FTN Associates Ltd.
water resources / environmental consultants

STORMWATER RUN-ON
AND
RUN-OFF CONTROL PLAN

PLUM POINT ENERGY STATION
CLASS 3N LANDFILL

PERMIT NO. 0303-S3N
AFIN: 47-00461

OCTOBER 2021

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STORMWATER RUN-ON AND RUN-OFF CONTROL PLAN

PERMIT NO. 0303-S3N
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Prepared for

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Osceola, AR 72370

Prepared by

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FTN No. R14590-2503-001

October 2021

PROFESSIONAL ENGINEER'S CERTIFICATION

In accordance with §257.81 I certify under penalty of law that I have personally examined and am familiar with the information submitted in this demonstration and all attached documents, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

This Stormwater Run-on and Run-off Control Plan for the Plum Point Energy Station Class 3N CCR Landfill near Osceola, Arkansas, was prepared und the direction and supervision of a qualified, State of Arkansas-registered Professional Engineer. Mr. Jason Ghidotti, PE, of FTN Associates, Ltd., was responsible for the overall preparation of the plan.

FTN Associates, Ltd.
No. 63

No. 10031
JASON J. GHIDOTTI

10/07/2021

Jason Ghidotti, PE #10031

Date

PLAN AMENDMENTS

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1.0 INTRODUCTION

1.1 Purpose of Plan

In accordance with 40 CFR *§257, Subpart D - Disposal of Coal Combustion Residuals From Electric Utilities* (the CCR Rule), the purpose of this plan is to provide information that demonstrates that the stormwater run-on and run-off control system for the Plum Point Energy Station (PPES) Class 3N CCR Landfill (the Landfill) will collect and convey a 24-hour, 25-year storm event. From §257.81(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:*
>
> > *(1) 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*
> >
> > *(2) 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.*

This Stormwater Run-on and Run-off Control Plan (the Plan) includes:

1. A discussion of how the stormwater run-on and run-off control system has been designed and constructed (Section 2.0 Existing Conditions); and
2. Demonstration of how these controls prevent stormwater run-on and manage run-off at the Landfill (3.0 Methodology).

Appendix A includes definitions for terms included in this Plan.

1.2 Plum Point Energy Station Information

The Plum Point Services Company, LLC (PPSC) Plum Point Energy Station (the Plant, PPES) Class 3N Landfill (the Landfill) is located in Mississippi County, approximately 2 miles southeast of Osceola, Arkansas. The 245-acre solid waste management facility is located within the Plant boundaries. The location of the facility is shown on Figure 1 (all figures are located in

Appendix B). The site is characterized by flat terrain and is situated within the Mississippi River floodplain. The Plant is located in an agricultural and industrial area.

PPSC is the owner of the landfill facility but uses a contractor to operate the Landfill for disposal of CCR materials generated at the Plant and general maintenance of the landfill facility.

The Plant generates electricity through the combustion of coal, which produces CCR materials that are captured through the facility air emission control systems and placed in the onsite landfill. The CCRs consist of bottom ash, economizer ash, fly ash, and coal pulverizer rejects.

The bottom ash is the coarsest fraction of the coal ash and is collected in a water-filled trough beneath the steam generation furnace. Bottom ash is composed of angular, glassy particles with a porous surface texture and has the consistency of coarse sand. Coal pulverizer rejects are periodically sluiced to the collection trough beneath the boiler furnaces along with the bottom ash. The economizer ash is the heavier fraction of fly ash and is collected in hoppers and is periodically transferred via dry flight conveyors to a submerged flight conveyor that carries the bottom ash, economizer ash, and coal pulverizer rejects to a concrete basin called the “Bottom Ash Stockout Area.” The collected materials are periodically loaded into haul trucks and taken to the Landfill.

The largest fraction of the CCR material generated from the coal combustion process is fly ash. The fly ash is composed of very fine particles similar to glass and has the consistency of a powder. The plant has a fly ash collection system that captures dry air heater ash and dry scrubber ash in a series of fabric filter and air heater hoppers. The collected material is conveyed to a large silo, which is periodically unloaded into haul trucks and transferred to the Landfill.

The Plant air emission controls include a dry Flue Gas Desulfurization (FGD) system and an activated carbon injection system. The FGD system is designed to cool down the flue gas and remove sulfur dioxide and particulate matter from the gases emitted from the coal-fired boiler. This is accomplished by a chemical reaction using a slurry of calcium hydroxide with the flue gases, while simultaneously allowing the hot flue gases to dry the reaction products (calcium sulfite, calcium sulfate, calcium chloride, and calcium fluoride). The dry reaction products are collected with the fly ash materials in a fabric filter hopper system. The activated carbon injection system removes mercury from the gases emitted from the coal-fired boiler. The mercury combines chemically with powdered activated carbon and is removed in the same filter system as the fly ash and dry scrubber ash.

The used FGD lime slurry is collected and reused within the FGD system. The retained solids are containerized and periodically transported to the Ash Containment Area, and then to the onsite landfill.

Water is pumped from the Mississippi River and clarified to become either cooling tower makeup water or service water for plant use. The sludge generated from this process is conveyed to a filter press where the solids are containerized and periodically transported to the onsite landfill. The filtrate from this process is pumped back to the clarifiers for treatment.

Although it varies greatly, the Plant generates approximately 250,000 tons of fly ash, bottom ash, and filter cake per year, of which approximately 85% is fly ash, 10% is bottom ash, and 5% is filter cake. The amount placed in the Landfill also varies from year to year, but the average for the past 5 years is approximately 150,000 cubic yards (cy), in-place volume.

The permitted landfill area is located west of the plant site as shown on Figure 2. The landfill is permitted to have 12 disposal areas, varying in size from 15 to 9 acres.

1.3 Permit History

In July 2001, Genesis Environmental Consulting, Inc. (GEC) submitted an application on behalf of Plum Point Energy Associates, LLC, to the Arkansas Department of Environmental Quality (ADEQ) for a solid waste disposal facility at the PPES. In October 2002, ADEQ issued a solid waste permit (0303-S3N) to construct and operate the proposed Class 3N facility.

Prior to construction of the landfill, GEC submitted a minor permit modification application in November 2005 to revise the final landfill grading plan, stormwater control plan, bottom grading plan, earthwork balance calculations, and Construction Quality Assurance (CQA) Plan. The application also included the request for an alternative bottom liner design. ADEQ requested the inclusion of a leachate collection system and Terracon Consultants, Inc. (which had purchased GEC) submitted revised permit documents in July 2006. ADEQ approved the minor permit modification in September 2006. Cell 1 of the landfill and the western stormwater pond were constructed in 2008. The Plant and the Landfill began operation in March 2010.

Since beginning operation, the landfill constructed an adjacent cell, Cell 3, in 2014 and began placing waste in the new cell in 2015.

1.4 Existing Conditions of Landfill

The current ADEQ-permitted PPES Class 3N Landfill is approximately 173 acres in size and has been designed to have 12 waste disposal cells (Figure 2, Appendix A). Cells 1 through 10 are about 15 acres in size with approximate dimensions of 1,000 ft by 660 ft. Cells 11 and 12 are narrower and smaller than the remaining cells to accommodate a potential archeological concern located east of the Landfill. Cell 11 is about 9.6 acres (450 ft by 1,000 ft) and Cell 12 is about 10.8 acres (500 ft by 1,000 ft). The permitted disposal capacity (air space) is 22,400,000 cubic yards.

The Landfill has been designed to meet Arkansas Pollution Control and Ecology Commission Regulation No. 22 standards. The bottom of the Landfill is divided to slope north or south to leachate collection sumps. The elevation of the bottom varies from 245 ft National Geodetic Vertical Datum (NGVD) in the center of the Landfill to 230 ft NGVD at the collection sump. The final surface of the Landfill has 4:1 (horizontal to vertical) slopes up to elevation 335 ft NGVD and then slopes at 5% to elevation 365 ft NGVD (Figure 3).

The bottom liner system for Waste Cells 1 and 3 were prepared in accordance with the 2002 permit for the facility (i.e., 12-inch minimum thickness compacted clay liner with a maximum hydraulic conductivity of 1×10^{-7} cm/sec, a 60-mil HDPE liner and a leachate collection system). Waste Cells 1 and 3 comprise the active disposal area of the CCR landfill that received CCR materials after October 19, 2015.

No final cover system has been installed on Waste Cells 1 and 3. However, as shown on Figure 1, the west, north, and south slopes of Cell 1 and the north, east, and south slopes of Cell 3 have received interim soil cover.

2.0 EXISTING STORMWATER CONTROL SYSTEM

The existing stormwater control system for the facility has been developed to collect and convey stormwater around and away from the site to prevent run-on. The Landfill's perimeter ditches generally drain to the west and then south. The outer perimeter ditch directs offsite stormwater around the landfill. The internal perimeter ditch directs onsite stormwater to the facility Stormwater Pond, located on the west side of the landfill. The water from the Stormwater Pond is eventually released through the facility’s National Pollutant Discharge Elimination System (NPDES) permitted stormwater outfall to the outer perimeter ditch. The southern stormwater ditch captures and directs stormwater from the southern and eastern slopes of Cells 1 and 3 towards to the south. An overview of the existing stormwater system is shown on Figure 3 in Appendix B.

The stormwater system is composed of grass-lined channels and culverts at roadway and railroad crossings. Typical details are included in Appendix B, Figure 4. These system components were designed and constructed to convey stormwater and to minimize erosion. Clay-lined perimeter berms and compacted clay expansion berms (Appendix B) at the external edges of each landfill cell also prevent stormwater from entering the cells and becoming run-on.

As defined by the CCR Rule, stormwater run-off includes any stormwater that falls upon and is discharged from active areas of the landfill. In the case of covered slopes, the stormwater does not come in contact with CCR and can be directly discharged to adjacent stormwater channels. In the case of open landfill areas, the stormwater is either stored within the waste mass or is collected as leachate and discharged as allowed by the facility landfill permit.

For Cells 1 and 3, the leachate flows to lined collection sumps in the northern end of each cell and is pumped to an onsite lined storage pond. The leachate is then either spray applied to the waste to control dust or is transferred to the PPES lime slurry water system for reuse to reduce usage of clean water. The clay-lined perimeter berms and compacted clay expansion berms shown in Figure 5 also prevent run-off from Cells 1 and 3.

3.0 METHODOLOGY

Hydrologic and Hydraulic analyses were completed for the run-on and run-off stormwater system based on the 24-hour, 25-year storm event. For the Hydrologic analysis, flows were calculated using the Rational Method, which is given by the following formula:

$$Q = CIA$$

where,

Q = Flow in cubic feet per second (cfs)
C = Run-off coefficient (dimensionless)
I = Rainfall intensity in inches per hour (in/hr)
A = Drainage area in acres (ac)

The values for the run-off coefficient, C, were based on the slope and the surface conditions. The drainage area, A, was delineated for each basin. Data from the NOAA Atlas 14, Volume 9, Version 2 was used to develop a formula for calculating the rainfall intensity, I. This formula was created by plotting the site's precipitation frequency estimates for the 25-year storm event against the prescribed 24-hour duration. Microsoft Excel was utilized to add a power trend line to the plotted data. The resulting equation of the trend line was used to calculate the intensity and is given by the following equation:

$$I = 20.667 \times {T_c}^{-0.505}$$

where,

I = Rainfall intensity in inches per hour (in/hr)
T_c = Time of Concentration (minutes)

The Time of Concentration, T_c, is time for the most hydraulically distant particle of water to travel to the discharge point of each respective drainage area and is calculated using the methodology described in the USDA Technical Release 55 (TR-55), *Urban Hydrology for Small Watersheds*. The TR-55 method computes T_c assuming that water moves through a drainage area as either sheet flow, shallow concentrated flow, open channel flow, or some combination thereof. The input variables used in the T_c calculations include flow length, slope, 2-year 24-hour rainfall depth, and surface roughness of the flow path. The flow length and slope were measured in AutoCAD. The 2-year 24-hour rainfall was taken from the NOAA Atlas 14, Volume 9, Version 2. The open channel dimensions used in the T_c calculations were based on the landfill construction drawings and recent survey data. The Manning's "n" values used to represent roughness in the T_c calculations were based on observations from site reconnaissance and best engineering judgment.

For the hydraulic analysis, Manning's formula, the most widely used open channel uniform flow equation, was used to compute the water surface elevation and to evaluate the capacity of the stormwater ditches:

$$V = \frac{1}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

where,

V = Mean velocity (ft/sec)
n = Manning's coefficient
R = Hydraulic radius (ft)
S = Friction slope (ft/ft)

Culvert capacities were evaluated based upon the methodologies set forth in *Hydraulic Design Series No. 5, Hydraulic Design of Highway Culverts (1985)* as prepared by the U.S. Federal Highway Administration. The culverts were analyzed using both inlet and outlet control assumptions to determine which would generate the greater headwater depth.

The Stormwater Pond was modeled using Bentley Systems (Haestad) *PondPack* which uses the methodologies listed above.

The capacities of the internal perimeter channel, external perimeter channel, and south stormwater ditch were computed using Bentley *FlowMaster* software using the same methodologies. The capacity of the dual HDPE 42-inch arch equivalent culvert was calculated using Bentley *CulvertMaster*.

3.1 Prevention of Stormwater Run-on

Stormwater is generated from a watershed adjacent to the landfill on the north side. Designated as Basin 1, it is a tilled row-crop area north of the landfill, consists of approximately

32 acres. As it is difficult to ascertain what portion of the area drains south toward the landfill, the entire area was considered for this analysis. The resulting basin delineation and corresponding longest flow path is shown on Figure 3.

As shown on Figure 3, the areas to the east and south of the site drain away from the landfill, and therefore were not considered for hydrologic and hydraulic analyses of potential stormwater run-on.

The perimeter stormwater channel used to route stormwater around the active landfill to prevent run-on is a large trapezoidal channel of as much as 25 feet in width at the bottom. It is formed by the landfill, Leachate Pond and Stormwater Pond perimeter berms and the adjacent elevated railway west of the site. For this analysis, the bottom was assumed to be no more than 15 feet in width.

3.2 Control of Stormwater Run-off

As described in Section 1.0, stormwater run-off is generated from the active portions of the landfill, those that have not received final cover. The active portion of the landfill was divided into three drainage basins for the stormwater run-off hydrologic and hydraulic analysis. As shown on Figure 3, Basin 2 comprises the slopes of Cells 1 and 3 that have received interim soil cover and that drain to the Stormwater Pond. Basin 2 is 14.5 acres in size. Flow from Basin 2 is not considered leachate as it has not come in contact with waste material.

Basin 3 comprises the open, uncovered portions of Cells 1 and 3, covering 12.7 acres. Stormwater that does not infiltrate the CCR waste material is routed to chimney drains that have been installed in various locations within the waste mass. The surface of the waste is sloped toward the chimney drains, which allow runoff to reach the leachate drainage systems beneath the waste and thence the leachate sumps located in each cell. The leachate is pumped from the sumps via dual-contained pipelines to the lined storage pond, as described in Section 2.0.

Basin 4 comprises the southern and eastern slopes of Cell 3 and adjacent areas that have received interim cover but do not drain to the Stormwater Pond. Basin 4 drains to a ditch and flows south to the stormwater outfall. Basin 4 is 17.9 acres in size. Flow from Basin 4 is not considered leachate as it has not come in contact with waste material. Basins 2 through 4 and their corresponding longest flow paths are shown on Figure 3.

4.0 RESULTS

Hydrologic and hydraulic calculation for the run-on and run-off analysis are presented in Appendices C and D, respectively.

4.1 Stormwater Run-on Results

As described above, one drainage basin, Basin 1, currently contributes to the potential stormwater run-on at the landfill. Hydrologic analysis results for Basin 1 for the 24-hour, 25-year storm event are presented in Appendix C. Results are summarized in Table 4.1, below.

Table 4.1, Run-on hydrologic analysis results.

Basin	**Area, A (acres)**	**Time of Concentration, Tc (minutes)**	**Composite Run-off Coefficient, C**	**Rainfall Intensity, I_{25} (in/hr)**	**Peak Discharge, Q_{25} (ft^3/sec)**
1	<32	31.0	0.28	4.0	35.4

To prevent run-on, stormwater is conveyed around the landfill via the outer perimeter stormwater channel as shown on Figure 3. Hydraulic analysis of the channel using the calculated peak flow rate from Table 4.1 are presented in Appendix C. Results are summarized in Table 4.2, below.

Table 4.2, Run-on channel hydraulic analysis results.

Channel	**Length, L (ft)**	**Slope, S (ft/ft)**	**Chanel Depth, D (ft)**	**Channel Roughness Coefficient, n**	**Peak Flow, Q_{25} (ft^3/sec)**	**Peak Velocity, V_{25} (ft/sec)**	**Flow Depth, D_{25} (ft)**
Outer Perimeter Ditch	3,900	0.003	5.0	0.045	35.4	1.8	1.2

The calculations confirm that the existing outer perimeter stormwater channel will convey the peak flow rates from the 24-hour, 25-year storm event and will prevent stormwater from becoming run-on, running into or inundating the active landfill area.

4.2 Stormwater Run-off Results

As described in Section 3.2, the active portion of the landfill can be divided into three hydrologic basins. Basin 2 is treated as stormwater and flows via the inner perimeter ditch to the Stormwater Pond. Basin 3 is treated as leachate, is collected in the leachate sumps and is pumped to storage. Basin 4 is treated as stormwater and flows to the stormwater outfall via ditches to the south of the active landfill area. Results from the hydrologic analysis of these three basins for the 24-hour 25-year storm event are presented in Appendix D. Results are summarized in Table 4.3, below.

Table 4.3, Run-off hydrologic analysis results.

Basin	**Area, A (acres)**	**Time of Concentration, Tc (minutes)**	**Composite Run-off Coefficient, C**	**Rainfall Intensity, I_{25} (in/hr)**	**Peak Discharge, Q_{25} (ft^3/sec)**
2 (Stormwater)	14.5	10.8	0.28	6.64	27.0
3 (Leachate)	10.9	3.8	0.40	10.93	55.5
4 (Stormwater)	17.9	23.1	0.28	4.62	23.2

To manage the runoff from Basin 2, the stormwater is conveyed around the landfill via the inner perimeter stormwater channel and associated culverts to the Stormwater Pond as shown on Figure 3. Hydraulic analysis of this system should consider not only the flow capacity of the inner perimeter channel and culverts, but also the storage capacity of the Stormwater Pond using the Basin 2 hydrograph resulting from the 24-hour, 25-year storm.

Runoff from Basin 4 is conveyed to the stormwater outfall via ditches to the south of Cells 1 and 3. A hydraulic analysis of this ditch was performed to verify that it possessed the required flow capacity of Basin 4. Results of these analyses are presented in Appendix C. Results are summarized in Tables 4.4 through 4.6, below.

Table 4.4, Run-off channel hydraulic analysis results.

Channel	**Length, L (ft)**	**Slope, S (ft/ft)**	**Channel Depth, D (ft)**	**Channel Roughness Coefficient, n**	**Peak Flow, Q_{25} (ft^3/sec)**	**Peak Velocity, V_{25} (ft/sec)**	**Flow Depth, D_{25} (ft)**
Inner Perimeter Ditch	1,200	0.005	4.0	0.045	27.0	2.1	1.1
South Ditch	1400	0.005	2	0.045	23.2	1.9	0.9

Table 4.5, Run-off culvert hydraulic analysis results.

Culvert	**Length, L (ft)**	**Slope, S (ft/ft)**	**Number/ Diameter (in)**	**Type**	**Peak Flow, Q_{25} (ft^3/sec)**	**Headwater Depth, H (ft)**
2	230	0.013	2@42”	HDPE/ARCH	27.0	1.2

Table 4.6, Run-off pond hydraulic analysis results.

Pond	**Top Elevation (ft)**	**Available Storage (ft^3)**	**Calculated Peak Elevation (ft)**	**Calculated Peak Storage (ft^3)**
Stormwater Pond	243	1,733,400	235.8	108,140

For stormwater run-off from the active portions of the landfill, the analysis shows that the channel, culverts and Stormwater Pond are of sufficient size to contain the run-off from the 24-hour 25-year storm. The system has excess capacity as it was designed and constructed to handle future conditions as the landfill develops.

For leachate generated by the open portions of the active landfill, the leachate collection and transmission systems have been designed to store and convey the leachate resulting from the 24-hour 25-year storm.

APPENDIX A

Definitions

DEFINITIONS

The following definitions are from §257.53 of the CCR Rule and used in this Plan:

Active Life (or In Operation): the period of operation beginning with the initial placement of CCR in the CCRunit and ending at completion of closure activities in accordance with §257.102.

Active portion: that part of the CCR unit that has received or is receiving CCR or non-CCR waste and that has not completed closure in accordance with §257.102.

Coal Combustion Residues (CCR): fly ash, bottom ash, boiler slag, and flue gas desulfurization materials generated from burning coal for the purpose of generating electricity by electric utilities and independent power producers.

CCR Landfill: an area of land or land excavation that CCR and which is not a surface impoundment, an underground injection well, a salt dome formation, a salt bed formation, an underground or surface coal mine, or a cave. It also includes sand and gravel pits and quarries that receive CCR, CCR piles, and any practice that does not meet the definition of a beneficial use of CCR.

CCR Unit: any CCR landfill, CCR surface impoundment, or lateral expansion of a CCR unit, or a combination of more than one of these units. This term includes both new and existing units.

Closed Unit or Landfill: placement of CCR in a CCR unit has ceased, and the owner or operator has completed closure of the CCR unit in accordance with § 257.102 and has initiated post-closure care in accordance with § 257.104

Existing CCR Landfill: a CCR Landfill that receives CCR both before and after October 15, 2015, or for which construction commenced prior to October 14, 2015. A CCR landfill has commenced construction if the owner or operator has obtained the federal, state, and local approvals or permits necessary to begin physical construction and a continuous onsite physical construction program had begun prior to October 14, 2015.

Hydraulic Conductivity: the rate at which water can move through a permeable medium (i.e., the coefficient of permeability).

Lateral Expansion: a horizontal expansion of the waste boundaries of an existing CCR landfill or existing CCR surface impoundment made after October 14, 2015.

New CCR Landfill: a CCR landfill or lateral expansion of a CCR landfill that first receives CCR or commences construction after October 14, 2015. A CCR landfill has commenced construction if the owner or operator has obtained the federal, state, and local approvals or permits necessary to begin physical construction and a continuous onsite physical construction program had begun after to October 14, 2015.

Operator: the person(s) responsible for the overall operation of a CCR unit.

Qualified Professional Engineer: an individual who is licensed by a state as a Professional Engineer to practice one or more disciplines of engineering and who is qualified by education, technical knowledge and experience to make the specific technical certifications required under this subpart. Professional engineers making these certifications must be currently licensed in the state where the CCR unit(s) is located.

Recognized and Generally Accepted Good Engineering Practices: engineering maintenance or operation activities based on established codes, widely accepted standards, published technical reports, or a practice widely recommended throughout the industry. Such practices generally detail approved ways to perform specific engineering, inspection, or mechanical integrity activities.

Run-Off: any rainwater, leachate, or other liquid that drains over land from any part of a CCR landfill or lateral expansion of a CCR landfill.

Run-On: any rainwater, leachate, or other liquid that drains over land onto any part of a CCR landfill or lateral expansion of a CCR landfill.

Structural Components: liners, leachate collection and removal systems, final covers, run-on and run-off systems, inflow design flood control systems, and any other component used in the construction and operation of the CCR unit that is necessary to ensure the integrity of the unit and that the contents of the unit are not released into the environment.

APPENDIX B

Figures

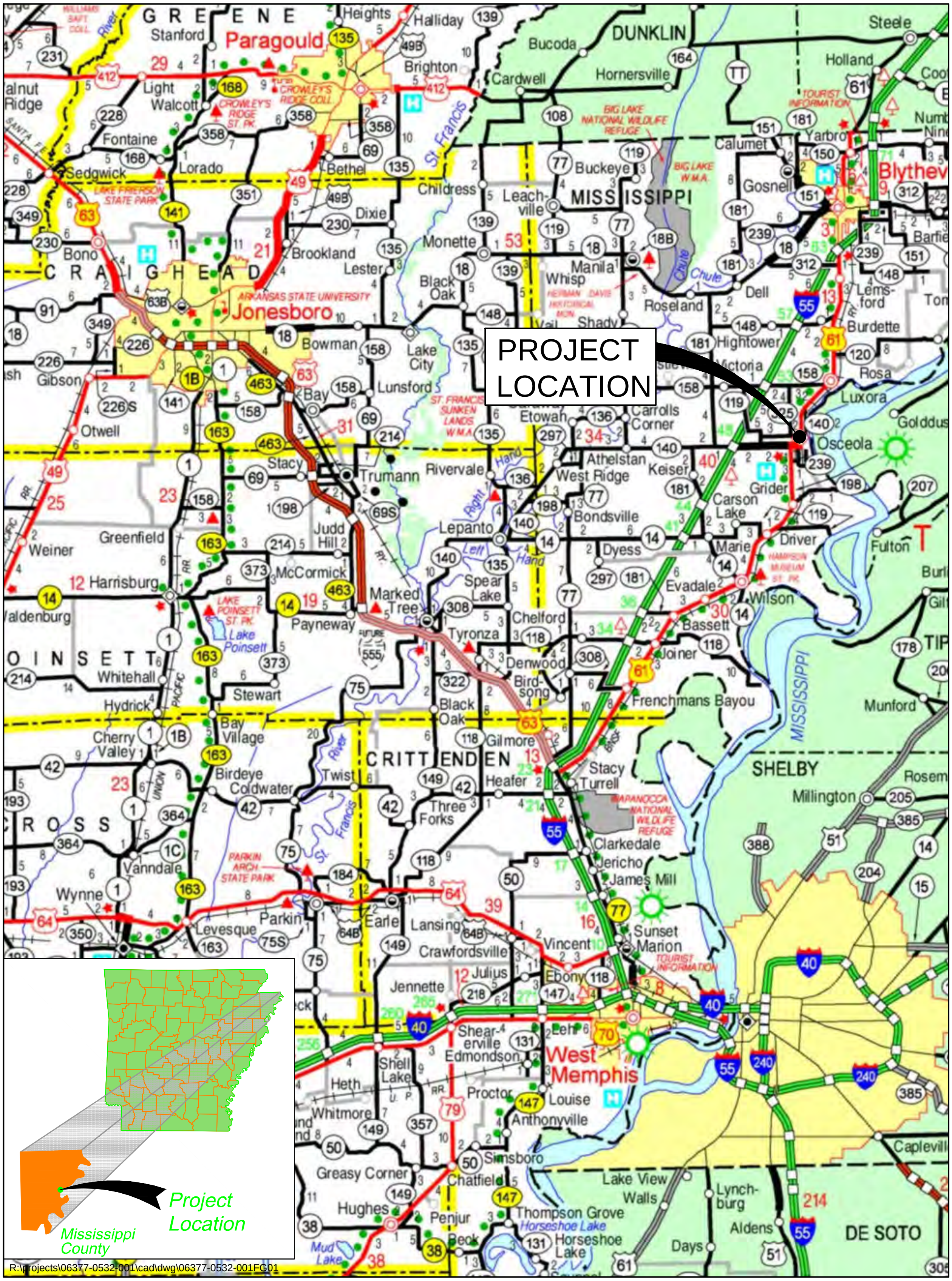
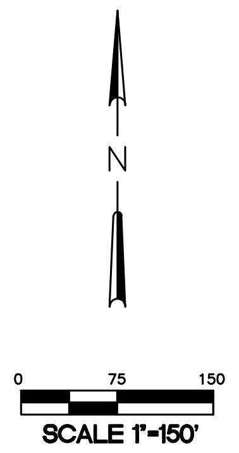


Figure 1. Site location map.



LEGEND

— — —	WASTE CELL BOUNDARY
— · —	EXISTING PERMITTED B0UNDARY
— 230 —	EXISTING INDEX CONTOUR (5-FT)
— — —	EXISTING INTERMEDIATE CONTOUR (1-FT)
═ ═ ═	EXISTING GRAVEL ROAD
-o-o-o-	EXISTING FENCE
ø	EXISTING POWER POLE
— OHE —	EXISTING OVERHEAD ELECTRIC LINE
—◄—	EXISTING STORMWATER DITCH
▨	INTERIM COVER AREA

NOTE:

TOPOGRAPHIC INFORMATION IS FROM SURVEYS CONDUCTED BY HARMON SURVEYING, INC. IN AUGUST 2017 (SITE) AND JANUARY 2021 (CELLS 1 AND 3).

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FTN Associates, Ltd.
water resources / environmental consultants

PLUM POINT SERVICES COMPANY, LLC
PLUM POINT ENERGY STATION CLASS 3N LANDFILL
STORMWATER RUN-ON/RUN-OFF PLAN

OSCEOLA, ARKANSAS

FIGURE 2
EXISTING CONDITIONS

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APPROVED: JJG	PROJECT NO. 14590-2503-001
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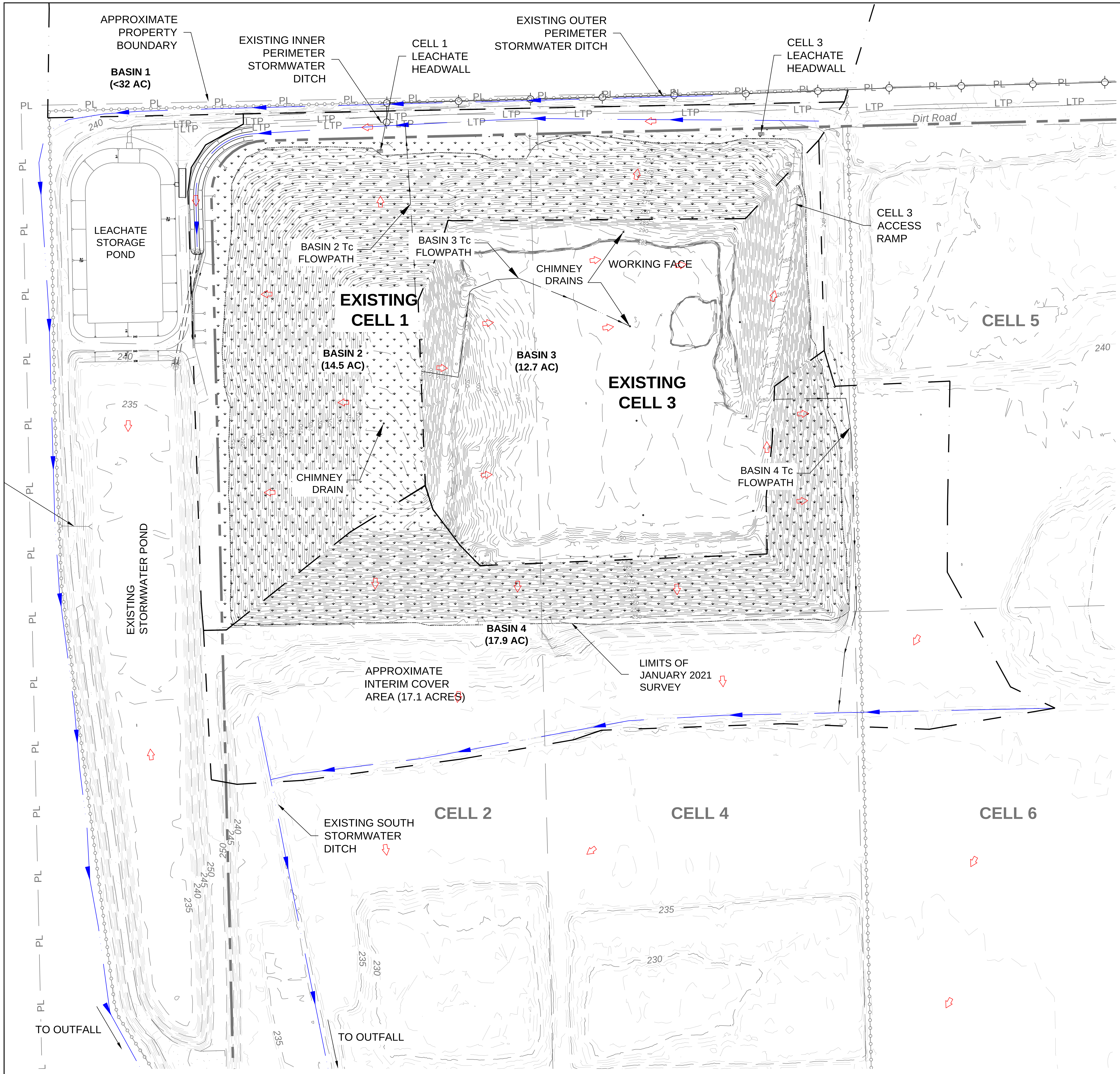

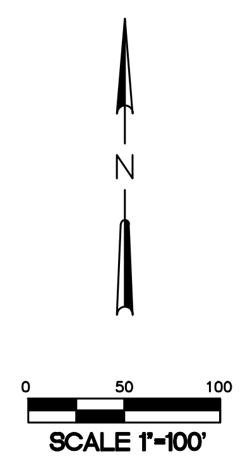

LEGEND

— — —	WASTE CELL BOUNDARY
▬ ▬ ▬	EXISTING PERMITTED B0UNDARY
— — 230 — —	EXISTING INDEX CONTOUR (5-FT)
— — — —	EXISTING INTERMEDIATE CONTOUR (1-FT)
═ ═ ═	EXISTING GRAVEL ROAD
-o-o-o-o-	EXISTING FENCE
⌀	EXISTING POWER POLE
— OHE —	EXISTING OVERHEAD ELECTRIC LINE
—◄—	EXISTING STORMWATER DITCH
▨	INTERIM COVER AREA
— · —	DRAINAGE BASIN
⇘	OVERLAND FLOW DIRECTION
>—<	CULVERT

NOTE:

TOPOGRAPHIC INFORMATION IS FROM SURVEYS CONDUCTED BY HARMON SURVEYING, INC. IN AUGUST 2017 (SITE) AND JANUARY 2021 (CELLS 1 AND 3).

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PLUM POINT SERVICES COMPANY, LLC
PLUM POINT ENERGY STATION CLASS 3N LANDFILL
STORMWATER RUN-ON/RUN-OFF PLAN
OSCEOLA, ARKANSAS

FIGURE 3
STORMWATER PLAN

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APPROVED: JJG	PROJECT NO. 14590-2503-001
SCALE: 1" = 100'	DATE: 09/15/21
SHEET NO. FIGURE 3	

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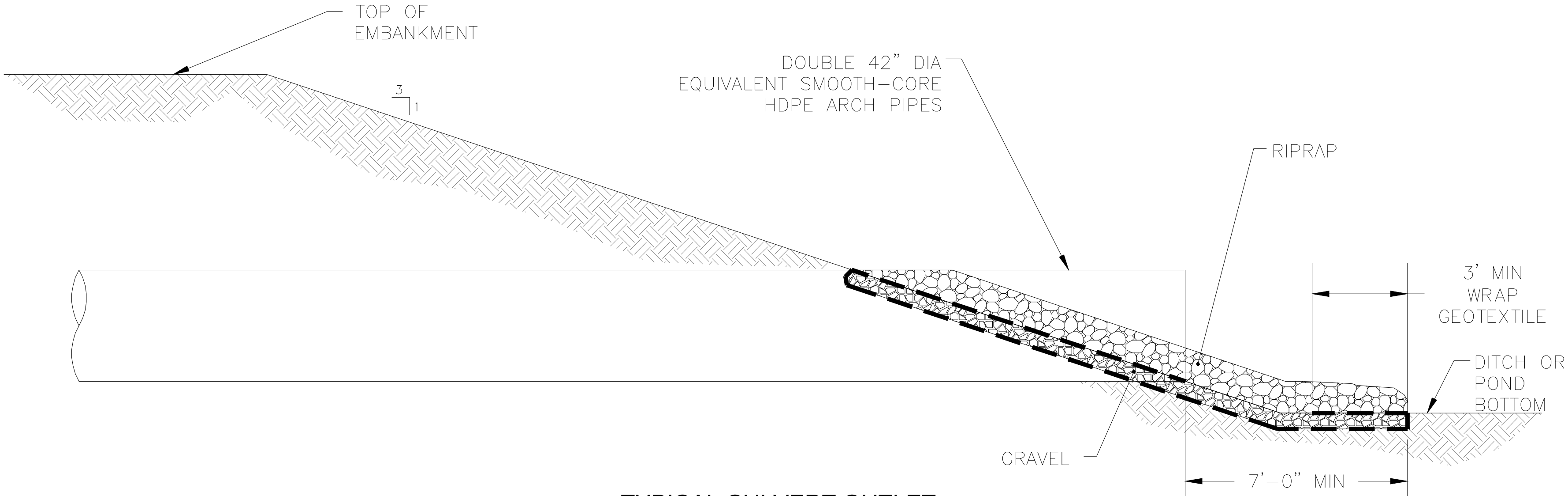
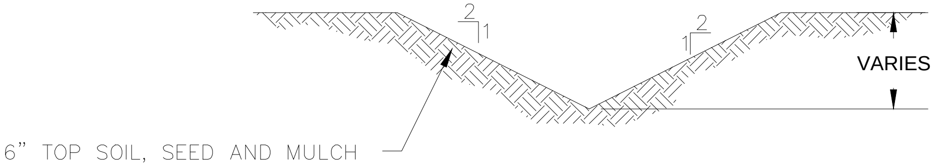
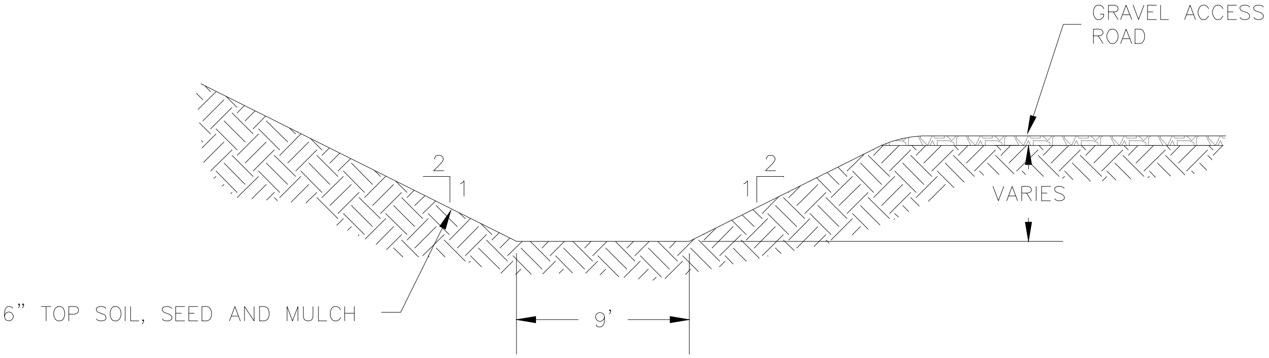


TYPICAL CULVERT OUTLET

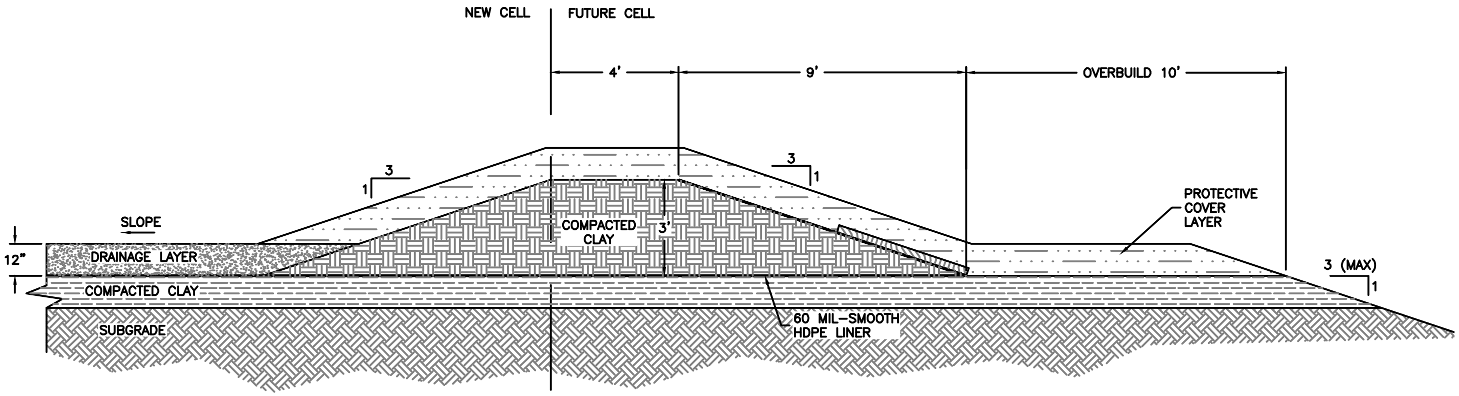


GRASS-LINED SWALE

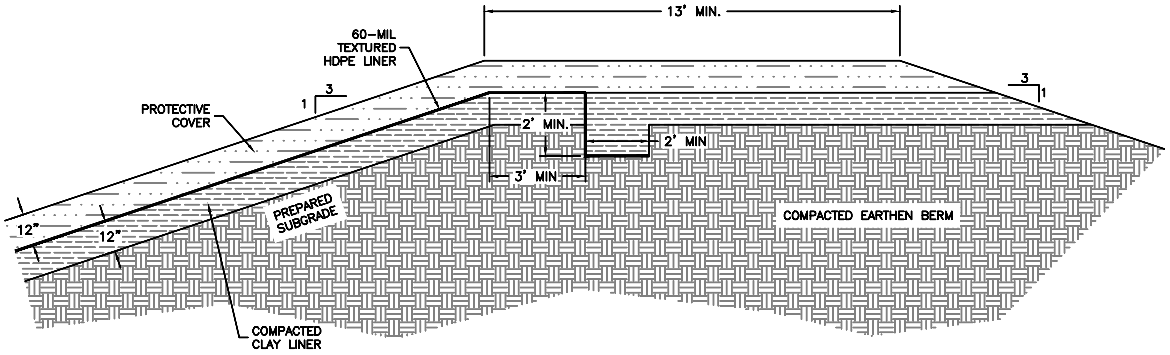


GRASS-LINED TRAPEZOIDAL CHANNEL

Figure 4. Typical Stormwater Details.



LANDFILL EXPANSION BERM



LANDFILL PERIMETER BERM

Figure 5. Landfill Berm Details.

APPENDIX C

Run-on Hydrologic and Hydraulic Calculations

T_c and Flow Calculations for
Basin 1

INPUT

Flow Type	Length	Slope
Overland	400	0.005
Shallow	400	0.005
Channel	1300	0.005
Total Length	2100	

OVERLAND FLOW

(Sheet Flow)

$$T_c = \frac{.007*(n*L)^{\wedge}.8}{(P2yr,24hr)^{\wedge}.5*s^{\wedge}.4}$$ (TR-55)

Minimum Assumed Slope = 0.0005 ft/ft

Rainfall = 2yr, 24-hour 3.82 in

Segment	Length, ft	Manning's	Slope (ft/ft)	Tc (hr)
1	400	0.060	0.0050	0.379

SHALLOW FLOW

Unpaved V = 16.1345*S^0.5

t=L/3600V (TR-55)

Paved V = 20.3282*S^0.5

Segment	Length, ft	Paved	Slope (ft/ft)	Velocity	Tc
2	400	No	0.005	1.14	0.097

Tc in hr

CHANNEL FLOW

t=L/3600V

V=(1.49*r^2/3*s^.5)/n (TR-55)

Segment	Length, ft	Slope (ft/ft)	ManningsN	Side Slope	Bottom Width	Depth	Area	WP*	HydrRadius	Velocity	Tc (hr)
3	1300.00	0.01	0.020	2	15	3	63.000	28.416	2.22	8.96	0.040

hydraulic radius = area/wetted perimter

*Note: Assume channel is full

TOTAL TIME

$T_C = T_{SHEET} + T_{SHALLOW} + T_{CHANNEL}$

Segment	T_C	T_C
	(hr)	(min)
1	0.379	22.74
2	0.097	5.84
3	0.040	2.42
CUMULATIVE T_c	**0.517**	**31.0**

FLOW CALCULATION

Q = CIA

C =	0.28
I (in/hr) =	4.02
A (ac) =	31.50
Therefore Q =	**35.44**

cfs

Worksheet for Outer Perimeter Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.00300	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	15.00	ft
Discharge	35.44	ft³/s

Results

Normal Depth	1.15	ft
Flow Area	19.81	ft²
Wetted Perimeter	20.12	ft
Hydraulic Radius	0.98	ft
Top Width	19.58	ft
Critical Depth	0.54	ft
Critical Slope	0.03768	ft/ft
Velocity	1.79	ft/s
Velocity Head	0.05	ft
Specific Energy	1.20	ft
Froude Number	0.31	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.15	ft
Critical Depth	0.54	ft
Channel Slope	0.00300	ft/ft

Worksheet for Outer Perimeter Channel

GVF Output Data

Critical Slope	0.03768	ft/ft

Worksheet for Outer Perimeter Channel - Max Capacity

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.00300	ft/ft
Normal Depth	3.50	ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	15.00	ft

Results

Discharge	257.35	ft^3/s
Flow Area	77.00	ft^2
Wetted Perimeter	30.65	ft
Hydraulic Radius	2.51	ft
Top Width	29.00	ft
Critical Depth	1.91	ft
Critical Slope	0.02664	ft/ft
Velocity	3.34	ft/s
Velocity Head	0.17	ft
Specific Energy	3.67	ft
Froude Number	0.36	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.50	ft
Critical Depth	1.91	ft
Channel Slope	0.00300	ft/ft

Worksheet for Outer Perimeter Channel - Max Capacity

GVF Output Data

Critical Slope	0.02664	ft/ft

APPENDIX D

Run-off Hydrologic and Hydraulic Calculations

T_c and Flow Calculations for Basin 2

INPUT

Flow Type	Length	Slope
Overland	100	0.250
Shallow	259	0.250
Channel	634	0.005
Total Length	993	

OVERLAND FLOW

(Sheet Flow)

$$T_c=\frac{\text{.007*(n*L)\^{}.8}}{\text{(P2yr,24hr)\^{}.5*s\^{}.4}}\qquad\text{(TR-55)}$$

Minimum Assumed Slope = 0.0005 ft/ft

Rainfall = 2yr, 24-hour 3.82 in

Segment	Length, ft	Manning's	Slope (ft/ft)	Tc (hr)
1	100	0.450	0.2500	0.131

SHALLOW FLOW

Unpaved V = 16.1345*S^0.5

t=L/3600V (TR-55)

Paved V = 20.3282*S^0.5

Segment	Length, ft	Paved	Slope (ft/ft)	Velocity	Tc
2	259	No	0.250	8.07	0.009

Tc in hr

CHANNEL FLOW

t=L/3600V (TR-55)

V=(1.49*r^2/3*s^.5)/n

Segment	Length, ft	Slope (ft/ft)	ManningsN	Side Slope	Bottom Width	Depth	Area	WP*	HydrRadius	Velocity	Tc (hr)
3	634.00	0.005	0.030	3	9	2	30.000	21.649	1.39	4.37	0.040

hydraulic radius = area/wetted perimter

*Note: Assume channel is full

TOTAL TIME

$T_C = T_{SHEET} + T_{SHALLOW} + T_{CHANNEL}$

Segment	T_C	T_C
	(hr)	(min)
1	0.131	7.86
2	0.009	0.54
3	0.040	2.42
CUMULATIVE T_c	**0.180**	**10.8**

FLOW CALCULATION

Q = CIA

C =	0.28
I (in/hr) =	6.64
A (ac) =	14.50
Therefore Q =	**26.95**

cfs

Worksheet for Inner Perimeter Channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045
Channel Slope	0.005 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	9.00 ft
Discharge	26.95 cfs

Results

Normal Depth	1.1 ft
Flow Area	13.1 ft²
Wetted Perimeter	15.8 ft
Hydraulic Radius	0.8 ft
Top Width	15.43 ft
Critical Depth	0.6 ft
Critical Slope	0.037 ft/ft
Velocity	2.06 ft/s
Velocity Head	0.07 ft
Specific Energy	1.14 ft
Froude Number	0.394
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.1 ft
Critical Depth	0.6 ft
Channel Slope	0.005 ft/ft
Critical Slope	0.037 ft/ft

Worksheet for Inner Perimeter Channel

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.045
Channel Slope	0.005 ft/ft
Normal Depth	4.0 ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	9.00 ft

Results

Discharge	356.36 cfs
Flow Area	84.0 ft²
Wetted Perimeter	34.3 ft
Hydraulic Radius	2.4 ft
Top Width	33.00 ft
Critical Depth	2.7 ft
Critical Slope	0.025 ft/ft
Velocity	4.24 ft/s
Velocity Head	0.28 ft
Specific Energy	4.28 ft
Froude Number	0.469
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	4.0 ft
Critical Depth	2.7 ft
Channel Slope	0.005 ft/ft
Critical Slope	0.025 ft/ft

Culvert Calculator Report
42" HDPE arch (2 barrel)

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	242.00	ft	Headwater Depth/Height	0.47	
Computed Headwater Elevation	239.23	ft	Discharge	26.95	cfs
Inlet Control HW Elev.	239.16	ft	Tailwater Elevation	235.80	ft
Outlet Control HW Elev.	239.23	ft	Control Type	Entrance Control	

Grades

Upstream Invert	238.00	ft	Downstream Invert	235.00	ft
Length	230.00	ft	Constructed Slope	0.013043	ft/ft

Hydraulic Profile

Profile	S2		Depth, Downstream	0.56	ft
Slope Type	Steep		Normal Depth	0.56	ft
Flow Regime	Supercritical		Critical Depth	0.82	ft
Velocity Downstream	7.66	ft/s	Critical Slope	0.002936	ft/ft

Section

Section Shape	Arch		Mannings Coefficient	0.012	
Section Material	Concrete		Span	4.26	ft
Section Size	51.12 x 31.31 inch		Rise	2.61	ft
Number Sections	2				

Outlet Control Properties

Outlet Control HW Elev.	239.23	ft	Upstream Velocity Head	0.34	ft
Ke	0.20		Entrance Loss	0.07	ft

Inlet Control Properties

Inlet Control HW Elev.	239.16	ft	Flow Control	Unsubmerged	
Inlet Type	Groove end projecting (arch)		Area Full	17.3	ft²
K	0.00450		HDS 5 Chart	0	
M	2.00000		HDS 5 Scale	0	
C	0.03170		Equation Form	1	
Y	0.69000				

Culvert Calculator Report
42" HDPE arch (2 barrel)

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	239.10	ft	Headwater Depth/Height	0.42	
Computed Headwater Elevation	239.10	ft	Discharge	22.29	cfs
Inlet Control HW Elev.	239.03	ft	Tailwater Elevation	235.80	ft
Outlet Control HW Elev.	239.10	ft	Control Type	Entrance Control	

Grades

Upstream Invert	238.00	ft	Downstream Invert	235.00	ft
Length	230.00	ft	Constructed Slope	0.013043	ft/ft

Hydraulic Profile

Profile	CompositeS1S2		Depth, Downstream	0.80	ft
Slope Type	Steep		Normal Depth	0.50	ft
Flow Regime	N/A		Critical Depth	0.74	ft
Velocity Downstream	3.99	ft/s	Critical Slope	0.002940	ft/ft

Section

Section Shape	Arch		Mannings Coefficient	0.012	
Section Material	HDPE		Span	4.26	ft
Section Size	51.12 x 31.31 inch		Rise	2.61	ft
Number Sections	2				

Outlet Control Properties

Outlet Control HW Elev.	239.10	ft	Upstream Velocity Head	0.30	ft
Ke	0.20		Entrance Loss	0.06	ft

Inlet Control Properties

Inlet Control HW Elev.	239.03	ft	Flow Control	Unsubmerged	
Inlet Type	Groove end projecting (arch)		Area Full	17.3	ft²
K	0.00450		HDS 5 Chart	0	
M	2.00000		HDS 5 Scale	0	
C	0.03170		Equation Form	1	
Y	0.69000				

Subsection: Master Network Summary

Catchments Summary

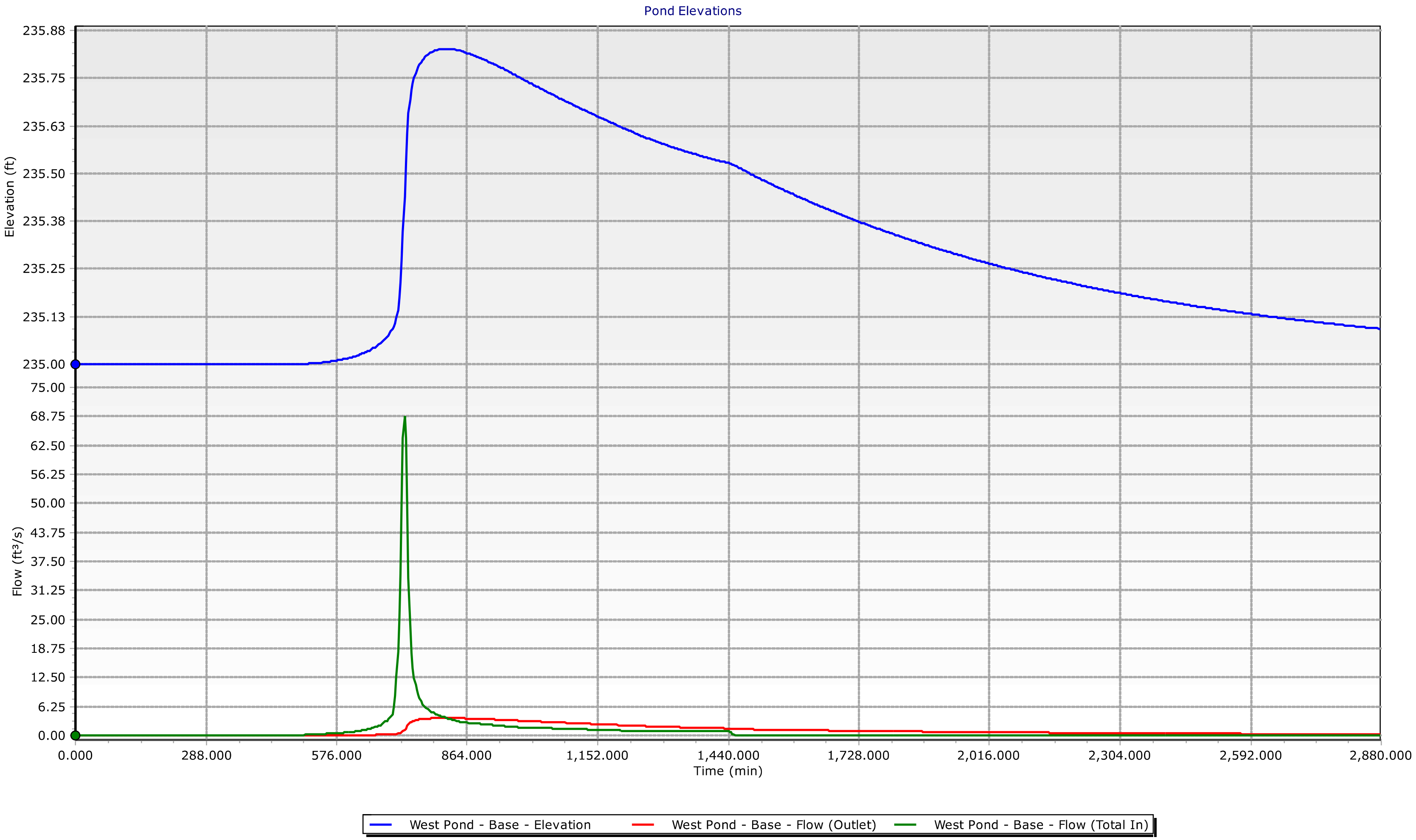
Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
Basin 2	Base	25	185,669.000	726.000	68.80

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)
Pond Outlet	Base	25	173,529.000	819.000	3.75

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (min)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft³)
West Pond (IN)	Base	25	185,669.000	726.000	68.80	(N/A)	(N/A)
West Pond (OUT)	Base	25	173,529.000	819.000	3.75	235.83	108,140.000


Pond Elevations
Elevation (ft)
235.88
235.75
235.63
235.50
235.38
235.25
235.13
235.00
Flow (ft³/s)
75.00
68.75
62.50
56.25
50.00
43.75
37.50
31.25
25.00
18.75
12.50
6.25
0.00
0.000
288.000
576.000
864.000
1,152.000
1,440.000
1,728.000
2,016.000
2,304.000
2,592.000
2,880.000
Time (min)
West Pond - Base - Elevation
West Pond - Base - Flow (Outlet)
West Pond - Base - Flow (Total In)

T_c and Flow Calculations for Basin 3

INPUT

Flow Type	Length	Slope
Overland	80	0.330
Shallow	540	0.015
Channel	0	0.005
Total Length	620	

OVERLAND FLOW

(Sheet Flow)

$$T_c=\frac{.007*(n*L)^\wedge.8}{(P2yr,24hr)^\wedge.5*s^\wedge.4}$$ (TR-55)

Minimum Assumed Slope = 0.0005 ft/ft

Rainfall = 2yr, 24-hour 3.82 in

Segment	Length, ft	Manning's	Slope (ft/ft)	Tc (hr)
1	80	0.050	0.3300	0.017

SHALLOW FLOW

Unpaved V = 16.1345*S^0.5

t=L/3600V (TR-55)

Paved V = 20.3282*S^0.5

Segment	Length, ft	Paved	Slope (ft/ft)	Velocity	Tc	
2	540	No	0.040	3.23	0.046	Tc in hr

CHANNEL FLOW

t=L/3600V

V=(1.49*r^2/3*s^.5)/n (TR-55)

Segment	Length, ft	Slope (ft/ft)	ManningsN	Side Slope	Bottom Width	Depth	Area	WP*	HydrRadius	Velocity	Tc (hr)
3	0.00	0.01	0.020	2	15	3	63.000	28.416	2.22	8.96	0.000

hydraulic radius = area/wetted perimter

*Note: Assume channel is full

TOTAL TIME

$T_C = T_{SHEET} + T_{SHALLOW} + T_{CHANNEL}$

Segment	T_C	T_C
	(hr)	(min)
1	0.017	1.01
2	0.046	2.79
3	0.000	0.00
CUMULATIVE T_c	**0.063**	**3.8**

FLOW CALCULATION

Q = CIA

C =	0.40	
I (in/hr) =	10.93	
A (ac) =	12.70	
Therefore Q =	**55.52**	cfs

T_c and Flow Calculations for Basin 4

INPUT

Flow Type	Length	Slope
Overland	100	0.250
Shallow	706	1.000
Channel	1200	0.002
Total Length	2006	

OVERLAND FLOW
(Sheet Flow)

$$T_c = \frac{.007*(n*L)^{.8}}{(P2yr,24hr)^{.5}*s^{.4}}$$ (TR-55)

Minimum Assumed Slope = 0.0005 ft/ft
Rainfall = 2yr, 24-hour 3.82 in

Segment	Length, ft	Manning's	Slope (ft/ft)	Tc (hr)
1	100	0.450	0.2500	0.131

SHALLOW FLOW
Unpaved V = 16.1345*S^0.5
t=L/3600V
Paved V = 20.3282*S^0.5
(TR-55)

Segment	Length, ft	Paved	Slope (ft/ft)	Velocity	Tc
2	706	No	0.010	1.61	0.122

Tc in hr

CHANNEL FLOW
t=L/3600V
V=(1.49*r^2/3*s^.5)/n
(TR-55)

Segment	Length, ft	Slope (ft/ft)	ManningsN	Side Slope	Bottom Width	Depth	Area	WP*	HydrRadius	Velocity	Tc (hr)
3	1200.00	0.002	0.030	4	5	2	26.000	21.492	1.21	2.52	0.132

hydraulic radius = area/wetted perimter

*Note: Assume channel is full

TOTAL TIME

$T_C = T_{SHEET} + T_{SHALLOW} + T_{CHANNEL}$

Segment	T_C	T_C
	(hr)	(min)
1	0.131	7.86
2	0.122	7.29
3	0.132	7.93
CUMULATIVE T_c	**0.385**	**23.1**

FLOW CALCULATION

Q = CIA

C =	0.28
I (in/hr) =	4.62
A (ac) =	17.90
Therefore Q =	**23.20**

cfs

Worksheet for South Ditch

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045
Channel Slope	0.005 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Bottom Width	10.00 ft
Discharge	23.20 cfs

Results

Normal Depth	0.9 ft
Flow Area	12.5 ft²
Wetted Perimeter	17.5 ft
Hydraulic Radius	0.7 ft
Top Width	17.30 ft
Critical Depth	0.5 ft
Critical Slope	0.039 ft/ft
Velocity	1.86 ft/s
Velocity Head	0.05 ft
Specific Energy	0.97 ft
Froude Number	0.387
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.9 ft
Critical Depth	0.5 ft
Channel Slope	0.005 ft/ft
Critical Slope	0.039 ft/ft

Worksheet for South Ditch

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.045
Channel Slope	0.005 ft/ft
Normal Depth	2.0 ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Bottom Width	10.00 ft

Results

Discharge	103.12 cfs
Flow Area	36.0 ft²
Wetted Perimeter	26.5 ft
Hydraulic Radius	1.4 ft
Top Width	26.00 ft
Critical Depth	1.3 ft
Critical Slope	0.031 ft/ft
Velocity	2.86 ft/s
Velocity Head	0.13 ft
Specific Energy	2.13 ft
Froude Number	0.429
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	2.0 ft
Critical Depth	1.3 ft
Channel Slope	0.005 ft/ft
Critical Slope	0.031 ft/ft