SOUTH CAROLINA ELECTRIC & GAS

SCANA®
POWER FOR LIVING

RUN-ON & RUN-OFF CONTROL PLANS

FOR THE

WATEREE STATION CLASS THREE LANDFILL

RICHLAND COUNTY, SOUTH CAROLINA

JULY 2016

SOUTH CAROLINA
GARRETT AND MOORE, INC.
No. C3371
CERTIFICATE OF AUTHORIZATION

GARRETT & MOORE
Engineering for the Power and Waste Industries

SOUTH CAROLINA
REGISTERED PROFESSIONAL ENGINEER
22411
7/15/16
J. STEFAN BRAY

1 OVERVIEW

The EPA Administrator, Gina McCarthy, signed the Disposal of Coal Combustion Residuals from Electric Utilities final rule on December 19, 2014, and it was published in the Federal Register (FR) on April 17, 2015. The regulations provide a comprehensive set of requirements for the safe disposal of coal combustion residuals (CCRs), commonly known as coal ash, from coal-fired power plants. The rule will be administered as part of the Resource Conservation and Recovery Act [RCRA, 42 United States Code (U.S.C.) §6901 et seq.], using the Subtitle D approach.

South Carolina Electric & Gas (SCE&G) is subject to the CCR Rule. Based on SCE&G's review of the rule, the **Class Three Landfill at SCE&G Wateree Station** has been determined to be an existing CCR landfill subject to the CCR rule requirements.

2 PURPOSE

The purpose of this report is to document that the Wateree Station Class Three Landfill run-on and run-off controls meet the requirements of CCR rule §257.81 – *Run-on and Run-off Controls for CCR Landfills.*

3 APPLICABLE REGULATIONS

CCR rule §257.81 - *Run-on and Run-off Controls for CCR Landfills* states the following:

> (a) The owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate, and maintain:
>
> > (I) A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and
> >
> > (II) A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.
>
> (b) Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under § 257.3–3.
>
> (c) Run-on and run-off control system plan—
>
> (1) *Content of the plan*. The owner or operator must prepare initial and periodic run-on and run-off control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section. These plans must document how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements of this section. Each plan must be supported by appropriate engineering calculations.

4 LANDFILL DESCRIPTION

Wateree Station is coal-fired electric generation plant located along the Wateree River near Eastover, Richland County, South Carolina. The Class Three landfill associated with the plant is entirely located

within the property boundaries of Wateree Station. The landfill facility is comprised of 18 landfill cells, planned for development in multiple phases and encompassing a total of approximately 141 lined acres.

The active disposal unit was constructed in accordance with the construction permit (permit # LF3-00026) issued from the South Carolina Department of Health and Environmental Control (DHEC) on September 30, 2008, modified on June 28, 2013. Cells 1 through 5, encompassing approximately 34-acres, were placed into operation in accordance with an operation approval issued by DHEC on April 21, 2010. Cells 6 through 9, encompassing an additional approximate 37-acres, were placed into operation in accordance with an operation approval issued by DHEC on February 2, 2015.

The receiving Wastewater Pond was constructed in accordance with construction permit number 19333-IW issued on December 7, 2009, with approval to place into operation issued on June 10, 2010.

The ultimate development of the Class Three landfill is comprised of 18 landfill cells, planned for development in multiple phases. Cells 1 through 9 and all future phases of the Class Three landfill have been designed to control run-on and run-off from the 24-hour, 25-year storm.

5 Run-on Control Plan

§ 257.81 (a)(I) requires a run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.

Sheet 2 from the solid waste permit to construct drawings (Attachment 1) illustrates the ultimate development of the Wateree Station Class Three Landfill. Grades shown on Sheet 2 represent landfill subgrade. Stormwater run-on is collected and diverted before reaching the active disposal area by perimeter ditches and is routed to the wastewater pond. The perimeter ditch detail is shown on Sheet D-1 (Attachment 1).

As constructed, the active Class Three Landfill (Cells 1 through 9) is encompassed by perimeter diversion ditches on the north, east, and south. Stormwater run-on is collected in these ditches, diverted away from the active disposal area, and conveyed to the wastewater pond. Along the west perimeter of the landfill, an inter-phase diversion ditch and a stormwater diversion ditch are used to collect run-on and convey it away from the active portion of the landfill to receiving downgradient management ponds. Sheet 4 from the Class Three Landfill Cells 6-9 Construction Project drawings (Attachment 2) shows the location of the perimeter diversion ditches. The diversion ditch details are shown on Sheet D-1, Detail 5 (Attachment 2).

Permanent perimeter ditch performance is demonstrated in Section 5. Temporary interphase run-on diversion ditch performance is summarized below. Run-on collected in the interphase ditch is routed to permitted stormwater detention basins that do not receive run-off from active CCR management areas.

Interphase Run-on Diversion Ditch

Maximum Design Flow:	117 cfs
Maximum Design Capacity:	125 cfs

Given the combination of the existing drainage features and perimeter ditches, run-on will not occur onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.

5 Run-off Control Plan

§ 257.81 (a)(II) requires a run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

Run-off from the currently active portion of the landfill and all future phases of development is managed by perimeter ditches. Perimeter ditches discharge to the adjacent downgradient lined wastewater pond. The perimeter ditches and wastewater pond are designed to manage the volume resulting from the 24-hour, 25-year storm. Relevant engineering calculations for the stormwater management system are included as Attachment 3 and summarized as follows:

Perimeter Ditches

Maximum Design Flow:	354 cfs
Maximum Design Capacity:	550 cfs

Wastewater Pond

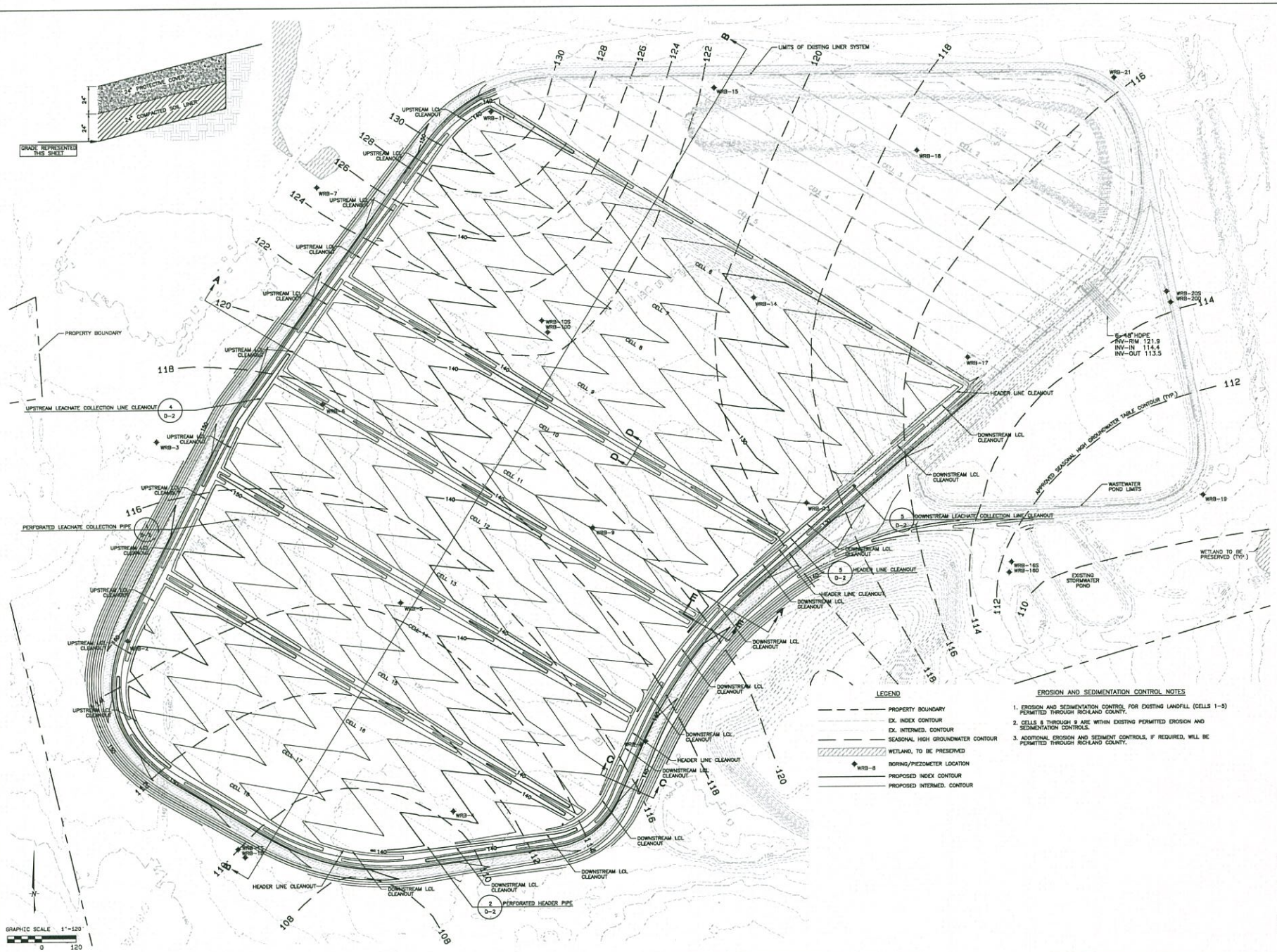
Berm Crest Elevation:	122.0 ft
24-hour, 25-year water surface elevation:	117.5 ft
Freeboard:	4.5 ft

As indicated above, the perimeter ditches and the downstream receiving wastewater pond exceed the required capacity requirements to collect and control the water volume resulting from a 24-hour, 25-year storm.

6 CONCLUSION

The existing Cells 1 through 9 Class Three Landfill and all future phases of Class Three Landfill Development meet the requirements of **§ 257.81(a)**. As demonstrated above, 1) run-on to the active disposal unit is prevented by elevation of the landfill grades relative to existing topography, and 2) the stormwater management system consisting of perimeter ditches and wastewater pond is designed to collect and control the volume resulting from a 24-hour, 25-year storm.

ATTACHMENT 1



REVISION	DATE

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SCE&G - WATEREE STATION - CLASS THREE LANDFILL
CELLS 6-18 PERMIT MODIFICATION DRAWINGS

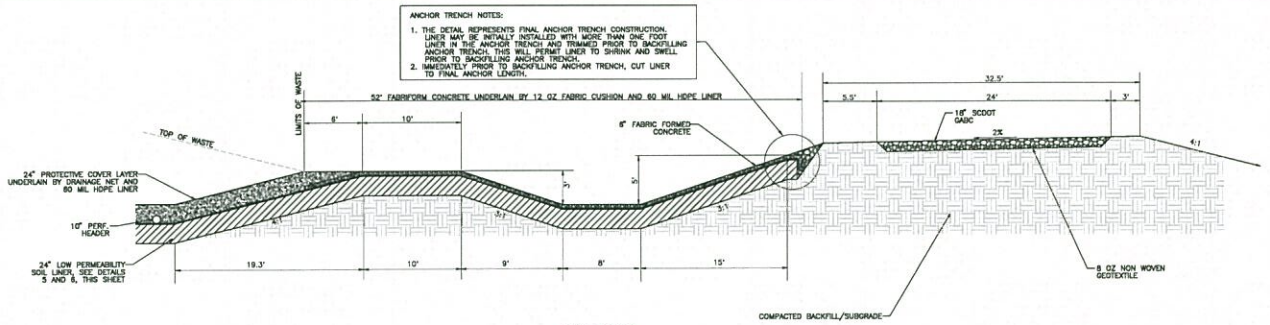
SUBGRADE PLAN

SHEET 2

SOUTH CAROLINA PROFESSIONAL ENGINEER 17580 JANICE P. MOORE

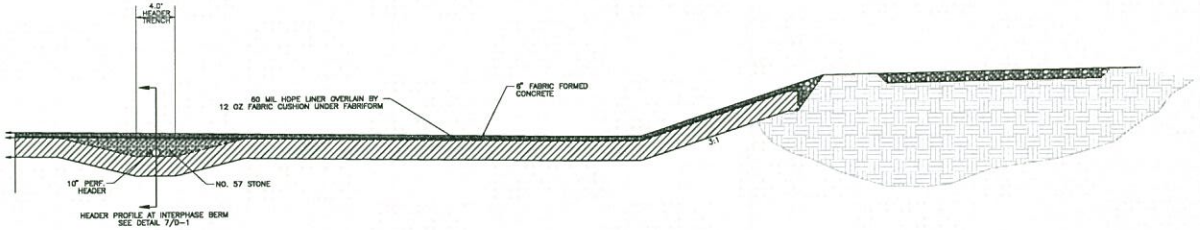
SOUTH CAROLINA REGISTERED LANDSCAPE ARCHITECT No. C3371 JANICE P. MOORE CERTIFICATE OF AUTHORIZATION

Path: V:\SCE&G\Wateree\PERMIT TO CONSTRUCT OCT 2012\PTC DRAWINGS\Wateree Cell 6-8 Plans 11-06-12.pnc Plot Date/Time: Tue Nov 6,2012 / 11:41:43



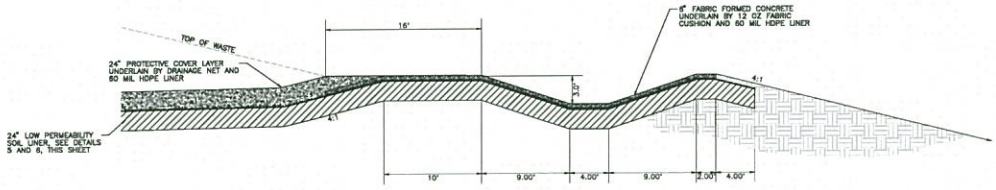
SECTION C-C
LANDFILL BERM/PERIMETER ACCESS ROAD CROSS-SECTION 1 D-1
1"=5'

24" LOW PERMEABILITY SOIL LINER - ALT #1 5 D-1
24" SOIL LINER 1x10-7 CM/SEC
N.T.S.

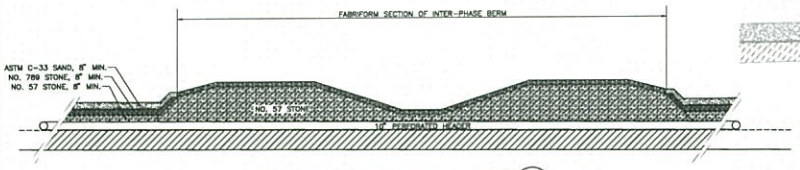


SECTION E-E
LANDFILL BERM/PERIMETER ACCESS ROAD AT INTERPHASE BERM CROSS-SECTION 2 D-1
1"=5'

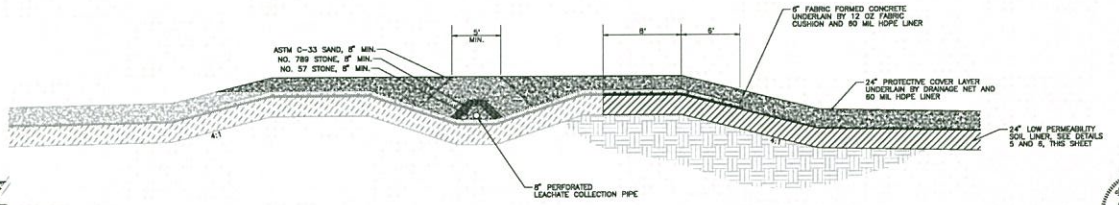
24" LOW PERMEABILITY SOIL LINER - ALT #2 6 D-1
GCL UNDERLAIN BY 24" SOIL LINER 1x10-5 CM/SEC
N.T.S.



SECTION D-D
INTER-PHASE BERM CROSS-SECTION FOR INITIAL PHASE CONSTRUCTION 3 D-1
1"=5'



HEADER PROFILE AT INTER-PHASE BERM 7 D-1
1"=5'



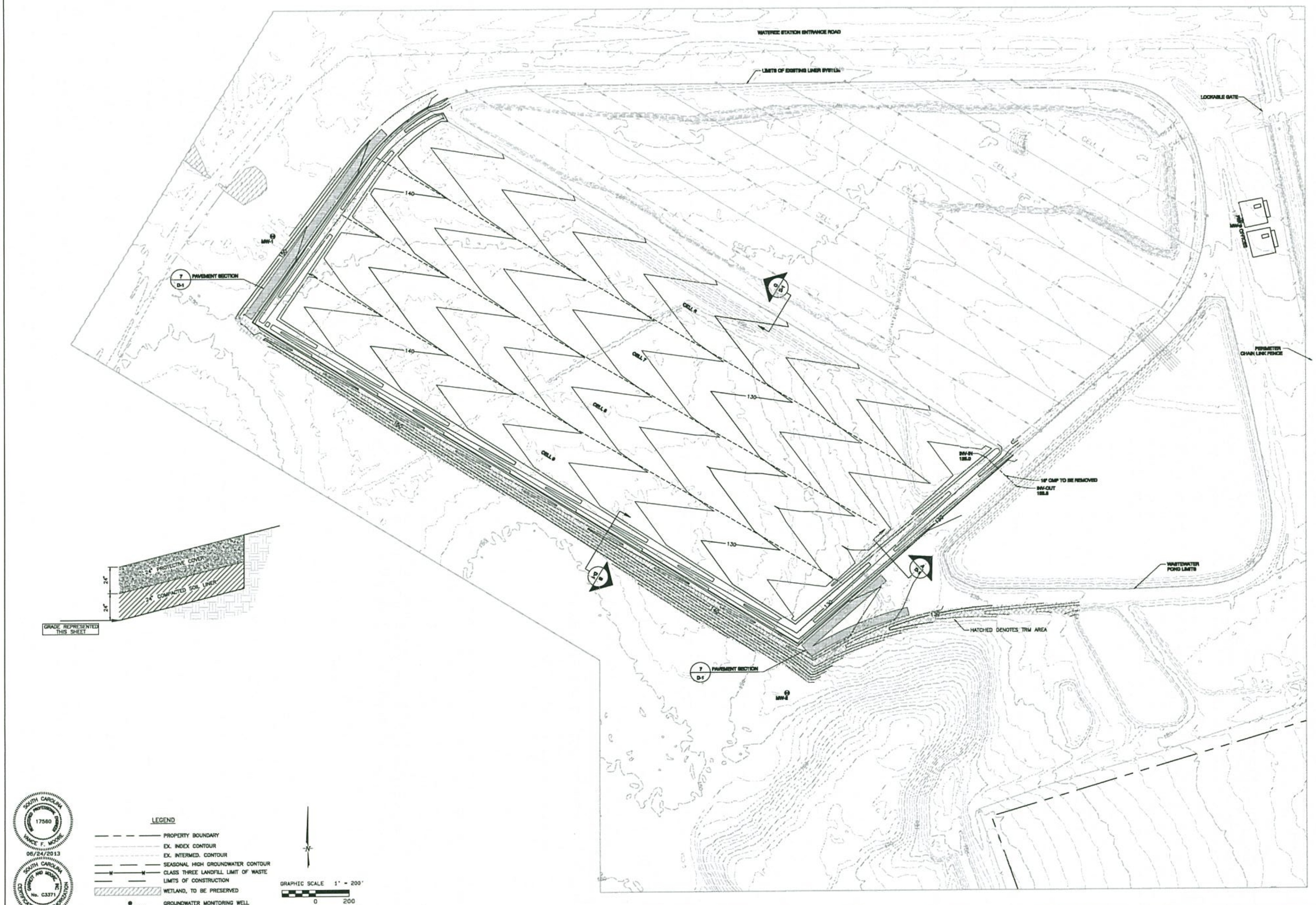
SECTION D-D
INTER-PHASE BERM CROSS-SECTION FOR FUTURE PHASE CONSTRUCTION 4 D-1
1"=5'

REVISION	DATE			
1)		GARRETT & MOORE Engineering for the Power and Waste Industries	SCE&G - WATEREE STATION - CLASS THREE LANDFILL CELLS 6-18 PERMIT MODIFICATION DRAWINGS	DETAILS
2)				
3)				
4)				

SHEET D-1

Path: V:\SCE&G\Wateree\PERMIT TO CONSTRUCT OCT 2012\PTC DRAWINGS\Wateree Cell 6-18 Plans 11-06-12.pro Plot Date/Time: Wed Nov 14 2012 / 10:38:38

ATTACHMENT 2



WATEREE STATION ENTRANCE ROAD
LIMITS OF EXISTING LINER SYSTEMS
LOCKABLE GATE
CELL 1
CELL 2
CELL 3
CELL 6
CELL 7
CELL 8
CELL 9
140
130
PAVEMENT SECTION
MW-1
MW-2
PERIMETER CHAIN LINK FENCE
18" CMP TO BE REMOVED
WASTEWATER POND LIMITS
HATCHED DENOTES TRIM AREA
24" PROTECTIVE COVER
24" COMPACTED SOIL LINER
GRADE REPRESENTED THIS SHEET
LEGEND
PROPERTY BOUNDARY
EX. INDEX CONTOUR
EX. INTERMED. CONTOUR
SEASONAL HIGH GROUNDWATER CONTOUR
CLASS THREE LANDFILL LIMIT OF WASTE
LIMITS OF CONSTRUCTION
WETLAND, TO BE PRESERVED
GROUNDWATER MONITORING WELL
GW-1
GRAPHIC SCALE 1" = 200'
0
200
SOUTH CAROLINA
17560
VANCE F. MOORE
06/24/2013
No. C3371
CERTIFICATE OF AUTHORIZATION

REVISION	DATE
1)	
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3)	
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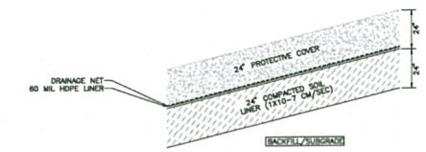
GARRETT & MOORE
Engineering for the Power and Waste Industries

SCE&G - WATEREE STATION
CLASS THREE LANDFILL CELLS 6 - 9 CONSTRUCTION PROJECT

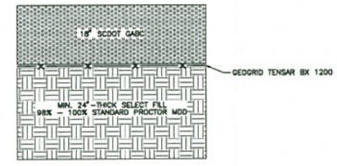
SUBGRADE PLAN

SHEET 4



24" LOW PERMEABILITY SOIL LINER - OPTION #1 (1/D-1)
24" SOIL LINER 1x10-7 CM/SEC
N.T.S.

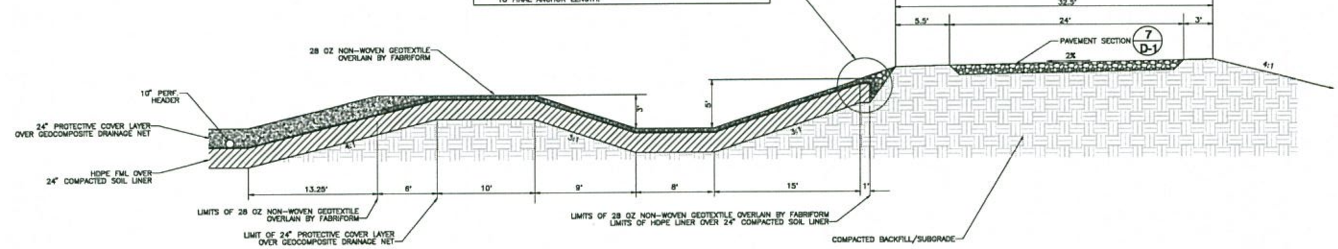
24" LOW PERMEABILITY SOIL LINER - OPTION #2 (2/D-1)
GCL UNDERLAIN BY 24" SOIL LINER 1x10-5 CM/SEC
N.T.S.



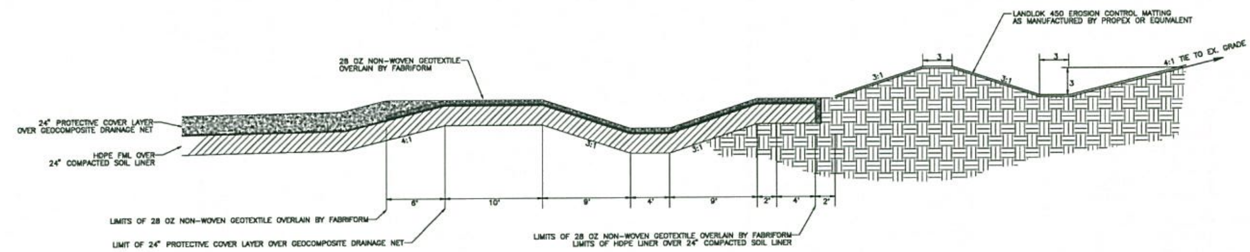
PAVEMENT SECTION (7/D-1)
N.T.S.

ANCHOR TRENCH NOTES:

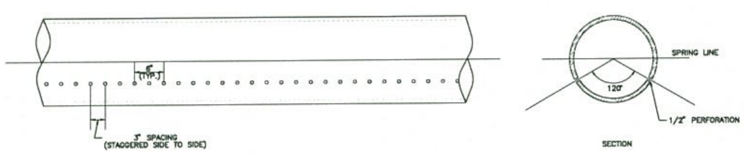
1. THE DETAIL REPRESENTS FINAL ANCHOR TRENCH CONSTRUCTION. LINER MAY BE INITIALLY INSTALLED WITH MORE THAN ONE FOOT LINER IN THE ANCHOR TRENCH AND TRIMMED PRIOR TO BACKFILLING ANCHOR TRENCH. THIS WILL PERMIT LINER TO SHRINK AND SWELL PRIOR TO BACKFILLING ANCHOR TRENCH.
2. IMMEDIATELY PRIOR TO BACKFILLING ANCHOR TRENCH, CUT LINER TO FINAL ANCHOR LENGTH.


28 OZ NON-WOVEN GEOTEXTILE OVERLAIN BY FABRIFORM
10" PERF. HEADER
24" PROTECTIVE COVER LAYER OVER GEOCOMPOSITE DRAINAGE NET
HDPE FML OVER 24" COMPACTED SOIL LINER
32.5'
5.5'
24'
3'
PAVEMENT SECTION 7/D-1
2%
4:1
3:1
13.25'
6'
10'
9'
8'
15'
1'
LIMITS OF 28 OZ NON-WOVEN GEOTEXTILE OVERLAIN BY FABRIFORM
LIMIT OF 24" PROTECTIVE COVER LAYER OVER GEOCOMPOSITE DRAINAGE NET
LIMITS OF 28 OZ NON-WOVEN GEOTEXTILE OVERLAIN BY FABRIFORM
LIMITS OF HDPE LINER OVER 24" COMPACTED SOIL LINER
COMPACTED BACKFILL/SUBGRADE

SECTION A-A
LANDFILL BERM/PERIMETER ACCESS ROAD CROSS-SECTION (4/D-1)
1"=5'


28 OZ NON-WOVEN GEOTEXTILE OVERLAIN BY FABRIFORM
LANDLOK 450 EROSION CONTROL MATTING AS MANUFACTURED BY PROPEX OR EQUIVALENT
24" PROTECTIVE COVER LAYER OVER GEOCOMPOSITE DRAINAGE NET
HDPE FML OVER 24" COMPACTED SOIL LINER
4:1 TIE TO EX. GRADE
3:1
4:1
3
6'
10'
9'
4'
9'
2'
4'
2'
LIMITS OF 28 OZ NON-WOVEN GEOTEXTILE OVERLAIN BY FABRIFORM
LIMIT OF 24" PROTECTIVE COVER LAYER OVER GEOCOMPOSITE DRAINAGE NET
LIMITS OF 28 OZ NON-WOVEN GEOTEXTILE OVERLAIN BY FABRIFORM
LIMITS OF HDPE LINER OVER 24" COMPACTED SOIL LINER

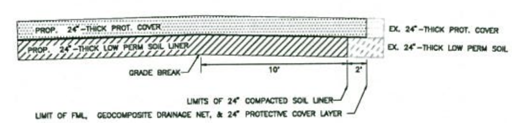
SECTION B-B
INTERPHASE DITCH/BERM SECTION (5/D-1)
1"=5'



ELEVATION

SECTION

PERFORATED LEACHATE COLLECTION PIPE (3/D-1)
N.T.S.



SECTION C-C
EX. TO PROPOSED CELL TIE-IN (6/D-1)
N.T.S.

REVISION	DATE
1)	
2)	
3)	
4)	

GARRETT & MOORE — Engineering for the Power and Waste Industries

SCE&G - WATEREE STATION - CLASS THREE LANDFILL
CELLS 6 - 9 CONSTRUCTION DRAWINGS

DETAILS

SHEET D-1

ATTACHMENT 3

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

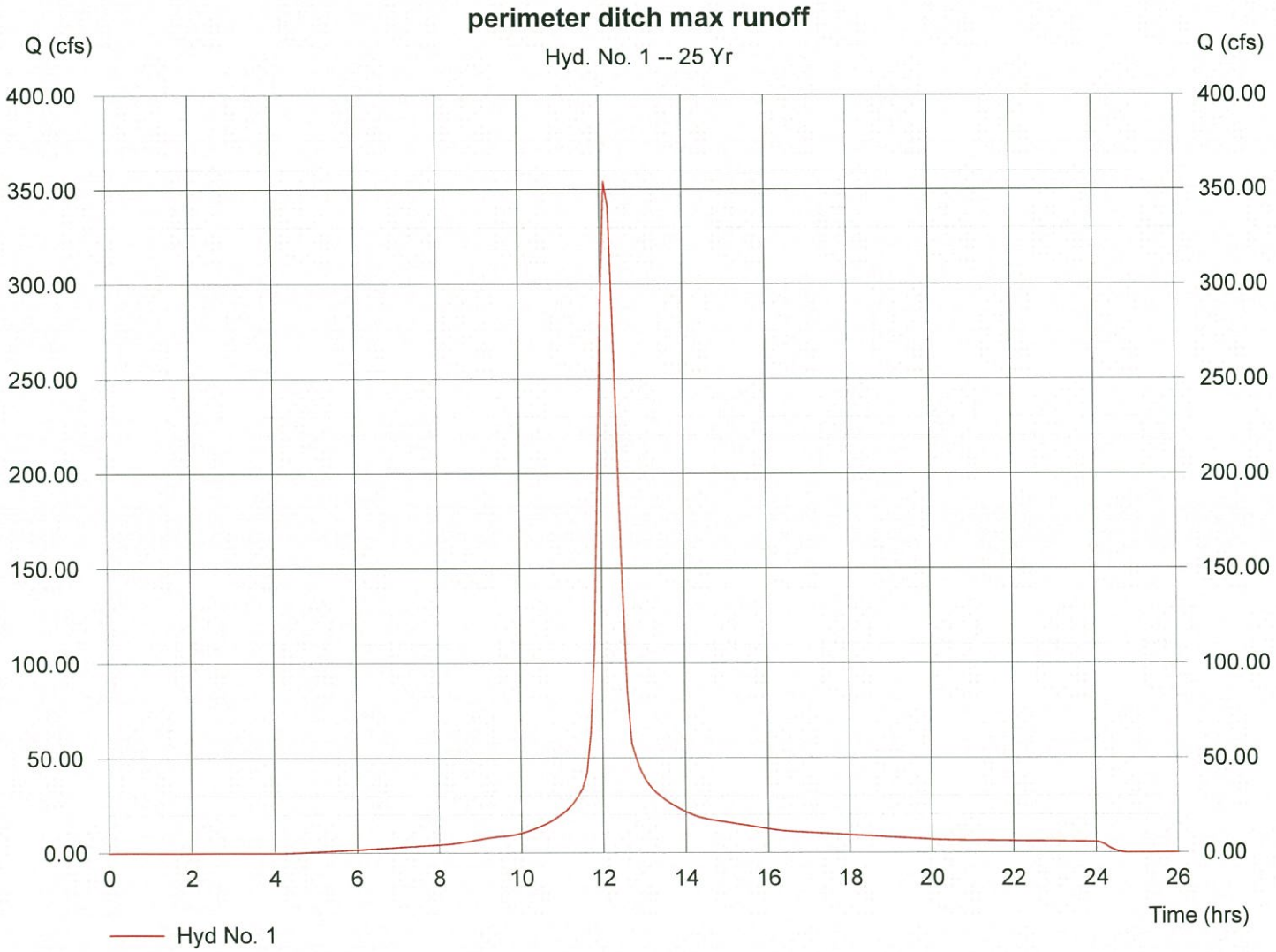
Tuesday, Jul 12 2016, 3:52 PM

Hyd. No. 1

perimeter ditch max runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 354.23 cfs
Storm frequency	= 25 yrs	Time interval	= 6 min
Drainage area	= 82.000 ac	Curve number	= 87
Basin Slope	= 3.2 %	Hydraulic length	= 5830 ft
Tc method	= KIRPICH	Time of conc. (Tc)	= 23.29 min
Total precip.	= 6.40 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 1,458,791 cuft



GARRETT & MOORE

1258 Benson Road, Garner, NC 27529

PROJECT	Wateree Station Class Three Landfill		
SUBJECT	Perimeter Ditch Evaluation		
COMPUTED BY	C Fortner	**CHECKED BY**	V Moore
DATE	7/13/2016		

Channel Section Designation: Perimeter Ditch - Fabric Formed Concrete
Channel Section Descritption: Maximum Runoff

A. Discharge,Q, using Manning Equation with assigned maximum depth of flow, y.

Input Data

max depth of flow (ft), y:	2.48785203
longitudinal slope (ft/ft), S:	0.007
bottom width (ft), b:	8
channel side slope (m:1):	3
design Q (cfs):	550

PERMANENT LINING: Fabriform Concrete
roughness coefficient, *n*: 0.012
max. shear stress (psf), Td: 4

Permanent lining flow capacity, Q (cfs) = 550.00

Channel design controlled by permanent lining flow capacity.

A, area (sf)	P, wetted perimeter (ft)	R, hydraulic radius (ft)	S, slope (ft/ft)	Q, flow (cfs)	V, velocity (ft/s)
38.47103935	23.73	1.62	0.007	550.00	14.30

B. Normal Depth and Shear Stress using Normal-Depth Procedure (known Q)

Discharge (cfs), Q: 550.00 (design max. Q of controlling lining system, from above)
longitudinal slope (ft/ft), S: 0.007
bottom width (ft), b: 8
channel side slope (m:1): 3

Input

TEMPORARY LINING: Fabriform Concrete
roughness coefficient, *n*: 0.012
max. shear stress (psf), Td: 4

Iterate y to make Zav = Zreg

Temp. Lined Channel:	y-var. (ft)	A (ft)	P (ft)	R (ft)	Zav	Zreq	V (ft/s)	Td (psf)
	2.48458166	38.3960913	23.71	1.62	52.94	52.94	14.32	1.09

OK

Referenced Tables and Figures from *North Carolina Erosion and Sediment Control Planning and Design Manual (1988).*

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

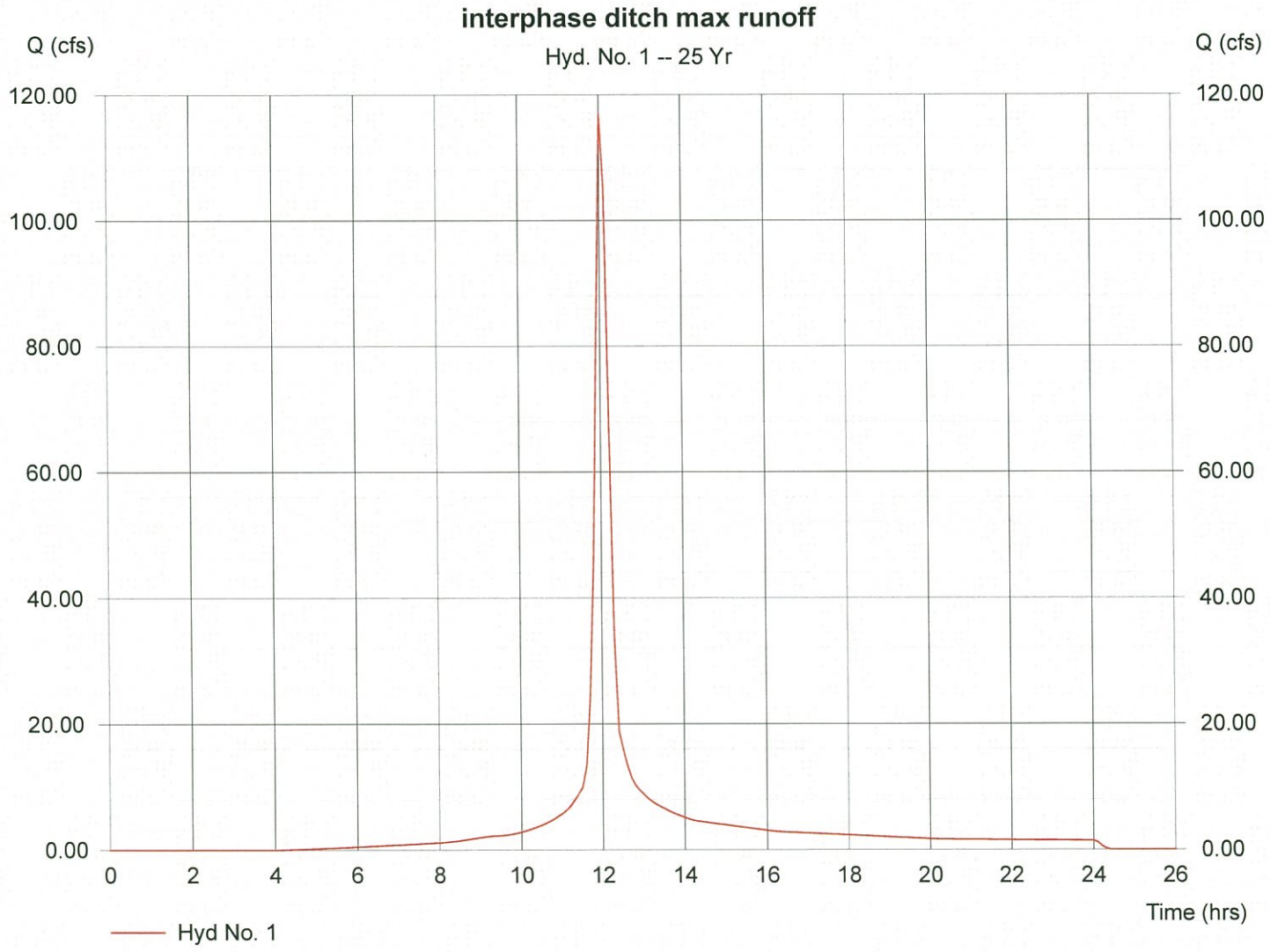
Tuesday, Jul 12 2016, 3:27 PM

Hyd. No. 1

interphase ditch max runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 116.99 cfs
Storm frequency	= 25 yrs	Time interval	= 6 min
Drainage area	= 22.000 ac	Curve number	= 87
Basin Slope	= 2.1 %	Hydraulic length	= 2134 ft
Tc method	= KIRPICH	Time of conc. (Tc)	= 12.63 min
Total precip.	= 6.40 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 366,922 cuft



GARRETT & MOORE

1258 Benson Road, Garner, NC 27529

PROJECT	Cope Station Class Three Landfill		
SUBJECT	Perimeter Ditch Evaluation		
COMPUTED BY	C Fortner	**CHECKED BY**	V Moore
DATE	7/12/2016		

Channel Section Designation: Interphase Diversion Ditch
Channel Section Descritption: Maximum Runoff

A. Discharge,Q, using Manning Equation with assigned maximum depth of flow, y.

	Input Data
max depth of flow (ft), y:	2.46084908
longitudinal slope (ft/ft), S:	0.007
bottom width (ft), b:	3
channel side slope (m:1):	3.5
design Q (cfs):	125

TEMPORARY LINING: Bare channel with North American Green Blanket, C125/C150BN.
roughness coefficient, *n*: 0.012
max. shear stress (psf), Td: 2.25

Temporary lining flow capacity, Q (cfs) = 364.58

PERMANENT LINING: Tall Fescue
max. velocity of lining (ft/s): 5
retardance class for lining: D (from table 8.05c)
VR (max velocity x R): 6.8 (including one retardance class increase)
Manning's *n*: 0.035 (rough channel with grass)

Permanent lining flow capacity, Q (cfs) = 125.00 CONTROLS

Channel design controlled by permanent lining flow capacity.

A, area (sf)	P, wetted perimeter (ft)	R, hydraulic radius (ft)	S, slope (ft/ft)	Q, flow (cfs)	V, velocity (ft/s)
28.57777086	20.92	1.37	0.007	125.00	4.37

B. Normal Depth and Shear Stress using Normal-Depth Procedure (known Q)

Discharge (cfs), Q: 125.00 (design max. Q of controlling lining system, from above)
longitudinal slope (ft/ft), S: 0.007
bottom width (ft), b: 3
channel side slope (m:1): 3.5

	Input
TEMPORARY LINING:	Bare channel with North American Green Blanket, C125/C150BN.
roughness coefficient, *n*:	0.012
max. shear stress (psf), Td:	2.25

Iterate y to make Zav = Zreg

	y-var. (ft)	A (ft)	P (ft)	R (ft)	Zav	Zreq	V (ft/s)	Td (psf)
Temp. Lined Channel:	1.534621795	12.8465896	14.17	0.91	12.03	12.03	9.73	0.67
								OK

PERMANENT LINING: Tall Fescue
max. velocity of lining (ft/s): 5
retardance class for lining: D (table 8.05a)
VR (max velocity x R): 6.8 (including one retardance class increase)
Manning's *n*: 0.035 (rough channel with grass)

Flow capacity controlling lining: permanent

	y-var. (ft)	A (ft)	P (ft)	R (ft)	Zav	Zreq	V (ft/s)	Td (psf)
Perm. Lined Channel:	2.45802541	28.5206874	20.89	1.36	35.09	35.09	4.38	1.07

Referenced Tables and Figures from *North Carolina Erosion and Sediment Control Planning and Design Manual (1988).* V OK

WATEREE STATION CLASS 1 ISWLF RUNOFF POND FLOW ESTIMATIONS

Average

Phases Operational	Drainage Area to WW Pond [1] (AC)	Average Monthly Rainfall (Inches)	Runoff Coefficient	Average Monthly Runoff (Cubic Feet)	Average Monthly Runoff (Gallon)	Average Daily Pump Rate [2] (MGD)	Average Daily Pump Rate [2] (GPM)
1 thru 1	73	5.0	0.75	993,713	7,432,970	0.248	172
1 thru 2	100	5.0	0.75	1,361,250	10,182,150	0.339	236
1 thru 3	116	5.0	0.75	1,579,050	11,811,294	0.394	273
1 thru 4	136	5.0	0.75	1,851,300	13,847,724	0.462	321
1 thru 5	160	5.0	0.75	2,178,000	16,291,440	0.543	377

Peak

Phases Operational	Drainage Area to WW Pond [1] (AC)	25-Yr 24-Hr Rainfall (Inches)	Runoff Coefficient	25-Yr 24-Hr Runoff (Cubic Feet)	25-Yr 24-Hr Runoff (Gallon)	Average Daily Pump Rate for a 7-day Drawdown of 25-Yr, 24-Hr Event[3] (MGD)	Average Daily Pump Rate for a 7-day Drawdown of 25-Yr, 24-Hr Event[3] (GPM)
1 thru 1	73	6.4	0.75	1,271,952	9,514,201	1.359	944
1 thru 2	100	6.4	0.75	1,742,400	13,033,152	1.862	1,293
1 thru 3	116	6.4	0.75	2,021,184	15,118,456	2.160	1,500
1 thru 4	136	6.4	0.75	2,369,664	17,725,087	2.532	1,758
1 thru 5	160	6.4	0.75	2,787,840	20,853,043	2.979	2,069

Notes

1) Includes current phase as well as all previous phases.
2) Equals discharge rate to pump "Average Monthly Runoff" amount in a 30-day period @ 24 hrs/day.
3) Equals pump discharge rate to pump "25-Yr, 24-Hr Runoff" amount in a 7-day period @24 hrs/day.

Garrett & Moore 5/1/2007

Wastewater Management Calculation Summary

SCE&G WATEREE STATION ISWLF
WASTEWATER POND CAPACITY ANALYSIS

Stage				Cummulative	
Elev	to Elev	Volume		Volume	
FT	FT	CY	CF	CF	
110	112	25,233	681,291	681,291	
112	114	26,803	723,681	1,404,972	
114	116	28,413	767,151	2,172,123	
116	118	30,057	811,539	2,983,662	<<<<
118	120	31,732	856,764	3,840,426	
120	122	33,446	903,042	4,743,468	>>>>
122	124	35,227	951,129	5,694,597	

<<<< 25-year Storm Volume Retained
>>>> 100-year Storm Volume Retained