ACTUAL SURFACE ELEVATIONS, TO OWNER AND ENGINEER FOR POTENTIAL ADJUSTMENTS TO WELL BORING DEPTHS. FOLLOWING REVIEW OF ADJUSTED WELL SCHEDULE, CONTRACTOR SHALL OBTAIN WRITTEN AUTHORIZATION FROM OWNER AND ENGINEER PRIOR TO DRILLING.

5 5,6 15 LANDFILL GAS EXTRACTION WELL SCHEDULE

COMMONWEALTH OF VIRGINIA
CHARLES WARREN
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1/31/23
PROFESSIONAL ENGINEER

NO.	REVISION	DATE

SHEET TITLE: DETAILS 3

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PERMIT MODIFICATION DESIGN PLANS

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