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March 26, 2026
File: rpt_001_let_175578990
Revision 0

Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

Re: Periodic Run-On and Run-Off Control System Plan
New CCR Landfill
EPA Final Coal Combustion Residuals (CCR) Rule
TVA Shawnee Fossil Plant
Paducah, McCracken County, Kentucky

1.0 PURPOSE

This letter documents Stantec Consulting Services' (Stantec) certification that the Periodic Run-On and Run-Off Control System Plan for the New CCR Landfill at the Tennessee Valley Authority (TVA) Shawnee Fossil Plant is in compliance with 40 CFR 257.81 of the EPA CCR Rule. The EPA CCR Rule requires certifications to be performed at 5-year periodic intervals. The initial certification of the run-on and run-off control system plan was placed in the operating record on March 26, 2021.

2.0 INITIAL RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

The March 2021 assessment found that the TVA Shawnee Fossil Plant New CCR Landfill Initial Run-On and Run-Off Control System Plan met the requirements of 40 CFR 257.81.

At the time of the initial assessment, certain run-off control measures were already in-place, including the stormwater ponds and a perimeter ditch/pipe stormwater collection network around the proposed Stage 1 landfill area. The stormwater ponds were designed for final closed conditions but also serve as run-off and sediment control structures during interim construction conditions for active and closed landfill cells.

3.0 CURRENT RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

Stantec reviewed the conditions and results of the initial plan and changes in conditions that have occurred in the past five years at the site. The Stage 1 landfill cell has been constructed over the last five years, including installation of the bottom liner and leachate collection and removal system, the aforementioned run-off control measures, and placement of CCR embankment across a portion of the constructed Stage 1 landfill cell. The Stage 1 run-off control measures are comprised of a perimeter ditch/pipe network that gravity drains to the southern stormwater pond. No additional stages of the landfill have been constructed at the time of this assessment.

Reference: **Periodic Run-On and Run-Off Control System Plan**
New CCR Landfill
EPA Final Coal Combustion Residuals (CCR) Rule
TVA Shawnee Fossil Plant
Paducah, McCracken County, Kentucky

4.0 SUMMARY OF FINDINGS

The attached periodic plan documents that the Run-On and Run-Off Control System Plan for the TVA Shawnee Fossil Plant New CCR Landfill meets the requirements set forth in 40 CFR 257.81.

5.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, William Mattingly, being a Professional Engineer in good standing in the Commonwealth of Kentucky, do hereby certify, to the best of my knowledge, information, and belief:

1. that the information contained in this certification is prepared in accordance with the accepted practice of engineering;
2. that the information contained herein is accurate as of the date of my signature below; and
3. that the run-on and run-off control system plan for the TVA Shawnee Fossil Plant New CCR Landfill meets the requirements specified in 40 CFR 257.81.

SIGNATURE Will Mattingly DATE 3/26/2026

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ATTACHMENTS: Periodic Run-On and Run-Off Control System Plan

STATE OF KENTUCKY
WILLIAM ROBERT MATTINGLY, IV
29111
LICENSED
PROFESSIONAL ENGINEER

Stantec

Periodic Run-On and Run-Off Control System Plan Revision 0

New CCR Landfill, TVA Shawnee Fossil Plant, Paducah, McCracken County, Kentucky

March 26, 2026

Prepared for:

Tennessee Valley Authority

Prepared by:

Stantec Consulting Services Inc.

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1.0 BACKGROUND

1.1 INTRODUCTION

On April 17, 2015, the Environmental Protection Agency (EPA) published the "Disposal of Coal Combustion Residuals (CCR) from Electric Utilities" final rule (EPA Final CCR Rule) in the Federal Register. The Tennessee Valley Authority (TVA) contracted with Stantec Consulting Services Inc. (Stantec) to provide a Periodic Run-on and Run-off Control System Plan for the Shawnee Fossil Plant's (SHF) New CCR Landfill that meets requirements of the EPA Final CCR Rule §257.81.

SHF is a coal-fired, electric-generating plant. The plant is located in McCracken County, Kentucky, along the south shore of the Ohio River near river mile 946, just east of the confluence of Little Bayou Creek with the Ohio River. The SHF New CCR Landfill is located on the Shawnee East Site, which consists of about 205 acres that TVA acquired in 2016 next to the eastern boundary of the SHF reservation. The landfill will be constructed in three stages over a total footprint of 88 acres. The final embankment will be about 115 feet tall, with maximum 4H:1V slopes, and will accommodate about 8 million cubic yards of CCR material (fly ash, bottom ash, and gypsum) across an estimated 25-year operational life.

The SHF New CCR Landfill is planned to be constructed in three stages, with each stage consisting of one landfill cell. The facility stormwater and leachate ponds were constructed in 2021, prior to placement of the CCR embankment in the Stage 1 landfill cell. Prior to placement of CCR embankment, each landfill stage is constructed by installing the perimeter stormwater pipe network and perimeter ditch, as well as the bottom liner and leachate collection and removal system.

Figure 1 illustrates the approximate boundary of the SHF New CCR Landfill, the locations of the constructed stormwater and leachate ponds, the location of the stormwater run-off perimeter ditch, and the approximate limits of the Stage 1 landfill cell. The Stage 1 landfill cell currently receives CCR embankment material which is placed on top of the constructed bottom liner and leachate collection and removal system.

Temporary benches and flumes that drain to the perimeter ditch will be constructed as the placement of CCR embankment in the three landfill cells achieves each planned design bench elevation. Temporary cover provided on the landfill cell outer slopes during construction mitigates erosion of the placed CCR embankment from surface run-off. During closure of the landfill cells, permanent flumes will be constructed on top of the final cover system.

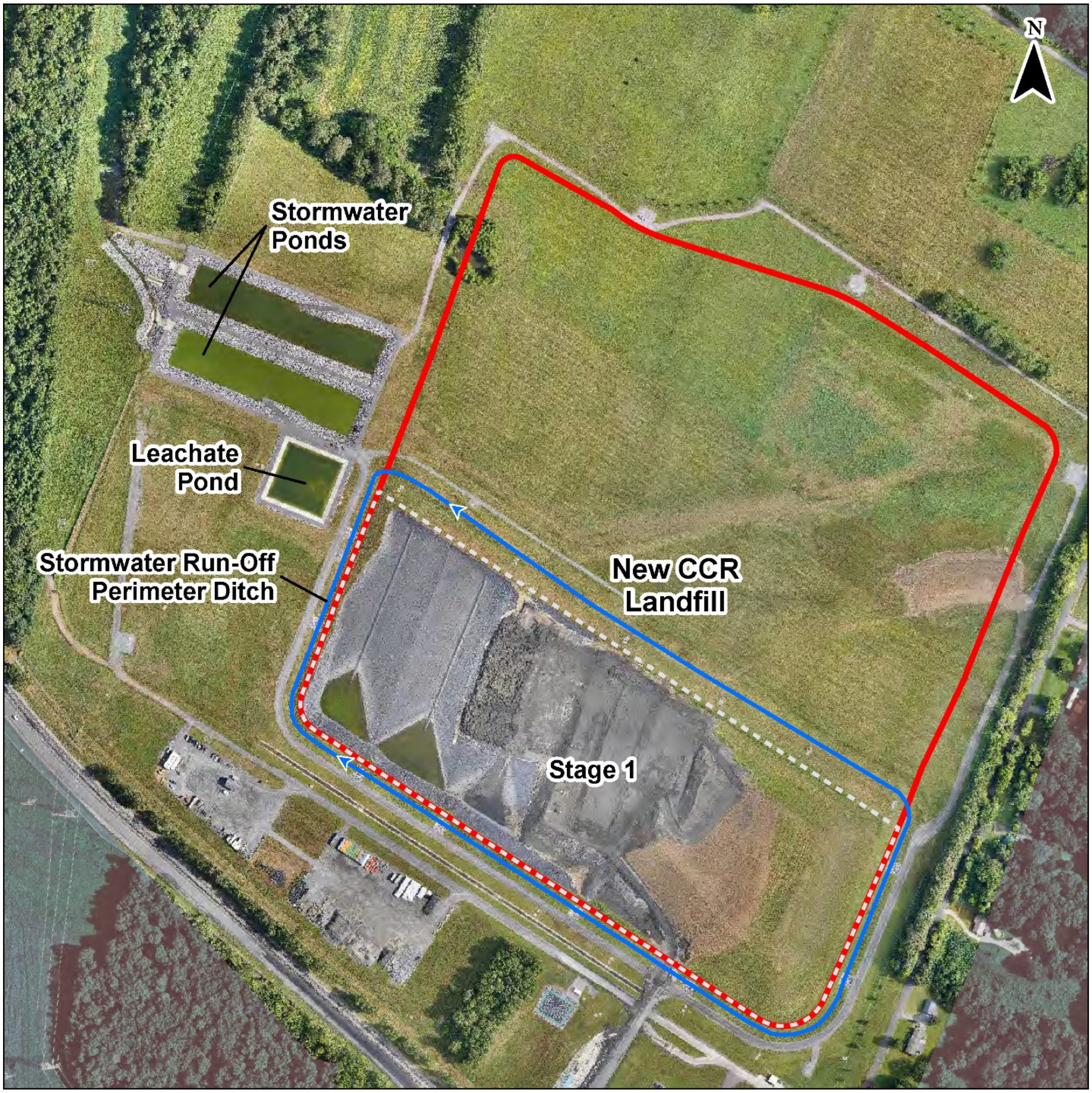

Figure 1. SHF New CCR Landfill – Current Conditions

1.2 OBJECTIVE

As required by §257.81 of the EPA Final CCR Rule, an owner or operator of a new CCR landfill is required to demonstrate that run-on and run-off control systems have been designed and constructed to meet the CCR Rule. The initial Run-On and Run-Off Control System Plan, placed in the operating record on March 26, 2021, documented that the run-on and run-off control system requirements for the SHF New CCR Landfill met the requirements of §257.81 of the EPA Final CCR Rule. This periodic plan updates the plan to reflect current as-constructed conditions.

The objective of the analysis described herein is to evaluate compliance of the SHF New CCR Landfill run-on and run-off control system related to §257.81 requirements, specifically the following:

1. Run-on: The run-on control system must prevent flow onto the active SHF New CCR Landfill areas for all stormwater flows up to the peak discharge from a 25-year, 24-hour storm event.

2. Run-off: The run-off control system must collect and control the water volume resulting from a 25-year, 24-hour storm event.

3. Run-off (permitted discharge): Run-off point sources that discharge into waters of the United States must discharge through a National Pollutant Discharge Elimination System (NPDES) permitted outfall.

1.3 PLAN ELEMENTS

Specific Run-on and Run-off Control System Plan elements include:

- A description of stormwater control design and structures,
- Appropriate hydrological engineering calculations related to run-on and run-off flows,
- Amendments to the plan whenever there is a change in conditions that would substantially affect the plan, and
- A professional engineer’s certification stating that the Run-on and Run-off Control System Plan meets the requirements of §257.81 of the EPA Final CCR Rule.

The plan shall be revised every five years and is considered complete when placed in the facility’s operating record.

2.0 PERIODIC RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

The Periodic Run-On and Run-Off Control System Plan describes how the current as-constructed SHF New CCR Landfill meets requirements of §257.81 of the EPA Final CCR Rule. It is noted that the landfill does not have run-on flow as it is constructed to elevations above adjacent ground.

The designed run-off controls for the SHF New CCR Landfill consist of ditches/flumes, underground piping, and ponds. A series of flumes and bench ditches will convey surface water from the landfill to a perimeter ditch that follows the base of the embankment. Within the perimeter ditch, drop inlet structures collect and convey flow to an underground pipe system that generally follows the alignment of the perimeter ditch. The pipe system flows by gravity to one of two stormwater ponds, which serve as sediment control structures and ultimately discharge into an unnamed tributary of Little Bayou Creek. The pond discharge is monitored through a Kentucky Pollutant Discharge Elimination System (KPDES) compliance point.

Criteria listed in Section 1.2 were used to evaluate the run-off control system for both final closed conditions and current conditions. This includes run-off hydrology and hydraulic analysis (modeling, calculations, etc.) of the final closed conditions in addition to assessment of the current as-constructed conditions.

PC-SWMM modeling software (version 5.1) was used to model hydrology and hydraulics of the final closed conditions. The model consists of subwatersheds to simulate run-off over a specified area, inlets collecting the run-off, pipes conveying the run-off downstream, and hydraulic outlet structures which store and release the run-off.

Assessment of the as-constructed run-off control system incorporated comparisons of current hydrologic conditions against the final closed conditions. This evaluation was performed to identify conditions that may result in greater run-off flow or volume to the constructed run-off control features than those calculated in the final closed conditions analysis. Assessment of current conditions included checking if run-off control features surround the active landfill to intercept, contain, and convey run-off to the stormwater ponds.

Details of the run-off analysis and results are provided in the following Sections 2.1 through 2.3, followed by the assessment of the current as-constructed conditions in Section 2.4.

2.1 HYDROLOGIC ANALYSIS

The hydrology of the final closed conditions was modeled using Natural Resources Conservation Service (NRCS) methodologies within PC-SWMM. Standard values were selected from tables provided within the User's Guide to *SWMM 5 (13th Edition)* for parameters not included below.

2.1.1 Rainfall Run-off and Distribution

The precipitation depth for the 24-hour, 25-year storm is 6.1 inches and was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, which is the same NOAA depth reported in the initial assessment. The NOAA precipitation data is provided in Appendix A. The SCS Type II storm distribution was applied to develop the rainfall hyetograph used in the PC-SWMM model.

2.1.2 Curve Number

The Curve Number method was used to model stormwater infiltration. For the final closed condition, the cover type was assumed to be "open space (lawns, parks, etc.)". The final cover system will consist of (from bottom to top) a minimum 6-inch soil base, 40-mil thick textured Linear Low Density Polyethylene (LLDPE) flexible geomembrane, a geocomposite drainage layer, 18 inches of protective cover soil, and 6 inches of vegetative cover soil. A soil group D classification was assumed for the cover. This yields a curve number of 80/84/89 for Good/Fair/Poor (respectively) grass cover conditions. A "good condition (grass cover > 75%)" has been assumed. Therefore, the curve number used in modeling capped landfill areas was 80.

2.1.3 Subwatershed Delineation

Subwatersheds were delineated based on the closure design landfill surface.

2.1.4 Lag Time

Each subwatershed was assigned an average slope percentage, based on the closure design landfill surface. Flow lengths were also calculated for each subwatershed as the sum of the sheet flow, shallow concentrated flow, and channel flow.

2.1.5 Reach Routing

The dynamic wave method was selected as the routing approach. Within PC-SWMM, the dynamic wave method allows for channel storage, backwater, entrance/exit losses, flow reversal, and pressurized flow. This routing represents pressurized flow when a closed conduit is full and allows flooding to occur when the water depth exceeds the maximum available depth at an inlet.

2.2 HYDRAULIC ANALYSIS

Hydraulic calculations were performed to design the bench ditches, flumes, perimeter ditch, pipe network, and stormwater ponds as described below.

2.2.1 Bench Ditches and Flumes

The bench ditches will be V-shaped with a right side-slope of 10H:1V, a left side-slope of 4H:1V, a depth of 2.5 feet, and a channel slope of 1 to 2%. A Manning's roughness (n) of 0.033 was assumed based on a vegetated condition. PC-SWMM was used to estimate the peak run-off for the 24-hour, 25-year storm for the drainage area associated with each bench ditch in the closure design. The peak run-off associated with the largest subwatershed area in the closure design was used to check the capacity of the bench ditches using Manning's equation for open channel flow.

The flumes will be trapezoidal in shape with a 6-foot bottom width, 3H:1V side slopes, a depth of 2 feet, and a channel slope of 25%. A Manning's roughness (n) of 0.04 was assumed for the armored flumes. PC-SWMM was used to estimate the peak run-off for the 24-hour, 25-year storm for the drainage area associated with each flume. The peak run-off associated with the largest subwatershed in the closure design was used to check the capacity of the flumes.

2.2.2 Pipes and Perimeter Ditch

The perimeter ditch and pipe network around the landfill were designed using PC-SWMM.

The perimeter ditch serves as storage above the rim of the drop inlet structures. Each inlet was modeled as a storage node within PC-SWMM to account for this storage. Stage-area curves were computed using the closure design landfill surface and were computed from the rim of the drop inlet structure to the crest of the perimeter road (which represents the top of the ditch). The inflow stage-area curves are included in the PC-SWMM input in Appendix B.

2.2.3 Stormwater Ponds

Two stormwater ponds were designed and constructed to collect and control the stormwater from the landfill prior to discharging it to an unnamed tributary of Little Bayou Creek. Each pond includes a perforated primary spillway and an emergency spillway. The low flow outlets are located on the riser to reduce exit velocities during smaller storm events, thus reducing the amount of sediment transported from the site. The first set of perforations consists of six, 1.5-inch diameter orifices set at elevation 354 feet. After that, there are additional rows consisting of six, 1-inch diameter perforations placed at 1-foot intervals from elevation 355 feet to elevation 358 feet. These perforations are used to set the normal pool elevation. The first row of six, 1.5-inch diameter orifices are modeled in PC-SWMM to allow the ponds to accurately portray the normal pool elevation. The primary spillway consists of a 24-inch diameter high-density polyethylene (HDPE) riser structure with a top elevation of 359 feet. The risers are connected to horizontal 24-inch diameter HDPE pipes. This vertical riser was modeled in PC-SWMM as a bottom orifice connected to a pipe.

The emergency spillway is trapezoidal in shape with a 10-foot bottom width, 2-foot height, 5H:1V side slopes, and placed at an invert elevation of 362 feet. The emergency spillway was modeled as a trapezoidal weir.

2.3 FINAL CLOSED CONDITIONS ANALYSIS RESULTS

Results of the hydrologic and hydraulic analysis of run-off controls for the final closed conditions are shown in Appendix C for the bench ditches and flumes, and Appendix D for the perimeter ditch and pipe network.

The peak run-off associated with the bench ditches was 5.9 cubic feet per second (cfs). The maximum depth was determined to be 0.6 feet for the 24-hour, 25-year storm. This results in a minimum of 1.9 feet of freeboard.

The peak run-off associated with the flumes was 27.5 cfs. The maximum depth was determined to be 0.5 feet for the 24-hour, 25-year storm. This results in a minimum of 1.5 feet of freeboard.

The pipe network profiles from PC-SWMM were used to check the elevations within the perimeter ditch for the 24-hour, 25-year storm. The profiles show that the water surface elevation is below the top of the road elevation, with a minimum of 2.9 feet of freeboard.

The peak 24-hour, 25-year water surface elevations within the ponds are 359.6 feet and 359.7 feet for the north and south stormwater ponds, respectively. These water surface elevations result in a freeboard of 4.4 feet for the north stormwater pond and 4.3 feet for the south stormwater pond.

2.4 CURRENT CONDITIONS ASSESSMENT

At the time of the March 2021 initial assessment, the SHF New CCR Landfill facility leachate and stormwater ponds, and Stage 1 of the landfill had been constructed in accordance with the design. Stage 1 construction consisted of the stormwater pipes and perimeter ditch, as well as the bottom liner and leachate collection and removal system. This included construction of the portion of the final landfill perimeter ditch along the south side and east/west ends of the Stage 1 landfill cell.

In the last 5-years and at the time of this assessment, the Stage 1 landfill cell has become operational with ongoing placement of the CCR embankment across the constructed cell and is nearing the first design bench elevation. A KPDES compliance point was established to monitor discharge from the stormwater ponds.

The Stage 1 landfill cell is approximately 32 acres or 36% of the final proposed 88-acre landfill from which the facility stormwater ponds are designed to receive run-off. The current Stage 1 landfill cell subbasin drainage areas are less than or equal to the final closure design subbasin areas which drain to the constructed perimeter ditch and pipe network stormwater run-off collection features. Therefore, the current constructed pipe network, perimeter ditch, and stormwater ponds are capable of collecting and controlling the 24-hour, 25-year storm run-off volume from the current as-constructed Stage 1 landfill cell surface area.

2.5 AMENDMENTS TO PLAN

If there is a change in conditions that would substantially affect the current version of the Periodic Run-on and Run-off Control System Plan, then the plan will be amended as required by §257.81(c)(2) and placed in the operating record as required by §257.105(g)(3).

3.0 CONCLUSION

The Periodic Run-on and Run-off Control System Plan for the TVA SHF New CCR Landfill meets the requirements of §257.81 of the EPA Final CCR Rule. The following summarizes compliance with EPA Final CCR Rule criteria:

1. Run-on: The landfill will not have run-on flow as it is constructed to elevations above adjacent ground.

2. Run-off: The bench ditches, flumes, pipe network, perimeter ditch, and stormwater ponds are capable of collecting and controlling the run-off water volume of a 24-hour, 25-year storm. The closed condition of the landfill was evaluated for design purposes. The landfill will be constructed in stages, with total run-off increasing to the stormwater features as each subsequent stage is constructed. The results presented herein show that the landfill run-off management system is capable of conveying the run-off associated with the final closed condition and therefore is also capable of conveying the run-off for the current conditions.

3. Run-off (permitted discharge): Run-off from the landfill flows to the stormwater ponds. The pond discharge is monitored through a KPDES compliance point. Therefore, the run-off is handled in accordance with the surface water requirements.

4.0 REFERENCES

Environmental Protection Agency (EPA). (2015). “Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule.” Federal Register, Vol. 80, No. 74, Part II, Environmental Protection Agency, 40 CFR Parts 257 and 261. April 17, 2015.

James, et. al. (2010). User’s Guide to SWMM5, 13th Edition, November, 2010.

National Oceanic and Atmospheric Administration (NOAA). (2006). NOAA Atlas 14, Precipitation Frequency Atlas of the United States, Volume 2, Version 3, 2006.

Stantec Consulting Services Inc. (Stantec). (2017). “Basis of Design Report, 100% Site-Wide, Permit-Level, Revision 0.” Prepared for Tennessee Valley Authority, April 28, 2017.

Stantec (2021). “Initial Run-on and Run-off Control System Plan TVA Shawnee New CCR Landfill.” Prepared for Tennessee Valley Authority, March 26, 2021.

TVA (2025, 2026). Aerial Imagery. August 2025 and January 2026.

APPENDIX A
NOAA RAINFALL DEPTHS

NOAA Atlas 14, Volume 2, Version 3
Location name: West Paducah, Kentucky, USA*
Latitude: 37.1399°, Longitude: -88.7742°
Elevation: 362 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.421 (0.388-0.458)	0.496 (0.458-0.540)	0.577 (0.531-0.627)	0.641 (0.590-0.696)	0.721 (0.660-0.782)	0.779 (0.712-0.844)	0.837 (0.761-0.905)	0.897 (0.812-0.970)	0.973 (0.875-1.05)	1.03 (0.921-1.12)
10-min	0.657 (0.605-0.715)	0.779 (0.718-0.847)	0.902 (0.830-0.980)	0.996 (0.916-1.08)	1.11 (1.02-1.20)	1.19 (1.09-1.29)	1.27 (1.16-1.38)	1.35 (1.22-1.46)	1.45 (1.30-1.57)	1.52 (1.36-1.65)
15-min	0.807 (0.744-0.879)	0.956 (0.882-1.04)	1.12 (1.03-1.21)	1.23 (1.13-1.34)	1.38 (1.26-1.49)	1.48 (1.35-1.60)	1.59 (1.44-1.72)	1.68 (1.52-1.82)	1.81 (1.63-1.96)	1.90 (1.70-2.06)
30-min	1.08 (0.991-1.17)	1.29 (1.19-1.40)	1.54 (1.42-1.67)	1.72 (1.59-1.87)	1.96 (1.80-2.13)	2.14 (1.96-2.32)	2.32 (2.10-2.50)	2.49 (2.25-2.69)	2.72 (2.45-2.94)	2.89 (2.58-3.13)
60-min	1.32 (1.22-1.44)	1.59 (1.46-1.73)	1.94 (1.78-2.10)	2.20 (2.03-2.39)	2.56 (2.34-2.77)	2.83 (2.59-3.07)	3.11 (2.83-3.36)	3.40 (3.08-3.68)	3.78 (3.41-4.10)	4.09 (3.65-4.43)
2-hr	1.58 (1.44-1.72)	1.90 (1.74-2.07)	2.33 (2.13-2.54)	2.67 (2.44-2.90)	3.12 (2.84-3.39)	3.48 (3.15-3.78)	3.85 (3.47-4.19)	4.23 (3.80-4.60)	4.76 (4.24-5.18)	5.18 (4.58-5.64)
3-hr	1.72 (1.57-1.88)	2.06 (1.89-2.27)	2.53 (2.32-2.78)	2.91 (2.66-3.18)	3.42 (3.11-3.74)	3.83 (3.47-4.18)	4.26 (3.84-4.64)	4.70 (4.21-5.13)	5.33 (4.73-5.81)	5.82 (5.13-6.35)
6-hr	2.12 (1.94-2.34)	2.55 (2.33-2.81)	3.13 (2.86-3.44)	3.59 (3.27-3.94)	4.23 (3.83-4.63)	4.74 (4.28-5.19)	5.29 (4.74-5.78)	5.86 (5.22-6.40)	6.66 (5.88-7.28)	7.30 (6.40-7.99)
12-hr	2.56 (2.34-2.81)	3.08 (2.81-3.38)	3.78 (3.45-4.14)	4.34 (3.95-4.76)	5.11 (4.63-5.59)	5.74 (5.18-6.27)	6.39 (5.72-6.98)	7.07 (6.30-7.73)	8.03 (7.08-8.80)	8.80 (7.70-9.66)
24-hr	3.09 (2.88-3.32)	3.72 (3.47-3.99)	4.57 (4.26-4.90)	5.21 (4.85-5.59)	6.07 (5.64-6.51)	6.75 (6.24-7.23)	7.44 (6.86-7.96)	8.13 (7.47-8.71)	9.08 (8.30-9.74)	9.81 (8.93-10.5)
2-day	3.66 (3.41-3.93)	4.40 (4.10-4.73)	5.40 (5.02-5.78)	6.14 (5.71-6.58)	7.13 (6.61-7.63)	7.89 (7.31-8.45)	8.66 (8.00-9.28)	9.44 (8.69-10.1)	10.5 (9.61-11.2)	11.3 (10.3-12.1)
3-day	3.88 (3.61-4.16)	4.66 (4.34-5.00)	5.69 (5.30-6.10)	6.47 (6.01-6.93)	7.49 (6.95-8.03)	8.29 (7.67-8.88)	9.08 (8.38-9.73)	9.88 (9.10-10.6)	10.9 (10.0-11.8)	11.8 (10.7-12.7)
4-day	4.09 (3.81-4.39)	4.91 (4.57-5.27)	5.99 (5.58-6.42)	6.79 (6.32-7.28)	7.86 (7.29-8.43)	8.68 (8.04-9.30)	9.50 (8.77-10.2)	10.3 (9.50-11.1)	11.4 (10.5-12.3)	12.3 (11.2-13.2)
7-day	4.75 (4.42-5.11)	5.70 (5.30-6.13)	6.96 (6.47-7.48)	7.93 (7.35-8.52)	9.22 (8.53-9.91)	10.2 (9.44-11.0)	11.2 (10.3-12.1)	12.3 (11.2-13.2)	13.6 (12.4-14.7)	14.7 (13.4-15.9)
10-day	5.30 (4.94-5.69)	6.34 (5.91-6.81)	7.69 (7.17-8.26)	8.71 (8.12-9.35)	10.1 (9.35-10.8)	11.1 (10.3-11.9)	12.1 (11.2-13.0)	13.2 (12.2-14.2)	14.6 (13.4-15.7)	15.6 (14.3-16.8)
20-day	7.21 (6.76-7.68)	8.57 (8.05-9.14)	10.2 (9.57-10.9)	11.4 (10.7-12.2)	13.0 (12.1-13.8)	14.2 (13.2-15.1)	15.3 (14.3-16.3)	16.4 (15.3-17.5)	17.9 (16.6-19.1)	19.0 (17.6-20.3)
30-day	8.80 (8.30-9.34)	10.4 (9.84-11.1)	12.3 (11.6-13.1)	13.7 (12.9-14.5)	15.4 (14.5-16.4)	16.7 (15.7-17.8)	18.0 (16.9-19.2)	19.3 (18.0-20.5)	20.9 (19.5-22.3)	22.1 (20.6-23.6)
45-day	11.0 (10.4-11.7)	13.1 (12.3-13.9)	15.3 (14.4-16.2)	16.9 (15.8-17.9)	18.9 (17.7-20.0)	20.4 (19.1-21.6)	21.9 (20.4-23.2)	23.3 (21.7-24.7)	25.1 (23.3-26.6)	26.4 (24.4-28.1)
60-day	13.1 (12.3-13.8)	15.4 (14.6-16.3)	17.9 (17.0-18.9)	19.8 (18.7-20.8)	22.0 (20.8-23.2)	23.7 (22.3-25.0)	25.3 (23.8-26.7)	26.8 (25.2-28.3)	28.8 (27.0-30.5)	30.2 (28.2-32.0)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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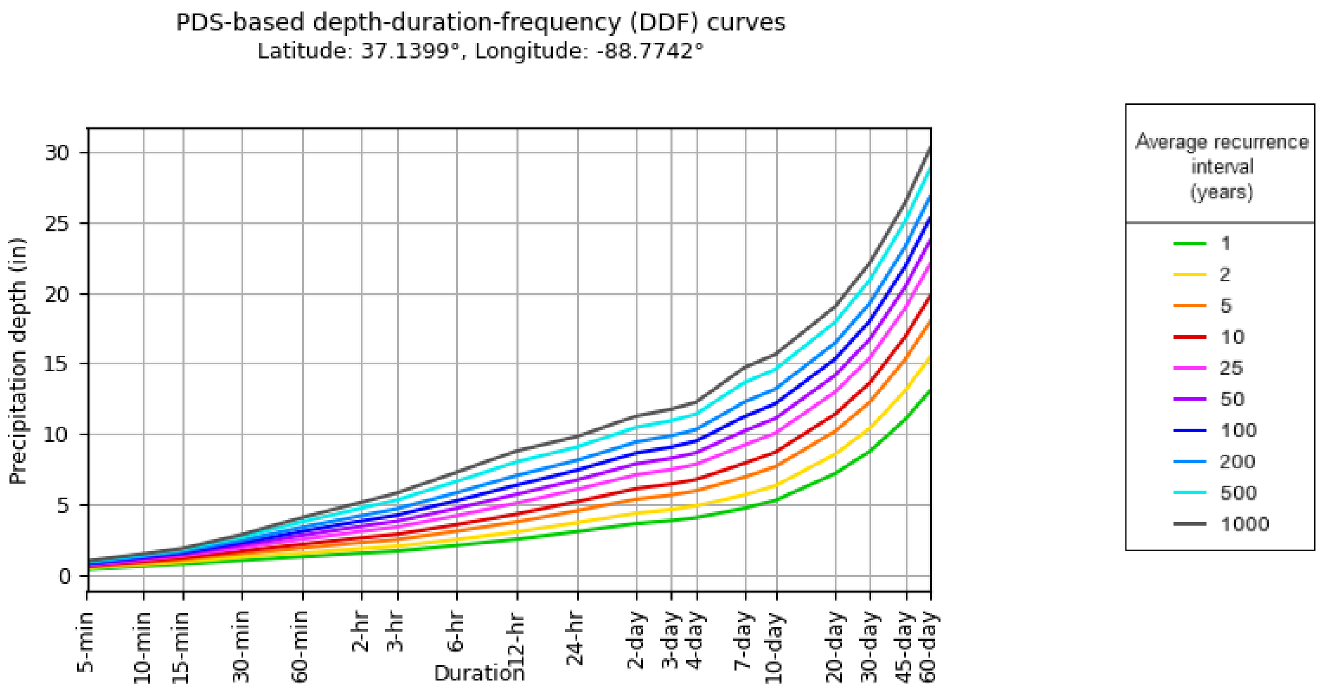
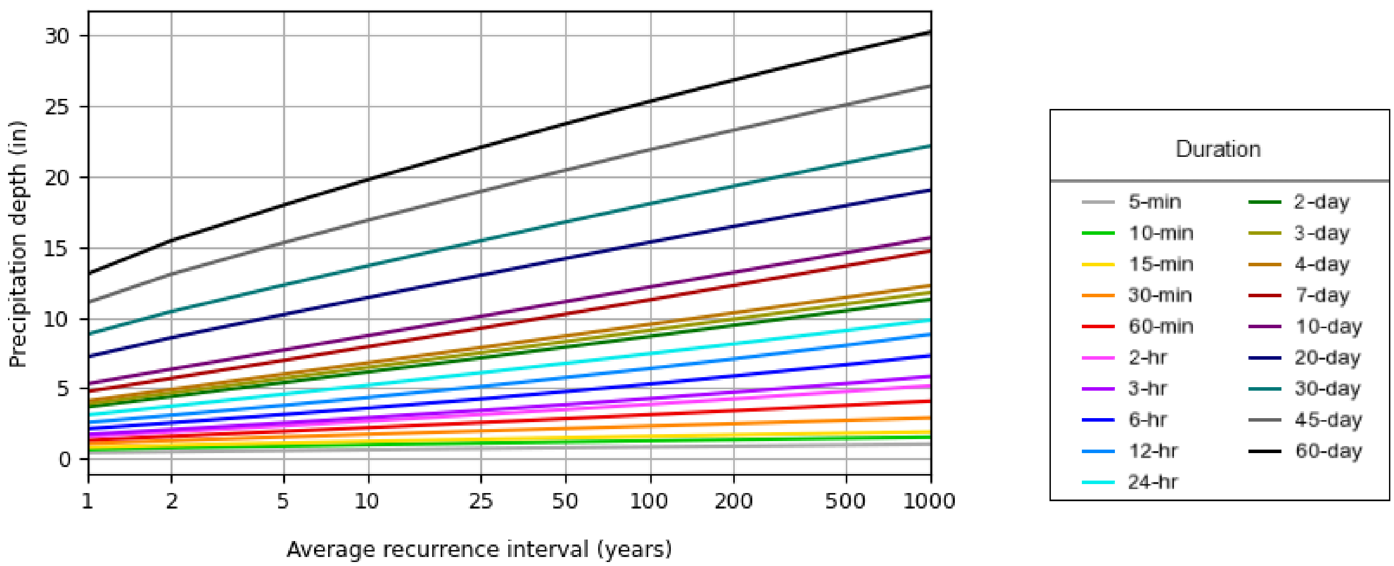
PF graphical





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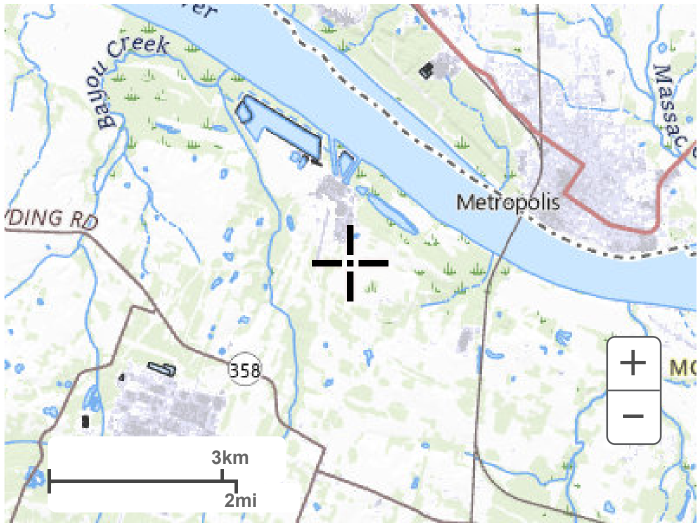
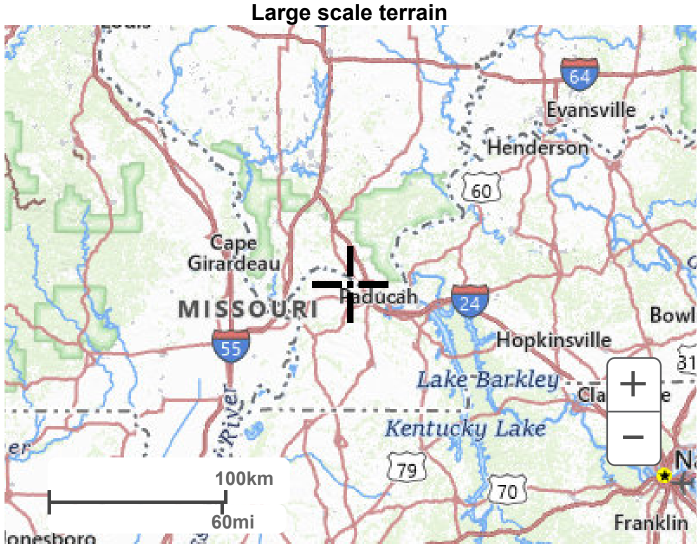
Maps & aerials

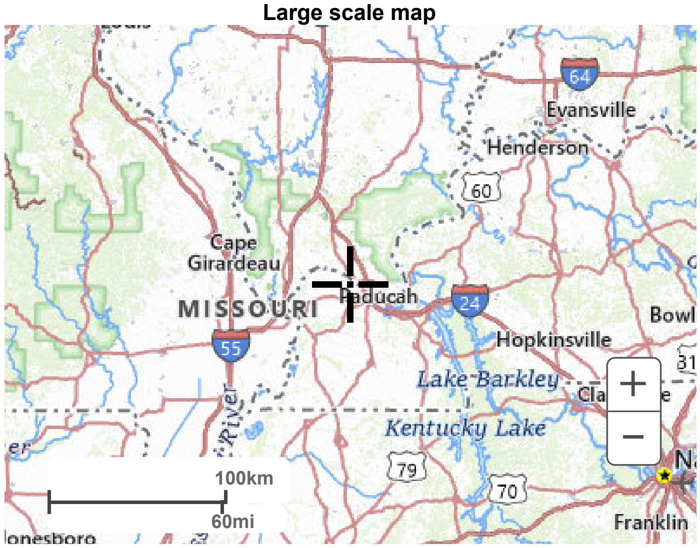
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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National Weather Service
National Water Center
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Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX B
PC-SWMM INPUT FILES

SHAWNEE FOSSIL PLANT PC-SWMM

```
[OPTIONS]
;;Options              Value
;;------------------- ------------
FLOW_UNITS             CFS
INFILTRATION           CURVE_NUMBER
FLOW_ROUTING           DYNWAVE
START_DATE             11/18/2016
START_TIME             00:00:00
REPORT_START_DATE      11/18/2016
REPORT_START_TIME      00:00:00
END_DATE               11/20/2016
END_TIME               00:00:00
SWEEP_START            01/01
SWEEP_END              12/31
DRY_DAYS               0
REPORT_STEP            00:01:00
WET_STEP               00:05:00
DRY_STEP               00:05:00
ROUTING_STEP           5
ALLOW_PONDING          NO
INERTIAL_DAMPING       PARTIAL
VARIABLE_STEP          0.75
LENGTHENING_STEP       0
MIN_SURFAREA           0
NORMAL_FLOW_LIMITED    BOTH
SKIP_STEADY_STATE      NO
FORCE_MAIN_EQUATION    H-W
LINK_OFFSETS           DEPTH
MIN_SLOPE              0
MAX_TRIALS             8
HEAD_TOLERANCE         0.005
SYS_FLOW_TOL           5
LAT_FLOW_TOL           5
MINIMUM_STEP           0.5
THREADS                4

[EVAPORATION]
;;Type          Parameters
;;------------- ----------
CONSTANT      0.0
DRY_ONLY      NO

[RAINGAGES]
;;                      Rain      Time   Snow   Data
;;Name                  Type      Intrvl Catch  Source
;;-------------------- --------- ------ ------ ----------
SCS_24h_Type_II_3.72in CUMULATIVE 0:05   1.0    TIMESERIES SCS_24h_Type_II_3.72in
SCS_24h_Type_II_5.21in CUMULATIVE 0:05   1.0    TIMESERIES SCS_24h_Type_II_5.21in
;25-Year Storm Event
SCS_24h_Type_II_6.08in CUMULATIVE 0:05   1.0    TIMESERIES SCS_24h_Type_II_6.08in
SCS_24h_Type_II_7.43in CUMULATIVE 0:05   1.0    TIMESERIES SCS_24h_Type_II_7.43in
SCS_24h_Type_II_9.08in CUMULATIVE 0:05   1.0    TIMESERIES SCS_24h_Type_II_9.08in

[SUBCATCHMENTS]
;;                                                Total    Pcnt.             Pcnt.
Curb     Snow
;;Name  Raingage         Outlet           Area     Imperv   Width    Slope    Length
Pack
;;-------------- ---------------- ---------------- -------- -------- -------- --------
-------- --------
```

```
S1    SCS_24h_Type_II_6.08in DI-14      9.1642   0        328.283  15.77    0
S10   SCS_24h_Type_II_6.08in DI-40      9.3767   0        333.973  16.24    0
S11   SCS_24h_Type_II_6.08in DI-51      3.6687   0        221.342  18.52    0
S12   SCS_24h_Type_II_6.08in DI-36      3.7858   0        221.951  20.17    0
S13   SCS_24h_Type_II_6.08in DI-48      8.4764   0        313.174  16.16    0
S14   SCS_24h_Type_II_6.08in DI-34      8.1437   0        291.967  16.21    0
S15   SCS_24h_Type_II_6.08in DI-46      3.6164   0        185.112  20.1     0
S16   SCS_24h_Type_II_6.08in DI-30      3.8669   0        260.746  15.78    0
S17   SCS_24h_Type_II_6.08in DI-42      3.4645   0        221.281  21.14    0
S18   SCS_24h_Type_II_6.08in DI-28      8.8979   0        313.586  16.1     0
S19   SCS_24h_Type_II_6.08in North      3.6043   0        1570.033 10       0
S2    SCS_24h_Type_II_6.08in DI-27      5.3815   0        263.391  18.56    0
S20   SCS_24h_Type_II_6.08in South      3.523    0        1534.619 10       0
S3    SCS_24h_Type_II_6.08in DI-12      2.508    0        220.704  18.96    0
S4    SCS_24h_Type_II_6.08in DI-23      5.5567   0        352.842  18.43    0
S5    SCS_24h_Type_II_6.08in DI-8       8.6482   0        314.454  16.17    0
S6    SCS_24h_Type_II_6.08in DI-21      7.9114   0        288.627  15.83    0
S7    SCS_24h_Type_II_6.08in DI-6       3.6253   0        250.266  19.71    0
S8    SCS_24h_Type_II_6.08in DI-17      3.1802   0        191.869  19.5     0
S9    SCS_24h_Type_II_6.08in DI-2       9.0393   0        319.604  16.19    0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo
PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ----------
----------
S1               0.012      0.24       0.05       0.2        0          OUTLET
S10              0.012      0.24       0.05       0.2        0          OUTLET
S11              0.012      0.24       0.05       0.2        0          OUTLET
S12              0.012      0.24       0.05       0.2        0          OUTLET
S13              0.012      0.24       0.05       0.2        0          OUTLET
S14              0.012      0.24       0.05       0.2        0          OUTLET
S15              0.012      0.24       0.05       0.2        0          OUTLET
S16              0.012      0.24       0.05       0.2        0          OUTLET
S17              0.012      0.24       0.05       0.2        0          OUTLET
S18              0.012      0.24       0.05       0.2        0          OUTLET
S19              0.012      0.24       0.05       0.2        0          OUTLET
S2               0.012      0.24       0.05       0.2        0          OUTLET
S20              0.012      0.24       0.05       0.2        0          OUTLET
S3               0.012      0.24       0.05       0.2        0          OUTLET
S4               0.012      0.24       0.05       0.2        0          OUTLET
S5               0.012      0.24       0.05       0.2        0          OUTLET
S6               0.012      0.24       0.05       0.2        0          OUTLET
S7               0.012      0.24       0.05       0.2        0          OUTLET
S8               0.012      0.24       0.05       0.2        0          OUTLET
S9               0.012      0.24       0.05       0.2        0          OUTLET

[INFILTRATION]
;;Subcatchment   CurveNum   HydCon     DryTime
;;-------------- ---------- ---------- ----------
S1               80         0          14
S10              80         0          14
S11              80         0          14
S12              80         0          14
S13              80         0          14
S14              80         0          14
S15              80         0          14
S16              80         0          14
S17              80         0.5        14
S18              80         0.5        14
S19              98         0.5        14
S2               80         0          14
S20              98         0.5        14
```

```
S3               80         0.5        14
S4               80         0          14
S5               80         0          14
S6               80         0          14
S7               80         0.5        14
S8               80         0.5        14
S9               80         0.5        14

[JUNCTIONS]
;;               Invert     Max.       Init.      Surcharge  Ponded
;;Name           Elev.      Depth      Depth      Depth      Area
;;-------------- ---------- ---------- ---------- ---------- ----------
J1               362        0          0          0          0
J2               362        0          0          0          0
J30              353        0          0          0          0
J31              353.5      8          0          0          0
J32              353.5      8          0          0          0
MH-1             354.04     10.27      0          0          0
MH-10            355.05     16.42      0          0          0
MH-11            355.1      16.48      0          0          0
MH-13            355.32     10.58      0          0          0
MH-15            354.05     12.89      0          0          0
MH-16            354.16     11.64      0          0          0
MH-18            354.37     16.06      0          0          0
MH-19            354.4      16.01      0          0          0
MH-20            354.49     12.91      0          0          0
MH-22            354.79     14.21      0          0          0
MH-24            355.05     16.43      0          0          0
MH-25            355.1      16.47      0          0          0
MH-26            355.17     10.63      0          0          0
MH-29            354.18     10.91      0          0          0
MH-3             354.28     13.32      0          0          0
MH-31            354.37     11.89      0          0          0
MH-32            354.41     12.71      0          0          0
MH-33            354.6      11.5       0          0          0
MH-35            354.87     11.33      0          0          0
MH-37            355.12     13.6       0          0          0
MH-38            355.16     12.16      0          0          0
MH-39            355.19     11.14      0          0          0
MH-4             354.37     16.06      0          0          0
MH-41            354.05     12.1       0          0          0
MH-43            354.35     11.51      0          0          0
MH-44            354.37     12.03      0          0          0
MH-45            354.42     12.89      0          0          0
MH-47            354.69     11.31      0          0          0
MH-49            355.04     11.76      0          0          0
MH-5             354.4      16.01      0          0          0
MH-50            355.12     13.6       0          0          0
MH-51            355.16     12.24      0          0          0
MH-7             354.61     13.39      0          0          0
MH-9             354.95     13.75      0          0          0

[OUTFALLS]
;;               Invert     Outfall      Stage/Table      Tide
;;Name           Elev.      Type         Time Series      Gate Route To
;;-------------- ---------- ------------ ---------------- ---- ----------------
O1               352        FREE                          NO

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve    Ponded   Evap.
;;Name           Elev.    Depth    Depth    Curve      Params
;;-------------- -------- -------- -------- ---------- -------- -------- --------
DI-12            355.17   10.63    0        TABULAR    SU3      0        0
```

```
DI-14            355.44   10.96    0         TABULAR    SU1        0         0
DI-17            354.27   13.33    0         TABULAR    SU8        0         0
DI-2             354.16   11.64    0         TABULAR    SU9        0         0
DI-21            354.6    13.4     0         TABULAR    SU6        0         0
DI-23            354.94   13.76    0         TABULAR    SU4        0         0
DI-27            355.31   10.59    0         TABULAR    SU2        0         0
DI-28            354.05   12.1     0         TABULAR    SU18       0         0
DI-30            354.35   11.45    0         TABULAR    SU16       0         0
DI-34            354.69   11.31    0         TABULAR    SU14       0         0
DI-36            355.04   11.76    0         TABULAR    SU12       0         0
DI-40            355.38   10.82    0         TABULAR    SU10       0         0
DI-42            354.18   10.91    0         TABULAR    SU17       0         0
DI-46            354.6    11.5     0         TABULAR    SU15       0         0
DI-48            354.87   11.33    0         TABULAR    SU13       0         0
DI-51            355.2    11       0         TABULAR    SU11       0         0
DI-6             354.49   12.91    0         TABULAR    SU7        0         0
DI-8             354.79   14.21    0         TABULAR    SU5        0         0
North            349      15       5         TABULAR    North      0         0
South            349      15       5         TABULAR    South      0         0

[CONDUITS]
;;     Inlet     Outlet              Manning     Inlet      Outlet     Init.      Max.
;;Name  Node       Node    Length       N        Offset     Offset     Flow       Flow
;;-------------- ---------------- ---------------- ---------- ---------- ----------
C1      J1      J30       170         0.013       0          0          0          0
C2      J2      J30       54          0.013       0          0          0          0
Ditch   J30     O1        475.71      0.011       0          0          0          0
Pipe1   MH-1    South     121         0.011       0          5          0          0
Pipe10  MH-10   MH-9      257         0.011       0          0          0          0
Pipe11  MH-11   MH-10     145         0.011       0          0          0          0
Pipe12  DI-12   MH-11     172         0.011       0          0          0          0
Pipe13  MH-13   DI-12     403         0.011       0          0          0          0
Pipe14  DI-14   MH-13     320         0.011       0          0          0          0
Pipe15  MH-15   South     111         0.011       0          5          0          0
Pipe16  MH-16   MH-15     302         0.011       0          0          0          0
Pipe17  DI-17   MH-16     300         0.011       0          0          0          0
Pipe18  MH-18   DI-17     260         0.011       0          0          0          0
Pipe19  MH-19   MH-18     85          0.011       0          0          0          0
Pipe2   DI-2    MH-1      312         0.011       0          0          0          0
Pipe20  MH-20   MH-19     243         0.011       0          0          0          0
Pipe21  DI-21   MH-20     300         0.011       0          0          0          0
Pipe22  MH-22   DI-21     501         0.011       0          0          0          0
Pipe23  DI-23   MH-22     425         0.011       0          0          0          0
Pipe24  MH-24   DI-23     280         0.011       0          0          0          0
Pipe25  MH-25   MH-24     153         0.011       0          0          0          0
Pipe26  MH-26   MH-25     178         0.011       0          0          0          0
Pipe27  DI-27   MH-26     383         0.011       0          0          0          0
Pipe28  DI-28   North     128         0.011       0          5          0          0
Pipe29  MH-29   DI-28     378         0.011       0          0          0          0
Pipe3   MH-3    DI-2      320         0.011       0          0          0          0
Pipe30  DI-30   MH-29     441         0.011       0          0          0          0
Pipe31  MH-31   DI-30     61          0.011       0          0          0          0
Pipe32  MH-32   MH-31     98          0.011       0          0          0          0
Pipe33  MH-33   MH-32     484         0.011       0          0          0          0
Pipe34  DI-34   MH-33     251         0.011       0          0          0          0
Pipe35  MH-35   DI-34     485         0.011       0          0          0          0
Pipe36  DI-36   MH-35     473         0.011       0          0          0          0
Pipe37  MH-37   DI-36     219         0.011       0          0          0          0
Pipe38  MH-38   MH-37     89          0.011       0          0          0          0
Pipe39  MH-39   MH-38     72          0.011       0          0          0          0
Pipe4   MH-4    MH-3      237         0.011       0          0          0          0
Pipe40  DI-40   MH-39     527         0.011       0          0          0          0
Pipe41  MH-41   North     119         0.011       0          5          0          0
```

```
Pipe42 DI-42   MH-41     348        0.011      0          0          0          0
Pipe43 MH-43   DI-42     457        0.011      0          0          0          0
Pipe44 MH-44   MH-43     68         0.011      0          0          0          0
Pipe45 MH-45   MH-44     111        0.011      0          0          0          0
Pipe46 DI-46   MH-45     503        0.011      0          0          0          0
Pipe47 MH-47   DI-46     231        0.011      0          0          0          0
Pipe48 DI-48   MH-47     506        0.011      0          0          0          0
Pipe49 MH-49   DI-48     455        0.011      0          0          0          0
Pipe5  MH-5    MH-4      78         0.011      0          0          0          0
Pipe50 MH-50   MH-49     220        0.011      0          0          0          0
Pipe51 MH-51   MH-50     96         0.011      0          0          0          0
Pipe52 DI-51   MH-51     96         0.011      0          0          0          0
Pipe53 J32     J30       184.84     0.011      0          0          0          0
Pipe54 J31     J30       192.81     0.011      0          0          0          0
Pipe6  DI-6    MH-5      239        0.011      0          0          0          0
Pipe7  MH-7    DI-6      320        0.011      0          0          0          0
Pipe8  DI-8    MH-7      481        0.011      0          0          0          0
Pipe9  MH-9    DI-8      446        0.011      0          0          0          0

[ORIFICES]
;;               Inlet            Outlet   Orifice      Crest      Disch.   Flap 
Open/Close
;;Name           Node             Node     Type         Height     Coeff.   Gate Time
;;-------------- ---------------- ---------------- ------------ ---------- ----------
---- ----------
N-spillway       North            J31      BOTTOM       10         0.65       NO   0
OR1              South            J32      SIDE         5          0.65       NO   0
OR10             North            J31      SIDE         5          0.65       NO   0
OR11             North            J31      SIDE         5          0.65       NO   0
OR12             North            J31      SIDE         5          0.65       NO   0
OR2              South            J32      SIDE         5          0.65       NO   0
OR3              South            J32      SIDE         5          0.65       NO   0
OR4              South            J32      SIDE         5          0.65       NO   0
OR5              South            J32      SIDE         5          0.65       NO   0
OR6              South            J32      SIDE         5          0.65       NO   0
OR7              North            J31      SIDE         5          0.65       NO   0
OR8              North            J31      SIDE         5          0.65       NO   0
OR9              North            J31      SIDE         5          0.65       NO   0
S-spillway       South            J32      BOTTOM       10         0.65       NO   0

[WEIRS]
;;           Inlet    Outlet   Weir     Crest  Disch.     Flap End       End
;;Name       Node     Node     Type     Height Coeff.     Gate Con.      Coeff.
Surcharge  RoadWidth  RoadSurf
;;-------------- ---------------- ---------------- ------------ ---------- ----------
---- --------- ---------- ---------- ---------- ----------
N-emergency   North    J1    TRAPEZOIDAL  13    3.33       NO   0        0          YES
S-emergency   South    J2    TRAPEZOIDAL  13    3.33       NO   0        0          YES

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4
Barrels
;;-------------- ------------ ---------------- ---------- ---------- ----------
----------
C1               TRAPEZOIDAL  2                10         3          3          1
C2               TRAPEZOIDAL  2                10         3          3          1
Ditch            TRAPEZOIDAL  5                5          3          3          1
Pipe1            CIRCULAR     3.739            0          0          0          1
Pipe10           CIRCULAR     3.272            0          0          0          1
Pipe11           CIRCULAR     3.272            0          0          0          1
Pipe12           CIRCULAR     3.272            0          0          0          1
Pipe13           CIRCULAR     3.272            0          0          0          1
Pipe14           CIRCULAR     3.272            0          0          0          1
```

Pipe15	CIRCULAR	3.272	0	0	0	1
Pipe16	CIRCULAR	3.272	0	0	0	1
Pipe17	CIRCULAR	3.272	0	0	0	1
Pipe18	CIRCULAR	3.272	0	0	0	1
Pipe19	CIRCULAR	3.272	0	0	0	1
Pipe2	CIRCULAR	3.739	0	0	0	1
Pipe20	CIRCULAR	3.272	0	0	0	1
Pipe21	CIRCULAR	3.272	0	0	0	1
Pipe22	CIRCULAR	3.272	0	0	0	1
Pipe23	CIRCULAR	3.272	0	0	0	1
Pipe24	CIRCULAR	3.272	0	0	0	1
Pipe25	CIRCULAR	3.272	0	0	0	1
Pipe26	CIRCULAR	3.272	0	0	0	1
Pipe27	CIRCULAR	3.272	0	0	0	1
Pipe28	CIRCULAR	3.739	0	0	0	1
Pipe29	CIRCULAR	3.739	0	0	0	1
Pipe3	CIRCULAR	3.739	0	0	0	1
Pipe30	CIRCULAR	3.272	0	0	0	1
Pipe31	CIRCULAR	3.272	0	0	0	1
Pipe32	CIRCULAR	3.272	0	0	0	1
Pipe33	CIRCULAR	3.272	0	0	0	1
Pipe34	CIRCULAR	3.272	0	0	0	1
Pipe35	CIRCULAR	3.272	0	0	0	1
Pipe36	CIRCULAR	3.272	0	0	0	1
Pipe37	CIRCULAR	3.272	0	0	0	1
Pipe38	CIRCULAR	3.272	0	0	0	1
Pipe39	CIRCULAR	3.272	0	0	0	1
Pipe4	CIRCULAR	3.739	0	0	0	1
Pipe40	CIRCULAR	3.272	0	0	0	1
Pipe41	CIRCULAR	3.272	0	0	0	1
Pipe42	CIRCULAR	3.272	0	0	0	1
Pipe43	CIRCULAR	3.272	0	0	0	1
Pipe44	CIRCULAR	3.272	0	0	0	1
Pipe45	CIRCULAR	3.272	0	0	0	1
Pipe46	CIRCULAR	3.272	0	0	0	1
Pipe47	CIRCULAR	3.272	0	0	0	1
Pipe48	CIRCULAR	3.272	0	0	0	1
Pipe49	CIRCULAR	3.272	0	0	0	1
Pipe5	CIRCULAR	3.739	0	0	0	1
Pipe50	CIRCULAR	3.272	0	0	0	1
Pipe51	CIRCULAR	3.272	0	0	0	1
Pipe52	CIRCULAR	3.272	0	0	0	1
Pipe53	CIRCULAR	2	0	0	0	1
Pipe54	CIRCULAR	2	0	0	0	1
Pipe6	CIRCULAR	3.739	0	0	0	1
Pipe7	CIRCULAR	3.739	0	0	0	1
Pipe8	CIRCULAR	3.739	0	0	0	1
Pipe9	CIRCULAR	3.739	0	0	0	1
N-spillway	CIRCULAR	2	0	0	0	
OR1	CIRCULAR	0.125	0	0	0	
OR10	CIRCULAR	0.125	0	0	0	
OR11	CIRCULAR	0.125	0	0	0	
OR12	CIRCULAR	0.125	0	0	0	
OR2	CIRCULAR	0.125	0	0	0	
OR3	CIRCULAR	0.125	0	0	0	
OR4	CIRCULAR	0.125	0	0	0	
OR5	CIRCULAR	0.125	0	0	0	
OR6	CIRCULAR	0.125	0	0	0	
OR7	CIRCULAR	0.125	0	0	0	
OR8	CIRCULAR	0.125	0	0	0	
OR9	CIRCULAR	0.125	0	0	0	
S-spillway	CIRCULAR	2	0	0	0	
N-emergency	TRAPEZOIDAL	2	10	5	5	

```
S-emergency      TRAPEZOIDAL  2                10         5          5

[LOSSES]
;;Link           Inlet      Outlet     Average    Flap Gate  SeepageRate
;;-------------- ---------- ---------- ---------- ---------- ----------
Pipe1            0          1          0          NO         0
Pipe15           0          1          0          NO         0
Pipe28           0          1          0          NO         0
Pipe41           0          1          0          NO         0
Pipe53           0.5        1          0          NO         0
Pipe54           0.5        1          0          NO         0

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
;Northern stormwater basin
North            Storage    0          57290.52
North                       1          61519.44
North                       2          65836.58
North                       3          70232.92
North                       4          74704.11
North                       5          79248.77
North                       6          83883.62
North                       7          88520.13
North                       8          93223.80
North                       9          97994.66
North                       10         102832.68
North                       11         107737.86
North                       12         112710.21
North                       13         117749.76
North                       14         122858.56
North                       15         128032.65

;Southern stormwater basin
South            Storage    0          54915.65
South                       1          58999.93
South                       2          63166.16
South                       3          67409.57
South                       4          71728.89
South                       5          76123.83
South                       6          80607.03
South                       7          85092.94
South                       8          89645.91
South                       9          94265.98
South                       10         98953.10
South                       11         103707.28
South                       12         108528.55
South                       13         113416.90
South                       14.00      118371.51
South                       15         123394.7

SU1              Storage    0          38.5
SU1                         6.03       38.5
SU1                         6.56       1249.18
SU1                         7.56       4507.77
SU1                         8.56       8163.12
SU1                         9.56       11779.46
SU1                         10.56      15221.95
SU1                         10.96      16588.84

SU10             Storage    0          38.5
SU10                        5.85       38.5
SU10                        6.62       1764.19
```

SU10		7.62	5027.48
SU10		8.62	9538.41
SU10		9.62	13779.39
SU10		10.62	17849.18
SU10		10.82	18671.25
SU11	Storage	0	38.5
SU11		6.02	38.5
SU11		6.8	1551.96
SU11		7.8	4552.06
SU11		8.8	8582.74
SU11		9.8	12048.12
SU11		10.8	15579.32
SU11		11	16277.03
SU12	Storage	0	38.5
SU12		6.76	38.5
SU12		6.96	355.59
SU12		7.96	3089.71
SU12		8.96	7281.46
SU12		9.96	10876.5
SU12		10.96	14385.72
SU12		11.76	17265.86
SU13	Storage	0	38.5
SU13		6.37	38.5
SU13		7.13	1476.29
SU13		8.13	4589.11
SU13		9.13	8889.86
SU13		10.13	12651.27
SU13		11.13	16401.38
SU13		11.33	17092.52
SU14	Storage	0	38.5
SU14		6.33	38.5
SU14		7.31	2424.7
SU14		8.31	5402.92
SU14		9.31	8668.28
SU14		10.31	11629.54
SU14		11.31	14595.13
SU15	Storage	0	38.5
SU15		6.33	38.5
SU15		6.4	134.76
SU15		7.4	2583.63
SU15		8.4	5527.2
SU15		9.4	9011.89
SU15		10.4	12361.01
SU15		11.4	15733.36
SU15		11.5	16461.34
SU16	Storage	0	38.5
SU16		6.52	38.5
SU16		6.65	344.78
SU16		7.65	2891.95
SU16		8.65	6863.96
SU16		9.65	11256.31
SU16		10.65	15386.52
SU16		11.45	18683.21
SU17	Storage	0	38.5
SU17		5.96	38.5
SU17		6.82	1561.06

SU17		7.82	4512.1
SU17		8.82	8548.05
SU17		9.82	12043.83
SU17		10.82	15536.9
SU17		10.96	15849.29
SU18	Storage	0	38.5
SU18		7.11	38.5
SU18		7.95	1965.46
SU18		8.95	5740.29
SU18		9.95	9430.91
SU18		10.95	12814.43
SU18		11.95	16188.36
SU18		12.15	16886.33
SU2	Storage	0	38.5
SU2		5.56	38.5
SU2		5.69	263.16
SU2		6.69	2906.41
SU2		7.69	6442.56
SU2		8.69	9296.94
SU2		9.69	12168.04
SU2		10.59	14759.17
SU3	Storage	0	38.5
SU3		5.62	38.5
SU3		5.83	251.33
SU3		6.83	2075.3
SU3		7.83	4715
SU3		8.83	7249.66
SU3		9.83	10025.45
SU3		10.63	12279.74
SU4	Storage	0	38.5
SU4		8.79	38.5
SU4		9.06	409.15
SU4		10.06	2762.28
SU4		11.06	6462
SU4		12.06	11146.58
SU4		13.06	16286.26
SU4		13.76	19401.77
SU5	Storage	0	38.5
SU5		9.23	38.5
SU5		10.21	2376.15
SU5		11.21	6372.16
SU5		12.21	10875.9
SU5		13.21	14826.39
SU5		14.22	18814.42
SU6	Storage	0	38.5
SU6		8.4	38.5
SU6		9.4	2112.13
SU6		10.4	4613.06
SU6		11.4	7604.39
SU6		12.4	10785.09
SU6		13.38	13677.33
SU7	Storage	0	38.5
SU7		7.91	38.5
SU7		8.51	1192.78
SU7		9.51	4301.47
SU7		10.51	7893.57

SU7		11.51	11887.75
SU7		12.51	15600.63
SU7		12.91	17120.95
SU8	Storage	0	38.5
SU8		8.31	38.5
SU8		8.73	799.25
SU8		9.73	3785.41
SU8		10.73	7512.08
SU8		11.73	11613.82
SU8		12.73	15403.11
SU8		13.33	17663.26
SU9	Storage	0	38.5
SU9		6.67	38.5
SU9		6.84	308.12
SU9		7.84	2230.74
SU9		8.84	5253.25
SU9		9.84	8803.95
SU9		10.84	12090.59
SU9		11.64	14662.58

APPENDIX C
BENCH DITCH AND FLUME CALCULATIONS

Bench Ditch Hydraulic Capacity

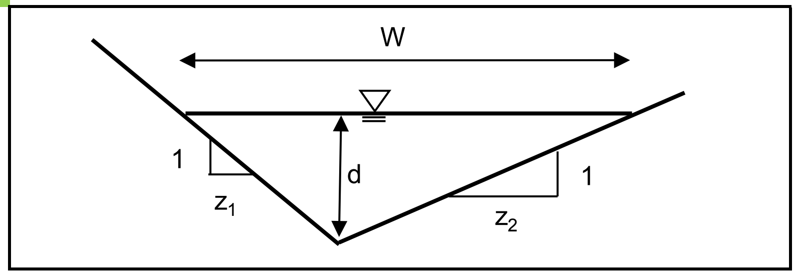
Client	Tennessee Valley Authority		
Project Name	SHF Proposed CCR Landfill		
	Bench ditch sizing calculation	**Prepared By:**	Caitlin Johnson, EIT
Location	Paducah, McCracken County, KY		
Date	3/7/2017	**Reviewed By:**	Joshua Kopp, PE
Stantec Project Number	175666001		

Drainage Ditch - Channel Capacity & Depth Calculations

Channel Section 4

4. Non-Symmetrical Triangular Section

Channel Sketch



Input Data:

Manning's "n" value	0.033	
Longitudinal Slope - S_o	0.020	ft/ft
Design Discharge - Q	5.9	ft^3/s - cfs

Channel Geometry Data:

Side Slope(s)

z_1 or z	10.0	z H:1V
z_2	4.0	z H:1V

Governing Geometry Equations

$$W = d(z_1 + z_2)$$

$$A = \frac{d^2}{2}(z_1 + z_2)$$

$$W_P = d\left(\sqrt{z_1^2 + 1} + \sqrt{z_2^2 + 1}\right)$$

Output Data:

Calculated Depth - d	**0.56**	feet
Calculated Top Width - W	**7.82**	feet
Calculated Area - A	2.18	ft^2
Calc. Wetted Perimeter - Wp	7.92	feet
Calc. Hydr. Radius - R	0.28	feet
Calculated Discharge - Q'	5.91	ft^3/s - cfs
Convergence	0.0400	ft^3/s - cfs
Calculated Velocity	**2.71**	ft / s
Calculated Shear Stress - τ_d	**0.70**	lb / ft^2

$$Q = \frac{1.49}{n} A R^{\frac{2}{3}} S_o^{\frac{1}{2}} \qquad R = \frac{A}{W_p}$$

$$\tau_d = \gamma d S \qquad V = \frac{Q}{A}$$

Riprap Ditch Hydraulic Capacity

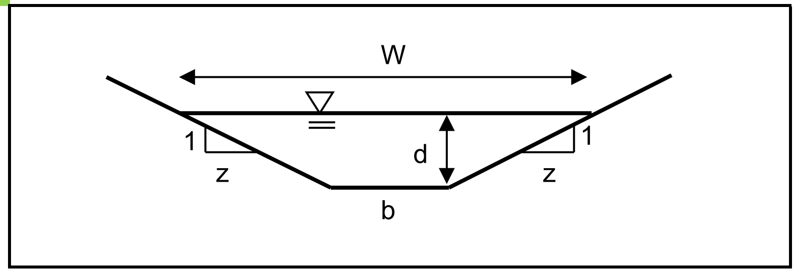
Client	Tennessee Valley Authority		
Project Name	SHF Proposed CCR Landfill		
	Flume sizing calculation	**Prepared By:**	Caitlin Johnson, EIT
Location	Paducah, McCracken County, KY		
Date	3/6/2017	**Reviewed By:**	Joshua Kopp, PE
Stantec Project Number	175666001		

Drainage Ditch - Channel Capacity & Depth Calculations

Channel Section 1

1. Uniform (Symmetrical) Trapezoidal Section

Channel Sketch



Input Data:

Manning's "n" value	0.04	
Longitudinal Slope - S_o	0.150	ft/ft
Design Discharge - Q	27.5	ft^3/s - cfs

Channel Geometry Data:

Bottom Width(s)		
b_1 or b	6	feet
Side Slope(s)		
z_1 or z	3.0	z H:1V

Governing Geometry Equations

$$W = b + 2dz$$

$$A = bd + zd^2$$

$$W_P = b + 2d\sqrt{z^2 + 1}$$

Output Data:

Calculated Depth - d	**0.48**	feet
Calculated Top Width - W	**8.88**	feet
Calculated Area - A	3.56	ft^2
Calc. Wetted Perimeter - Wp	9.03	feet
Calc. Hydr. Radius - R	0.39	feet
Calculated Discharge - Q'	27.67	ft^3/s - cfs
Convergence	0.1682	ft^3/s - cfs
Calculated Velocity	**7.76**	ft / s
Calculated Shear Stress - τ_d	**4.49**	lb / ft^2

$$Q = \frac{1.49}{n} AR^{\frac{2}{3}} S_o^{\frac{1}{2}} \qquad R = \frac{A}{W_p}$$

$$\tau_d = \gamma dS \qquad V = \frac{Q}{A}$$

APPENDIX D
25-YEAR, 24-HOUR STORM EVENT PROFILES

SHAWNEE FOSSIL PLANT PC-SWMM

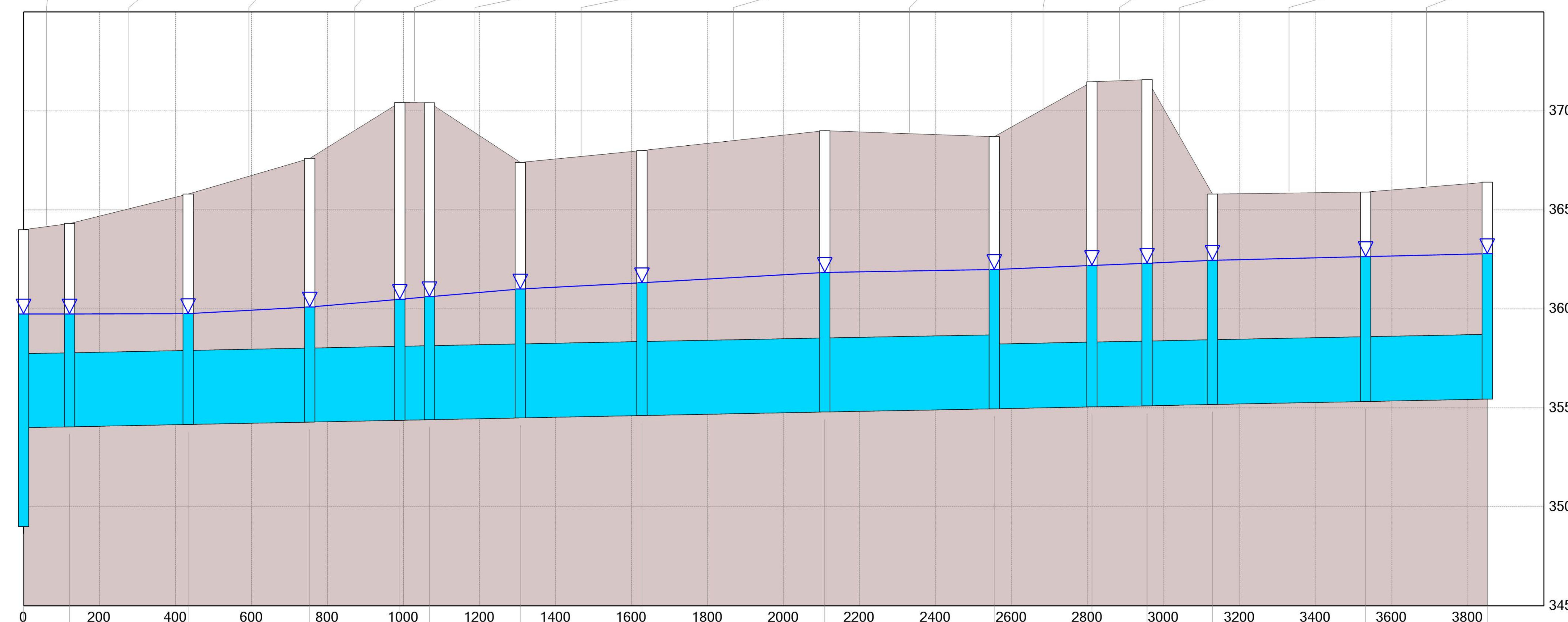
STORM SEWER 1 (SS1) 25-YR STORM EVENT

HGL

Peak values

Links:

Link	Q	L	D	V	S
Pipe1	Q=81.373 cfs	L=121 ft	D=3.739 ft	V=8.013 ft/s	S=0.00033 ft/ft
Pipe2	Q=81.369 cfs	L=312 ft	D=3.739 ft	V=7.411 ft/s	S=0.00038 ft/ft
Pipe3	Q=57.769 cfs	L=320 ft	D=3.739 ft	V=5.261 ft/s	S=0.00038 ft/ft
Pipe4	Q=57.75 cfs	L=237 ft	D=3.739 ft	V=5.26 ft/s	S=0.00038 ft/ft
Pipe5	Q=57.714 cfs	L=78 ft	D=3.739 ft	V=5.256 ft/s	S=0.00038 ft/ft
Pipe6	Q=57.672 cfs	L=239 ft	D=3.739 ft	V=5.252 ft/s	S=0.00038 ft/ft
Pipe7	Q=48.816 cfs	L=320 ft	D=3.739 ft	V=4.446 ft/s	S=0.00038 ft/ft
Pipe8	Q=48.801 cfs	L=481 ft	D=3.739 ft	V=4.445 ft/s	S=0.00037 ft/ft
Pipe9	Q=30.765 cfs	L=446 ft	D=3.739 ft	V=2.802 ft/s	S=0.00036 ft/ft
Pipe10	Q=30.782 cfs	L=257 ft	D=3.272 ft	V=3.661 ft/s	S=0.00039 ft/ft
Pipe11	Q=30.771 cfs	L=145 ft	D=3.272 ft	V=3.659 ft/s	S=0.00034 ft/ft
Pipe12	Q=30.757 cfs	L=172 ft	D=3.272 ft	V=3.658 ft/s	S=0.00041 ft/ft
Pipe13	Q=22.204 cfs	L=403 ft	D=3.272 ft	V=2.641 ft/s	S=0.00037 ft/ft
Pipe14	Q=22.184 cfs	L=320 ft	D=3.272 ft	V=2.638 ft/s	S=0.00038 ft/ft

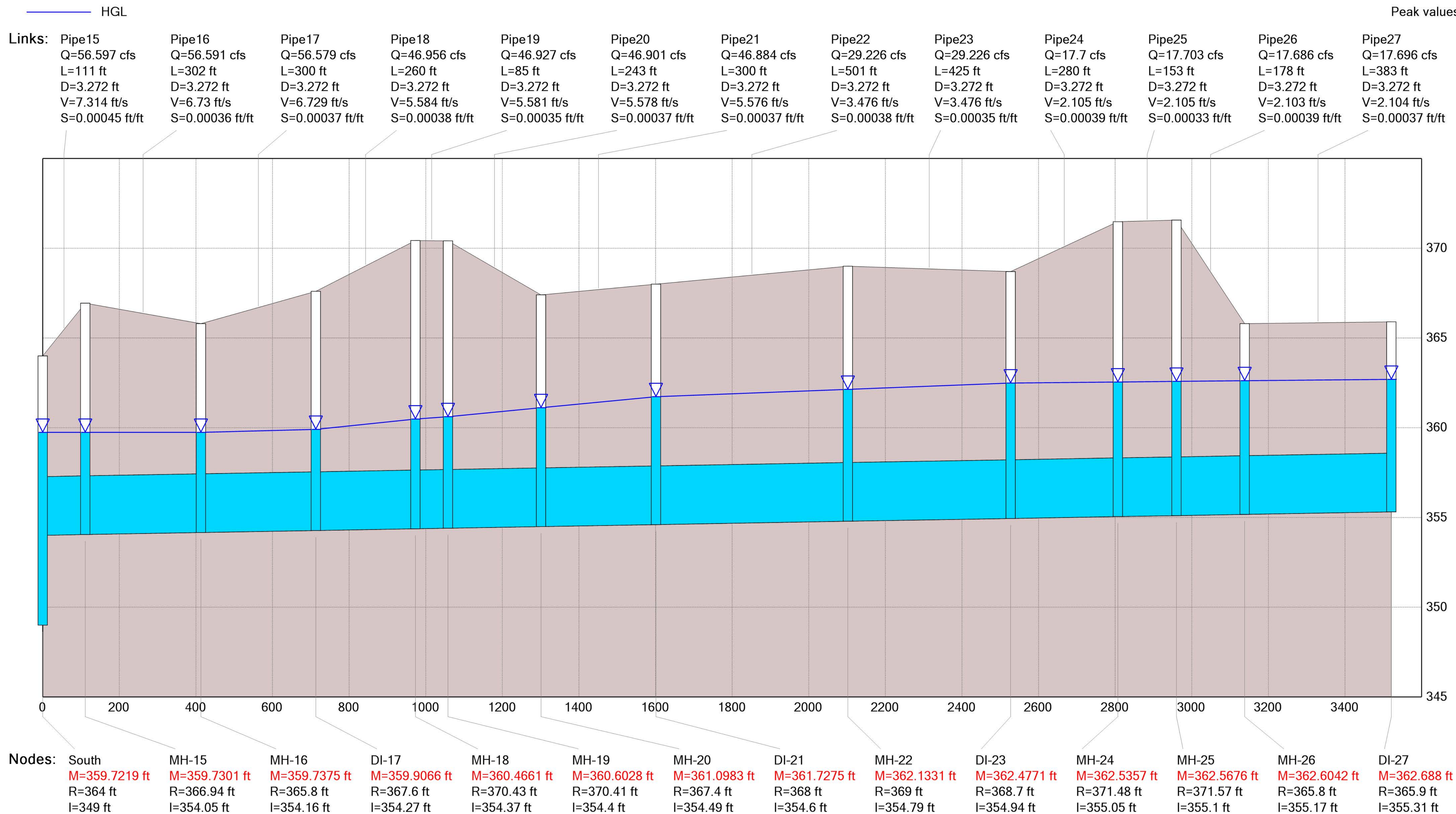


Nodes:

Node	M	R	I
South	M=359.7219 ft	R=364 ft	I=349 ft
MH-1	M=359.7336 ft	R=364.31 ft	I=354.04 ft
DI-2	M=359.743 ft	R=365.8 ft	I=354.16 ft
MH-3	M=360.0867 ft	R=367.6 ft	I=354.28 ft
MH-4	M=360.48 ft	R=370.43 ft	I=354.37 ft
MH-5	M=360.6007 ft	R=370.41 ft	I=354.4 ft
DI-6	M=360.9911 ft	R=367.4 ft	I=354.49 ft
MH-7	M=361.3032 ft	R=368 ft	I=354.61 ft
DI-8	M=361.826 ft	R=369 ft	I=354.79 ft
MH-9	M=361.9857 ft	R=368.7 ft	I=354.95 ft
MH-10	M=362.1806 ft	R=371.47 ft	I=355.05 ft
MH-11	M=362.295 ft	R=371.58 ft	I=355.1 ft
DI-12	M=362.4368 ft	R=365.8 ft	I=355.17 ft
MH-13	M=362.6261 ft	R=365.9 ft	I=355.32 ft
DI-14	M=362.7764 ft	R=366.4 ft	I=355.44 ft

SHAWNEE FOSSIL PLANT PC-SWMM

STORM SEWER 2 (SS2) 25-YR STORM EVENT



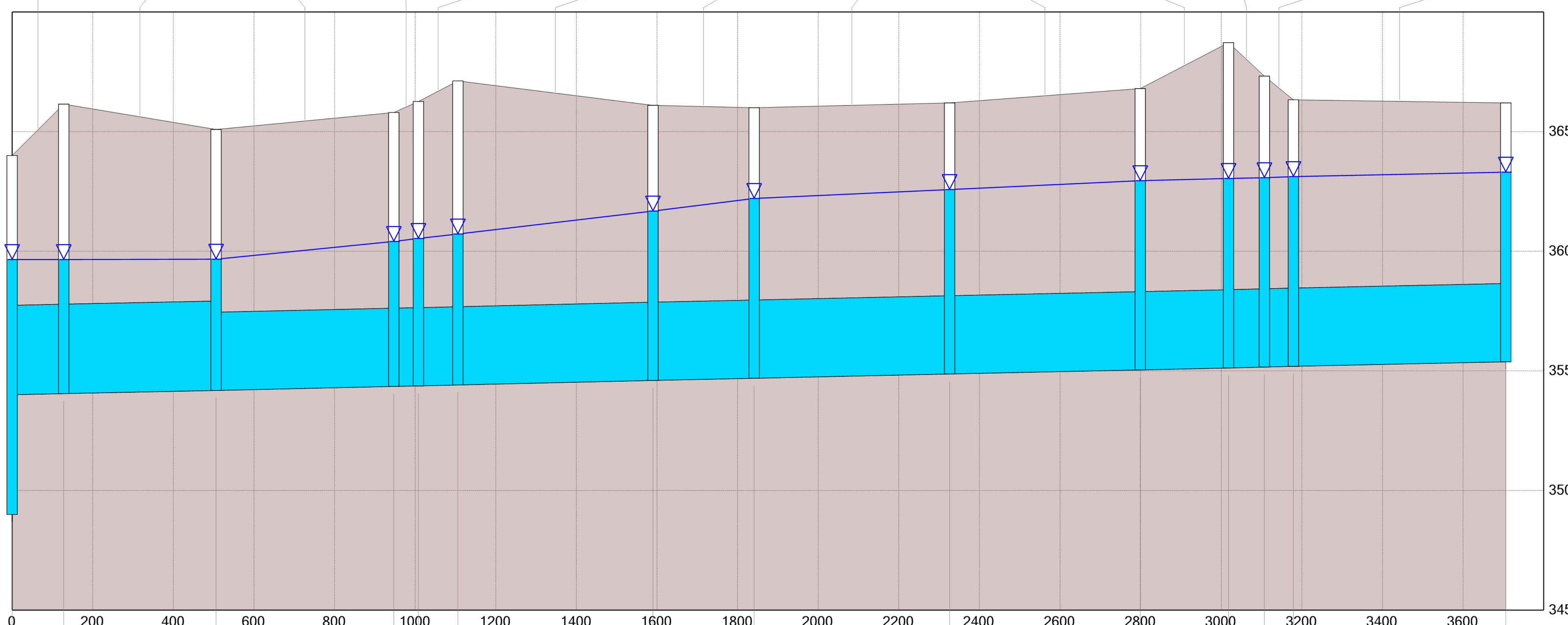
SHAWNEE FOSSIL PLANT PC-SWMM

STORM SEWER 3 (SS3) 25-YR STORM EVENT

HGL — Peak values

Links:

Pipe28	Pipe29	Pipe30	Pipe31	Pipe32	Pipe33	Pipe34	Pipe35	Pipe36	Pipe37	Pipe38	Pipe39	Pipe40
Q=79.494 cfs	Q=55.611 cfs	Q=55.603 cfs	Q=46.791 cfs	Q=46.714 cfs	Q=46.741 cfs	Q=46.737 cfs	Q=29.793 cfs	Q=29.783 cfs	Q=21.847 cfs	Q=21.807 cfs	Q=21.758 cfs	Q=21.721 cfs
L=128 ft	L=378 ft	L=441 ft	L=61 ft	L=98 ft	L=484 ft	L=251 ft	L=485 ft	L=473 ft	L=219 ft	L=89 ft	L=72 ft	L=527 ft
D=3.739 ft	D=3.739 ft	D=3.272 ft	D=3.272 ft	D=3.272 ft	D=3.272 ft	D=3.272 ft	D=3.272 ft	D=3.272 ft	D=3.272 ft	D=3.272 ft	D=3.272 ft	D=3.272 ft
V=7.859 ft/s	V=5.065 ft/s	V=6.613 ft/s	V=5.565 ft/s	V=5.556 ft/s	V=5.559 ft/s	V=5.558 ft/s	V=3.543 ft/s	V=3.542 ft/s	V=2.598 ft/s	V=2.593 ft/s	V=2.588 ft/s	V=2.583 ft/s
S=0.00039 ft/ft	S=0.00034 ft/ft	S=0.00039 ft/ft	S=0.00033 ft/ft	S=0.00041 ft/ft	S=0.00039 ft/ft	S=0.00036 ft/ft	S=0.00037 ft/ft	S=0.00036 ft/ft	S=0.00037 ft/ft	S=0.00045 ft/ft	S=0.00042 ft/ft	S=0.00036 ft/ft



Nodes:

North	DI-28	MH-29	DI-30	MH-31	MH-32	MH-33	DI-34	MH-35	DI-36	MH-37	MH-38	MH-39	DI-40
M=359.6422 ft	M=359.6518 ft	M=359.6566 ft	M=360.4098 ft	M=360.523 ft	M=360.709 ft	M=361.6792 ft	M=362.2052 ft	M=362.5746 ft	M=362.9471 ft	M=363.0309 ft	M=363.0653 ft	M=363.1105 ft	M=363.3036 ft
R=364 ft	R=366.15 ft	R=365.09 ft	R=365.8 ft	R=366.26 ft	R=367.12 ft	R=366.1 ft	R=366 ft	R=366.2 ft	R=366.8 ft	R=368.72 ft	R=367.32 ft	R=366.33 ft	R=366.2 ft
I=349 ft	I=354.05 ft	I=354.18 ft	I=354.35 ft	I=354.37 ft	I=354.41 ft	I=354.6 ft	I=354.69 ft	I=354.87 ft	I=355.04 ft	I=355.12 ft	I=355.16 ft	I=355.19 ft	I=355.38 ft

SHAWNEE FOSSIL PLANT PC-SWMM

STORM SEWER 4 (SS4) 25-YR STORM EVENT