CLOSURE PLAN – REVISION 02
40 C.F.R. SECTION 257.102(b)
PLANT SMITH ASH POND
FLORIDA POWER & LIGHT COMPANY

This Closure Plan was prepared for Florida Power & Light Company's (FPL's) Smith Electric Generating Plant (Plant Smith) Ash Pond, located in Southport, Florida. This Closure Plan was prepared in accordance with the United States Environmental Protection Agency's (EPA) "Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" Final Rule (40 C.F.R. Part 257, Subpart D) and meets the requirements of 40 C.F.R. §257.102(b) for closure of CCR surface impoundments.

The Plant Smith Ash Pond is currently being consolidated and closed in place in accordance with 40 C.F.R.§257.102(d) and no longer receives CCR.

Facility details are as follows:

Site Name / Address
Plant Smith
4300 Highway 2300
Southport, FL 32409

Owner Name / Address
Florida Power & Light Company
700 Universe Boulevard, JES/JB
Juno Beach, FL 33408

CCR Unit
Plant Smith Ash Pond

Closure Method
Closure in Place

CLOSURE PLAN

The purpose of this Closure Plan is to outline the methods and procedures underway to close the Plant Smith Ash Pond consistent with recognized and generally accepted good engineering practices. A Notice of Intent to Initiate Closure was completed for the Plant Smith Ash Pond on May 7, 2021. The Plant Smith Ash Pond will undergo closure consolidating the CCR footprint and closing the CCR unit in place in accordance with 40 C.F.R. §257.102(d). This Closure Plan may be amended in accordance with the requirements of 40 C.F.R. §257.102(b)(3) should there be a change in operation or unanticipated events that would substantially affect the written Closure Plan.

Methods and Procedures

The Plant Smith Ash Pond is currently being consolidated and closed in place. CCR in the Southwest (SW) and East ash pond areas will be relocated to the northwest portion of the unit, creating a consolidated footprint which is a nearly 70% reduction in the footprint of the original CCR Unit. During consolidation, the pond is being dewatered, to provide a stable base for the construction of a containment berm for the consolidated footprint and to excavate ash outside the consolidated footprint area. CCR will be excavated from the area outside the consolidated footprint, transported, and disposed of in the consolidated area.

Once CCR consolidation is completed and final grade has been achieved, final cover designed to minimize infiltration of liquids into the waste and potential releases of CCR from the unit will be installed. Closure will be conducted in a manner that minimizes the need for further maintenance and controls, and, to the maximum extent feasible, to protect human health and the environment. This will be accomplished by providing sufficient grades and slopes to:

- Preclude the probability of future impoundment of water, sediment, or slurry
- Ensure slope and cover system stability
- Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.
- Be designed so that the need for further controls is minimized while protection of human health and the environment is maximized.

Additionally, a fully encompassing engineered barrier wall and perimeter drainage system, as well as a comprehensive stormwater management system, will be constructed. These serve as engineering controls to enhance the closure design. The engineered barrier wall and perimeter drain are designed to eliminate discharge to the maximum extent possible from the area and prevent subsurface recharge of the final closure area from areas upgradient of the facility.

CCR Material Estimate

The final closed configuration of the ash pond will contain approximately 4,200,000 cubic yards of CCR consolidated and closed in place. This estimate is based on an evaluation of historical grades for the bottom of the impoundment. The actual volume will vary based on the actual bottom of the impoundment. The estimated volume includes one foot of over-excavation below the bottom of the CCR.

Final Cover

The final cover system was designed in accordance with 40 C.F.R. §257.102(d)(3)(ii) to minimize maintenance after closure of the CCR unit. The final cover system was designed to prevent the future impoundment of water and includes measures to prevent infiltration and sloughing and to minimize erosion from wind, water and settling. The largest area requiring a final cover is approximately 53 acres, following consolidation and closure in place.

The engineered final cover system consists of the following minimum components, listed from top to bottom

- Specified final cover infill as outlined in final closure plan design: 1/2” minimum sand infill to be used on the majority of the closure and 3/4” minimum HydroBinder® infill to be used on down drains
- Engineered Synthetic Turf (ClosureTurf®)
- 40 or 50 mil minimum low density polyethylene geomembrane liner. 50-mil Supergripnet liner is placed on slopes 3H:1V while the shallower slopes are capped with a 40-mil Microspike liner

The final cover system, consisting of engineered synthetic turf with run-on and run-off controls, meets the closure standards of 40 C.F.R. §257.102(d)(3)(i).

SCHEDULE

Closure activities for the Plant Smith Ash Pond are outlined in the schedule presented in Table 1. Closure milestones and activities are approximate and some of the activities will overlap.

Table 1: Plant Smith Ash Pond Closure Milestones Schedule

Closure Activity	Plant Smith Ash Pond
Closure Regulatory Interface and Permitting	Q1 2016
Begin Dewatering Activities	Q4 2017
Pre-closure Activities for Lined Wastewater Pond and Piping Systems (Subgrade Grading, Preparation, and CCR Consolidation)	4.5 years: Q1 2017 – Q2 2021
Redirection of Plant Stormwater and Process Water	April 2021
Notice of Intent to Close	May 2021
Closure Construction (CCR Consolidation, Stormwater Management, and Final Cover Installation)	2.5 Years: Q2 2021 – Q4 2024
End Final Closure Construction Activities	2024

CERTIFICATION

I certify that this Closure Plan for the Plant Smith Ash Pond was prepared in accordance with 40 C.F.R. §257.102(b).

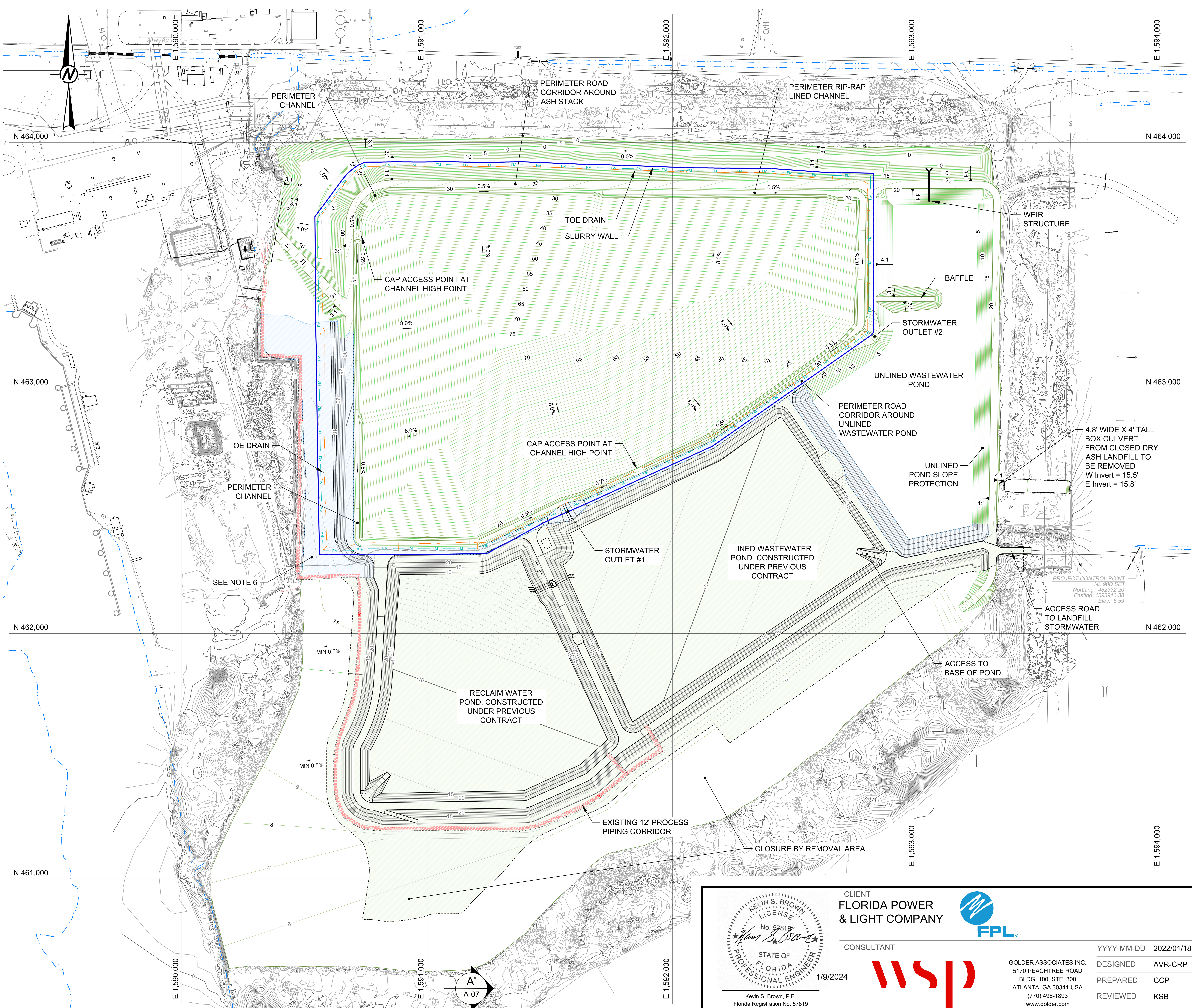
Kevin S. Brown, P.E.

Florida Licensed Professional Engineer No. 57819
WSP USA Inc.

KEVIN S. BROWN LICENSE No. 57819 STATE OF FLORIDA PROFESSIONAL ENGINEER

1/9/2024

Attachments: 1. Plant Smith Final Closure Plan
2. Compliance with the Closure Performance Standards Required by the CCR Rule - Plant Smith Ash Pond



LEGEND

20	EXISTING CONTOURS
20	PROPOSED CONTOURS
	SLURRY WALL
	TOE DRAIN
	TOE DRAIN MANHOLES
	EXISTING IMPROVEMENTS CONSTRUCTED UNDER PREVIOUS CONTRACT
	SEE NOTE 6

NOTES

1. THE BOTTOM ELEVATION OF EXISTING ASH MATERIAL IS ESTIMATED AT 5-FT.
2. THE VOLUME OF ASH REMOVAL IS ASSUMED TO INCLUDE MATERIAL UNDERCUT TO ELEVATION 4-FT (ONE FOOT OF ADDITIONAL MATERIAL REMOVAL).
3. FINAL CLOSURE AREA SLOPE MAY VARY, BUT SHALL NOT BE LESS THAN 8%. IF FINAL SLOPE IS SHALLOWER THAN 8%, THE DIVERSION BERMS WILL BE REDESIGNED PRIOR TO INSTALLATION OF CAP.
4. REFER TO CLOSURE DRAWINGS SHEET A-09 FOR FINAL COVER DETAILS.
5. BASE OF ASH MATERIALS IS ASSUMED. CONTRACTOR IS RESPONSIBLE FOR EXCAVATING ALL ASH MATERIALS WITHIN CLOSURE BY REMOVAL AND POND AREAS.
6. AREA SHADED INCLUDES THE ROAD ALONG THE NORTHERN BOUNDARY OF THE RECLAIM AND LINED WASTEWATER PONDS AND A PORTION OF THE WESTERN SLOPE OF THE FINAL CLOSURE AREA. GRADING IN THESE AREAS IS CONSIDERED COMPLETE AS OF THIS CONTRACT AND NO FILL OR EXCAVATION QUANTITIES ARE INCLUDED IN THIS CONTRACT. HOWEVER, THE ROAD SURFACE MATERIALS, SPILLWAY NO. 1 PROTECTION AND FINAL CAPPING REQUIRED IN THIS AREA IS INCLUDED UNDER THIS CONTRACT AND QUANTITIES REFLECT THESE AREAS.
7. GAS VENTING SYSTEM NOT SHOWN FOR CLARITY. REFER TO CLOSURE DRAWINGS SHEET A-06 FOR GAS VENTING PLAN AND VENT LOCATIONS.
8. FINAL GRADING ALONG NORTH CANAL REVISED PER ADDITIONAL GEOTECHNICAL INVESTIGATION AND ESTIMATE OF BOTTOM OF ASH ADJUSTMENTS.

REFERENCES

1. PRE-DISTURBANCE EXISTING PLANIMETRICS PROVIDED BY GULF POWER IN AUGUST 2016.
2. BASE MAP INFORMATION PROVIDED BY COOPER, BARNETTE, AND PAGE (CBP), TOPOGRAPHY IS DATED AUGUST 1, 2022.
3. COORDINATE SYSTEM: FL83-NF, NAVD 88.

0 200 400
1" = 200' FEET

KEVIN S. BROWN LICENSE No. 57819 STATE OF FLORIDA PROFESSIONAL ENGINEER
1/9/2024
Kevin S. Brown, P.E.
Florida Registration No. 57819

CLIENT
FLORIDA POWER & LIGHT COMPANY
FPL.

CONSULTANT
wsp
Authorization No. 1670

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YYYY-MM-DD	2022/01/18
DESIGNED	AVR-CRP
PREPARED	CCP
REVIEWED	KSB
APPROVED	KSB

PROJECT
PLANT SMITH
ASH IMPOUNDMENT CLOSURE
PHASES 2 TO 4

TITLE
FINAL CLOSURE PLAN

PROJECT NO.	REV.	DRAWING
31405024.022	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

Path: \\atlanta\cadd\Gulf Power\Plant Smith\1544251 Ash Pond Closure\Closure Design\Construction Plans 2021 PH 2-4\Exhibits\ | File Name: 154425121- Final Closure Plan_Exhibit.dwg

REPORT

Compliance with the Closure Performance Standards Required by the CCR Rule

Plant Smith Ash Pond

Submitted to:

Florida Power & Light Company

Submitted by:

WSP USA Inc.

5170 Peachtree Road Building 100 Suite 300

Atlanta, Georgia, USA 30341

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February 2023

Table of Contents

1.0 INTRODUCTION

WSP USA Inc. (WSP) (formerly Golder Associates Inc.) has prepared this *Compliance with the Closure Performance Standards Required by the CCR Rule* report on behalf of Florida Power & Light Company (FPL). This report demonstrates that the proposed closure plan for the Plant Lansing Smith Ash Pond (CCR Unit) is in compliance with the requirements of the United States Environmental Protection Agency's (EPA) "Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" Final Rule (40 C.F.R. Part 257, Subpart D) (the Federal CCR Regulations or CCR Rule) and specifically those in 40 C.F.R. §257.102 for closure of CCR surface impoundments.

1.1 Executive Summary

This report describes how the CCR Unit closure design meets the criteria outlined in 40 CFR §257.102 *Criteria for Conducting the Closure or Retrofit of CCR Units* and provides details as to how the closure and design complies with the closure performance standards of 40 CFR §257.102(d) *Closure performance standards when leaving CCR in place.*

The CCR Unit will be closed in place, with a consolidated footprint, and will include source control measures in accordance with the closure plan approved by the Florida Department of Environmental Protection (FDEP) (Gulf Power, 2016), that consist of (1) dewatering, consolidation and capping of CCR, and (2) installation of a subsurface drain system. These source control measures will be coupled with the installation of a vertical engineered barrier wall (also referred to as a "slurry wall") and combined these measures are designed to ensure compliance with the performance standards required by the CCR Rule.

1.2 Regulated Unit and CCR unit Location

Plant Smith is a power generating facility owned and operated by FPL and located in Southport, Florida. Plant Smith historically operated as a coal-fired facility and utilized an ash pond, as the CCR Unit, for management of CCR. Units 1 and 2 were the designation for the coal-fired plant and these units ceased operations in March of 2016. The original CCR Unit footprint comprised approximately 193 acres and continued to be utilized for management of stormwater generated from runoff from the plant and non-CCR wastewater through April 2021. Following this date, stormwater and process water are being managed in a new lined pond (further described below) at the facility.

The CCR Unit was commissioned in the 1960s for use in sluicing operations for CCR and such sluicing operations ceased in March of 2016. Figure 1 provides a map of the facility following ceased CCR operations in 2016. The CCR Unit included several internal dikes used for access and management of sluiced ash and stormwater flows. The ash cells within the pond were designated as the Northwest Pond, Southwest Pond, and the East Pond. Additional information is presented in the History of Construction for Existing CCR Surface Impoundment – Plant Smith Ash Pond (November 2021), located on FPL's CCR Rule Compliance website.

1.3 Summary of Closure Method

The closure method for the CCR Unit consists of closure in place with a consolidated footprint. The total estimated volume of CCR in the CCR Unit is approximately 4.2 million cubic yards, and approximately three million cubic yards will be relocated to the final closure area within the historical footprint. In general, CCR is being removed from the southern and eastern areas of the CCR Unit, dewatered, and then relocated to the northwest corner over existing CCR materials. Areas where ash is being relocated to the final closure area also include the southwestern and southern perimeter dikes. The consolidated final closure area is approximately 64 acres, a nearly 70% reduction in the footprint of the original CCR Unit.

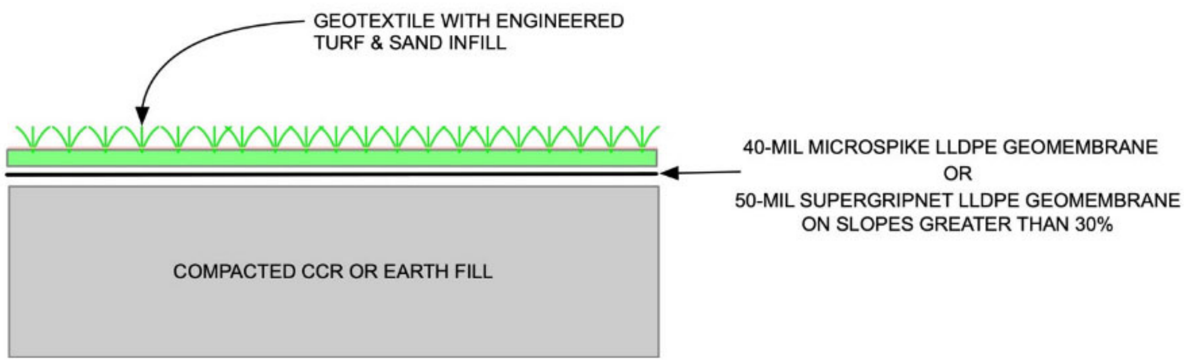
Along the northern and eastern boundaries of the final closure area, the existing CCR perimeter berm is being excavated and replaced with structural fill as needed to maintain site grades necessary for stormwater management. The final perimeter berm in these areas includes placed and compacted structural fill.

The entire final closure area, including the perimeter berm, is being capped with a ClosureTurf™ final cover system such that all CCR is covered. A perimeter channel is located on the inside of the final perimeter berm and will direct stormwater runoff from the final closure area to stormwater management ponds located south and east of the final closure area. The final closure grades are estimated to be eight percent, with potential revisions as required based on actual CCR quantities placed and compacted.

The ClosureTurf™ system consists of the following layers from top to bottom:

- ClosureTurf™ consisting of a combined geotextile and engineered turf layer with sand infill or concrete infill (Hydrobinder®)
- A 40-mil linear low density polyethylene geomembrane over the final closure area including the perimeter channel
- A 50-mil linear low density Supergripnet liner over the slopes of the perimeter berm and the final perimeter access road
- Compacted CCR or earthen subgrade material

A schematic of the typical final cover system is shown below.



The perimeter channel side slopes include Hydrobinder® to minimize erosion of the sand infill, and the bottom of the perimeter channel includes a one-foot layer of rip rap as ballast and drainage stone instead of sand infill. Section 2.7 of this report includes information on the equivalency of the final cover system to the requirements of the CCR Rule.

Finally, an engineered barrier wall (slurry wall) and perimeter drainage system are designed around the entire perimeter of the final closure area, to serve as engineering controls to enhance the proposed closure design. The slurry wall is designed to be installed at elevation 10 ft-MSL to elevation -15 ft-MSL. The designed slurry wall is currently partially installed along the southern and western boundaries of the final closure area. The final excavation slope of the existing CCR is also designed to be covered with a geocomposite drainage layer to collect remnant drainage that discharges into a perimeter toe drain located at the toe of the CCR excavation (the excavation slope and toe drain are partially constructed as of the date of this report). Water is and will continue to be collected and pumped from the toe drain using dedicated pump stations spaced at approximately 300 feet around the perimeter. Additional detail regarding the slurry wall is presented in Section 2.1.2.

2.0 CCR RULE CLOSURE PERFORMANCE STANDARDS

40 C.F.R. § 257.102(d) Closure performance standard when leaving CCR in place

This section of The CCR Rule contains the performance standards for the closure of a CCR unit when leaving CCR in place. The proposed closure for the Plant Smith Ash Pond is designed to meet the requirements 40 C.F.R. 257.102(d)(1) through 257.102(d)(3) as described in the Sections below.

2.1 Post-Closure Infiltration of Liquids and Releases

40 C.F.R. § 257.102(d)(1) The owner or operator of a CCR unit must ensure that, at a minimum, the CCR unit is closed in a manner that will:

(i) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere

Section 257.102(d)(1)(i) requires the final cover system to control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

2.1.1 Infiltration is controlled, minimized, or eliminated, to the maximum extent feasible

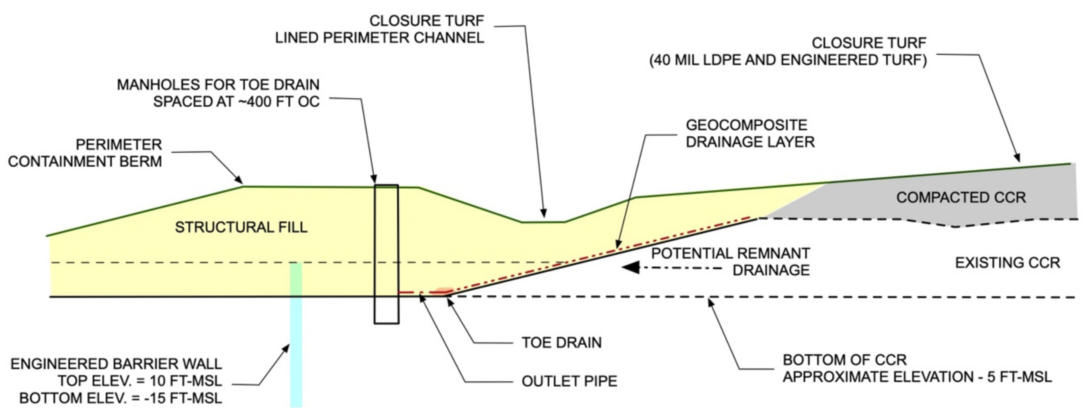
The control and minimization of infiltration in the post-closure state of the CCR Unit is achieved by the final grading configuration and installation of the final cover system. As discussed above, closure of the CCR Unit includes consolidation and closure in place of CCR. The final cover consisting of the geomembrane liner and synthetic turf system is designed to promote runoff of stormwater from the facility via eight percent final cover grades and positive drainage of the perimeter channel to designed stormwater spillways and subsequently to stormwater management ponds. Placement of the geomembrane is in accordance with industry standards, including full time construction quality assurance consisting of non-destructive and destructive test methods to ensure integrity of the geomembrane and panel seams. The geomembrane layer virtually eliminates infiltration of surface water into the final closure area thereby meeting the requirements set forth in §257.102(d)(1)(i) (See Section 2.7 for final cover equivalency information).

2.1.2 Releases of CCR, Leachate, or Contaminated run-off to the ground or surface waters or to the atmosphere are controlled, minimized, or eliminated to the maximum extent possible

The final cover system for the final closure area is designed to prevent infiltration and isolate the placed, dewatered, and compacted CCR from rainfall events, essentially eliminating the potential for discharge of CCR to the ground or surface water. As discussed in Section 2.7 below, the designed final cover system meets or exceeds the requirements set forth in the CCR Rule. The permeability of the geomembrane component of the ClosureTurf™ final cover system is many times less than the required soil cover and the geomembrane is installed with strict quality assurance standards that include testing of seams between panels and continuous observation by experienced technicians during installation. The installation of the final cover system will be certified by an experienced professional engineer registered in the State of Florida upon construction completion.

Management of stormwater from the final closure area includes positive drainage grades (8 percent) within the area that discharges runoff to the perimeter channel around the CCR Unit. This system is designed to safely handle the 25-year, 24-hour storm event with a minimum freeboard in the perimeter channel of 1-ft. Stormwater will be conveyed by the perimeter channel to spillways that discharge the stormwater to the ponds located south and east of the final closure area. These ponds are designed to maintain 5.2 feet (lined pond) and 6.1 feet (unlined pond) of freeboard during the 25-year, 24-hour storm events and 4.9 feet (lined pond) and 5.1 feet (unlined pond) of freeboard during 100-year, 24-hour storm events. Freeboard is calculated from the outer embankment elevation low point, 23 ft-MSL in the lined stormwater pond and 20 ft-MSL in the unlined stormwater pond. Because the final cover and perimeter channel are lined with the ClosureTurf™ system, erosion and discharge of sediment is reduced by more than 99 percent. Following large or consecutive storm events, it is possible that sand infill on the ClosureTurf™ system may migrate down the slopes and into the perimeter channel and ponds and will require periodic maintenance and replacement.

Further, the perimeter drain system (consisting of a geocomposite drainage layer over the excavated slope of existing CCR and toe drain designed to collect potential remnant drainage) as well as the engineered barrier wall (slurry wall) will eliminate discharge to the ground to the maximum extent possible. This perimeter drain and engineered barrier wall are designed to completely encompass the final closure area, eliminating discharge to the maximum extent possible from the area and preventing subsurface recharge of the final closure area from areas upgradient of the facility. The figure below provides a conceptual cross-section of the final closure area perimeter depicting the critical components of the final cover system.



A conceptual groundwater model was developed for the CCR unit based on available groundwater information, local rainfall information and the closure design. In order to optimize the depth of the slurry wall, a sensitivity analysis was performed. The slurry wall is designed to be installed from elevation 10 ft-MSL prior to completion of the structural fill perimeter berm and the sensitivity analysis indicated that the bottom elevation of -15 ft-MSL is the optimal depth as explained further below. South of the final closure area two lined wastewater ponds with underdrain systems have been constructed. These ponds and the underdrain system are installed south of the slurry wall and the pond liners will limit infiltration south of the final closure area while the underdrain systems will control uplift pressures on the lined wastewater ponds from groundwater.

The slurry wall depth was designed to contain groundwater in contact with CCR. Modelling was performed to optimize the slurry wall depth. Particle trace modelling was used for slurry walls to a depth of -5, -10 and -15 ft NAVD88 over a 50-year run period. The results showed that, for a slurry wall constructed to an elevation of -15 ft NAVD88, particles do not go beyond the slurry wall (i.e., according to the model, existing groundwater within the CCR does not move beyond the slurry wall over a 50-year time period). Groundwater flow will continue from the north and travel below the slurry wall.

Water collected in the toe drain will be pumped from proposed manholes fitted with pneumatic pumps to a force main where it will be discharged to the unlined wastewater pond for monitored discharge in accordance with the FDEP issued permits for the CCR unit. Each pneumatic pump is capable of pumping 10 gallons per minute and are self-actuated based on head above the pump intake. There are a total of 24 manholes with pumps spaced at approximately 400 linear feet (LF) on center around the perimeter of the final closure area. Final pumping rates from the toe drain will be dependent on site-specific factors and water levels; however, the designed system is capable of pumping water estimated to be collected in the toe drain based on the groundwater model.

Based on the modelling, the anticipated performance flows are:

- Remnant drainage from the CCR: ~159 ft^3/day or 0.8 gallons per minute (gpm)
- Total toe drain outflow: ~ 1,740 ft^3/day or 9 gpm

The toe drain is anticipated to intercept groundwater flow from upgradient of the final closure area. Based on groundwater modeling runs spanning more than 50 years, particle tracing shows that the slurry wall and toe drain are appropriately designed to retain and collect groundwater in contact with the CCR.

2.2 The closure method precludes the probability of future impoundment of water, sediment, or slurry

40 C.F.R. § 257.102(d)(1)(ii) "Preclude the probability of future impoundment of water, sediment, or slurry;"

The final cover system for the final closure area is designed to prevent the surface accumulation of water, sediment, and slurry. The final cover grades are designed to be eight percent to promote runoff of surface water and the perimeter channel system maintains a positive slope to two spillway outlets designed to discharge surface water to detention ponds. The stormwater management system is designed for the controlled management of stormwater resulting from the 25-year, 24-hour storm event and can safely handle flows from the 100-year, 24-hour storm event. As described in Section 2.1, there are no soil layers subject to erosion which will prevent the accumulation of sediment on the final cover system.

The final grades of eight percent will also withstand settlement of the underlying CCR over time without grade reversal. Much of the settlement of the underlying CCR occurs during placement and compaction of the CCR. The project technical specifications and construction quality assurance (CQA) plan require that the CCR be compacted to at least 90 percent of the maximum density based on the standard proctor curve and be within 5 percent of the optimum moisture content. The perimeter drainage channels are designed with slopes ranging from 0.5% to 1.6% and are protected from erosion by the final cover system. Along the perimeter channel alignment, most of the underlying CCR is excavated and relocated to the final closure area; thus, the reduced thickness of CCR along the alignment reduces the settlement potential during the post-closure period.

In general, the magnitude of settlement is proportional to the thickness of the CCR (e.g., greater thickness of materials will result in greater settlement). This concept means that the settlement of the final closure area will generally be uniform with minimal differential settlement. Settlement analyses indicate that the maximum settlement of 4.5 feet will occur in the center of the final closure area (where CCR is thickest) while settlement along the perimeter of the final closure area is estimated to be less than 0.5 feet. While most of this settlement will occur prior to placement of the final cover system (ClosureTurf™), any additional settlement will not induce strain or tension on the liner system due to this settlement profile (e.g. more settlement in the center versus the perimeter will not place the liner in tension). Note that if the predicted settlement were to occur following placement of the final cover system, the shortest distance from the closure area high point to the perimeter is about 600 feet, so this differential settlement would result in a final grade of about 7.3 percent as opposed to 8 percent. Thus, the design of the final cover system will preclude the probability of future impoundment of water, sediment, or slurry.

2.3 The closure method provides for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period

40 C.F.R. § 257.102(d)(1)(iii) "Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period;"

The final closure system is designed to prevent the sloughing or movement of the final cover during the closure and post-closure care period. Along the northern and western boundaries, the existing CCR berm is being excavated and replaced with a structural fill berm. The excavation slope of the existing CCR is 4H:1V to promote stability during construction and the final structural fill slope is 3H:1V. The overall height of the perimeter berms is generally less than 30 feet. Along the southern and eastern boundaries of the final closure area, the excavated CCR slope is 4H:1V and the slope is buttressed with a structural fill berm.

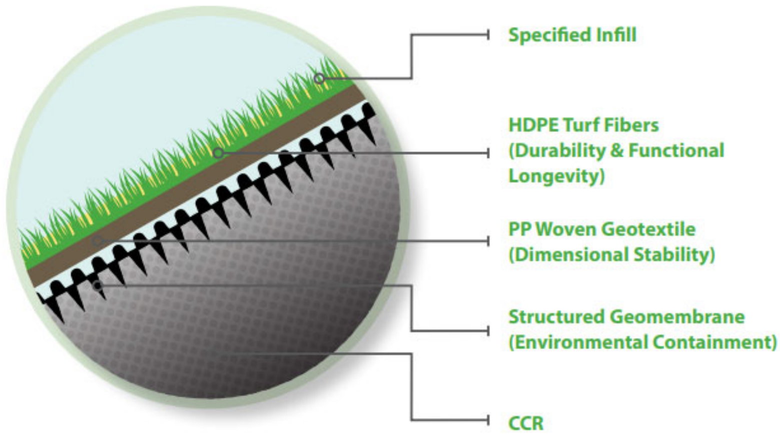
During construction, dewatering activities consisting of well points and/or rim ditches are used to control water surface within the CCR matrix such that the excavation slopes are not exposed to groundwater seeps which may impact stability. Further, all temporary excavation slopes are 4H:1V or shallower.

Under the final closure condition, the final closure area has been evaluated for a wide range of deep and shallow stability conditions under long-term conditions. The CCR unit is not located in an active seismic zone. The factor of safety for the designed long-term conditions is greater than 1.5 for the critical sections analyzed. The Safety Factor Assessment for Plant Smith Ash Pond (Rev. 01, October 2021) includes additional information related to the stability evaluation for the CCR unit.

2.4 The closure method minimizes the need for further maintenance of the CCR unit

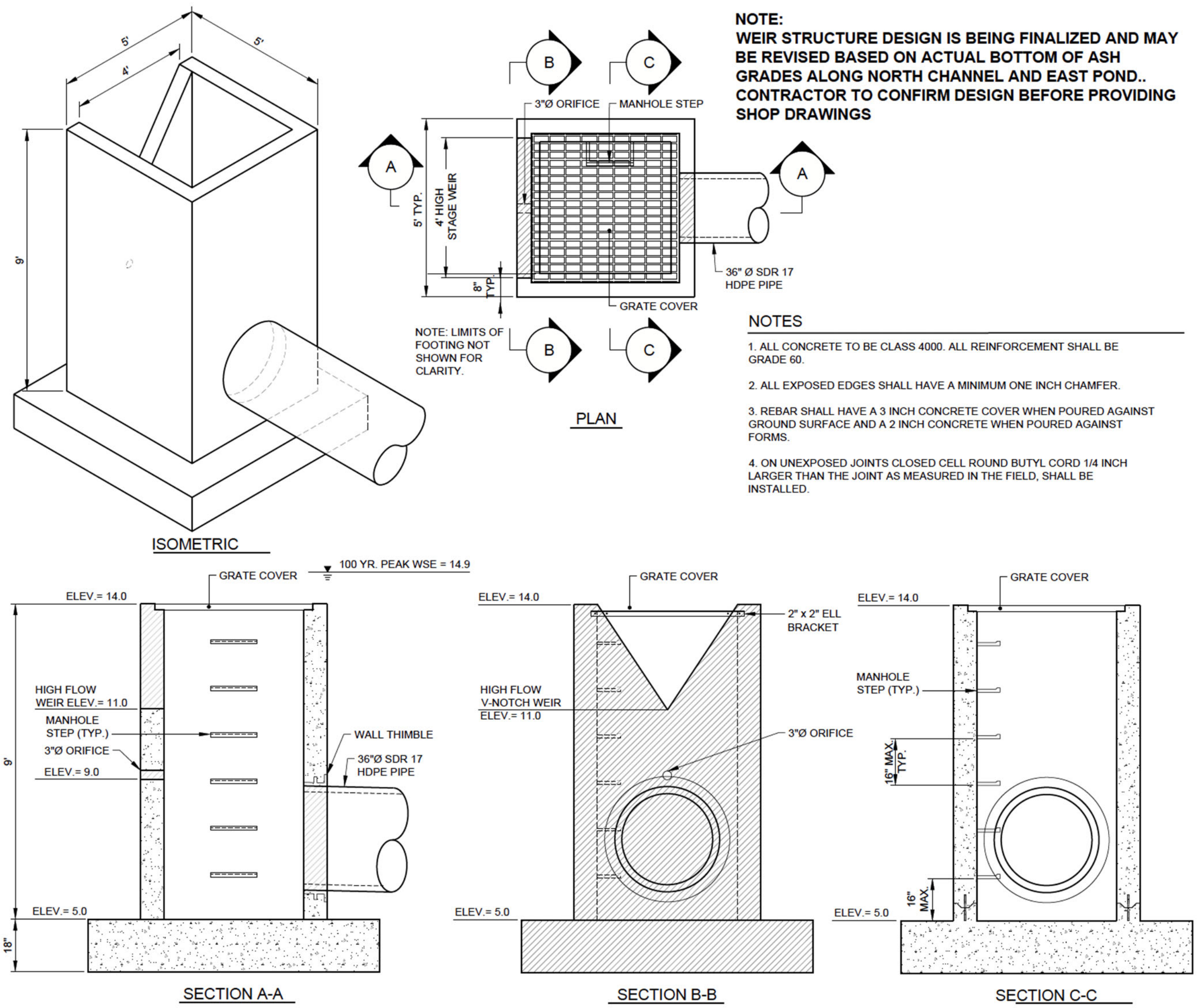
40 C.F.R. § 257.102(d)(1)(iv) "Minimize the need for further maintenance of the CCR unit;"

As described in previous sections, the closure design of the CCR unit incorporates a geomembrane liner and engineered turf cover system known commercially as ClosureTurf™. This system includes sand infill on top of the turf system that may require some periodic replacement following heavy storm events, but the synthetic cover system eliminates the need for traditional maintenance associated with soil and natural grass cover systems. The ClosureTurf™ system eliminates the need for periodic mowing, erosion repairs and revegetation, thereby significantly reducing maintenance during the post-closure period. A schematic of the ClosureTurf system is shown below. Additional information for ClosureTurf™ is included in Appendix B.



ClosureTurf™ System (WatershedGeo, 2022)

The stormwater detention system consists of two main ponds that provide substantial storage for stormwater that discharges from the final closure area. There are two primary spillway outlets that discharge stormwater into a fully lined pond and a separate pond with lined side slopes for erosion protection. The two ponds are connected via an overflow spillway and the presence of the liner on sideslopes will reduce the need for maintenance from erosion. The primary stormwater pond will have an integrated spillway structure that will allow for gravity drainage of detained water without the need for pumps. Further, the presence of the ClosureTurf™ system will essentially eliminate sediment loading in stormwater runoff, which eliminates the need for sediment cleanout of the ponds. The figure below shows the current design spillway structure, noting that this structure design may be revised depending on actual bottom of CCR grades.



The slurry wall and toe drain system only require maintenance of pneumatic operated pumps and associated pipelines. This maintenance can be readily completed with existing onsite personnel associated with operation of the power plant. A total of 24 pumps will be installed and maintenance of these pumps will include periodic cleaning of the pumps by removing them from the manholes and cleaning any visual sediment accumulation. The pumps are designed to be retrieved via a pipe sleeve to facilitate maintenance.

A maintenance plan will be developed prior to closure completion and implemented by plant personnel during the post-closure care period.

2.5 The closure method will be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices

40 C.F.R. § 257.102(d)(1)(v) "Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices."

Pre-closure activities for the facility were initiated in 2017, and the Notification of Intent to Initiate Closure in May 2021. The proposed closure design facilitates an accelerated construction schedule through the following primary features:

The consolidation method of closure reduces the amount of CCR that must be excavated by 25 percent; three million cubic yards of CCR must be excavated, dewatered, and relocated per the closure plan as opposed to the entire estimated four million cubic yards in place.

Consolidation of the CCR to a smaller footprint on the existing CCR unit reduces haul distances and accelerates the schedule for excavation and removal of the CCR from the closure by removal areas.

The final cover system eliminates the need for securing and hauling borrow material for a more traditional soil/geosynthetic cover system, including topsoil and sod.

A milestone schedule of pre-closure and closure construction activities is presented in the following table:

Closure Activity	Plant Smith Ash Pond
Closure Regulatory Interface and Permitting	Q1 2016
Initiation of Pre-Closure Dewatering Activities	Q4 2017
Pre-closure Activities for Lined Wastewater Pond and Piping Systems (Subgrade Grading, Preparation, and CCR Consolidation)	4.5 years: Q1 2017 – Q2 2021
Redirection of Plant Stormwater and Process Water	April 2021
Notice of Intent to Close	May 2021
Closure Construction (CCR Dewatering, Consolidation, Stormwater Management, and Final Cover Installation)	2.5 Years: Q2 2021 – Q4 2023
End Final Closure Construction Activities	2023

2.6 The closure method will provide stability for the final cover system

40 C.F.R. § 257.102(d)(2) "Drainage and stabilization of CCR surface impoundments. The owner or operator of a CCR surface impoundment or any lateral expansion of a CCR surface impoundment must meet the requirements of paragraphs (d)(2)(i) and (ii) of this section prior to installing the final cover system required under paragraph (d)(3) of this section."

§ 257.102(d)(2) provides that the owner or operator of a CCR surface impoundment must meet the drainage and stabilization requirements of paragraphs (d)(2)(i) and (ii) of this section prior to installing the final cover system required under paragraph (d)(3). This work is required for the purpose of ensuring that the final cover system subgrade will provide sufficient support for the cover system. This is addressed in Sections 2.7 and 2.8 below.

2.7 The Closure method will eliminate free liquids

40 C.F.R. § 257.102(d)(2)(i) "Free liquids must be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues."

§257.102(d)(2)(i) requires the elimination of free liquids by removing liquid waste or solidifying the remaining wastes and waste residues and stabilizing the remaining wastes to a sufficient degree to support the final cover system. Consistent with standard good engineering practices, the removal of standing water and additional liquids as needed to accomplish a stable in-place closure began in Q4 2017 consisting of removing water using a variety of methods, including but not limited to passive, gravity-based methods (e.g., rim ditches) and/or active dewatering methods (e.g., pumps and well points) as needed to allow for CCR excavation and transportation during closure construction.

Confirmation of adequate subgrade stability was additionally provided by the required compaction and proof-rolling of the final cover system subgrade areas that was performed in the manner documented in the project Construction Quality Assurance Plan. Details of free liquid removal and subgrade preparation activities performed are presented in the facility's Closure Plan and satisfy this requirement.

As part of dewatering, Florida Power & Light treated removed CCR contact water at the CCR unit during closure to provide treatment and management of discharge of contact water from the CCR Unit, consisting of a range of treatment technologies, sampling (constituents, frequency, and locations) for compliance with the FDEP issued permits for the CCR unit.

2.8 The Closure method will stabilize remaining waste to ensure support for the final cover system

40 C.F.R. § 257.102(d)(2)(ii) "Remaining wastes must be stabilized sufficient to support the final cover system"

The design approach for the closure of the CCR Unit allows for eight percent slopes of the final cover system with essentially no permanent driving force above the geomembrane (i.e., no soil fill). Note that typical peak interface friction angles between geotextiles and textured geomembranes and fill materials and textured geomembranes exceed 20 degrees, while the final slope angle in the final closure area is 4.6 degrees. Under these conditions, there are no concerns for stability of the final cover system from veneer failure (slipping of the liner surface along the CCR surface or slipping of the geotextile along the textured geomembrane), as the system would be stable under infinite slope conditions (the interface friction angle is much greater than the slope angle).

Along the perimeter of the final closure area, the perimeter berm is being constructed from controlled structural fill that is placed in six-inch lifts and compacted to 95 percent of the maximum standard proctor density in accordance with ASTM D 698. Final perimeter berm slopes are 3H:1V and are capped with the ClosureTurf™ system to eliminate erosion of the berm face and sloughing of the fill materials. Note that the ClosureTurf™ system along the surface of the final perimeter berm utilizes the SupergripNet geomembrane that includes spikes for increased interface friction between the structural fill and the geomembrane. Laboratory testing of coarse sand and the SupergripNet geomembrane indicate an interface friction angle of 35 degrees under peak strength and 31 degrees under large displacement conditions. The slope of the final perimeter berm is 18.4 degrees; thus, the geomembrane interface with the structural fill is also stable under infinite slope conditions. Also note that there are no permanent driving forces above the final cover surface (no soil fill), so the peak interface shear strengths noted previously should be applicable.

Traditional composite liner systems include a geomembrane overlain by a geosynthetic or natural drainage layer and a layer of soil capable of supporting vegetation. The soil cover provides an overburden pressure which negatively impacts veneer stability, depending on the final slope angle. For steeper sloped areas, the overburden soil can slough or erode with sufficient buildup of water pressure. The use of the ClosureTurf™ system reduces "driving" forces over the liner system by eliminating overburden over the synthetic liner system and increasing stability against veneer failure of the cover system.

The CCR placed in the final closure area is also placed in controlled lifts that require compaction verification. Free water from the final closure area is removed prior to placement of relocated CCR materials.

Note that vents are also incorporated into the final cover system to alleviate any potential pressure buildup beneath the final cover. These vents are installed over 15-ft wide strips of geocomposite.

2.9 The final cover system must include an infiltration layer that meets specified criteria

40 C.F.R. § 257.102(d)(3)(ii)(A) "The design of the final cover system must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (d)(3)(i)(A) and (B) of this section"

The final cover system meets the requirements of § 257.102(d)(3)(ii)(A) through the design permeability of the final cover system, which will be limited by a flexible geomembrane liner with a permeability less than the maximum allowed permeability of 1×10^{-5} cm/sec. The flexible membrane liner of the ClosureTurf® cover system is modeled to have a permeability of 4×10^{-12} cm/sec (per manufacturer specifications), significantly more protective than the requirements for permeability specified by the CCR Rule for final cover systems.

2.9.1 The final cover system must include an erosion layer that meets specified criteria

40 C.F.R. § 257.102(d)(3)(ii)(B) "The design of the final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in paragraph (d)(3)(i)(C) of this section"

The final cover system meets the requirements of § 257.102(d)(3)(ii)(B) because it provides equivalent or superior protection from wind and water erosion as compared to a 6-inch vegetated erosion layer because the synthetic engineered turf does not have the erosion potential. ClosureTurf® will retain the synthetic grass strands regardless of rainfall, drought, freeze-thaw cycles, lack of fertilization, and other factors typically having to be addressed to maintain a vegetative cover system.

2.9.2 The final cover system must be designed so that disruption to the integrity is minimized

40 C.F.R. § 257.102(d)(3)(ii)(C) "The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence."

The final cover system meets the requirement of § 257.102(d)(3)(ii)(C) to accommodate settling and subsidence because it relies on proven materials, design practices and construction techniques (e.g., geosynthetic FMLs, earthen dikes, rock armored stormwater channels, etc.). The closure method for the CCR Unit has been evaluated across a range of global (deep) and veneer (shallow) stability conditions and meets or exceeds applicable requirements. Satisfactory slope stability evaluations were completed for both short- and long-term conditions, including provision for impacts from design storm events and from the theoretically potential seismic (earthquake) hazard at the CCR unit based on the CCR unit location. Additionally, the potential settlement is well within the specifications for the cover system (for which compaction requirements for CCR are to at least 90 percent of the maximum density based on the standard proctor curve, per the CQA Plan), and similar cover systems are regularly and successfully used at sites where settlements are typically significantly higher than those predicted for the Plant Smith Ash Pond closure.

As discussed earlier in Section 2.3, the CCR Unit closure provides for minimal calculated post-closure settlement, low seismic hazard risk, and well known and understood subsurface conditions without a history of subsidence risk. This is further summarized in the Location Restriction Demonstrations, dated October 17, 2018. The low calculated potential settlement and subsidence magnitudes and the absence of known geologic subsidence risks at the CCR unit, combined with the ability of the cover system materials and design and construction techniques to accommodate much higher displacements and seismic loadings (well above those predicted) demonstrate that this regulatory requirement has been met.

2.10 The final cover system must have a written certification

40 C.F.R. § 257.102(d)(3)(iii) "The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority that the design of the final cover system meets the requirements of this section."

As required by § 257.102(d)(3)(iii), a Florida-registered professional engineer has certified that the design of the final cover system meets the requirements of 40 C.F.R. Section 257.102(d)(3). Additionally, following construction completion, the construction of the final cover system per the CQA Plan will be certified by a Florida-registered professional engineer.

Signature Page

WSP USA Inc.

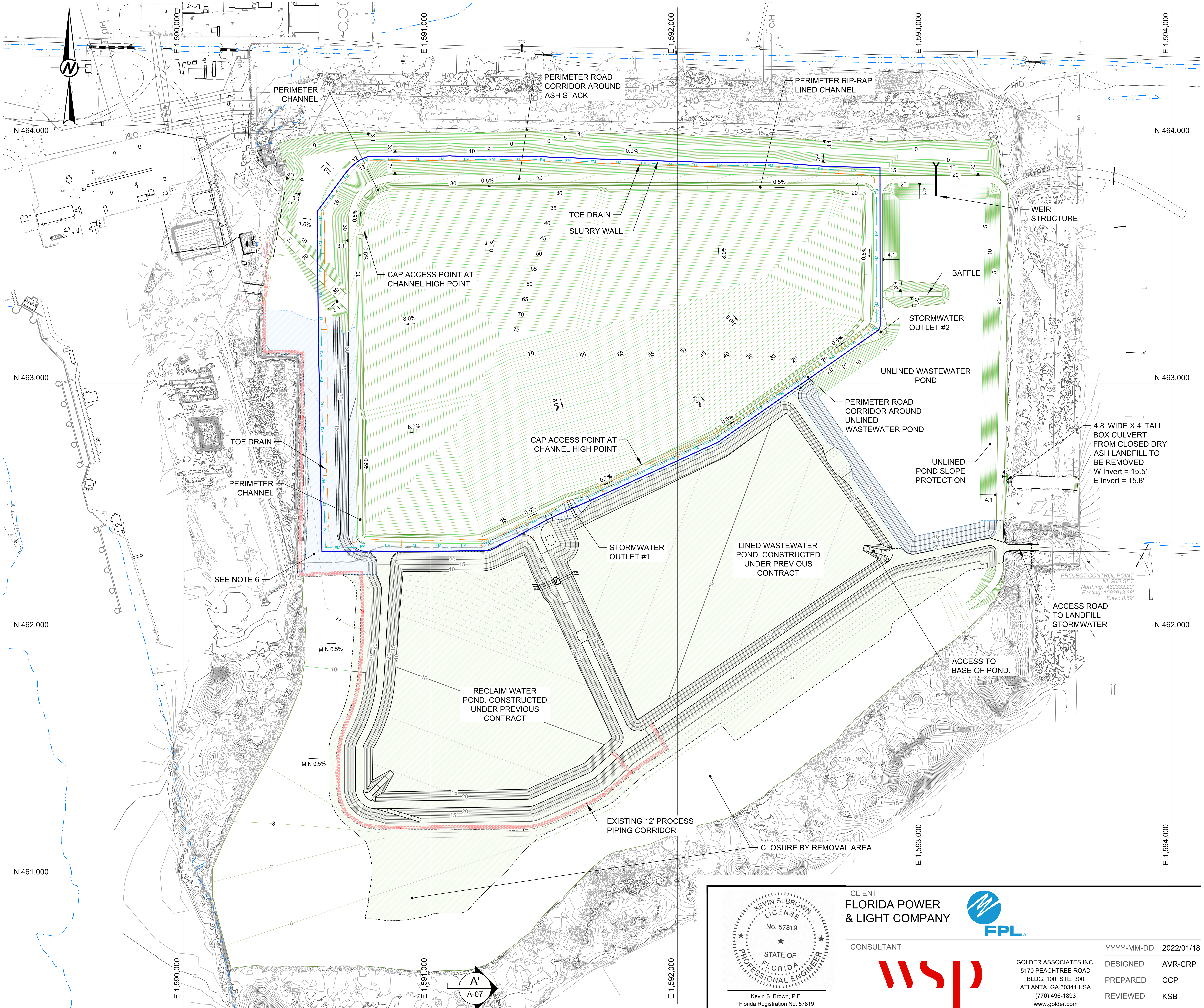
Kevin S. Brown, PE
Director, Civil Engineer

Lizmarie Steel, PE
Senior Engineer

KSB/LS/ls

Appendix A

Closure Design Drawings – Plant Smith Ash Pond



LEGEND

20	EXISTING CONTOURS
20	PROPOSED CONTOURS
	SLURRY WALL
	TOE DRAIN
	TOE DRAIN MANHOLES
	EXISTING IMPROVEMENTS CONSTRUCTED UNDER PREVIOUS CONTRACT
	SEE NOTE 6

NOTES

1. THE BOTTOM ELEVATION OF EXISTING ASH MATERIAL IS ESTIMATED AT 5-FT.
2. THE VOLUME OF ASH REMOVAL IS ASSUMED TO INCLUDE MATERIAL UNDERCUT TO ELEVATION 4-FT (ONE FOOT OF ADDITIONAL MATERIAL REMOVAL).
3. FINAL CLOSURE AREA SLOPE MAY VARY, BUT SHALL NOT BE LESS THAN 8%. IF FINAL SLOPE IS SHALLOWER THAN 8%, THE DIVERSION BERMS WILL BE REDESIGNED PRIOR TO INSTALLATION OF CAP.
4. REFER TO CLOSURE DRAWINGS SHEET A-09 FOR FINAL COVER DETAILS.
5. BASE OF ASH MATERIALS IS ASSUMED. CONTRACTOR IS RESPONSIBLE FOR EXCAVATING ALL ASH MATERIALS WITHIN CLOSURE BY REMOVAL AND POND AREAS.
6. AREA SHADED INCLUDES THE ROAD ALONG THE NORTHERN BOUNDARY OF THE RECLAIM AND LINED WASTEWATER PONDS AND A PORTION OF THE WESTERN SLOPE OF THE FINAL CLOSURE AREA. GRADING IN THESE AREAS IS CONSIDERED COMPLETE AS OF THIS CONTRACT AND NO FILL OR EXCAVATION QUANTITIES ARE INCLUDED IN THIS CONTRACT. HOWEVER, THE ROAD SURFACE MATERIALS, SPILLWAY NO. 1 PROTECTION AND FINAL CAPPING REQUIRED IN THIS AREA IS INCLUDED UNDER THIS CONTRACT AND QUANTITIES REFLECT THESE AREAS.
7. GAS VENTING SYSTEM NOT SHOWN FOR CLARITY. REFER TO CLOSURE DRAWINGS SHEET A-06 FOR GAS VENTING PLAN AND VENT LOCATIONS.
8. FINAL GRADING ALONG NORTH CANAL REVISED PER ADDITIONAL GEOTECHNICAL INVESTIGATION AND ESTIMATE OF BOTTOM OF ASH ADJUSTMENTS.

REFERENCES

1. PRE-DISTURBANCE EXISTING PLANIMETRICS PROVIDED BY GULF POWER IN AUGUST 2016.
2. BASE MAP INFORMATION PROVIDED BY COOPER, BARNETTE, AND PAGE (CBP), TOPOGRAPHY IS DATED AUGUST 1, 2022.
3. COORDINATE SYSTEM: FL83-NF, NAVD 88.

0 200 400
1" = 200' FEET

KEVIN S. BROWN LICENSE No. 57819 STATE OF FLORIDA PROFESSIONAL ENGINEER

Kevin S. Brown, P.E.
Florida Registration No. 57819

CLIENT
FLORIDA POWER & LIGHT COMPANY

CONSULTANT

Authorization No. 1670

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YYYY-MM-DD	2022/01/18
DESIGNED	AVR-CRP
PREPARED	CCP
REVIEWED	KSB
APPROVED	KSB

PROJECT
PLANT SMITH
ASH IMPOUNDMENT CLOSURE
PHASES 2 TO 4

TITLE
FINAL CLOSURE PLAN

PROJECT NO.	REV.	DRAWING
31405024.022	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

Appendix B

ClosureTurf Manufacturer's Information – WatershedGeo

An Environmental Safeguard for Coal Ash Waste

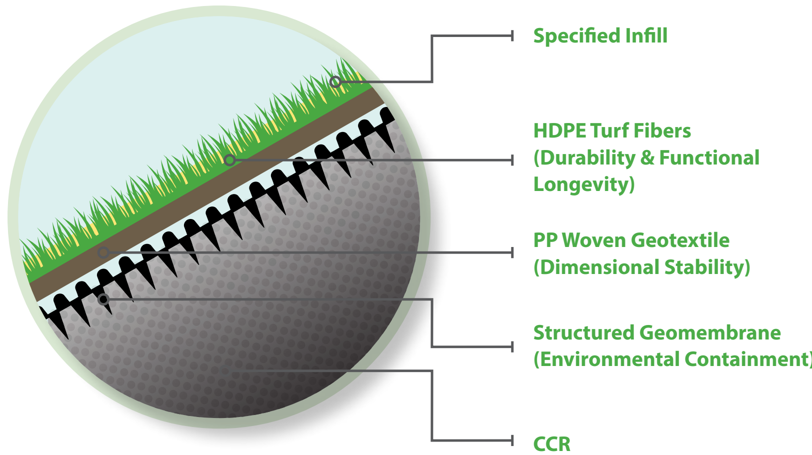
ClosureTurf®

CCR Closure Technology

U.S. Patent Nos. 7,682,105 & 8,585,322
Canada Patent No. 2,663,170 • U.S. & International Patent Pending

Subtitle D Compliant, Final Closure System

ClosureTurf is a three component system comprised of an engineered synthetic turf for durability and functional longevity, a specified infill for enhanced protection and a structured geomembrane for environmental containment. Currently being used on large-scale CCR disposal projects as a final cover system rather than the traditional soil vegetative closure methods, ClosureTurf allows for a faster closure, is safer and more cost-effective — both during construction and in post-closure maintenance and custodial care, and offers several environmental benefits compared to traditional closure methods.



Bringing Final Closure to Coal Ash Disposal Challenges

Specifically designed to address the stringent requirements of CCR closure regulations, ClosureTurf® is proving to be a most effective solution for utilities and industrial sites facing aggressive mandates. ClosureTurf can reduce the closure construction schedule by at least 50%, thereby accelerating the project schedule. Through our patented engineered synthetic turf/infill/geomembrane system, the traditional 24" soil layer is eliminated, so borrow soil, transportation risks to and from the site, and long-term soil-related maintenance are no longer challenges the owner has to face.

Coal Energy Applications:

> Ash impoundment closures

> Synthetic gypsum removable covers

> Coal refuse area closures

> Coal overburden pile closures

Significant Improvements to Water Quality

With traditional prescriptive soil covers, a significant risk exists for sediment pollution through erosion of the soil layer. Due to it's unique design, the ClosureTurf system provides clean runoff water perpetually. Additionally, with the virtual elimination of any borrow soil and related trucking, an independent analysis shows an approximately 80% reduction in ClosureTurf's carbon footprint when compared to traditional methods of closure.

Over 25 Million Square Feet Installed

To date, over 25 million square feet of ClosureTurf has been successfully installed in the U.S. Some of our more recent projects include a cement kiln dust landfill, an industrial sludge and ash lagoon, a waste to energy ash monofil landfill and utility coal ash ponds.

> Improved Safety

With no soil requirements, there are virtually no trucks and equipment on local roads or on the project site

> Accelerated Project Schedule

Reduces overall closure construction schedule by ~50%

> Water Quality Enhancement

Significantly cleaner runoff reduces potential storm water pollution of local waterways

> Maintenance Cost Savings

Total overall maintenance costs are typically reduced by approximately 90% in comparison to prescriptive covers

> Environmental & Community Benefits

Prevents dust, odors and air pollution for nearby residents; reduces carbon footprint by 80%

> Renenewable Energy Opportunities

Serves as an ideal foundation for possible future ballasted solar arrays

WatershedGeo® Unearthing Solutions 770.777.0386 • watershedgeo.com • info@watershedgeo.com

ClosureTurf®

ADVANCED FINAL COVER SYSTEM

The only final cover solution that provides a predictable benchmark of performance.

Created and Patented by: WatershedGeo® Unearthing Solutions

ClosureTurf® Overview

Superior Performance When Compared to EPA Subtitle D Landfill Final Covers

Watershed Geosynthetics, LLC (Watershed Geo) has prepared this document to present the benefits of using ClosureTurf® as an alternative final cover system for EPA Subtitle D landfill applications. ClosureTurf offers substantial technical and environmental benefits when compared to traditional and regulatory prescriptive final covers of landfills and other waste containment facilities.

ClosureTurf provides significant technical benefits, including elimination of soil erosion, enhanced geotechnical stability, accelerated construction schedule, and reduced post-closure maintenance. These benefits have been validated through extensive independent laboratory and field tests as well as real-world performance of more than 1,500 acres of ClosureTurf installations and operations. ClosureTurf is a more environmentally sound application too. It provides improved runoff water quality, minimum land disturbance, and significant carbon footprint reduction.

<u>ClosureTurf Benefits</u>

1) Regulatory Compliance

ClosureTurf is a three-component system comprised of a structured geomembrane, an engineered synthetic turf, and a specified infill. The EPA Subtitle D rules state that an alternative cover design may be used upon approval, as long as it provides equivalent protection against infiltration and erosion. As presented in this document later, ClosureTurf exceeds the equivalency performance requirements of the EPA Subtitle D prescriptive soil cover. Specifically, the analysis results have shown that the ClosureTurf system has much less leakage and erosion than the prescriptive soil cover.

2) Safety and Community Impact Reduction

ClosureTurf eliminates approximately 550 truck trips per acre from local roadways that would otherwise be used to transport soil to and from a borrow site (note: 1 truck load equals to 2 trips). This reduction in size, number and duration of equipment means an overall increase in safety on both the project site and roads (i.e., less possible accidents involved with equipment and vehicle operations), as well as reduction in dust at the site, mud on the roads, and noise impacts on the surrounding community. Most traditional closures also require destruction of land in the community for project soil sources, resulting in additional environmental impact and loss of future land use.

3) Sustainability

ClosureTurf reduces the carbon footprint of a final cover closure by approximately 80% when compared with traditional soil/vegetative covers. Additionally, ClosureTurf provides an ideal foundation for future beneficial uses, such as solar farms. Traditional post-closure plans identify the post-closure use simply as "dead space". ClosureTurf has been used to install photovoltaic solar panel arrays on top it, allowing the unused space to be utilized as a renewable energy site. This feature is inherent with the ClosureTurf system and requires no special modifications to the cover system to accommodate possible future use for solar farms.

4) Water Quality

ClosureTurf provides clean runoff with very low turbidity because it does not have a soil layer, except for the thin (0.5-inch thick) layer of sand infill. The system significantly reduces sediment loading to surrounding channels and sedimentation/detention basins either onsite or offsite. ClosureTurf has a positive impact on overall storm water quality, allowing effluent levels to meet or be well below the regulatory turbidity limits.

5) Geotechnical Factors of Safety

ClosureTurf improves the geotechnical factors of safety of the final cover. By removing the soil layer, the veneer-type final cover failure that typically occurs through the interface between the soil and geosynthetic components of the traditional soil cover systems is no longer a focus of concern. In addition, the system has a light weight that is typically about 5 pounds per square foot (psf). Placement of ClosureTurf creates insignificant loading on the underlying waste and thus, insignificant waste settlement. As a comparison, the waste settlement caused by the much heavier traditional soil covers can potentially reverse drainage and create ponding, especially at landfill top decks where the slopes are usually relatively flat.

6) Water Conservation

ClosureTurf reduces the need of water for soil compaction and dust control during construction. It also eliminates the need of irrigation during the post-closure maintenance period for vegetation or re-vegetation of traditional soil cover systems.

7) Land Conservation

ClosureTurf does not required the destruction of land to obtain soils to achieve the closure. It optimizes land conservation through the elimination of excavation of borrow pits on native land, as well as providing space for renewable energy sites (e.g., solar farms) that might otherwise need to be constructed in other undeveloped areas.

8) Maintenance Cost Savings

ClosureTurf requires very low post-closure maintenance. The cost of maintenance is estimated to be as much as 90% less than traditional soil cover systems as a result of reduction in maintenance activities including vegetation, mowing, fertilization, irrigation, re-vegetation, erosion repairs, and stormwater pond cleaning associated with traditional soil covers.

9) Project Schedule/Installation Rate

ClosureTurf requires fewer resources to complete a final cover closure from pre-design through final acceptance. ClosureTurf installs 2 to 3 times faster than traditional soil covers and uses lighter and fewer pieces of equipment. The increase in project-completion efficiency means that owners, operators and their design/construction team can effectively cover more acreage with ClosureTurf than with traditional soil cover systems. Additionally, the standardization of engineering and construction details associated with ClosureTurf reduces the burden on the regulatory review and approval process.

10) Longevity

ClosureTurf is expected to have a design life of more than 100 years for the infilled engineered synthetic turf component based on field ultra violet (UV) test results. The underlying geomembrane will last much longer because of the UV protection provided by the infill and the engineered synthetic turf. Studies by the Geosynthetic Institute (GSI) show that the geomembrane can last more than 400 years under covered conditions.

ClosureTurf® Detail Description

ClosureTurf is an environmentally friendly and aesthetically pleasing engineered synthetic turf final cover system that is designed for long-term performance. This system eliminates or significantly reduces the challenges associated with traditional soil cover systems, including erosion control, veneer slope stability, and post-closure maintenance. A section of ClosureTurf is shown in Figure 1. Its components include the following from bottom to top:

- Structured Geomembrane, which is made of either high density polyethylene (HDPE) or linear low density polyethylene (LLDPE);
- Engineered Synthetic Turf, which is comprised of polyethylene (PE) fibers tufted through a double layer of woven polypropylene (PP) geotextile backing manufactured for high UV and heat resistance; and
- Specified Infill.

The ClosureTurf system is placed directly on top of the prepared subgrade.

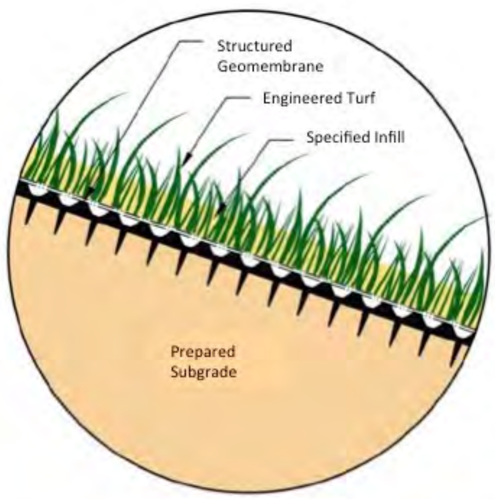


Figure 1 – Cross Section of ClosureTurf® System

ClosureTurf has been approved as an alternative final cover system in many states across the U.S. Approvals were based on a demonstration that ClosureTurf meets the minimum requirements defined in applicable State or Federal EPA regulations.

The minimum technical requirements for Subtitle D final cover systems are presented in 40 CFR 258.60. The regulation allows for a prescriptive (minimum criteria) cover system or an alternative (performance based) cover system. The specific requirements of 40 CFR 258.60 for approval of an alternative final cover system are as follows:

"(B) The Director of an approved State may approve an alternative final cover design that includes:

(1) An infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (a) (1) and (a) (2) of this section, and

(2) An erosion layer that provides equivalent protection from wind and water erosion as the erosion layer specified in paragraph (a) (3) of this section."

Engineering analysis results have demonstrated that the ClosureTurf final cover system: (1) results in a greater reduction in infiltration than the Subtitle D prescriptive cover; and (2) provides greater protection from erosion, while maintaining functional longevity with reduced post-closure maintenance burden. More than 2,800 acres of ClosureTurf has been (or is being) constructed in more than 25 states in the U.S., as shown in the project map below.

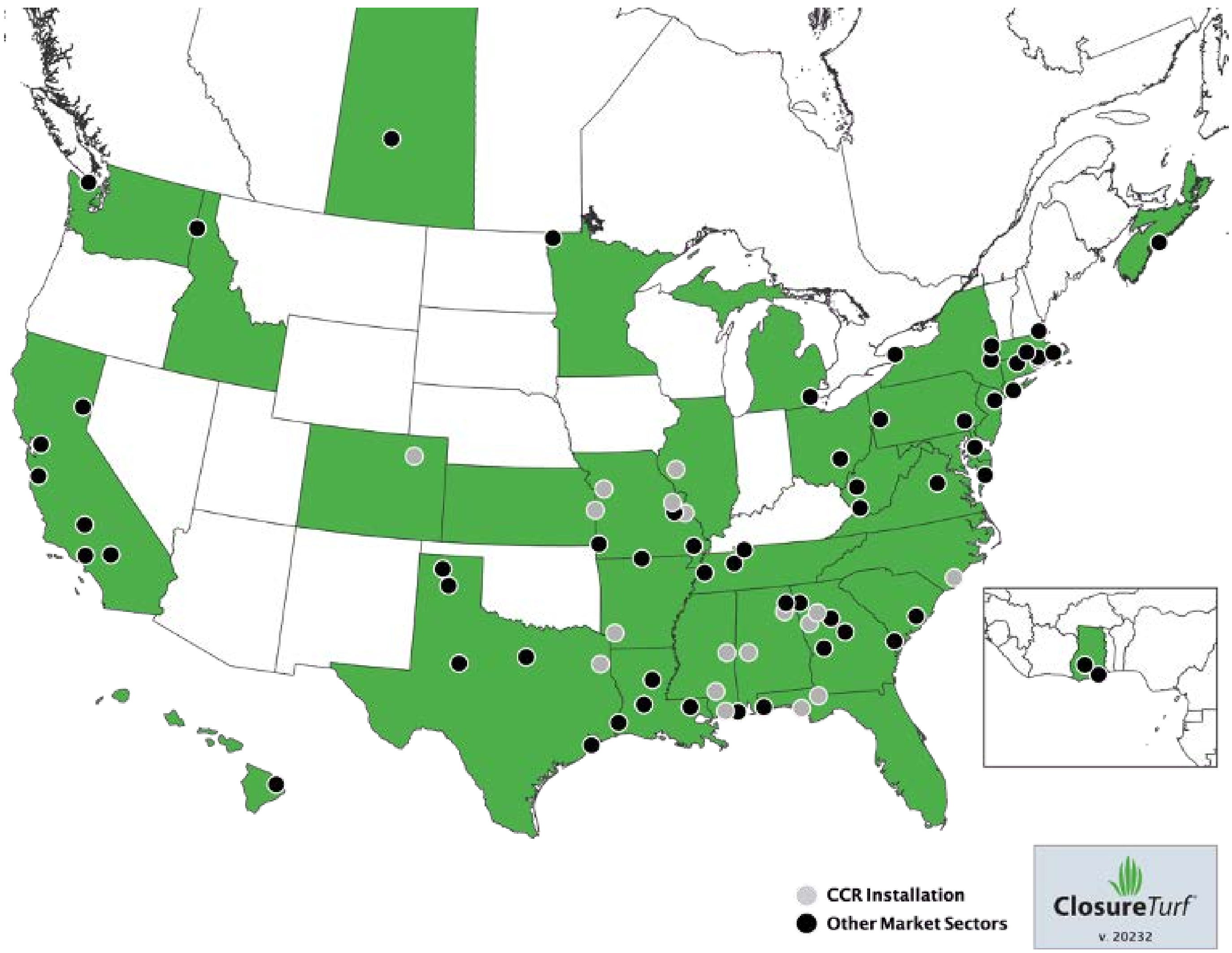


Figure 2 - Locations of ClosureTurf

Infiltration Equivalency Analysis

Infiltration through a cover system is typically evaluated using either of the following two methodologies: the Hydrologic Evaluation of Landfill Performance (HELP) Model or the Giroud Method. Both methods have been used to compare the infiltration performance of the ClosureTurf final cover system to the prescriptive Subtitle D soil cover. A summary of the results is shown in Table 1.

The results show that the ClosureTurf Final Cover System has much less infiltration than the prescriptive Subtitle D soil cover. These results are expected since ClosureTurf does not have a soil layer that can potentially hold significant hydraulic head over the geomembrane.

Table 1 – Summary of Results for Infiltration Equivalency Analysis

Infiltration Equivalency Analysis	ClosureTurf® Cover System	Prescriptive Subtitle D Cover System
Help Model for Site– Average Annual Infiltration (Cubic Feet/Acre/Year)	8.3	347
Giroud Method with Silty-Sandy Soil below the ClosureTurf Peak Daily Infiltration (Gallons/Acre/Day)	1.33	4.51
Giroud Method with Silty-Sandy Soil with Some Clay below the ClosureTurf Peak Daily Infiltration (Gallons/Acre/Day)	0.24	4.51

Erosion Control

Rainfall Erosion Control Testing

ClosureTurf was tested at TRI Environmental in accordance with ASTM 6459 - Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall- Induced Erosion. ClosureTurf was tested in a rainfall simulator to an intensity of over 6.5 in/hr with less than 0.04% loss of sand infill.

Figure 3 – Rainfall Erosion Control Testing on ClosureTurf® (3H:1V Slope)

The typical design criterion for sediment runoff on a traditional landfill soil cover is 3 tons/acre/year. The measured loss of sand infill (0.04%) of the ClosureTurf is approximately 0.03 tons/acre for a 6.5 in/hr rainfall intensity. Using ClosureTurf will significantly reduce sediment loads and runoff turbidity. Also, the ClosureTurf System filters the storm water and provides "clean" runoff as shown in the testing samples in Figure 4 below.

Enhanced Water Quality

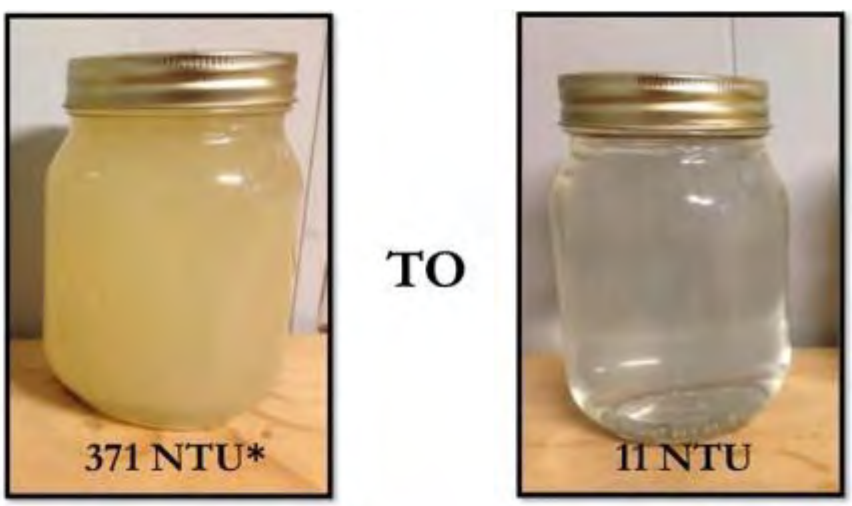


Figure 4 – Samples from Two Storm Water Ponds at the Same Facility

Pond 1 (left sample) for the soil cover and Pond 2 (right sample) for the ClosureTurf

Table 3 – Analytical Results from Storm Water Samples at a Southeastern Landfill

Parameter	Area with Soil Cover	Area with ClosureTurf®
Turbidity (NTU)	371	11
Total Suspended Solids-TSS (mg/L)	349	<4
pH	6.5	7.3
Total Organic Carbon-TOC (mg/L)	174	1
Toxic Release Inventory-TRI (mg/L)	16	0.5

In areas of channelized flow (bench drains, down chutes, and perimeter channels), the ClosureTurf can be infilled with HydroBinder® (sand cement infill) instead of sand. ClosureTurf with HydroBinder has been tested at Colorado State University Engineering Research Center (CSU) in accordance with ASTM D 7277 – Standard Test Method for Performance Testing of Articulated Concrete Block (ACB) Revetment Systems for Hydraulic Stability in Open Channel Flow. The results of the testing were analyzed in accordance with ASTM D 7276 - Standard Guide for Analysis and Interpretation of Test Data for Articulating Concrete Block (ACB) Revetment Systems in Open Channel Flow. Testing was performed up to the 5.5-ft overtop flume capacity which resulted in 40 fps in velocity. The photos in Figure 5 show this steady state testing being performed.

Figure 5 – Steady State Hydraulic Testing of ClosureTurf® with HydroBinder® at CSU

The full-scale wave overtopping testing for side slope protection was also performed on the ClosureTurf with HydroBinder at CSU. CSU has the world's largest wave overtopping simulator which they developed for the U.S. Army Corp of Engineers. Testing was performed on HydroTurf for 13 hours with 9 hours at the maximum capacity of the simulator (4.0 cfs/ft which represents a generic hurricane with a 0.2 percent annual exceedance probability; i.e., a 500-year event). The photos in Figure 6 show wave overtop testing on the HydroTurf.

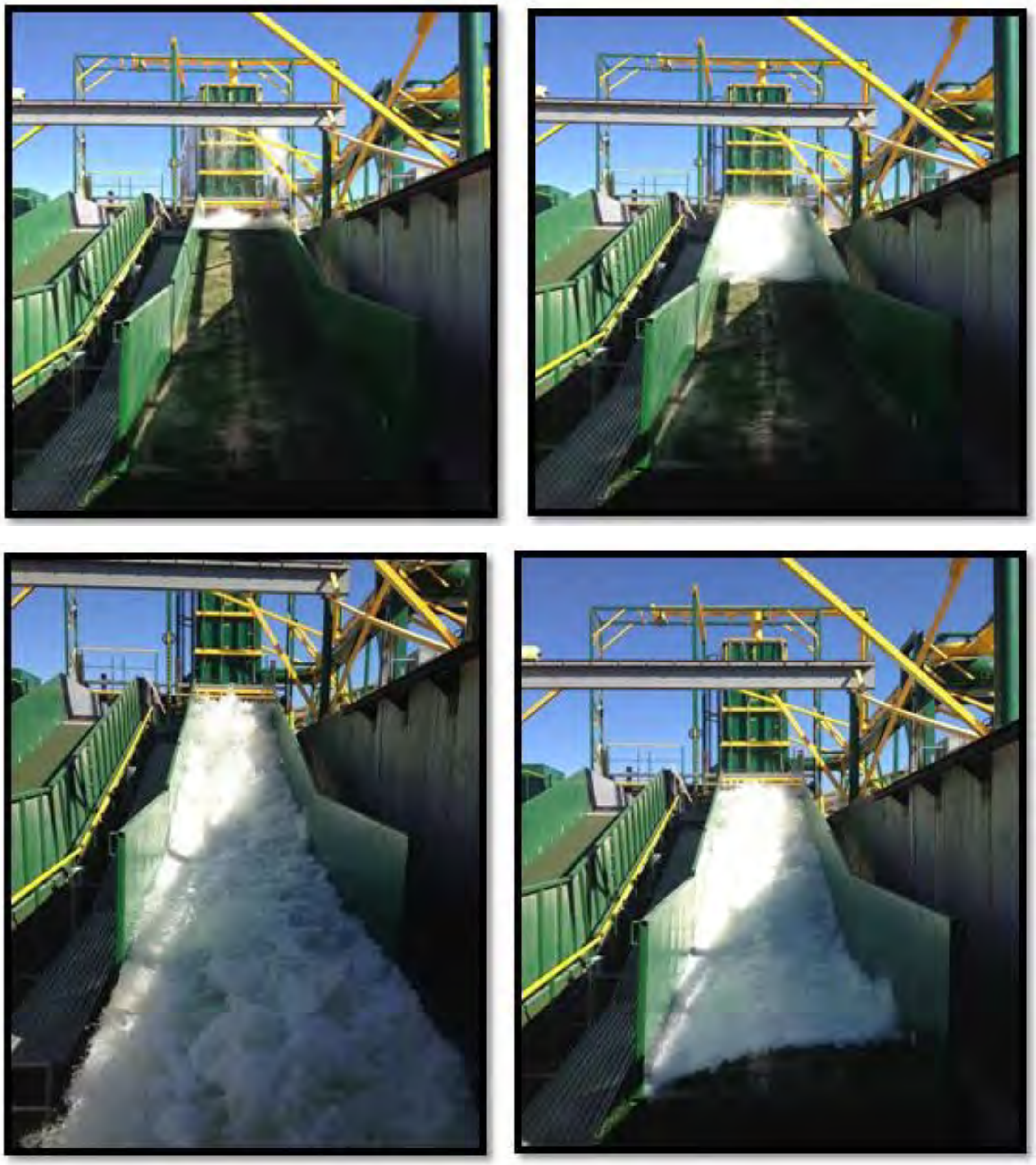


Figure 6 – Wave Overtopping Hydraulic Testing of ClosureTurf with HydroBinder

Longevity and Protection Provided by ClosureTurf

ClosureTurf® is not an exposed cover system. It is a hybrid system that provides full protection of the most critical element of the closure system – the geomembrane. ClosureTurf differs from exposed geomembrane systems as follows:

- Access and drivability of exposed geomembrane systems are severely limited without means of protecting the geomembrane;
- Exposed geomembranes are vulnerable to wildlife trafficking;
- The engineered turf component of ClosureTurf serves as a protective ballast providing physical protection and weathering protection to the underlying geomembrane;
- Since ClosureTurf looks and feels like natural vegetation, it is much more aesthetically pleasing than an exposed geomembrane system; and
- ClosureTurf has a much longer functional longevity than exposed geomembrane systems.

For ClosureTurf, the engineered synthetic turf layer provides protection of the structured geomembrane so that it is not exposed to the environment. If properly maintained, the engineered synthetic turf layer will have a 100+ year functional longevity. The results of 10 years of independent weathering data for the synthetic turf yarns are shown in Figure 7. When this data is extrapolated to 100 years, the yarn has an approximate 65% retained tensile strength. In other words, the projected half-life of the engineered turf layer far exceeds 176 years. This longevity has been independently evaluated by multiple organizations who are experienced in the longevity performance of geosynthetics.

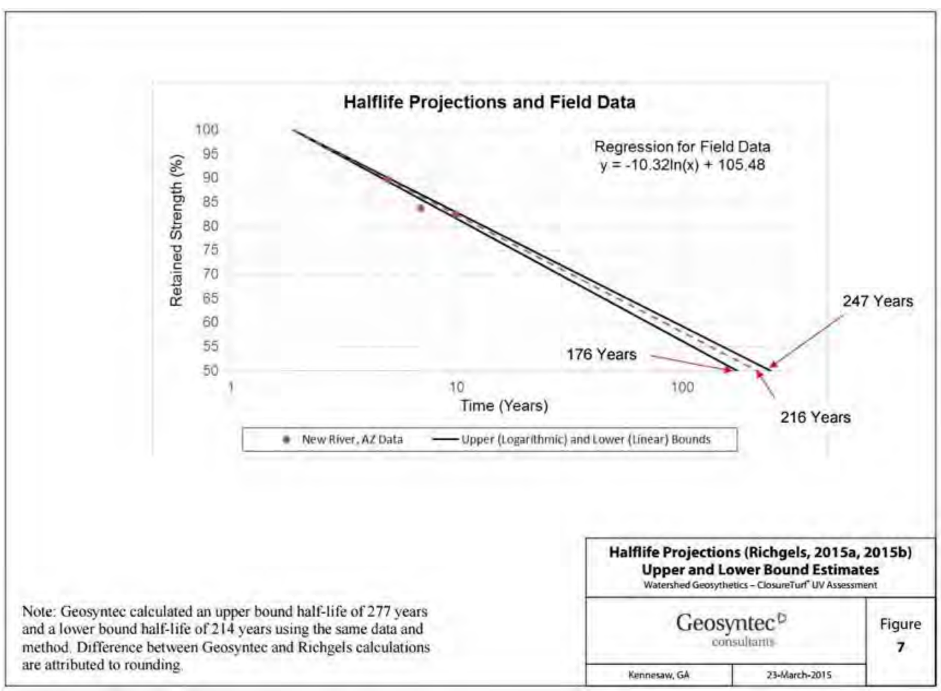


Figure 7 – Longevity Data Analysis Results

Traffic Loading Evaluation

Rubber tired vehicles are allowed to drive on the ClosureTurf system. Typically, the suggested ground pressure for vehicles on landfill side slopes is less than 35 psi; and the suggested ground pressure for vehicles on top decks (10% or less) and designed access roads is less than 120 psi. The allowed ground pressure should be verified and approved by the design engineer.

Aerodynamic Evaluation

ClosureTurf has unique aerodynamic features that react against the wind causing a resistance to the uplift component. It was tested in the wind tunnel at the Georgia Tech Research Institute (GTRI) at wind speed up to 120 mph and no wind uplift was observed. The photo in Figure 8 shows the wind tunnel test results at 170 fps (120 mph).

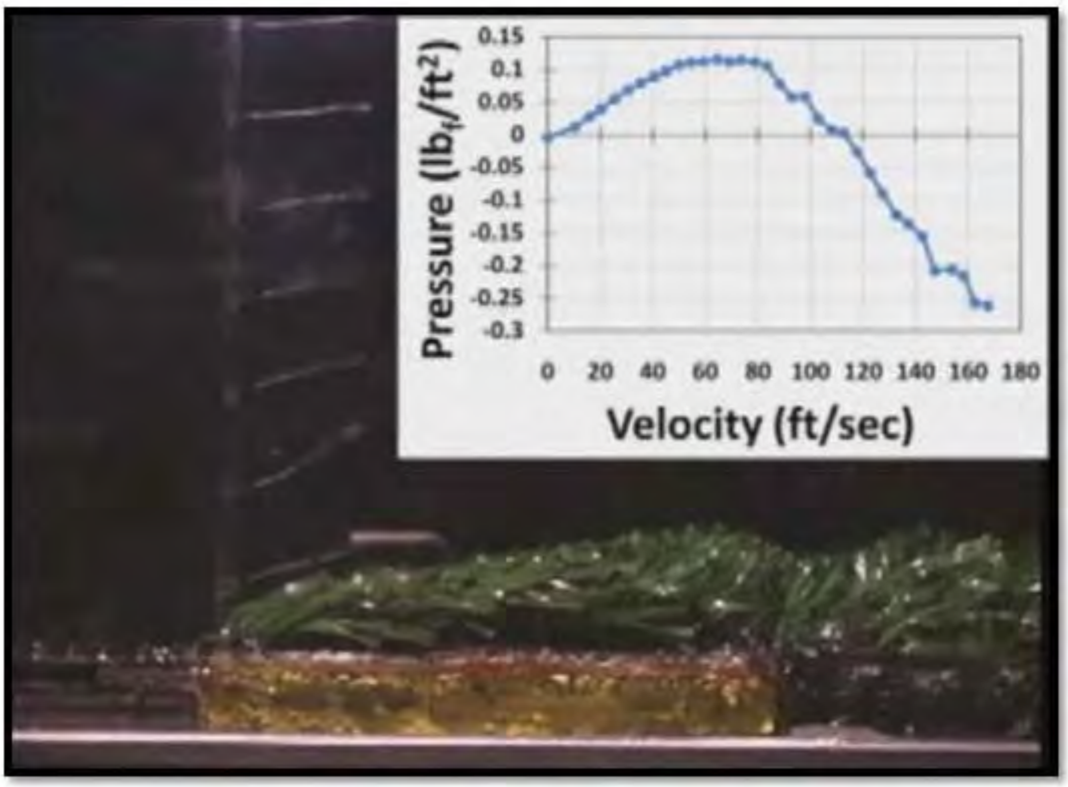


Figure 8 – Wind Tunnel Test of ClosureTurf

Carbon Footprint

ClosureTurf is estimated to result in approximately 1/5 of the carbon footprint of a traditional soil cover. The major factors influencing the carbon footprint are the number of truck loads to haul the materials and the equipment used to construct the cover system. Carbon footprint calculations are shown in the following chart in Figure 9.

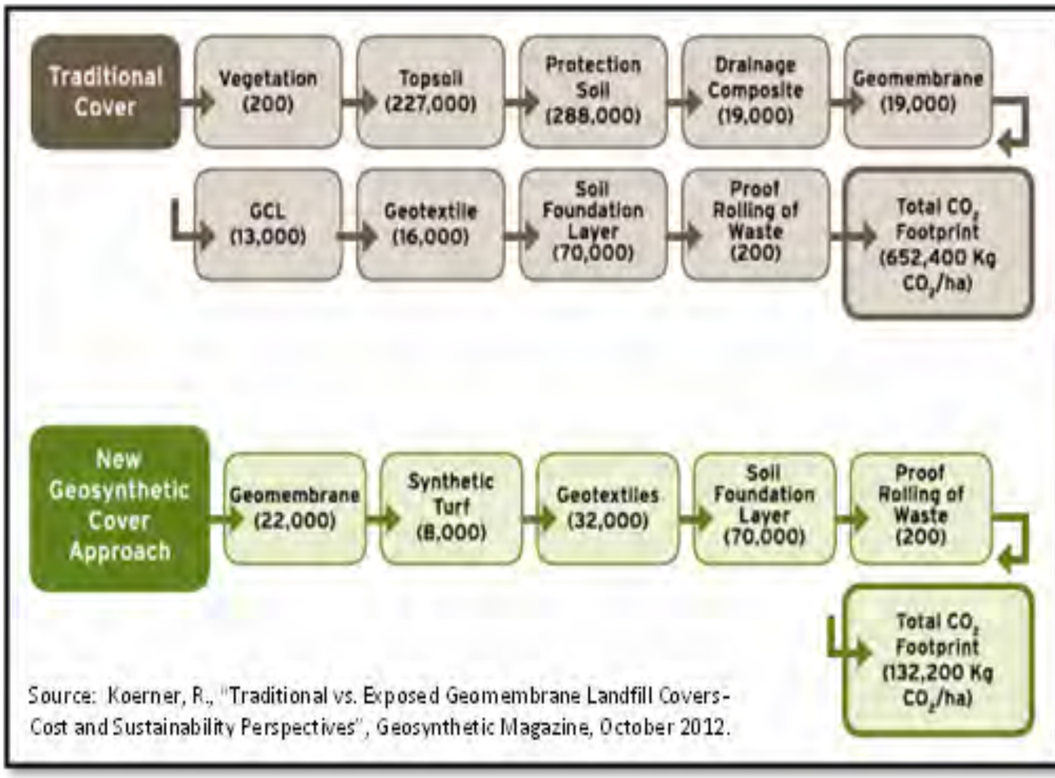


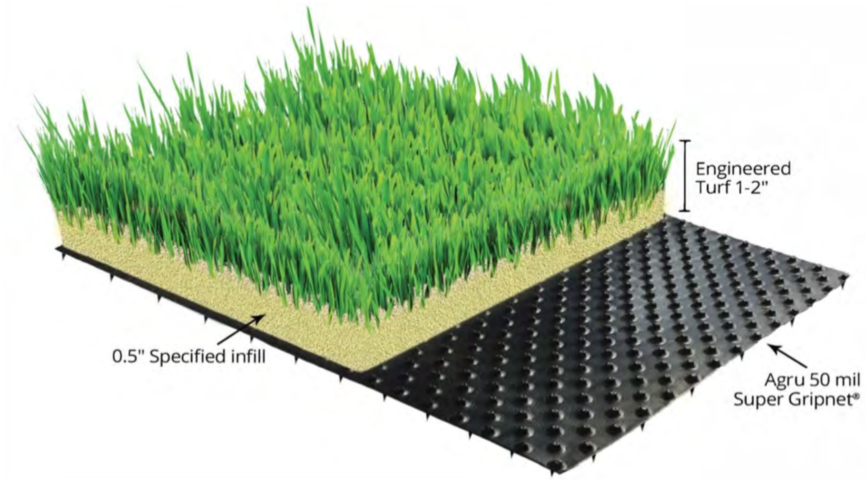
Figure 9 – Carbon Footprint Evaluation of ClosureTurf vs. Traditional Soil Cover

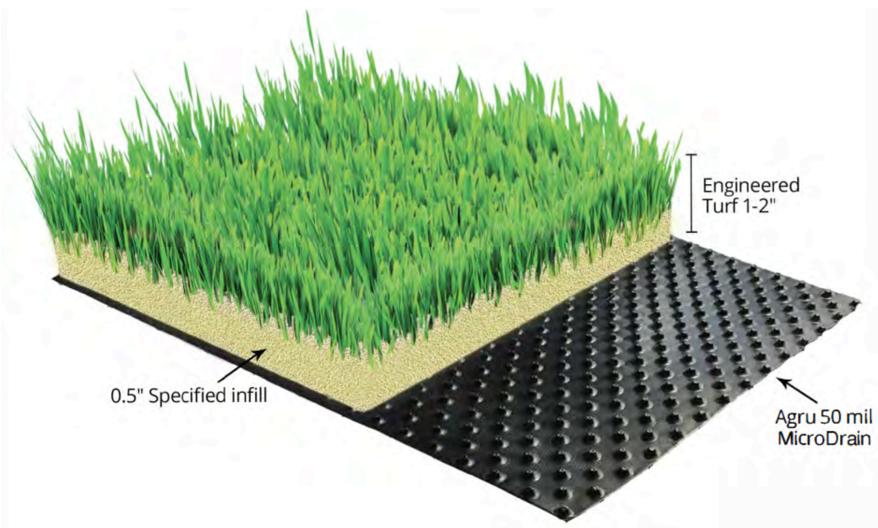
Landfill Gas Emission Control

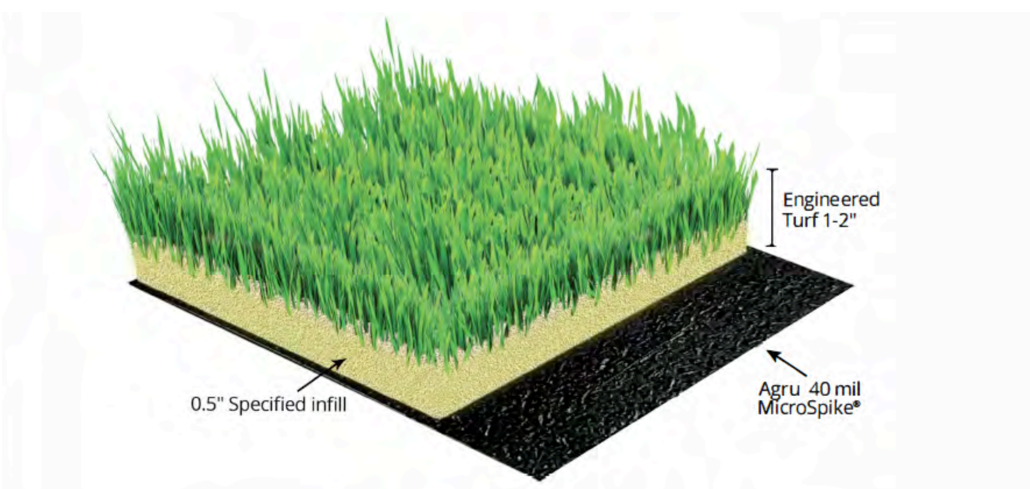
ClosureTurf controls landfill gas fugitive emissions by encapsulating the closed areas with the geomembrane. When the patented ClosureTurf Surficial Gas Collection system is utilized, high gas collection efficiency and significant reduction in condensate generation can be realized. The ClosureTurf system also has patented pressure relief valves to release gas pressure buildup in case the landfill gas collection and control system is temporarily not functioning (e.g., flare shutdowns).

ClosureTurf® System & Design

<u>System Options</u>



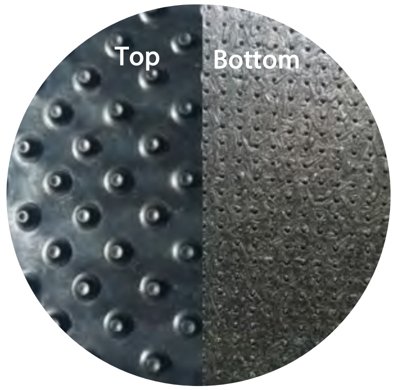




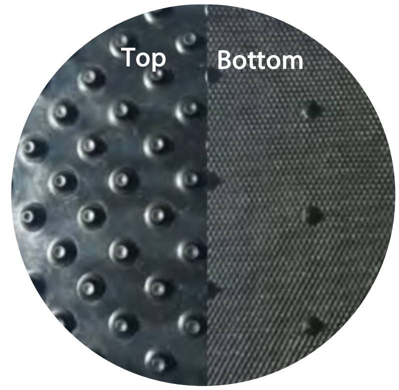
<u>Components</u>

1. Structured HDPE or LLDPE Geomembrane

AGRU MicroSpike®
(40 mil)



AGRU MicroDrain®
(50 mil)



AGRU Super GripNet®
(50 or 60 mil)

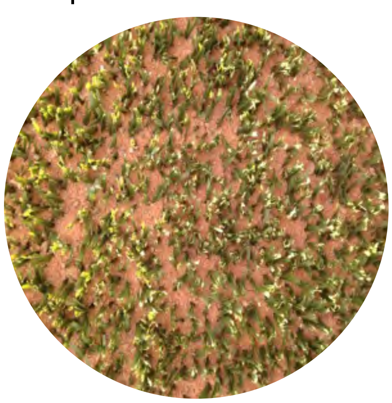
2. Engineered Turf

Olive

Blend

Tan

3. Specified Infill

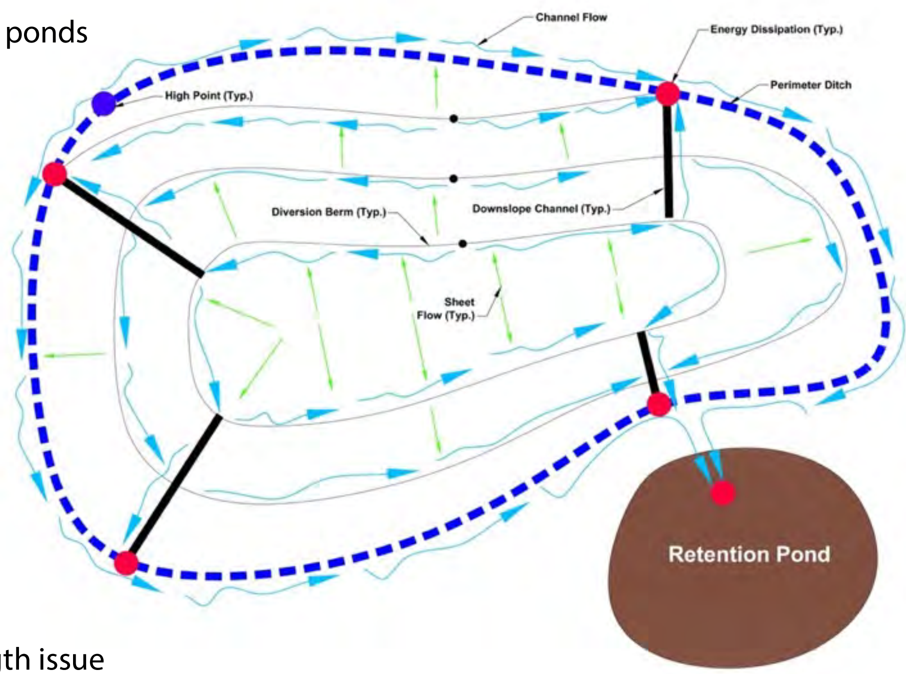


Specified Sand Infill

HydroBinder®
For areas where designer would normally spec riprap, pipe or articulated concrete block

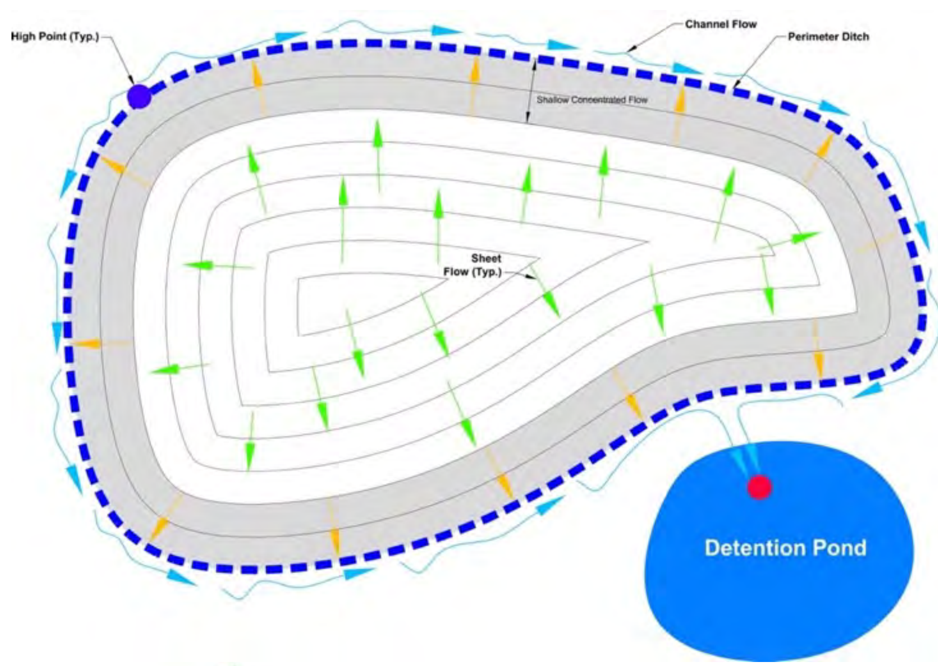
Typical Hydrology Design

- Mitigate the volume & sheer forces with diversion berms
  - Channelize the storm water
  - Help convey runoff of cover system
- Benches go to downchutes
- Downchutes go to retention ponds



Benchless Design

- Eliminates critical slope length issue
- Diversion berms and downslope channels are no longer required
- Stormwater is kept in sheet flow and shallow concentrated flow
- Stormwater Quality Volume is unnecessary
- Sediment Volume calculations are not required



HydroBinder® Features & Benefits

HydroBinder is a specialized pozzolanic infill created specifically for bench drains, downchutes and perimeter channels on landfill covers. It will flex and move with typical differential settlements that occur on permanent covers. It provides superior hydraulic performance capable of handling high sheer stress and large flows resulting in very high velocities.

ClosureTurf® Installation

1. Subgrade Preparation

2. Surficial Gas Management System (if applicable)

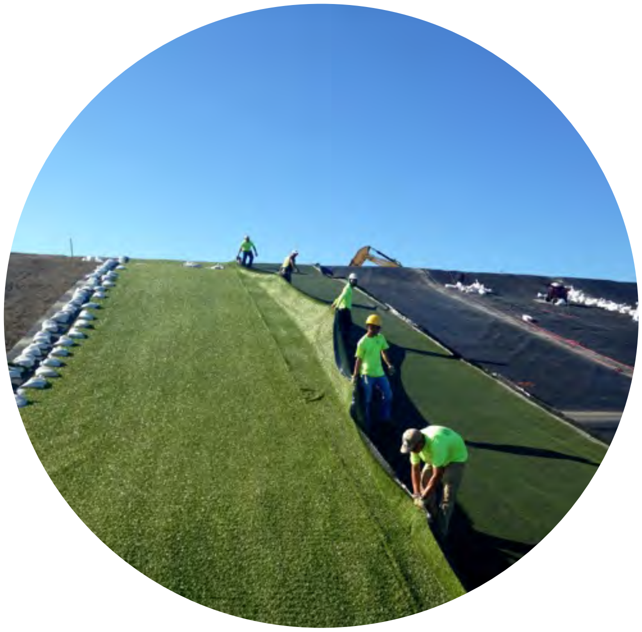
3. <u>Structured Geomembrane</u>

Geomembrane arrives on site in rolls.

Workers manually unroll the membrane down the slope.

Geomembrane seams are heat welded together.

4. <u>Engineered Synthetic Turf</u>

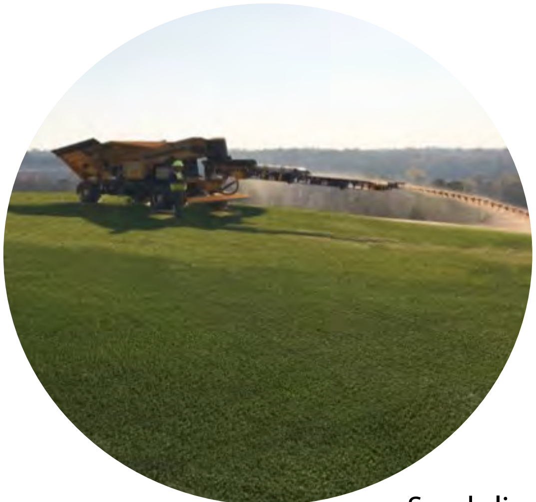


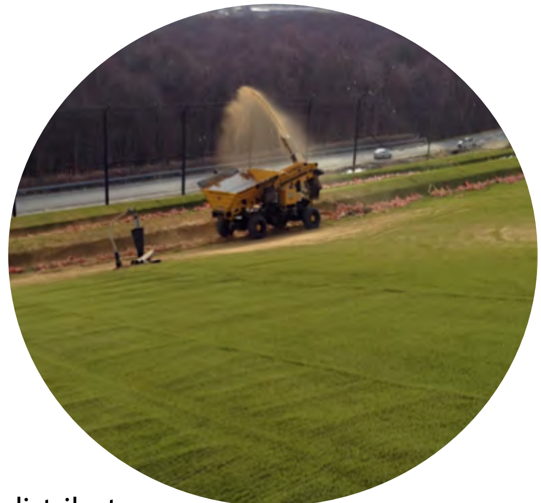
Workers manually unroll the engineered turf down the slope and position for seaming.

Turf seams are sewn together.

Turf seams are heat welded together.

5. <u>Sand Infill</u>





Sand slinger evenly distributes
sand on the engineered turf.

Sand is brushed into the turf.

6. <u>Pressure Relief Valves</u>

Before valve is installed.

After valve is installed.

ClosureTurf integrates easily with traditional gas systems.

ClosureTurf® Water Quality

Closed landfills can generate large amounts of surface runoff. With a traditional soil cap, rainstorms will ultimately transport sediment and dissolved materials such as fertilizers and chemical components. They also require a water collection area to allow the sediment to settle out before it can be released off site. This requires more space, more monitoring and is ultimately more expensive.

Because soil loss from runoff is virtually eliminated with ClosureTurf®, water quality is no longer an issue. The sand infill component acts as a natural filter as the water moves down the slope and surface water runoff pond maintenance can be reduced proportional to the area covered. When retention ponds no longer require sediment storage and sediment baffles, overall volume of the pond is significantly increased. Surface water runoff areas that are lined with a cementitious infill will no longer need water quality orifices, sediment removal berms and sediment routing baffles installed in the sediment ponds. In fact, the name “sediment pond” may be changed to “surface water pond” because there is no longer a significant sediment element contributing to the total volume required. Also, the ponds can be considered DE-tention ponds rather than RE-tention ponds because water is only held long enough to mitigate the design-storm event. Another unique feature of ClosureTurf is the ability to rely on sheet flow versus accumulated concentrated flows (such as exists with on-slope berms and down chutes). This results in dramatically increasing time of concentration. And, since there will be no sediment component, pond size can be adjusted accordingly.

One of the most important issues concerning proper site erosion control is the turbidity of the surface water as it is discharged from the site. A third-party analysis was performed that compared turbidity on a closed cell of ClosureTurf versus a cell with a soil cover cap at the same landfill. The study was done at a site having a history of NTU exceedance due to the very fine sediment soils that are common to the region. Data samples collected showed ClosureTurf at 11 NTU's and the soil cap at 371 NTU's (shown in image on right). After years of attempting a wide variety of erosion control methods, the landfill owner was finally able to get well below the minimum Turbidity values required by the regulations.

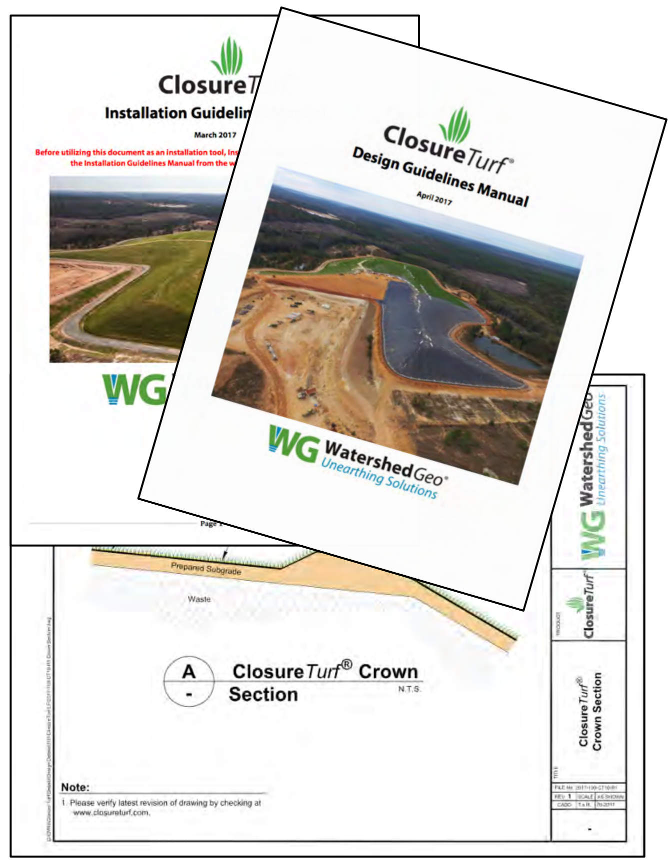
The hydrology and erosion elimination characteristics of ClosureTurf provide many environmental benefits that contribute to water quality. It results in very low storm water runoff turbidity and provides water quality improvement across the spectrum. Most importantly, it can consistently provide repeatable water quality results for every design storm event.

Watershed Geo Technical Services

Our expert staff consists of hydrologists, geotechnical and civil engineers. Together, we have spent our entire careers:

- In the landfill business (design, construction, maintenance and management)
- Specifying proper use of geosynthetics
- Managing individual sites through closure and post---closure

Engineering Support



Our staff can provide support throughout the entire closure process, from design and installation to post-closure inspections and maintenance. Some of our day-to-day activities for clients that are performed at no charge include:

- Choosing the correct profile based on hydrology criteria, slope design and other design considerations
- Design guidelines and specifications
- CAD drawings and custom support
- Installation guidelines
- Takeoffs to ensure accuracy in material waste and overlap
- Value engineering/ design considerations to optimize costs
- Surficial gas collection management system support
- Gas system planning for collection valves and vents

Post Closure Support

We also provide a performance agreement option for our clients. ClosureTurf reduces most of the costs and challenges associated with post closure care. However, periodic inspections and maintenance should be performed to ensure the product continues to perform as designed. The performance agreement is an affordable tool developed to help ensure the integrity over the life of the product. It also provides accurate record keeping for those involved with the management of the site. This is especially helpful if site managers switch roles.

ClosureTurf® Cost Savings

Cost savings, both short- and long- term, can be recognized in several ways with ClosureTurf.

Airspace

ClosureTurf allows an additional two feet of airspace because the soil layer is eliminated, if the landfill is permitted by the final cover top elevation. The value of the airspace can be realized in many ways, including additional income with the gained two-feet expansion, lower annual bonding obligations, lower the cost per ton of those bonding requirements and potentially receive a one-time significant credit to their financial bottom line.

Closure Design

With the benchless design approach, the following items can reduce overall costs.

- Reduction/elimination of diversion berms and down slope channels
- Reduction/elimination of energy dissipation devices
- Reduction/elimination of sediment storage and water quality volumes
- Detention of storm water rather than retention allowing for smaller pond volume
- Reduction/elimination of maintenance

Elimination/Reduction of Deep Gas Wells

Deep gas wells extending to within feet of the base liner were designed so that their expected radius of influence to collect gas would overlap. One aspect of a gas design not often discussed was that the "radius of influence" of each gas well was not a 2D object as drawn, but rather a 3D area of influence. The gas that migrated above the well screen and beyond the vertical radius of influence would certainly cause pressure to build on the final cover system. Deep gas wells also introduced many new problems. The change in temperature at ~200 feet deep versus the surface temperature caused large quantities of condensate. Condensate, simply stated, is instant leachate. Since the wells must be designed to allow the free flow of gas, they are prone to watering in both from the percolation of leachate and the creation of leachate as the deep well produces condensate. This is a major reason why deep wells must be replaced from time to time. With the patented surficial gas management system used in conjunction with ClosureTurf, landfill gas is collected without the expense of these deep wells, potentially eliminating or at least greatly reducing the need all together.

Borrow Soil

Borrow pits necessitate the destruction of land. ClosureTurf greatly reduces the destruction of native, undisturbed land that is only being destroyed to provide soil for a landfill cover. Eliminating the need for a borrow pit makes environmental as well as economic sense. Depending upon the proximity of borrow sources, soil can be a costly item to get on site. ClosureTurf eliminate this layer and reduces the need for construction vehicles to transport.

Incremental Closures

ClosureTurf makes it easy to install in small, incremental closures. This closure method reduces both fugitive emissions and the infiltration of leachate which provides significant savings for the owner.

Accelerated Project Schedule

The consistency offered by a standardized system such as ClosureTurf provides efficiencies that can be easily realized, from pre-design through construction. A significantly larger amount of closure acreage can be constructed using ClosureTurf than a traditional soil cover, effectively allowing more projects to be constructed with a given set of fixed resources. Typically, ClosureTurf installs 2 to 3 times faster than traditional covers.

Post Closure Care

The annual maintenance costs for ClosureTurf runs, on average, as much as 90% lower than those for a traditional soil and vegetated cover system. The following is an example of a maintenance activity comparison.

Traditional Cap	ClosureTurf
Mowing (4 events per year)	Not Required
Erosion Control (2 events per year)	Not Required
Reseeding (1/3 area once per year)	Not Required
Fertilizing (1/3 area once per year)	Not Required
Soil Replacement (typical 1 ton/per acre per year avg – per EPA)	Sand infill replacement (<2% total area per 5 years)
Pond Cleanout (avg once per every 4 years)	Not Required
Major Storm Repair (4 hours equipment after 1 event/year)	Not Required
Site Inspection (1 inspection per quarter)	Site inspection (Every 5 to 10 years)
Financial assurance (-2% per year)	Financial assurance (-2% per year)

- Over a 30-year period, the average cost to maintain a prescriptive soil cover is estimated to be $1,200 - $1,500 acre/year. ClosureTurf averages around $250 acre/year.
- Several ClosureTurf sites have experienced hurricane-force winds and multiple 100- year storms. The most severe storm event occurred at a 25-acre closure in Pensacola Florida, with the storm occurrence exceeding 500-years (25+ inches of rain over 24 hours). The required maintenance to bring the installation back to specification was performed solely with 1 infill spreader and a 3- man crew over 2.5 days.
- The projected long-term performance is well in excess of 100 years for the turf and 400 years for the geomembrane. As part of a redundant protection approach, the engineered turf backing is designed to resist UV from potential exposure. Any infill that may be dislodged due to unanticipated concentrated flows or settlement does not require immediate or even annual infill addition (suggest a 5–year evaluation of infill condition).
- Sites experience less erosion (5 to 10 tons per acre per year for soil versus a negligible amount for ClosureTurf).
- ClosureTurf provides predictability of final cover performance and post-closure maintenance costs that is not dependant on site-specific or weather-related factors. Furthermore, this predictable performance is economically competitive with typical methods.

Landfill Gas Collection

The ClosureTurf Surficial Gas Collection System is designed to allow LFG to rise to the waste surface. The collection points across the surface which are integrated into the geomembrane component can relieve the gas actively or passively based on specific site needs and desires. This collection mechanism provides for an increased quantity of gas collected as well as an increase in quality of gas collected all because gas collection can be performed at the surface of a landfill. Surface collection also reduces potential oxygen intrusion through wells and supports a safer gas management system with much lower exposure to oxygen migration into the landfill.

Reduction of Leakage

The HELP Model and JP Giroud Model analyses prove ClosureTurf has significantly less leakage than traditional soil covers.

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