OPERATIONS PLAN

PLANT SCHERER
COAL COMBUSTION RESIDUALS
(CCR) LANDFILL
MONROE COUNTY, GEORGIA

FOR

Georgia Power

JANUARY 2023

GEORGIA REGISTERED NO. 27185 PROFESSIONAL ENGINEER R. BRANT LANE

1/31/23

GEORGIA DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
Approved
Solid Waste Management Program
Approved By: Keith Stevens Digitally signed by Keith Stevens Date: 2023.03.17 10:15:44 -04'00'

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1. GENERAL SITE INFORMATION

This permit was designed to meet the requirements of the site limitations provided by Georgia EPD as of November 17, 2017 provided in Section 5 of this Operations Plan. The Operations Plan, CQA Plan, Closure Plan, Post-Closure Care Plan, Permit Drawings, and the Hydrogeologic Assessment Review for Permit Application all demonstrate how the facility design is in compliance with all site limitations.

This Operations Plan was developed to meet the requirements set forth in Rule 391-3-4-.10 (5)(a) of the Georgia Solid Waste Rules & Regulations (CCR Rules) which address the Operation Criteria of Coal Combustion Residuals (CCR) Landfills. Additionally, the site limitations for the facility provided by Georgia EPD on November 17, 2017, are provided in Section 5 of this Operations Plan.

A. Volumes and Estimated Life

The total area of the Plant Scherer Coal Combustion CCR landfill is 350 acres (within the site permit boundary). Cells 1 and 2 may receive sluiced flue gas desulfurization (FGD) materials (i.e. gypsum) and solid CCR materials. Cell 3 and the PAC/Ash Cell is designed for and receives only solid CCR materials. The waste disposal area is divided in four (4) cells as follows:

	CCR Volume (cy)	**LIFE[1] (yrs.)**	**Types of Waste Disposed**
Cell 1	1,894,965	4.2	Sluiced FGD/Gypsum, Solid CCR, CCR Water Treatment Residuals, Solidified FGD liquid waste
Cell 2	4,086,832	6.0	
Cell 3	1,420,952	8.0	Solid CCR, CCR Water Treatment Residuals, Solidified FGD liquid waste
PAC/Ash Cell	451,974	60	

Note:
[1] The disposal life of the facility is based on the following projected average annual disposal rates (Tons/Yr. Average):

	Gypsum Volume	PAC/Ash Volume	CCR
Year 1	46,403	4,765	240,250
Year 2	106,357	4,765	240,250
Year 3	184,019	4,765	240,250
Year 4	259,940	4,765	240,250
Year 5 and beyond	267,326	4,765	240,250

The estimated life of gypsum cells is based on a dry unit weight of 72 lbs./cu. ft.
The estimated life of the PAC/ Ash cells is based on a dry unit weight of the PAC-Class C Ash mix of 46.91 lbs./ cu. ft.
The estimated life of Cell 3 is based on a unit weight of 100 lbs./cu.ft.

The actual site life may differ depending on the amount of gypsum and other CCR disposed, and the amount removed from the site for beneficial use.

B. Coal Combustion Residuals (CCRs) Description

The facility will receive solid waste produced from the generation of electricity from coal (CCRs) as defined in Rule 391-3-4-.01, and materials in contact with or that contain or absorb CCR (truck liners, truck wash sediments containing ash, etc.) generated by Georgia Power Company. Allowable wastes include:

(i) CCR (fly ash, bottom ash, flue gas desulfurization materials, and boiler slag);

(ii) Materials in contact with or that contain CCR, or used to collect or absorb CCR, that were generated by Georgia Power Company;

(iii) Other waste generated from milling coal in preparation for the combustion process; and

(iv) Coal combustion water treatment residuals (after evaluation described below)

a. Coal combustion water treatment residuals are generated primarily from processes that support the combustion of coal or other fossil fuels that are co-disposed with fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste. The residuals result from the treatment of the following wastewaters: coal pile run-off, boiler cleaning solutions, boiler blowdown, process water treatment and demineralizer regeneration wastes, cooling tower blowdown, air heater and precipitator washes, and effluents from floor and yard drains and sumps.

Prior to the receipt of coal combustion water treatment residuals, a geotechnical engineering evaluation will be performed on the coal combustion water treatment residuals to confirm the handling and placement of this material will not result in unstable conditions or increased pore water pressures of the waste mass and that the in-place strength requirements for long-term stability required under Section 2.L. of this Operations Plan will be achieved. A report will be prepared by a Professional Engineer registered to practice in the State of Georgia that will include the results of the testing of the coal combustion water treatment residuals. Additionally, this Operations Plan will be revised as necessary to specify any material-specific required handling, processing, and placement procedures for the coal combustion water treatment residuals. The revised Operations Plan will be submitted to Georgia EPD for approval prior to receipt of the coal combustion water treatment residuals.

As required by the Rules, CCRs do not include putrescible or hazardous materials regulated under Subtitle C of the Resource Conservation Recovery Act (RCRA).

C. Zoning

A letter demonstrating compliance with local zoning and land use ordinances dated February 21, 2018 is included in Section 3 of this permit application package.

D. Buffers

The CCR landfill is located entirely on Georgia Power Company property. A minimum 200-foot undisturbed buffer exists inside the permitted site boundary as indicated on permit drawings H1C11003 and H1C11004. A minimum 500-foot undisturbed buffer exists between the CCR disposal boundary and any adjacent residences and/or water supply wells.

A minimum 25-foot buffer exists between the CCR disposal boundary and any on-site springs and surface waters (perennial or intermittent). All erosion control measures and/or diversion ditches conform to the Erosion and Sedimentation Control Act and are protective of all streams in the landfill watershed and any associated perennial or intermittent tributaries.

Disturbance of wetland areas is prohibited, except as permitted by the United States Army Corps of Engineers. A statement certifying that wetlands will not be impacted as a result of construction activities at the site will be submitted to EPD, signed and stamped by the professional engineer responsible for construction.

Additional discussion of buffers required by the Scherer Landfill Site Limitations dated 11/17/2017 is provided in Section 3.4 of the *Hydrogeologic Assessment Review for Permit Application* included in Part B, Section 1 of the Permit Application.

E. Site Survey Control

The permitted site boundary is shown on drawing H1C11004 included in Section 10 of the permit application. Corner markers consisting of $^1/_2$-inch diameter rebars with GPC Red Cap have been installed to delineate this boundary. A permanent survey control monument is maintained at the location indicated on drawing H1C11004 for vertical and horizontal control.

F. Limited Access

This CCR landfill is for exclusive use by Georgia Power Company for CCR disposal and is located entirely within the Plant Scherer property boundary. Only authorized personnel are allowed on the plant property. Access to the landfill is further restricted by a chain link security fence and gates.

G. Posted Information

The CCR landfill is for exclusive use by Georgia Power Company for CCR disposal, and is not open to, or accessible by the public. Signage indicating the specific waste that can be placed in the CCR landfill is posted at the entrance. Also, signage denoting the limits of the buffer zone and the location of groundwater and surface water monitoring points is in place.

Reference permit drawing H1C11034 for signage details.

H. Communication

Communications are by cell phone or two-way radio with Plant Scherer. Telephone communications are maintained at the plant.

I. First Aid

First aid supplies are available at the plant.

J. Employee Facilities

Employee restroom facilities are available at Plant Scherer, as well as portable toilets in select locations around the landfill.

2. OPERATIONAL PROCEDURES

A. Supervision

The CCR landfill is under the supervision of an operator who is present at all times during operation and who is properly trained in the operation of landfills and the implementation of the CCR landfill's permit.

The CCR landfill may operate twenty-four (24) hours a day. Personnel trained in landfill operations will be present at all times. Supervision is provided by Georgia Power Company trained personnel.

Training in the operation of CCR waste landfills and the implementation of the approved permit is provided by Georgia Power Company with documentation of training maintained in the facility's operating records.

B. Exclusion of Prohibited Wastes

No hazardous, putrescible wastes or other non-approved wastes will be deposited at this site. To ensure the exclusion of prohibited wastes, the supervisor and/or operator regularly performs random inspections of the CCR material placement operation (generally referred to as "stacking operations"). The results of each inspection are recorded and maintained as part of the facility's operating record. Facility personnel receive training to recognize prohibited wastes.

If prohibited wastes are detected at any time, Georgia Power will remove such waste and ensure it is transported to a properly permitted solid waste handling facility. Any incident of prohibited waste will be described in a report and placed in the facility's operating record.

C. Prohibited Acts

The CCR landfill is operated and maintained in a manner described herein, to prevent open burning, scavenging, and the open dumping of waste.

D. Erosion and Sediment Control

All necessary erosion and sediment control measures will be constructed or installed in accordance with Best Management Practices (BMPs) that meet the requirements of the latest version of the Manual for Erosion and Sediment Control in Georgia (E&S Manual). Any required diversion berms, ditches and other stormwater management structures will be constructed in accordance with the E&S Manual.

E. Access Roads

The current sluice method of gypsum delivery to the landfill does not require the use of temporary access roads within the lined disposal cells. For disposal of PAC, coal ash, and gypsum, if converted to dry disposal, within the lined disposal cells, temporary access roads composed of graded aggregate, bottom ash, or other all-weather surface will be maintained within the cells. Access to the stacking operation will be provided by ramps and perimeter berms. Final access roads are designed to provide continued access for maintenance and inspection. Details for permanent access roads are provided in the permit drawings. Additionally, access roads may be paved at Georgia Power's discretion to enhance all-weather performance.

F. Fire Protection

Fly ash, bottom ash and boiler slag are by-products of the coal combustion process and consist of non-combustible coal minerals. Synthetic gypsum is a by-product of the flue gas desulfurization process in which flue gas is forced through a fluidized bed of calcium carbonate (limestone). This oxidation process produces calcium sulfate (gypsum) and water, neither one is a combustible material. Coal combustion water treatment residuals and other wastes generated from milling coal are also not fire hazards. Litter and other putrescible wastes are not permitted for disposal at this landfill and as a result, the occurrence of fire related to CCRs disposal is not possible, and therefore no soil fire protection is required. Fly ash and gypsum are available for fire control if needed.

For areas receiving PAC/Ash for disposal, 25 cubic yards of soil, fly ash, or gypsum will be stockpiled within or nearby the cell for use to extinguish a fire, if necessary.

G. Site Equipment

The following list of typical equipment will be used during operation of this site:

- CAT D5H-5S dozer or equivalent,
- Excavators,
- Drum Rollers,
- Water truck with spray attachment,
- Off-road trucks,
- Backup and/or specialized equipment will be leased or subcontracted on an as-needed basis, and
- Other equipment, as needed.

H. Recovered Materials Processing Operations

CCRs may be recovered (removed) from the CCR landfill for beneficial re-use in construction, manufacturing, agriculture and other industries. During recovery operations, personnel will leave two (2) feet minimum depth of in-place CCR material over the protective soil cover on the bottom of the cells.

When recovered materials are removed by truck, the truck tires will be cleaned to avoid tracking of recovered materials offsite.

Georgia Power will maintain a record of the volume of CCR material that is recovered for beneficial re-use and will report it to EPD in accordance with Rule 391-3-4-.17(5). See Section 4.C. of this Operations Plan. On-going recovery of CCR material will cause the site life to vary.

I. Controlled Unloading of Waste

The synthetic gypsum will be sluiced to a controlled discharge location(s) within the disposal cells. Other CCR material will be hauled to the disposal cells in dump trucks and unloaded. See Section 2.L. of this plan for spreading, compaction, and stability procedures and Section 2.P. for dust control procedures.

Georgia Power will maintain a record of the volume of CCR that is placed in the CCR landfill and will report it to EPD in accordance with Rule 391-3-4-.17(5). See Section 4.C of this Operations Plan.

J. Solid Waste Processing Operations

Solidification

A water recovery treatment process for liquid flue gas desulfurization wastes at Plant Scherer produces CCR liquid waste. This liquid meets the definition of CCR waste because it only contains material resulting from flue gas desulfurization (the process which produces gypsum solids). The liquid will be added to solidification agents and mixed in a concrete truck in transit to the Plant Scherer CCR landfill.

Pilot tests conducted with materials used in this solidification operation indicate there are no issues in handling the solidified materials due to any heat of reaction.

Bulk solidification agents to be used will include one or more of the following: PAC ash, Portland cement, lime, gypsum and aluminates (i.e. sodium aluminate). CCR liquid waste will be added to the solidification agents and mixed in concrete trucks prior to placement in solidification containers.

This waste solidification plan shall include encapsulation and disposal of CCR waste only.

Specific operational requirements for the solidification process at the CCR landfill are provided below.

Operational Requirements for Solidification

1. The shallow, water-tight, welded steel waste solidification containers (see Solidification Container Detail below) shall be located within the lined area of the landfill so that the existing leachate collection system beneath the solidification areas will provide added containment for the solidification process. The water-tight solidification containers may be relocated within the existing lined landfill area, as necessary, to accommodate landfill operations. A minimum 25' buffer shall be maintained between the solidification container and the existing edge of liner.

2. The steel solidification containers will serve as the primary containment for the curing phase of solidification operation. The steel solidification containers will be placed on top of the existing waste. Additional soil and all-weather access areas may be placed around the solidification containers to provide stable areas for truck access and equipment operations.

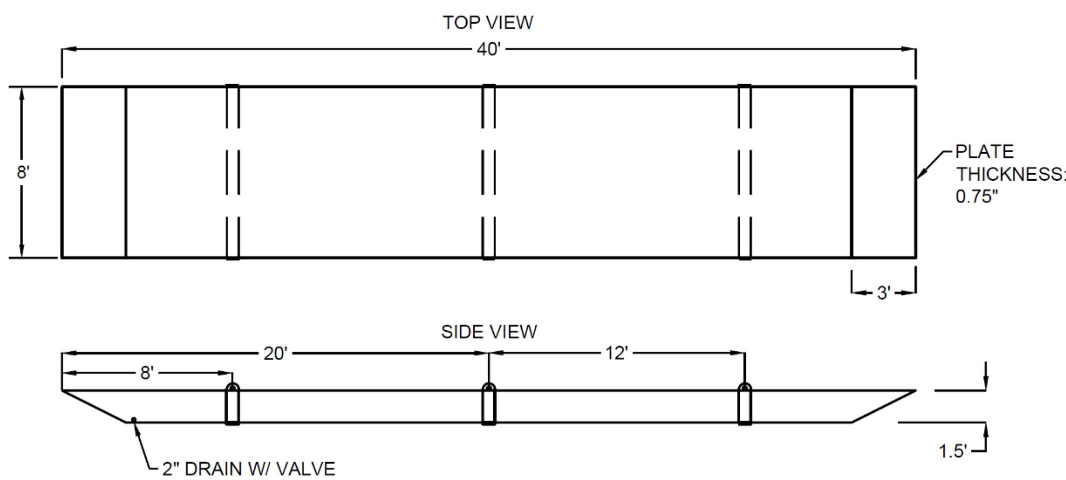
3. Earthen or CCR berms will be constructed on the landfill, around the solidification area to prevent runoff from solidification operations from leaving the lined area.

4. CCR liquid waste will be mixed with solidification agents prior to arriving at the landfill site to prevent generation of dust or particulate emissions at the landfill.

5. Solidified waste will be confirmed to be absent of all free liquids by qualified personnel using Method 9095 (Paint Filter Liquids Test), as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Pub. No. SW-846) prior to removal from the solidification container.

6. Once solidification is complete, the waste shall be removed from the solidification container and placed in the active landfill cell where it will be incorporated into other previously placed CCR wastes in a manner that will not impede infiltration through the waste mass.

7. When solidification operation is taking place, the solidification area will be visually inspected at least daily to ensure all solidification materials are confined within the containers and containment berms remain in place.



SOLIDIFICATION CONTAINER DETAIL

K. Waste Requiring Special Handling

PAC/Ash

The PAC/ash will be conditioned with the addition of water during loading at the silo located at the plant. Typically, the PAC/ash will be conditioned with 1000 to 2000 gallons of water for each 10 tons of dry PAC/ash (41% to 83% moisture). Efforts will be made to achieve conditioning at optimum plus 11% (62%) moisture for ease of handling, transporting, placement, and testing.

The PAC/ ash mixture will be transported to the PAC/ ash cell by tandem dump trucks. Experience has indicated that the PAC/ash mix will tend to adhere to the bed of the trucks. Polyethylene is typically used to line the truck beds prior to loading to facilitate dumping the PAC/ash. As such, the polyethylene will be placed in the landfill along with the PAC/ash as it is dumped.

Beginning at the northwest end, an approximate 100 ft. wide working lift will be established proceeding eastward along the high side of the cell. The PAC/ ash will be unloaded along this working lift and uniformly spread in approximately 8- to 10- inch lifts (nominal loose thickness) and compacted to achieve a minimum 90% of its maximum dry density as determined by ASTM D698. The working lift will typically be filled to its maximum elevation and slope, as noted on the permit drawings, along the full length of the cell. Additional lifts may be started and operated as the initial lift is being filled. However, no more than one working lift can be operated at one time without prior approval. The exposed working area of the PAC/ash lifts shall be limited to approximately two acres.

Subsequent working lifts shall be placed parallel to the initial lift as the cell is filled in an easterly direction.

The working slope between lifts shall be 4H:1V or flatter.

Temporary or intermediate cover consisting of soil and/or gypsum may be required for the exposed PAC/ash. The temporary cover shall be placed in maximum 6- inch to 12-inch lifts (nominal loose thickness), spread and back - bladed smooth to facilitate run-off from the lift surface.

Prior to accepting coal combustion water treatment residuals for disposal, an evaluation of long-term stability will be undertaken, and this section will be updated with any special handling requirements.

Any PAC/ash fill areas that have reached final grade, or will not receive additional PAC/ash fill, will be covered in accordance with the closure/post closure plan.

L. Spreading, Compaction, and Stability

Gypsum

Synthetic gypsum will be sluiced to the discharge location(s) within the disposal cells. The slurry will be directed to varying locations within the disposal cells by interior berms and ditches constructed from previously settled gypsum, or a trough constructed out of durable material such as HDPE or plywood. The gypsum, which settles out of the slurry, will be excavated and placed in the cell to provide a uniform compacted lift across the cell. The gypsum stack will be increased in height using interior gypsum berms constructed with excavated gypsum from the interior ditches.

Other CCR Material

CCR material will be uniformly spread in approximately 6- to 8- inch horizontal lifts (nominal loose thickness) and compacted to achieve a minimum 92% of its maximum dry density as determined by ASTM D698. Proper placement of CCR includes stabilization of wet materials by mixing with dry materials or by drying, no downhill pushing and/or compaction of CCR, and benching lifts of CCR material when placing against existing CCR slopes.

The surface of the compacted material will be rolled with a smooth drum roller to seal the surface to reduce infiltration and graded to prevent ponding of precipitation. Efforts will be made to achieve conditioning at a moisture content suitable for ease of handling, transporting, placement, compaction and testing.

Moisture Conditioning

Georgia Power may utilize an irrigation type system or other forms of moisture conditioning, such as the use of water trucks, at the Plant Scherer CCR Landfill. The irrigation system will be installed in phases as CCR waste is placed in the constructed cells. If needed, the irrigation system may also be extended to the surface of each additional lift of CCR disposed. Water for the irrigation system will be pumped from one of the landfill clear pools or sediment ponds and sprayed over lined areas. All run-off will be contained within the lined waste footprint or lined containment ditches. Water will be applied at a rate that minimizes run-off and does not oversaturate the waste. Any potential runoff will be directed to one of the landfill's lined sediment or clear pool ponds. Spray nozzles and pipe sizes will be sized and adjusted by the landfill operator as necessary to meet operational requirements and minimize run-off. Pipe material for the irrigation system will be HDPE but may be modified at the operator's discretion.

Cell 3 Initial Fill

For the initial fill operations in Cell 3, a temporary containment berm will be constructed no farther than 100ft. down gradient from edge of CCR placement, defining the initial working area. The 24 inches of sand drainage and protective layer for the LCRS down gradient of the temporary containment berm will be covered with a sacrificial 40mil HDPE geomembrane (rain cover), or approved equivalent material, to prevent excessive storm-water run-off from entering the LCRS and prevention of erosion of the protective layer. Sandbags placed generally on a 10ft. by 10ft. grid will be used to prevent wind uplift of the rain cover. As the working face and working area are advanced, the berm and rain flap will be removed and constructed farther down-gradient to define the new working area. The initial fill will consist of 2 to 3 ft. of compacted ash covering the working area defined by the containment berm. The compacted CCR will be compacted with smooth drum roller to create a smooth surface minimizing infiltration of storm water and facilitating run-off. The leachate collected by the LCRS will be collected in the sump and pumped to the PAC/Ash pond. The storm water run-off will be routed to the non-leachate stormwater pond.

Long-Term Stability Considerations

The long-term stability of the cells has been confirmed assuming that the majority of the CCR material is placed as discussed in this section of the Operations Plan and consists of either gypsum or other CCRs (fly ash, bottom ash, PAC), and has the minimum shear strength discussed in the engineering report calculations. For gypsum disposed in Cells 1 and 2, the minimum shear strength will be 28 degrees, or a combination of friction and cohesion equal to or greater than the shear strength envelope represented by 28 degrees. For CCR disposed in Cell 3, the minimum shear strength will be 26.5 degrees, or a combination of friction and cohesion equal to or greater than the shear strength envelope represented by 26.5 degrees.

The strength of the CCR materials placed within each cell shall be evaluated at least annually to confirm that the minimum strength required for stability is being achieved. A test pad section constructed inside the cells using the field methods representative of placement conditions shall be built to obtain representative samples for testing in the laboratory.

CCR materials placement operations should be conducted in a manner to minimize the infiltration of water into the waste. The landfill shall be regularly monitored for standing water, leachate outbreaks, pumping and rutting of CCR materials under traffic loading, or other signs that may indicate that liquids are not draining properly. Additionally, waste placement procedures should not be modified in a manner that may create impermeable zones of waste. If waste permeabilities change or signs of saturated waste conditions are observed, the stability of the landfill slopes shall be re-evaluated based on the new conditions.

Additionally, CCR material will be placed and compacted in uniform and continuous lifts beginning in the bottom of the cell with CCR materials abutting the perimeter berm. If needed, intermediate CCR slopes with a maximum slope inclination of 3H:1V and maximum height of 30 feet can be formed in the bottom of the cell without abutting the exterior berm of the cell to maintain intermediate stability conditions. Intermediate slopes higher than 30 feet must be buttressed by the perimeter berm.

M. Daily and Intermediate Cover

CCRs are predominantly inorganic by-products of the coal combustion process. Synthetic gypsum is a by-product of the flue-gas desulfurization process in which the flue gas is forced through a fluidized bed of calcium carbonate (limestone). Additionally, litter and other putrescible wastes are not allowed to be disposed at this CCR landfill. Therefore, daily and intermediate covers are not necessary for the control of disease vectors, odor, fires, scavenging, and litter.

Additionally, the CCRs will be deposited in a moistened condition thus reducing the possibility of fugitive dust. The possibility of fugitive dust from this CCR landfill will be further controlled by water spray from water trucks or irrigation type systems (See Section 2.P. of this plan).

N. Disease Vector Control

The CCR landfill is used only for the disposal of materials described in Section 1.B. Vector controls are not required at this CCR landfill, since no litter or putrescible wastes are disposed.

O. Litter Control

The Plant Scherer CCR Landfill is used exclusively for disposal of CCR materials. These materials do not contain litter or contribute to blowing refuse. Routine inspection of the CCR landfill site is conducted regularly, and any litter and/or waste blown onto the site, is removed.

P. Dust Control

The purpose of this fugitive dust control plan is to demonstrate compliance with the fugitive dust requirements in CCR Rule 391-3-4-.10(5)(a).

This fugitive dust control plan identifies and describes the CCR fugitive dust control measures that Georgia Power Plant Scherer uses to minimize CCR from becoming airborne at the facility, including CCR fugitive dust originating from CCR units, roads, and other CCR management and material handling activities.

CCR Rule 391-3-4-.10(2)(a), by reference to 40 CFR 257.53, defines “fugitive dust” as “solid airborne particulate matter that contains or is derived from CCR, emitted from any source other than through a stack, or chimney”. Fugitive dust originating from Cells 1, 2 3, and the PAC/Ash Cell is controlled using water suppression, material compaction, or covering ash with conditioned CCR.

The fugitive dust control measures identified and described in this plan were adopted and implemented based upon an evaluation of site-specific conditions and are determined to be applicable and appropriate for the Scherer CCR Landfill. Evaluation included assessing the effectiveness of the fugitive dust control measures for the facility, taking into consideration various factors such as site conditions, weather conditions, and operating conditions.

CCR that is transported via truck to Cells, 1,2, 3, and the PAC/Ash Cell is conditioned to appropriate moisture content to reduce the potential for fugitive dust.

Water suppression is used as needed to control fugitive dust on facility roads used to transport CCR and on other CCR management areas.

Speed limits are also utilized to reduce the potential for fugitive dust.

Trucks used to transport CCR are filled to or under capacity to reduce the potential for material spillage.

Trucks used to transport CCR to the landfill are covered and the ash is conditioned to an appropriate moisture content to reduce the potential for fugitive dust.

Trucks used to transport ash and gypsum off-site are covered.

Plant personnel assess the effectiveness of the control measures by performing visual observations of all CCR units and surrounding areas and implementing appropriate corrective actions for fugitive dust, as necessary. Logs are used to record the utilization of water-spray equipment.

When complaints are received from a citizen regarding a CCR fugitive dust event at the facility, the complaints are documented and investigated. Appropriate steps are taken if needed, including any corrective action.

Georgia Power may amend the written CCR fugitive dust control plan at any time provided the revised plan is placed in the facility's operating record as required by 40 CFR 257.105(g)(1). Georgia Power must amend the written plan whenever there is a change in conditions that would substantially affect the written plan in effect.

Coal Combustion Residuals (CCR) Annual Fugitive Dust Control Reports for the Plant Scherer CCR Units are published in the Georgia Power website under Environmental Compliance.

Q. Explosive Gas Control (Methane Gas)

Methane gas is not generated in the disposal area because the FGD and the coal combustion processes do not produce waste that generate methane gas. Also, waste that may generate methane gas, such as putrescible wastes and litter, is not allowed at this CCR landfill; thus, a methane gas monitoring system is not required.

R. Run-On/Run-Off Control

CCR is contained within a lined earthen berm to prevent stormwater from the surrounding area from entering the disposal cells (run-on). CCR placement is confined to within this berm. Run-off from active cells, as well as any disturbed areas, is routed into the lined return water / sediment ponds designed to collect and control the flow resulting from a 24-hour, 25-year storm. The details for erosion and sediment control structures are included in the permit drawings.

The Initial Run-On and Run-Off Control Plan that Georgia Power developed in October 2016 to meet the requirements of the Federal CCR Rule is included in Appendix 1. Additionally, the plan has been revised as part of the periodic assessment and also includes calculations for proposed Cell 2. Cell 3 Calculations are included in the Cell 3 Engineering Report located in Section 2 of Part B of the permit application. The most recent Run-On and Run-Off Control Plan is provided in Appendix 2. The Run-On and Run-Off Control Plan will be reviewed and updated every 5 years. Georgia Power may amend the written run-on and run-off control system plan at any time provided the revised plan is placed in the facility's operating record. Georgia Power must amend the written run-on and run-off control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

S. Surface Water Requirements

Lined sediment ponds and a clear pool pond are provided to capture all leachate, sluice water and stormwater run-off from the CCR disposal cells. Ditches contained within the perimeter earthen berms convey all run-off to these ponds. A return water pumping system is provided to pump water from the clear pool pond back to the electric generation facility where it is utilized in the FGD process or treated in accordance with the facility's NPDES wastewater permit prior to discharge. The ponds are designed to retain, without the consideration of pumping, three days of process flows (sluice flow), leachate, and the surface stormwater run-off for a 24 - hr. 100 yr. storm event.

The PAC Ash Sedimentation Basin, the South (Cell 1) Sedimentation Basin, and the North (Cell 2) Sedimentation Basin are existing. The North Sedimentation Basin currently provides supplemental storage capacity for the facility and will continue to be utilized in this capacity until the construction of Cell 2. The North Sedimentation Basin will be modified during Cell2 construction to also receive run-off from the Cell 2 area.

T. Final Grading

The final slopes were designed to remain permanently stable, to control erosion, to allow placement, compaction, and seeding of cover material, to minimize percolation of precipitation into the final cover, and to provide diversion of surface run-off from the disposal area. The final surface slopes are between 3% and 33% (3H:1V). Final grading plans and final cover system details are provided in the permit drawings. Vegetation of final cover will be completed at the time of final cover placement.

U. Vegetation

All areas of the landfill required to be vegetated, as well as all ponds, will be maintained throughout the life of the CCR landfill. The following schedule indicates the recommended species, planting dates, and fertilization requirements. Reference the latest edition of the Manual for Erosion and Sediment Control in Georgia. Any disturbed area that will remain exposed for more than three (3) months will receive temporary vegetation.

VEGETATION SCHEDULE

BROADCAST														
SPECIES	RATES	PLANTING DATES												COMMENTS
		J	F	M	A	M	J	J	A	S	O	N	D	
Wilmington Bahia alone	60 lbs. / ac	····	····	··——	——	——	····	····	····	····	····	····	····	Low growing.
Wilmington Bahia w/ other perennials	30 lbs. / ac			——	——				··——	——	——··			Mix with sericea lespedeza. Low growing.
Tall Fescue alone	50 lbs. / ac			——	——				··——	——	——··			
Tall Fescue w/ other perennials	30 lbs. / ac								··——	——	——··			Mix with sericea lespedeza.
Reed Canary alone	50 lbs. / ac								··——	——	——··			
Reed Canary w/ other perennials	30 lbs. / ac	····	····	··——	——	——	····	····	····	····	····	····	····	
Ambro Virgata or Appalow Lespedeza scarified	60 lbs. / ac			··	——	——	··							Mix with bahai or tall fescue. Do not mix with sericea lespedeza.
Ambro Virgata or Appalow Lespedeza unscarified	60 lbs. / ac	——	——	····	····	····	····	····	····	——	——	——	——	Mix with bahai or tall fescue. Do not mix with sericea lespedeza.

Note: Solid lines indicate optimum dates, dotted lines indicate permissible but marginal dates.

FERTILIZATION (Warm Season Grasses)			
YEAR	**N-P-K**	**RATE**	**N TOP DRESSING RATE**
First	6-12-12	1500 lbs./ac	50 - 100 lbs./ac
Second	6-12-12	800 lbs./ac	50 - 100 lbs./ac
Maintenance	10-10-10	400 lbs./ac	30 lbs./ac

V. Continuity of Operation

Access roads and ramps are provided to the active disposal cells. The permanent access road to the landfill is an all-weather road and allows access to the landfill during inclement weather for disposal, inspection, and maintenance or replacement of equipment.

3. ENVIRONMENTAL PROTECTION

A. Inspections

1. 7-day Inspections

Georgia Power will inspect the CCR landfill at intervals not exceeding seven (7) days. The 7-day inspections will be made by a Qualified Person and include observation and documentation of any appearance of actual or potential structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the landfill.

Georgia Power will record the results of these inspections on a self-generated form that will be filed in the facility's operating record. If a potential deficiency or release is identified during an inspection, Georgia Power will remedy the deficiency or release as soon as feasible. Georgia Power will prepare documentation detailing the corrective measures taken and place it in the facility's operating record.

2. Annual Inspections

As required by Chapter 391-3-4-.10(5)(a) of the Georgia Solid Waste Rules, a Professional Engineer registered in Georgia will inspect the CCR landfill on an annual basis. This annual inspection includes, at a minimum:

a. A visual inspection of the CCR landfill to identify signs of distress or malfunction of the CCR landfill.

b. A review of available information regarding the status and condition of the CCR landfill, including, but not limited to, files available in the facility's operating record such as:

   i. The results of the 7-day inspections and the results of previous annual inspections,

   ii. Files available in the operating record and other conditions which have disrupted or have the potential to disrupt the operation or safety of the CCR landfill.

c. If a potential deficiency or release is identified during an inspection, Georgia Power will remedy the deficiency or release as soon as feasible. Georgia Power will prepare documentation detailing the corrective measures taken and place it in the facility's operating record.

B. Annual Reporting

At the completion of each annual inspection, the Professional Engineer who completed the inspection will prepare an annual inspection report that includes the following:

a. Any changes in geometry of the CCR landfill components since the previous annual inspection;

b. The approximate volume of CCR contained in the unit at the time of the inspection;

c. Any appearances of an actual or potential structural weakness of the CCR within the CCR landfill, or any existing conditions that are disrupting or have the potential to disrupt the operation and stability of the CCR landfill; and

d. Any other change(s) which may have affected the stability or operation of the CCR landfill since the previous annual inspection.

Annual Inspection Reports for the Plant Scherer CCR landfill, which meet the requirement of Chapter 391-3-4-.10(5) of the Georgia Rules, can be found online at Georgia Power website under Environmental Compliance.

C. Ponds with Leak Detection Systems (Sediment Ponds / Return Water Ponds)

Georgia Power will maintain permanent pumps in the leak detection sumps of the double-lined ponds and will operate them as needed to maintain liquids in the leak detection system lower than one (1) foot.

D. Groundwater Monitoring Plan

Groundwater monitoring will be performed in accordance with the schedule and requirements indicated in the Plant Scherer CCR Landfill Groundwater Monitoring Plan included in Section 7 of this permit application. The plan meets the requirements of Georgia CCR Rule 391-3-4-.10(6).

Additionally, results of analytical tests performed on FGD samples are reported in the groundwater monitoring reports.

4. RECORDKEEPING, NOTIFICATION, AND PUBLICLY ACCESSIBLE INTERNET SITE REQUIREMENTS

The Plant Scherer CCR Landfill complies and will continue to comply with the recordkeeping, notification, and publicly accessible internet site requirements set forth in Georgia CCR Rule 391-3-4-.10(8).

The publicly accessible internet site for the Plant Scherer CCR facilities is found at the Georgia Power website under Environmental Compliance.

A. Recordkeeping

Georgia Power maintains and will continue to maintain the facility's operating record at all times during the life of the CCR landfill, including the closure and post closure periods. These records are maintained by plant personnel and are located at Plant Scherer. The following records are maintained as part of the facility's operating record:

1. A copy of the permit and any operating conditions including location restrictions;
2. Inspection records, training procedures, and notification procedures required by this Plan and by Rule 391-3-4-.10(5) and (8);
3. Any demonstration, certification, finding, monitoring, testing, or analytical data pertaining to groundwater monitoring and as required by rule 391-3- 4 -.10(6);
4. Closure and post-closure plans and any monitoring, testing, or analytical data required by those Plans and Rules 391-3-4.10(7);
5. Any cost estimates and financial assurance documentation;
6. A copy of the permit documents for the CCR landfill;
7. A copy of the groundwater monitoring plan for the CCR landfill;
8. A copy of the Construction Quality Assurance Plan, construction certifications, closure certifications, and post-closure certifications.
9. The fugitive dust control plan, and any subsequent amendment of the plan, as required by 40 CFR 257.80(b), except that only the most recent control plan must be maintained in the facility's operating record irrespective of the time requirement of 5 years;
10. The annual CCR fugitive dust control report as required by 40 CFR 257.80(c);
11. The initial and periodic run-on and run-off control system plans as required by 40 CFR 257.81(c).)

All information contained in the facility's operating record will be furnished to the Georgia EPD or be made available at all reasonable times for inspection by EPD staff.

B. Notification and Internet Posting Requirements.

As specified by the Rules, Georgia Power will provide notifications to EPD within 30 days of placing documents in the facility's operating record. The notifications will be sent before the close of business on or before the day the notification is required to be completed. Notifications to EPD will be postmarked or sent by electronic mail. If a notification deadline falls on a weekend or federal holiday, the notification deadline will be extended to the next business day. Georgia Power will state in the notification to EPD if the relevant information was placed on the Georgia Power website under Environmental Compliance. Information required to be posted on the Georgia Power website under Environmental Compliance will be available to the public for at least five (5) years following the date on which the information was first posted.

C. Measuring and Reporting Requirements

In accordance with Rule 391-3-4-.17(5), on July 1 of each year after the first full year that the CCR Landfill permit is issued, Georgia Power will report to EPD the total volume of the CCR waste disposed in the CCR Landfill, and the CCR removed, recovered, or diverted for beneficial re-use. The required data will be submitted to EPD on forms issued by EPD.

5. SITE LIMITATIONS (AS OF NOVEMBER 17, 2017)

The site limitations provided below were provided by Georgia EPD for the Plant Scherer CCR Landfill site.

1. The area considered for acceptability includes only that delineated by the dashed boundary line and identified as "Proposed Permitted Site" on Southern Company Generation, Engineering and Construction Service's Figure 1-5 (Drawing ES1533 1-5), revised on May 13, 2008.

2. This facility may receive Coal Combustion Residuals (CCR), as defined in Rule 391-3-4-.01, and materials contaminated by CCR, or used to collect or absorb CCR, that were generated by Georgia Power Company.

3. An analysis of effluent drainage shall be included in the Design and Operation Plan for EPD approval. Should the liquid pressure head be determined to surpass 30 cm, the landfill is to have a double composite liner with a leak detection system. Otherwise, a composite liner and leachate collection system designed in accordance with Rule 391-3-4-.07(1)(d), or an alternate equivalent, shall be constructed. Liner systems shall underlie areas of permanent waste disposal as well as diversion ditches used for transport of gypsum-containing effluent.

4. A minimum 500-foot undisturbed buffer shall be maintained between the waste disposal boundary and any adjacent residences and/or water supply wells.

5. A minimum 200-foot undisturbed buffer shall be maintained between the waste disposal boundary and the permitted property boundaries, as shown on the above-referenced map.

6. A minimum 25-foot undisturbed buffer shall be maintained between the waste disposal boundary and any on-site springs, intermittent or perennial streams or surface water bodies. This limitation may be waived, at EPD's discretion, if approvable engineering measures (e.g. underdrains) are proposed.

7. A minimum 150-foot buffer shall be maintained between the waste disposal boundary and Berry Creek as labeled on Southern Company Generation, Engineering and Construction Service's Figure 1-2 (Drawing- ES1533 1-2).

8. If, during construction/excavation of the site, any springs or seeps are discovered, EPD shall be immediately notified and protective measures shall be incorporated into the facility's design and operations plans to prevent contamination of the spring or seep. Sampling of the spring or seep shall also be incorporated into the facility's groundwater sampling plan.

9. The bottom of the liner system shall be kept a minimum of 5 feet above the seasonal high groundwater elevation contours shown on Southern Company Generation, Engineering and Construction Service's Drawing H1C11028, revised on April 13, 2009.

10. An underdrain system can be installed where necessary to maintain the required water table separation of 5 feet. The project engineer must make periodic quality control inspections

during the installation of the underdrain system and shall certify that the system has been designed and installed to prevent groundwater from rising at any point to within 5 feet of the bottom of the liner system. The outfall(s) of the underdrain system must be incorporated into the groundwater-monitoring plan for the site.

11. The liner system shall be kept a minimum of five feet above bedrock. Bedrock exposed during the excavation of a waste cell shall be re-covered with five feet of compacted, rubble-free soil.

12. All erosion control measures and/or diversion ditches shall conform to the Erosion and Sediment Control Act and be protective of Berry Creek and its perennial and intermittent tributaries.

13. All soil borings, monitoring wells and piezometers, located within the proposed waste footprint, shall be abandoned by overdrilling and filling with a non-shrinking cement/bentonite mix via tremie pipe. The upper 10 feet of the boring can be filled with hydrated bentonite to surface grade. A report documenting the abandonment of all borings/piezometers shall be submitted to EPD prior to cell construction. This documentation shall be signed and stamped by the responsible professional geologist or engineer registered to practice in the State of Georgia.

14. Disturbance of wetland areas is prohibited except as permitted by the United States Army Corps of Engineers. Solid waste shall not be disposed within 50 feet of wetlands boundaries. A statement certifying that wetlands will not be impacted as a result of construction activities at the site shall be submitted, signed and stamped by the professional engineer responsible for the Design and Operation plans for the subject site.

15. No waste shall be disposed of in any 100-year flood hazard zone. The 100-year flood elevation must be shown on the Design and Operation plans.

16. Groundwater and surface water monitoring systems shall be installed at the site. Sampling parameters, sampling schedules, monitoring well construction and spacing shall adhere to the guidelines established in EPD's Rules of Solid Waste Management, Chapter 391-3-4. The system design and monitoring requirements shall be detailed in a groundwater monitoring plan that is prepared in accordance with the Georgia Manual for Groundwater Monitoring and is approvable by EPD.

APPENDIX 1 – INITIAL RUN-ON AND RUN-OFF CONTROL PLAN [40 C.F.R. PART 257.81] PLANT SCHERER COAL COMBUSTION BY-PRODUCT PRIVATE INDUSTRY SOLID WASTE DISPOSAL FACILITY (PLANT SCHERER LANDFILL), GEORGIA POWER COMPANY

INITIAL RUN-ON AND RUN-OFF CONTROL PLAN
40 C.F.R. PART 257.81
PLANT SCHERER COAL COMBUSTION BY-PRODUCT PRIVATE INDUSTRY SOLID WASTE DISPOSAL FACILITY (PLANT SCHERER LANDFILL)
GEORGIA POWER COMPANY

EPA's "Disposal of Coal Combustion Residuals from Electric Utilities" Final Rule (40 C.F.R. Part 257 and Part 261) subsection §257.81 requires the owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill to prepare a run-on and run-off control system plan to document how these control systems have been designed and constructed to meet the applicable requirements of this section of the rule. Each plan is to be supported by appropriate engineering calculations.

The CCR Landfill, known as the Plant Scherer Landfill, is located at Georgia Power Company's Plant Scherer, approximately 8 miles northeast of Forsyth, Georgia and is divided into Cells 1,2,&3 and a PAC Ash Cell. Cells 1 was designed with South and North Sedimentation Ponds, a Return Water Pond (Clear Pool) and a Return Water Pumping Facility, an Emergency Gypsum Slurry Pond, and a Gypsum Slurry Booster Pump Station. Cell 1 is active and was constructed with a composite liner system. All ponds and the Gypsum Slurry Booster Pump Station were constructed along with Cell 1. Cells 2 & 3 are future cells and are permitted with composite liners similar to Cell 1. The PAC Ash Cell is active and was constructed with a composite liner system. The PAC Ash Cell also consists of a Sedimentation Pond, a Clear Pool, and a Return Water Pumping Facility which were constructed along with the PAC Ash Cell. Future cells 2 and 3 will be designed and constructed in the same manner as Cell 1.

The storm water flows have been calculated using the Natural Resources Conservation Service (NRCS) method (also known as the Soil Conservation Service (SCS) method) using the 24 hour, 25-year storm event. The storm water detention system has been designed in accordance with the Georgia Soil and Water Conservation Commission requirements as well as other local, city, and government codes. The post developed storm water discharge was designed to be less than the pre-developed storm water discharge in accordance with the requirements of the State of Georgia.

Runoff curve number data was determined using Table 2-2A from Urban Hydrology for Small Watersheds (TR-55). Appendix A and B from TR-55 were used to determine the rainfall distribution methodology. Precipitation values were determined from NOAA's Precipitation Frequency Data Server (Atlas-14).

The NRCS provided information on the soil characteristics and hydrologic groups present at the site. The curve number used is based on the Hydrologic Soil Group (HSG) and type of runoff potential. For the coal combustion by-products (gypsum and PAC ash), the HSG is assumed to be Group C soils with moderately high runoff potential when thoroughly wet. For HSG C, the curve number for bare soil (similar to gypsum and PAC ash) is assumed to be 91. For areas outside of the CCR Landfill cells, HSG B is assumed and for the ponded areas the curve number is 100 and for the impervious gravel areas around the ponds, the curve number is assumed to be 85. This information was placed into Hydraflow and used to generate appropriate precipitation curves, storm basin routing information, and resulting rating curves to evaluate surface impoundment capacity.

The CCR Landfill was designed and constructed with perimeter berms and drainage ditches surrounding the active cells that prevent stormwater run-on from surrounding areas during the peak discharge of a 24-hr, 25-yr storm from flowing onto the active portion of the landfill. Cell 1 is designed to handle normal process flows of 850 gpm as well as the quantity of rainfall from a 24-hr, 25-year storm event and the PAC Ash Cell is designed to handle the quantity of rainfall from a 24-hr, 25-year storm event. Storm water run-off from Cell 1 is routed through the South Sedimentation Pond and Clear Pool which are designed to handle the run-off from a 24-hr, 25-yr storm and the normal process flows. Storm water run-off from the PAC Ash Cell is routed through its Sedimentation Pond and Clear Pool which are designed to handle the run-off from a 24-hr, 25-yr storm. This plan is supported by appropriate engineering calculations which are attached.

The facility is operated subject to and in accordance with § 257.3-3 of EPA's regulations.

I hereby certify that the run-on and run-off control system plan meets the requirements of 40 C.F.R. Part 257.81.

James C. Pegues, P.E.
Licensed State of Georgia, PE No. 17419

GEORGIA
REGISTERED
No. 17419
PROFESSIONAL
ENGINEER
JAMES C. PEGUES, JR.

Run-on and Run-off Control System Plan for Landfills:
Calculation Summary

for

Plant Scherer Coal Combustion By-product Disposal Facility (Landfill) PAC/Ash Cell

Prepared by:

Southern Company Services
Technical Services

Originator: Jim W. Minor 10/11/16
Jim W. Minor Date

Reviewer: JWi 10/11/16
Jason S. Wilson Date

Approval: 10/12/16
James C. Pegues Date

1.0 Purpose of Calculation

The purpose of this report is to provide data that demonstrates the Plant Scherer Landfill for the PAC/Ash Cell is designed to meet the requirements in Title 40 CFR Part 257.81 which are to collect and control the water volume resulting from a 24-hour, 25-year storm.

2.0 Summary of Conclusions

2.1 Site Overview

The Scherer Landfill consists of one PAC/Ash cell that is currently in operation. The cell is constructed with a perimeter raised dike and diversion ditch that prevents watershed run-on from entering the cell. Run-off within the cell is managed by a system of detention ponds and return water pumps that return stormwater run-off as process flows to the plant. An interior perimeter ditch directs run-off within the cell into the detention pond system through 24" diameter pipe culverts and a leachate collection & removal system. The detention pond system includes two ponds (sedimentation pond and clear pool) that are interconnected by a 36" diameter HDPE pipe culvert, as shown on sketch CS-SK-071416-1 on page 8 of this summary.

An emergency spillway is located in the Sedimentation Pond at elevation 434.00. The normal pool elevation for the clear pool and sedimentation pond is approximately 420.43. A value of 421.00 was used for this calculation.

An overview of the facility is provided in Table 1 below.

Table 1. Plant Scherer Landfill PAC/Ash Cell Site Characteristics

Pond Description	Storage Cell	Sedimentation Pond	Clear Pool
Size (Acres)	16.6	2.48	1.03
Outlet Type	Three 36" HDPE pipes	Trapezoidal spillway and two 36" HDPE pipes connected to clear pool	Connected to Sedimentation Pond by a 36" HDPE pipe
Outlets To:	Sedimentation Pond	Clear pool and emergency spillway	Pumped back to the plant and a 36" HDPE pipe connected to clear pool.

2.2 Run-on Control System Plan

There is no stormwater run-on into the facility because it is contained within earthen berms and a diversion ditch that prevent stormwater from the surrounding area from entering the cell.

2.3 Run-off Control System Plan

A hydrologic and hydraulic model was developed for the Plant Scherer Landfill PAC/Ash Cell to determine the hydraulic capacity of the cell. The design storm for the purposes of run-off control system plans is the 24-hour, 25-year rainfall event. The results from routing the design storm event through the cell are presented in Table 2 below.

Table 2. Plant Scherer Landfill PAC/Ash Cell Flood Routing Results

Storage Pond Name	Normal Pool Elevation (feet, NAVD 88)	Maximum 25-year pool elevation (feet, NAVD 88)	Spillway/Top of dike elevation (feet, NAVD 88)	Freeboard to Spillway (feet, NAVD 88)	Peak Inflow (cfs)	Peak Outflow (cfs)
Clear Pool	421	427.4	434.00/436.00	6.6/8.6	52.15	0
Sedimentation Pond	421	427.4	434.00/436.00	6.6/8.6	137.23	0

Based on our analysis, the detention pond system is adequate to collect and control the required volume of water resulting from a 24-hour 25-year storm.

3.0 Methodology

3.1 Hydrologic Analyses

The design storm for all run-on/run-off analyses is a 24-hour, 25-year rainfall event. A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized below in Table 3.

Table 3. Design Storm Distribution

Return Frequency (years)	Storm Duration (hours)	Rainfall total (inches)	Rainfall Source	Storm Distribution
25	24	6.35	NOAA Atlas 14	SCS Type II

The drainage basin area for the Plant Scherer Gypsum Storage Facility PAC/Ash cell was delineated based on topography developed for construction of the facility in 2010 and as-built data provided by Metro Engineering and Surveying Co., Inc. in October of 2010. Run-off characteristics were developed based on the Soil Conservation Service (SCS) methodologies as outlined in TR-55. Soil types were obtained based on the run-off characteristics of the material that is placed within the storage facility. Time of Concentration was also developed based on methodologies prescribed in TR-55.

Pertinent basin characteristics of the landfill are provided below in Table 4.

Table 4. Landfill Hydrologic Information

Drainage Basin Area	16.6
Hydrologic Curve Number, CN	91
Hydrologic Method	SCS Method
Time of Concentration (minutes)	10.02
Hydrologic Software	Autodesk Storm and Sanitary Analysis 2015

Run-off values were determined by importing the characteristics developed above into a hydrologic model with Autodesk Storm and Sanitary Analysis 2015 software.

3.2 Hydraulic Analyses

Storage values for the cell were determined by developing a stage-storage relationship utilizing contour data. The clear pool and sedimentation pond are interconnected by a 36” HDPE pipe and share a primary spillway that is an earthen trapezoidal weir lined with a turf reinforcement mat and sloped at 0.10% slope with a crest elevation of 433.50. A summary of spillway information is presented below in Table 5.

Table 5. Spillway Attribute Table

Spillway Component	US Invert elevation (feet, NAVD 88)	DS Invert elevation (feet, NAVD 88)	Dimension (ft)	Slope	Length	Spillway Capacity (cfs)
Primary	433.50	433.47	28	0.1	35	140

Based on the spillway attributes listed above, the data was input to Autodesk Storm and Sanitary Analysis to determine the pond performance during the design storm. Results are shown in Table 2.

4.0 Supporting Information

4.1 Curve Number

Table 6. Curve Number Data

Location	Terrain Type	Area	Curve Number
Clear Pool	Water & gravel	1.03	87.33
Sedimentation Pond	Water & gravel	2.48	88.08
PAC/Ash Cell	Bare Gypsum	16.6	91

4.2 Stage Storage Tables

Sedimentation Pond			
Stage	Elevation	Contour Area (s.f.)	Volume (c.f.)
0	416	8,566	0
2	418	13,665	22,231
4	420	19,308	55,204
6	422	25,388	99,900
8	424	31,516	156,804
10	426	37,844	226,164
12	428	44,369	308,377
14	430	51,094	403,840
16	432	58,088	513,022
18	434	65,113	636,223
20	436	72,426	773,762

Clear Pool			
Stage	Elevation	Contour Area (s.f.)	Volume (c.f.)
0	416	2,552	0
2	418	4,110	6,662
4	420	5,871	16,643
6	422	7,833	30,347
8	424	10,002	48,182
10	426	12,372	70,556
12	428	14,945	97,873
14	430	17,719	130,537
16	432	20,696	168,952
18	434	23,847	213,495
20	436	27,203	264,545

4.3 Time of Concentration

Time of Concentration (Tc) for the clear pool and south sedimentation pond area are the minimum Tc of 6 minutes. The Time of Concentration for the PAC/Ash cell area is shown below.

Time of Concentration

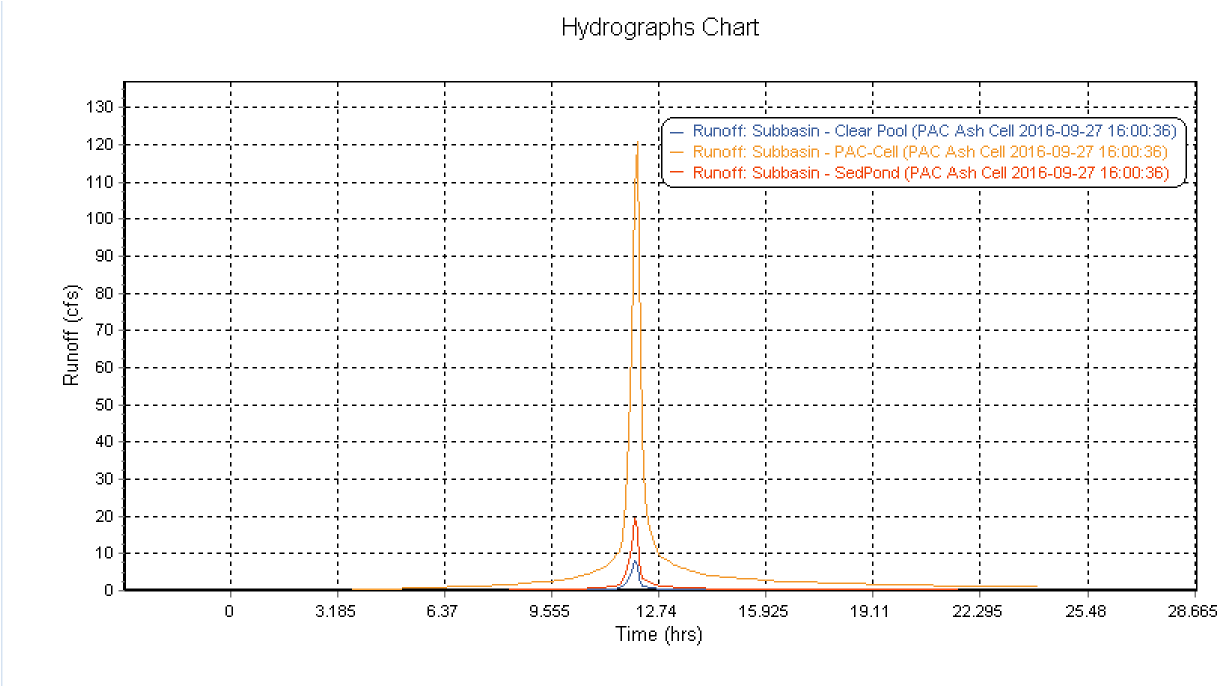
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.02	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	3.64	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.80	0.00	0.00
Velocity (ft/sec) :	1.47	0.00	0.00
Computed Flow Time (min) :	3.40	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	307	0.00	0.00
Slope (%) :	11.50	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.47	0.00	0.00
Computed Flow Time (min) :	0.94	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.038	0.00	0.00
Flow Length (ft) :	1331	0.00	0.00
Channel Slope (%) :	0.76	0.00	0.00
Cross Section Area (ft²) :	22.8	0.00	0.00
Wetted Perimeter (ft) :	18.7	0.00	0.00
Velocity (ft/sec) :	3.90	0.00	0.00
Computed Flow Time (min) :	5.69	0.00	0.00

Total TOC (min) 10.02

4.4 RESULTS



Runoff Summary Table

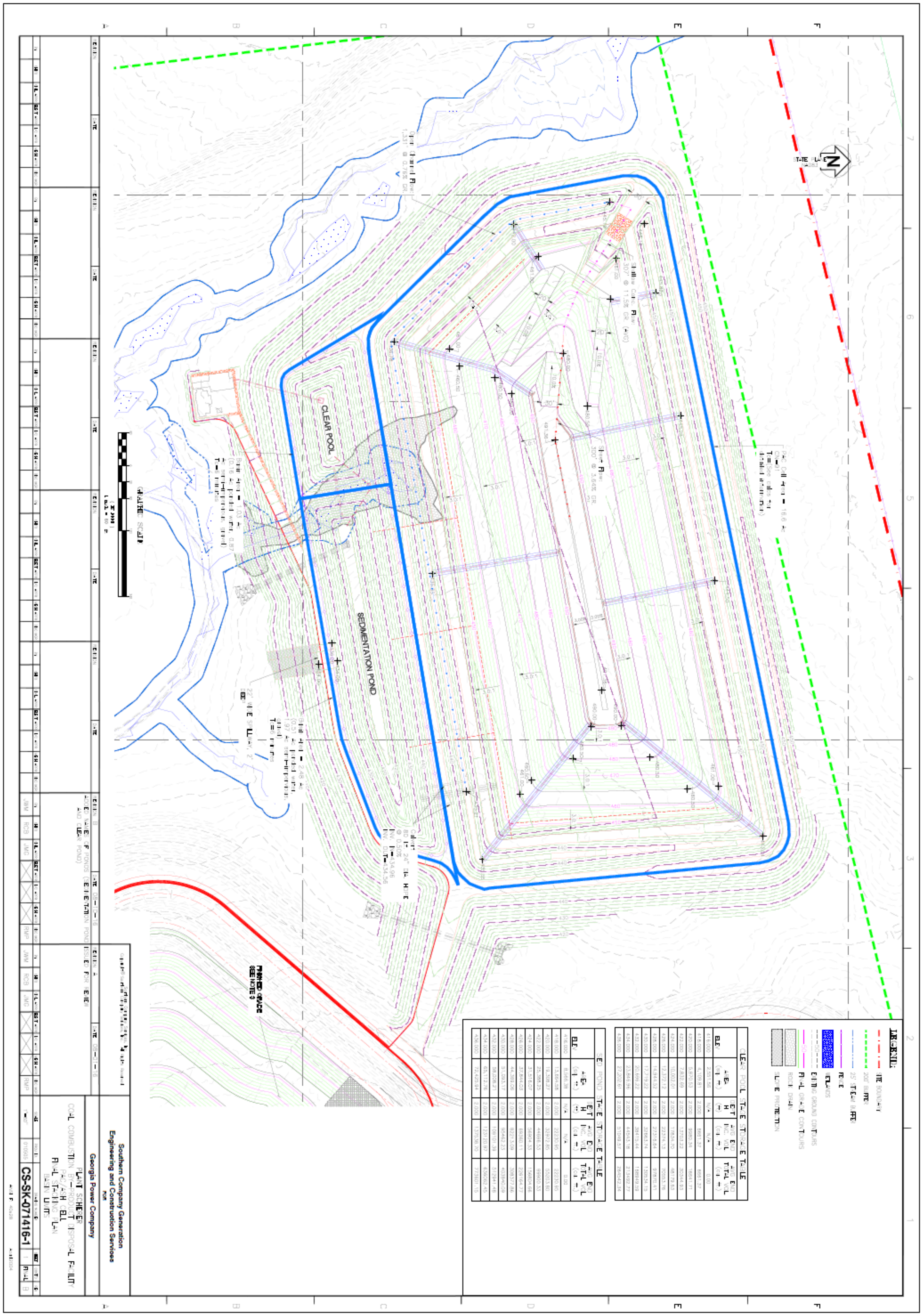
Time period
From: 07/06/2016, 12:00:00 AM
To: 07/07/2016, 12:00:00 AM

Thresholds
Exceedance: 0
Deficit: 0

Detention storage
Max flow: 0

Element ID	Clear Pool	PAC-Cell	SedPond
Maximum Runoff (cfs)	8.01	120.83	19.54
Minimum Runoff (cfs)	0.00	0.00	0.00
Event Mean Runoff (cfs)	0.23	4.01	0.56
Duration of Exceedances (hrs)	N/A	N/A	N/A
Duration of Deficits (hrs)	N/A	N/A	N/A
Number of Exceedances	N/A	N/A	N/A
Number of Deficits	N/A	N/A	N/A
Volume of Exceedance (ft³)	N/A	N/A	N/A
Volume of Deficit (ft³)	N/A	N/A	N/A
Total Runoff (ft³)	19815.84	345121.28	48511.92
Detention Storage (ft³)	N/A	N/A	N/A

4.5 DRAINAGE BASIN



Run-on and Run-off Control System Plan for Landfills:
Calculation Summary

for

Plant Scherer Coal Combustion By-product Disposal Facility (Landfill) Cell 1

Prepared by:

Southern Company Services
Technical Services

Originator: Jim W. Minor 10/11/16
Jim W. Minor Date

Reviewer: JW 10/11/16
Jason S. Wilson Date

Approval: 10/12/16
James C. Pegues Date

1.0 Purpose of Calculation

The purpose of this report is to provide data that demonstrates the Plant Scherer Landfill for gypsum disposal for Cell 1 is designed to meet the requirements in Title 40 CFR Part 257.81 which are to collect and control the water volume resulting from a 24-hour, 25-year storm.

2.0 Summary of Conclusions

2.1 Site Overview

The Plant Scherer Landfill for gypsum storage that is currently in operation is Cell 1. Cell 1 is constructed with a perimeter raised dike that prevents watershed run-on from entering the cell. Run-off within Cell 1 is managed by a system of detention ponds and return water pumps that return stormwater run-off as process flows to the plant. An interior perimeter ditch directs run-off within the cell into the South Sedimentation Pond through 36" diameter pipe culverts and a leachate collection & removal system. This detention pond system includes three ponds that are interconnected by 18" and 24" diameter HDPE pipe culverts. The three ponds consist of the South Sedimentation Pond, Clear Pool, and Emergency Gypsum Slurry Pond as shown on sketch CS-SK-070616-2 on page 8 of this summary.

An emergency spillway is located in the South Sedimentation Pond at elevation 412.00. The normal pool elevation for the clear pool and south sedimentation pond is approximately 400.59. A value of 401.00 was used for this calculation.

There is also an additional sedimentation pond (the north sedimentation pond which is labelled as Temporary Sediment Basin on sketch CS-SK-070616-2 on page 8 of this report) that has been constructed for the future Cell 2 development. It is adjacent to the clear pond but is not hydraulically connected and drains off-site. Run-off from the north sedimentation pond is discharged through two 36" diameter HDPE pipe culverts into an existing drainage feature offsite.

An overview of the facility is provided in Table 1 below.

Table 1. Plant Scherer Landfill Cell 1 Site Characteristics

Pond Description	Storage Cell	Emergency Gypsum Slurry Pond	South Sedimentation Pond	Clear Pool
Size (Acres)	36.8	2.5	3.8	1.5
Outlet Type	Eight 36" HDPE pipes and riser structure connected to a 36" HDPE pipe	Pumped back to the plant	Trapezoidal Spillway and 24" HDPE Pipe connected to Clear Pool	One 18"HDPE pump line
Outlets To:	South Sedimentation Pond and Clear Pool	Pumped back to the plant	Emergency Gypsum Slurry Pond and Clear Pool	Pumped back to the plant

2.2 Run-on Control System Plan

There is no stormwater run-on into the facility because it is contained within earthen berms that prevent stormwater from the surrounding area from entering Cell 1.

2.3 Run-off Control System Plan

A hydrologic and hydraulic model was developed for the Plant Scherer Gypsum Storage Facility Cell 1 area to determine the hydraulic capacity of the cell. The design storm for the purposes of run-off control system plans is the 24-hour, 25-year rainfall event. The results from routing the design storm event through the landfill are presented in Table 2 below.

Table 2. Plant Scherer Landfill Cell 1 Flood Routing Results

Storage Pond Name	Normal Pool Elevation (feet, NAVD 88)	Maximum 25-year pool elevation (feet, NAVD 88)	Spillway/Top of dike elevation (feet, NAVD 88)	Freeboard to Spillway (feet, NAVD 88)	Peak Inflow (cfs)	Peak Outflow (cfs)
Clear Pool	401	409.33	412.00/414.00	2.67	34.17	0
South Sedimentation Pond	401	409.33	412.00/414.00	2.67	223.93	0
Emergency Gypsum Slurry Pond	392	393.42	400±	6.58	20.05	0

Based on our analysis, the detention pond system is adequate to collect and control the required volume of water resulting from a 24-hour 25-year storm.

3. Methodology

3.1 Hydrologic Analyses

The design storm for all run-on/run-off analyses is a 24-hour, 25-year rainfall event. A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized below in Table 3.

Table 3. Design Storm Distribution

Return Frequency (years)	Storm Duration (hours)	Rainfall total (inches)	Rainfall Source	Storm Distribution
25	24	6.35	NOAA Atlas 14	SCS Type II

The drainage basin area for the Plant Scherer Gypsum Storage Facility Cell 1 area was delineated based on topography developed for construction of the facility in 2010 and as-built data provided by Metro Engineering and Surveying Co., Inc. in October of 2010. Run-off characteristics were developed based on the Soil Conservation Service (SCS) methodologies as outlined in TR-55. Soil types were obtained based on the run-off characteristics of the material that is placed within the storage facility. Time of Concentration was also developed based on methodologies prescribed in TR-55.

Pertinent basin characteristics of the landfill are provided below in Table 4.

Table 4. Landfill Hydrologic Information

Drainage Basin Area	36.8
Hydrologic Curve Number, CN	91
Hydrologic Method	SCS Method
Time of Concentration (minutes)	21.76
Hydrologic Software	Autodesk Storm and Sanitary Analysis 2015

Run-off values were determined by importing the characteristics developed above into a hydrologic model with Autodesk Storm and Sanitary Analysis 2015 software.

Process flows from Plant Scherer were considered in this analysis. Based on normal plant operations, the gypsum facility receives an additional 850 gallons per minute of inflow from the Plant.

3.2 Hydraulic Analyses

Storage values for the landfill were determined by developing a stage-storage relationship utilizing contour data. The Clear Pool, South Sedimentation Pond, and Emergency Gypsum Pond are interconnected by 18" and 24" diameter HDPE pipes. The Emergency Gypsum Slurry Pond is for emergency storage in the event that the South Sedimentation Pond and Clear Pool water elevation were to rise above elevation 411.00. The Clear Pool and South Sedimentation Pond are interconnected by a 24" diameter HDPE pipe and share a primary spillway that is a earthen trapezoidal weir lined with a turf reinforcement mat and sloped at 0.10% slope with a crest elevation of 414.00. A summary of spillway information is presented below in Table 5.

Table 5. Spillway Attribute Table

Spillway Component	US Invert elevation (feet, NAVD 88)	DS Invert elevation (feet, NAVD 88)	Dimension (ft)	Slope	Length	Spillway Capacity (cfs)
Primary	412	411.95	28	0.1	50	140

Based on the spillway attributes listed above, the data was input to Autodesk Storm and Sanitary Analysis to determine the pond performance during the design storm. Results are shown in Table 2

4. **Supporting Information**

4.1 Curve Number

Table 6. Curve Number Data

Location	Terrain Type	Area	Curve Number
Clear Pool	Water & gravel	1.5	90
South Sedimentation Pond	Water & gravel	3.8	92.11
Emergency Gypsum Slurry Pond	Water & gravel	2.5	89.44
Gypsum Cell	Bare Gypsum	36.8	91

4.2 Stage Storage Tables

South Sedimentation Pond			
Stage	Elevation	Contour Area (s.f.)	Volume (c.f.)
0	397	9,541	0
1	398	34,205	21,873
2	399	60,888	69,420
3	400	76,105	137,916
4	401	79,592	215,765
5	402	83,117	297,119
6	403	86,681	382,018
7	404	90,282	470,500
8	405	93,922	562,602
9	406	97,600	658,363
10	407	101,317	757,821
11	408	105,072	861,016
12	409	108,865	967,984
13	410	112,696	1,078,765
14	411	116,565	1,193,395
15	412	120,473	1,311,914
16	413	124,419	1,434,360
17	414	128,405	1,560,772

Clear Pool			
Stage	Elevation	Contour Area (s.f.)	Volume (c.f.)
0	397	18,110	0
1	398	19,395	18,753
2	399	20,720	38,810
3	400	22,083	60,212
4	401	23,485	82,996
5	402	24,927	107,202
6	403	26,407	132,869
7	404	27,927	160,036
8	405	29,486	188,742
9	406	31,084	219,027
10	407	32,721	250,930
11	408	34,397	284,489
12	409	36,112	319,743
13	410	37,866	356,732
14	411	39,659	395,495
15	412	41,492	436,070
16	413	43,363	478,498
17	414	45,278	522,818

Emergency Gypsum Slurry Pond			
Stage	Elevation	Contour Area (s.f.)	Volume (c.f.)
0	391	32,371	0
1	392	34,037	33,204
2	393	35,743	68,094
3	394	37,488	104,710
4	395	39,273	143,090
5	396	41,097	183,275
6	397	42,960	225,304
7	398	44,962	269,265
8	399	46,804	315,148
9	400	48,785	362,942

4.3 Time of Concentration

Time of Concentration (Tc) for the Clear Pool, South Sedimentation Pond, and Emergency Gypsum Slurry Pond area are the minimum Tc of 6 minutes. The Time of Concentration for the gypsum storage area is shown below.

Time of Concentration

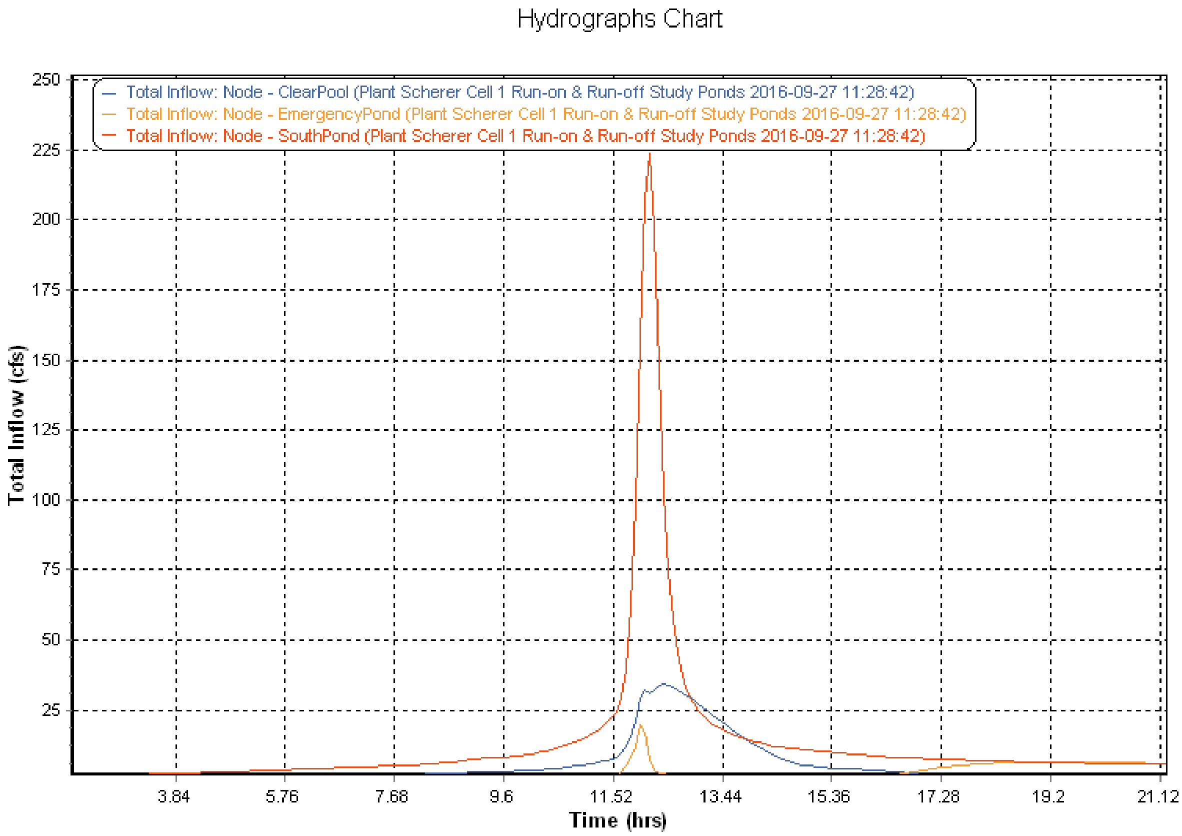
Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.02	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	0.25	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.80	0.00	0.00
Velocity (ft/sec) :	0.50	0.00	0.00
Computed Flow Time (min) :	9.92	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	658	0.00	0.00
Slope (%) :	11.4	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.45	0.00	0.00
Computed Flow Time (min) :	2.01	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.049	0.00	0.00
Flow Length (ft) :	2140	0.00	0.00
Channel Slope (%) :	1.16	0.00	0.00
Cross Section Area (ft^2) :	25.62	0.00	0.00
Wetted Perimeter (ft) :	21.95	0.00	0.00
Velocity (ft/sec) :	3.63	0.00	0.00
Computed Flow Time (min) :	9.82	0.00	0.00

Total TOC (min) 21.76

4.4 RESULTS



Total Inflow Summary Table

Time period

From: 07/06/2016, 12:00:00 AM

To: 07/07/2016, 12:00:00 AM

Thresholds

Exceedance: 0

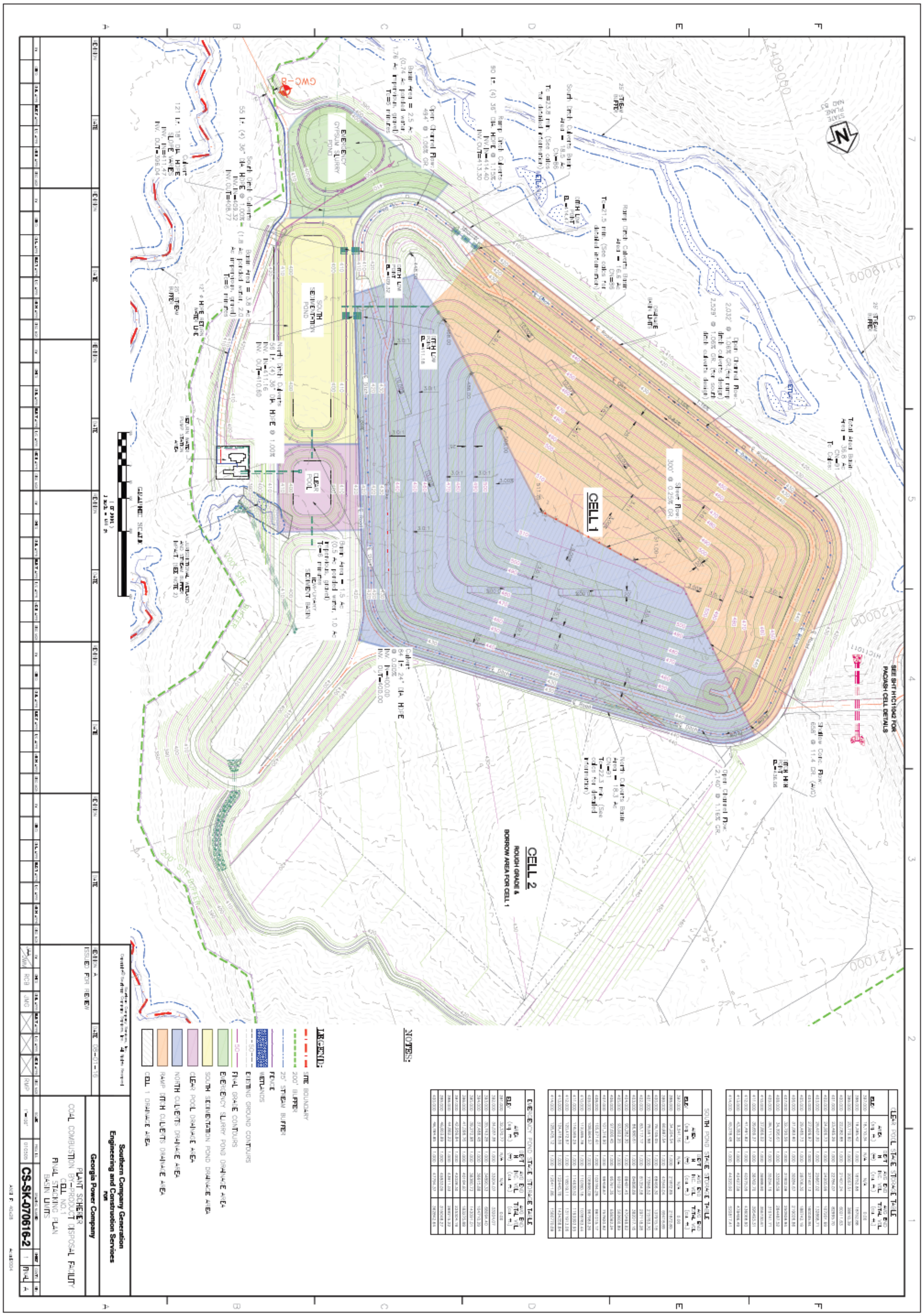
Deficit: 0

Detention storage

Max flow: 0

Element ID	ClearPool	EmergencyPond	SouthPond
Maximum Total Inflow (cfs)	34.17	20.05	223.93
Minimum Total Inflow (cfs)	0.11	0.00	1.89
Event Mean Total Inflow (cfs)	4.09	2.35	11.77
Duration of Exceedances (hrs)	N/A	N/A	N/A
Duration of Deficits (hrs)	N/A	N/A	N/A
Number of Exceedances	N/A	N/A	N/A
Number of Deficits	N/A	N/A	N/A
Volume of Exceedance (ft³)	N/A	N/A	N/A
Volume of Deficit (ft³)	N/A	N/A	N/A
Total Inflow Volume (ft³)	352222.6	201736.01	1012061.37
Detention Storage (ft³)	N/A	N/A	N/A

4.5 DRAINAGE BASIN



APPENDIX 2 – PERIODIC RUN-ON AND RUN-OFF CONTROL PLAN [391-3-4-.10(5) AND 40 C.F.R. PART 257.81] PLANT SCHERER COAL COMBUSTION BY-PRODUCT PRIVATE INDUSTRY SOLID WASTE DISPOSAL FACILITY (PLANT SCHERER LANDFILL), GEORGIA POWER COMPANY

PERIODIC RUN-ON AND RUN-OFF CONTROL PLAN
391-3-4-.10(5) and 40 C.F.R. PART 257.81
PLANT SCHERER COAL COMBUSTION BY-PRODUCT PRIVATE INDUSTRY SOLID WASTE DISPOSAL FACILITY (PLANT SCHERER LANDFILL)
GEORGIA POWER COMPANY

The Federal CCR Rule, and, for Existing CCR Landfills where applicable, the Georgia CCR Rule (391-3-4-.10) require the owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill to prepare a run-on and run-off control system plan to document how these control systems have been designed and constructed to meet the applicable requirements of this section of the Rule. *See* 40 C.F.R. § 257.81; Ga. Comp. R. & Regs. r. 391.3-4-.10(5)(a). In addition, the Rules require periodic run-on and run-off control system plans every five years. *See* 40 C.F.R. § 257.81(c)(4); Ga. Comp. R. & Regs. r. 391.3-4-.10(4)(b).

The CCR Landfill, known as the Plant Scherer Landfill, is located at Georgia Power Company's Plant Scherer, approximately 8 miles northeast of Forsyth, Georgia and is divided into Cells 1,2, and 3 and a PAC Ash Cell. Cell 1 was designed with South and North Sedimentation Ponds, a Return Water Pond (Clear Pool), a Return Water Pumping Facility, an Emergency Gypsum Slurry Pond, and a Gypsum Slurry Booster Pump Station. Cell 1 is active and was constructed with a composite liner system. All ponds and the Gypsum Slurry Booster Pump Station were constructed along with Cell 1. Cells 2 and 3 are future cells and are permitted with composite liners similar to Cell 1. The PAC Ash Cell is active and was constructed with a composite liner system. The PAC Ash Cell also consists of a Sedimentation Pond, a Clear Pool, and a Return Water Pumping Facility which were constructed along with the PAC Ash Cell. Future Cells 2 and 3 will be designed and constructed in the same manner as Cell 1.

The stormwater flows have been calculated using the Natural Resources Conservation Service (NRCS) method (also known as the Soil Conservation Service (SCS) method) using the 24 hour, 25-year storm event. The stormwater detention system has been designed in accordance with the Georgia Stormwater Management Manual requirements as well as other local, city, and government codes. The post developed stormwater discharge was designed to be less than the pre-developed stormwater discharge in accordance with the requirements of the State of Georgia.

Runoff curve number data was determined using Table 2-2A from Urban Hydrology for Small Watersheds (TR-55). Appendix A and B from TR-55 were used to determine the rainfall distribution methodology. Precipitation values were determined from the National Oceanic and Atmospheric Administration's (NOAA's) Precipitation Frequency Data Server (Atlas-14).

The NRCS provided information on the soil characteristics and hydrologic groups present at the site. The curve number used is based on the Hydrologic Soil Group (HSG) and type of runoff potential. For the coal combustion by-products (gypsum and PAC ash), the HSG is assumed to be Group C soils with moderately high runoff potential when thoroughly wet. For HSG C, the curve number for bare soil (similar to the gypsum and PAC ash cells) is assumed to be 91. For areas outside of the CCR Landfill cells, HSG B is assumed and for the ponded areas the curve number is 100. For the impervious gravel areas around the ponds, the curve number is assumed to be 85. This information was placed into Hydraflow Hydrographs 2019 and used to generate appropriate precipitation curves, storm basin routing information, and resulting rating curves to evaluate surface impoundment capacity.

The CCR Landfill was designed and constructed with perimeter berms and drainage ditches surrounding the active cells that prevent stormwater run-on from surrounding areas during the peak discharge of a 24-hr, 25-yr storm from flowing onto the active portion of the landfill. Cell 1 is designed to handle normal process flows of 850 gpm as well as the quantity of rainfall from a 24-hr, 25-year storm event, and the PAC Ash Cell is designed to handle the quantity of rainfall from a 24-hr, 25-year storm event. Stormwater run-off from Cell 1 is routed through the South Sedimentation Pond, North Sedimentation Pond and Clear Pool which are designed to handle the run-off from a 24-hr, 25-yr storm and the normal process flows. Stormwater run-off from the PAC Ash Cell is routed through its Sedimentation Pond and Clear Pool which are designed to handle the run-off from a 24-hr, 25-yr storm. This plan is supported by appropriate engineering calculations, which are attached.

The facility is operated subject to and in accordance with § 257.3-3 of EPA's regulations.

I hereby certify that the run-on and run-off control system plan meets the requirements of 40 C.F.R. § 257.81.

5/02/22

James C. Pegues, P.E.
Licensed State of Georgia, PE No. 17419

GEORGIA REGISTERED No. PE017419 PROFESSIONAL ENGINEER JAMES C. PEGUES, JR.

Southern Company

Environmental Solutions Calculation

Calculation Number:
DC-SH-121744-001

Project/Plant:	Unit(s):	Discipline/Area:
Scherer	1 - 4	Civil
Title/Subject: Run-on and Run-off System Study for the Gypsum Storage Cell 1 and 2.		
Purpose/Objective: Demonstrate compliance with the Title 40 CFR Part 257.81 and Ga. Comp. R. & Regs. r. 391.3-4-.10(5)(a)		
System or Equipment Tag Numbers: N/A	**Originator:** Jim Minor	

Contents

Topic	Page	Attachments (Computer Printouts, Tech. Papers, Sketches, Correspondence)	# of Pages
Purpose of Calculation/ Project Narrative	2		1
Summary of Conclusions/Methodology	3		1
Assumptions/Criteria	3-4		2
Design Inputs/References	10-11		2
Body of Calculation	12-74		72
Sketch of Basin Limits	74		1
Total # of pages including cover sheet & attachments:	74		

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
A	Issued for Review	JWM 3/25/22	AOG 3/25/22	SSS 3/25/22

Notes:

Calculations for the GSA for Cells 1 and 2.

GEORGIA REGISTERED No. PE031968 PROFESSIONAL ENGINEER JIM W. MINOR

J.W.Minor
4/26/22

Project	Prepared by	Date
Plant Scherer Run-on Run-off Control	Jim Minor	3/25/22
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm for GSA 1 & 2.	Reviewed by Ashley Grissom	Date 3/2522
	Calculation Number DC-SH- 121744-001	Sheet 2 of 74

Purpose of Calculation

The purpose of this report is to provide data that demonstrates the Plant Scherer Coal Combustion By-Product (CCB) Disposal Facility for gypsum disposal for Cell 1 and Cell 2 is designed to meet the requirements in the Federal CCR Rule Title 40 CFR Part 257.81 and Georgia CCR Rule (391-3-4-.10) from a 24-hour, 25-year storm for the run-on and run-off control system.

Project Narrative

The CCB disposal facility will consist of two gypsum cells. Cell 1 is currently in operation and is constructed with a perimeter raised dike that prevents watershed run-on from entering the cell. Cell 2 will be constructed in a similar manner with a perimeter raised dike that will prevent watershed run-on from entering the cell. Run-off within Cell 1 is managed by a system of detention ponds and return water pumps that return stormwater run-off as process flows to the plant. Cell 2 will be operated in the same manner with run-off within the Cell managed by a system of detention ponds and return water pumps that return stormwater run-off as process flows to the plant.

An interior perimeter ditch will direct run-off within the cells into the North and South Sedimentation Pond through 36” diameter pipe culverts and a leachate collection & removal system. The detention pond system includes four ponds that are interconnected by 18” and 24” diameter HDPE pipe culverts. The four ponds consist of the South Sedimentation Pond, Clear Pool, North Sedimentation Pond, and Emergency Gypsum Slurry Pond as shown on sketch CS-SK-BASIN on page 74 of this report.

An auxiliary spillway is located in the South Sedimentation Pond and North Sedimentation Pond at elevation 412.00. The normal pool elevation for the clear pool, south sedimentation pond, and north sedimentation pond is approximately 405.60. It is noted that the interconnected system of pond pool elevations will fluctuate between 405.6 and 399.00. For the purposes of this calculation, the maximum normal pool elevation of 405.6 was assumed for the stormwater model.

Project	Prepared by	Date
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Summary of Conclusions

Based on our analysis, the detention pond system is adequate to collect and control the required volume of water resulting from a 24-hour 25-year storm.

Storage Pond Name	Normal Pool Elevation** (feet, NAVD 88)	Maximum 25-year pool elevation (feet, NAVD 88)	Top of Dike Elevation (feet, NAVD 88)	Freeboard To Top of Dike (feet)
Clear Pool	405.60	411.90	414.00	2.10
North Sedimentation Pond	405.60	411.90	414.00	2.10
South Sedimentation Pond	405.60	411.90	414.00	2.10
Emergency Gypsum Slurry Pond	392.00	395.10	400±	4.90

**Normal pool is assumed at 405.60 as a conservative case. Pumps will control the water level and the pool elevation will fluctuate between 405.6 and 399.50. Elevation 405.60 was assumed as a worst-case scenario normal pool elevation.

Methodology

The stormwater flows have been calculated using the National Resources Conservation Service Method (also known as the Soil Conservation Service method-SCS Method) using the 24-hour 25-year storm event.

Drainage basin delineation was made using topographic survey data obtained in 2010, as-built data provided by Metro Engineering and Surveying Co., Inc. in October of 2010, design grades for the Cell 2 area and North Pond and associated diversion ditch, construction drawings prepared by Southern Company Environmental Solutions (drawings E1C11050 through E1C11078, H1C11000 through H1C11055, and as shown on sketch CS-SK-BASIN on page 74 of this report).

Assumptions/Criteria

Appendix B from the TR-55 reference was used to determine the following:

- Rainfall Distribution – Type II
- Precipitation Values (SCS 24-hour precipitation, obtained from NOAA, Atlas 14)
    - 2 yr-24 hr = 3.77 in
    - 5 yr-24 hr = 4.58 in
    - 10 yr-24 hr = 5.30 in
    - 25 yr-24 hr = 6.35 in

- 50 yr-24 hr = 7.21 in
- 100 yr-24 hr = 8.11 in

Time of concentration for each drainage basin was calculated using the topographic data and SCS TR-55 method. Several different contributing drainage basins (cell footprint and ponds) were delineated and the Tc values can be found in the detailed calculations attached and drainage basin sketch CS-SK-BASIN.

Manning's roughness coefficients for time of concentration calculations were assumed based on:

- Sheet flow, n = 0.011, based on TR55 Table 3-1 for sheet flow for bare soil.

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: [3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

- Channel flow see below calculation for n value.

Manning's n for Channels (Chow, 1959).

Type of Channel and Description	Minimum	Normal	Maximum
4. Excavated or Dredged Channels			
a. Earth, straight, and uniform			
1. clean, recently completed	0.016	0.018	0.020
2. clean, after weathering	0.018	0.022	0.025
3. gravel, uniform section, clean	0.022	0.025	0.030
4. with short grass, few weeds	0.022	0.027	0.033

For the Manning's assumption in the concrete channel, a value of 0.012 was used.

Channel geometry data was obtained from Hydraflow Express as follows:

Ditch	Bottom Width	Side Slopes	Depth	Assumed flow depth	Wetted perimeter	Flow Area
2' Ditch at Top Deck	2	2:1	1	0.67	5	2.238
Downchute (n=0.012)	6	4:1	1	0.33	8.72	2.416
Cell 1 Perimeter Ditch to Ramp Culverts[1]	15	2:1 and 2.5:1	5	1.2	20.7	20.4
Cell 1 Perimeter Ditch to S Culverts[1]	15	2:1 and 2.5:1	5	1.49	22.3	27.4
Cell 1 Perimeter Ditch to N Culverts[1]	15	2:1 and 2.5:1	5	1.2	21.1	22.3
Cell 2 Perimeter Ditch[1]	15	2:1 and 2.5:1	5	2.1	25.3	41.2
1. Actual flow depth, Wp, and Flow Area based on peak flow for the drainage basin.						

Project	Prepared by	Date
Plant Scherer Run-on Run-off Control	Jim Minor	3/25/22
Subject/Title	Reviewed by	Date
Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm for GSA 1 & 2.	Ashley Grissom	3/2522
	Calculation Number	Sheet
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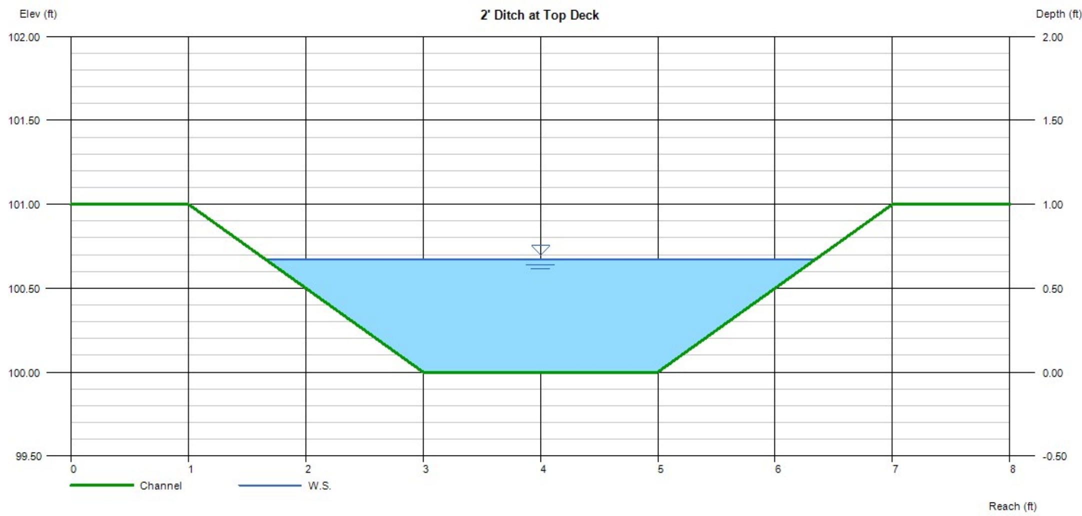
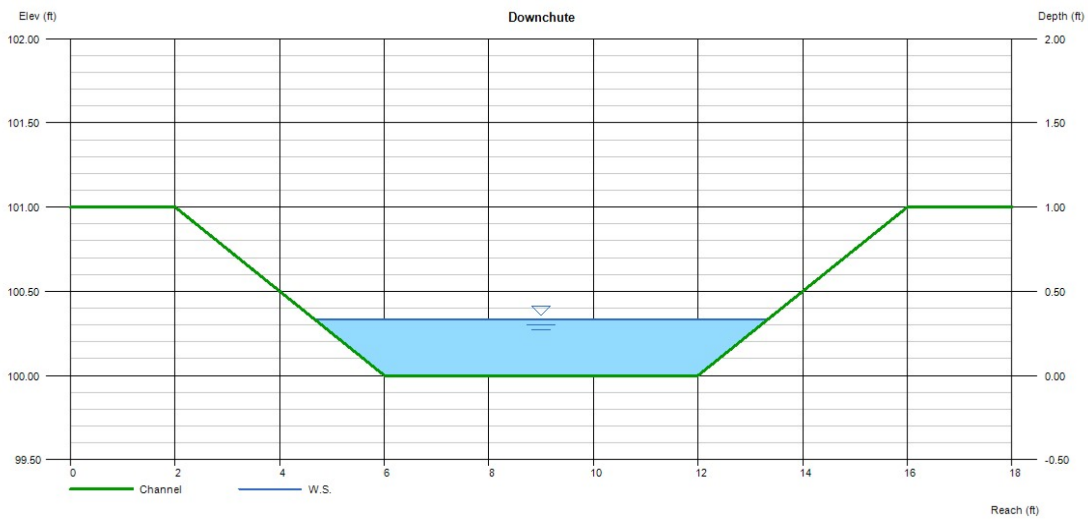
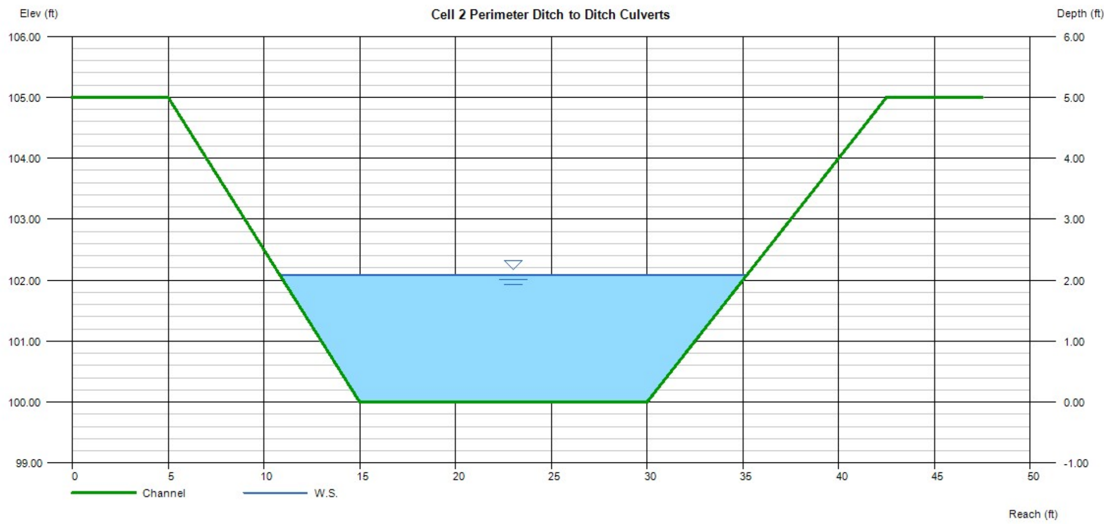


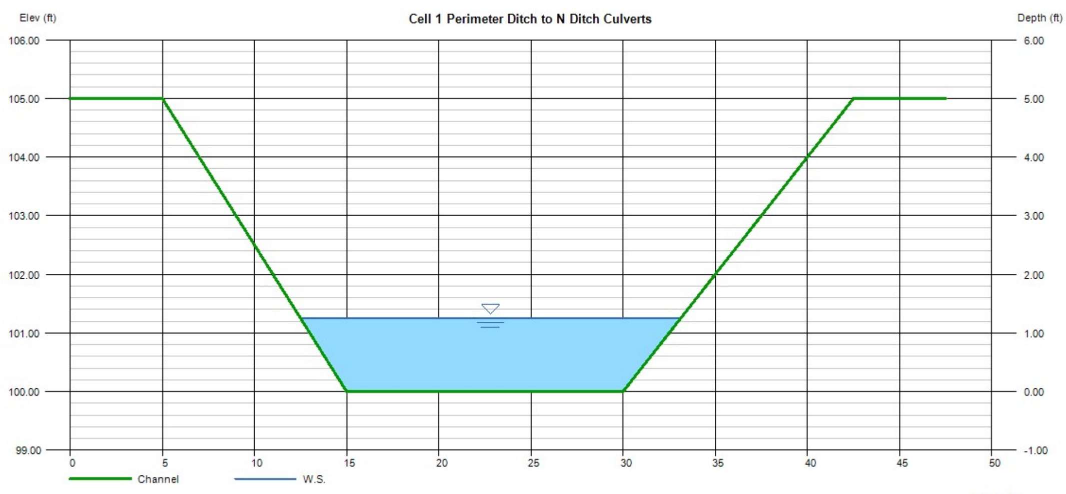
Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.67	5.504	2.238	2.46	5.00	0.52	4.68	0.76



Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.33	62.50	2.416	25.87	8.72	1.00	8.64	10.74



Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
2.09	310.5	41.18	7.54	25.30	2.12	24.40	2.97



Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
1.25	136.0	22.27	6.11	21.16	1.28	20.63	1.83

Project	Prepared by	Date
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Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm for GSA 1 & 2.	Reviewed by Ashley Grissom	Date 3/2522
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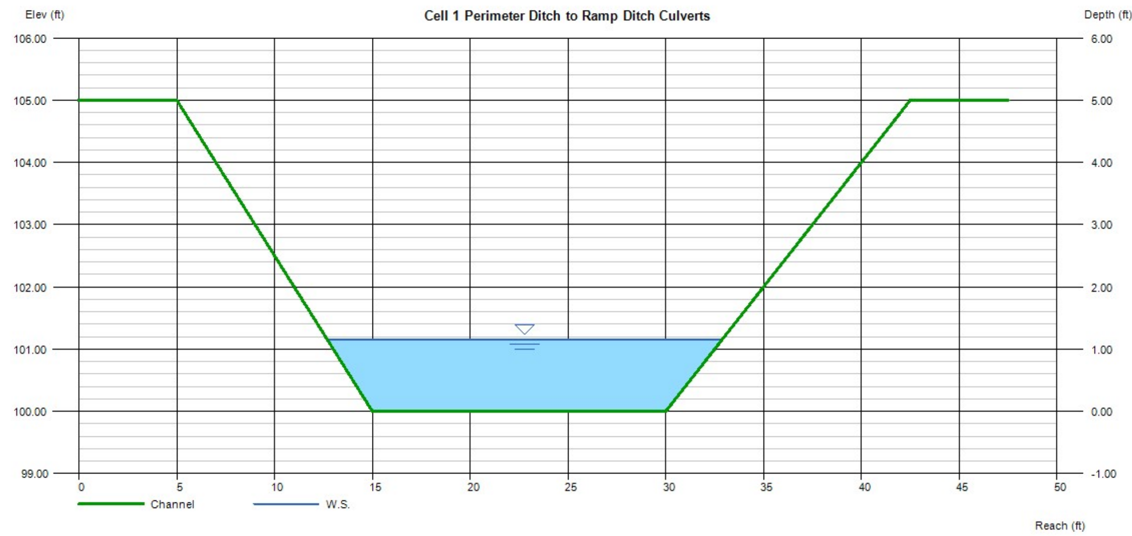

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
1.16	124.6	20.43	6.10	20.72	1.22	20.22	1.74

Project	Prepared by	Date
Plant Scherer Run-on Run-off Control	Jim Minor	3/25/22
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm for GSA 1 & 2.	Reviewed by Ashley Grissom	Date 3/2522
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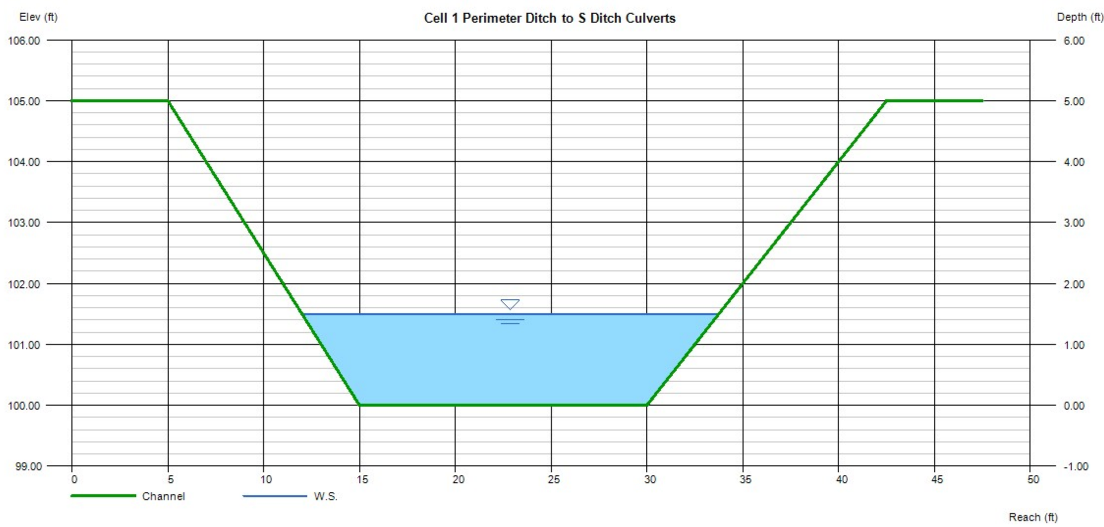


Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
1.49	194.5	27.35	7.11	22.34	1.60	21.70	2.28

Curve number data for each contributing drainage basin is provided in the detailed calculations attached. Generally, the curve number used is based on the Hydrologic Soil Group (HSG) and type of run-off potential. For the CCR by-product (gypsum), the HSG is assumed to be Group C, soils with moderately high run-off potential when thoroughly wet. A bare soil cover was assumed as a conversative condition. For HSG C, the curve number for bare soil (similar to the gypsum) is assumed to be 91. For areas outside of the gypsum cell, HSG B is assumed and for the ponded area the curve number is 100 and for the impervious gravel areas around the ponds, the curve number is assumed to be 85.

Select Curve Number

Select curve number from table

	Description	Condition	A	B	C	D	Condensed Description
1	FULLY DEVELOPED URBAN AREAS	Vegetation					
2	Open space (lawns, parks, etc.)						
3	grass cover < 50%	Poor	68	79	86	89	< 50% grass cover, Poor
4	grass cover 50% to 75%	Fair	49	69	79	84	50 - 75% grass cover, Fair
5	grass cover > 75%	Good	39	61	74	80	> 75% grass cover, Good
6	Impervious Areas						
7	Paved parking lots, roofs, driveways		98	98	98	98	Paved parking & roofs
8	Streets and roads						
9	Paved: curbs and storm sewers		98	98	98	98	Paved roads with curbs & sewers
10	Paved: open ditches (with right-of-way)	50% imp	83	89	92	93	Paved roads with open ditches, 50% imp
11	Gravel (with right-of-way)		76	85	89	91	Gravel roads
12	Dirt (with right-of-way)		72	82	87	89	Dirt roads
13	Urban Districts	impervious					
14	Commercial & business	85% imp	89	92	94	95	Urban commercial, 85% imp
15	Industrial	72% imp	81	88	91	93	Urban industrial, 72% imp
16	Residential Districts						
17	(by average lot size)	impervious					
18	1/8 acre (town houses)	65% impervious	77	85	90	92	1/8 acre lots, 65% impervious
19	1/4 acre	38% impervious	61	75	83	87	1/4 acre lots, 38% impervious
20	1/3 acre	30% impervious	57	72	81	86	1/3 acre lots, 30% impervious
21	1/2 acre	25% impervious	54	70	80	85	1/2 acre lots, 25% impervious
22	1 acre	20% impervious	51	68	79	84	1 acre lots, 20% impervious
23	2 acre	12% impervious	46	65	77	82	2 acre lots, 12% impervious
24	Western Desert Urban Areas						
25	Natural desert (pervious areas only)		63	77	85	88	Natural western desert
26	Artificial desert landscaping		96	96	96	96	Artificial desert landscape
27	DEVELOPING URBAN AREA	(No Vegetation)					
28	Newly graded area (pervious only)		77	86	91	94	Newly graded area
29	CULTIVATED AGRICULTURAL LAND						
30	Fallow						
31	Bare soil		77	86	91	94	Fallow, bare soil
32	Crop residue (CR)	Poor	76	85	90	93	Fallow, crop residue, Poor

Edit... OK Cancel Help

There are no additional process inflows into the ponds. The normal pool elevation for the clear pool, north pond, and south sedimentation pond was provided by the Plant Scherer Environmental Manager. Pumps will maintain the water level between elevation 399.5 and 405.6.

Design Inputs/References

- TR-55 – Urban Hydrology for Small Watersheds, Appendix B, National Resources Conservation Service, Conservation Engineering Division, 1986. (Used to generate Hydraflow Rainfall Report)
- Autodesk Storm and Sanitary Analysis 2015, version 9.1.140.1 Mar 03 2014, 08:09:20
- Georgia Power Company – Plant Scherer – Coal Combustion By-Product Disposal Facility Drawings E1C11050 through E1C11078.
- Metro Engineering & Surveying Co., Inc. – Georgia Power Company Plant Scherer Storage Facility Topographic Map dated October 29, 2010.
- SCS Calculation DC-SH-3511DE-001-C01A0.
- SCS Calculation DC-SH- 646612-010.

- NOAA Atlas 14, Volume 9, Version 2 for Juliette, GA. (http://dipper.nws.noaa.gov/hdsc/pfds/pfds_printpage.html?lat=33.0775&lon=-83.7959&data=depth&units=english&series=pds#maps)
- Hydraflow Express Extension for Autodesk AutoCAD Civil 3D, version 10.4
- Hydraulic Engineering Circular No. 15, 3rd Edition.

Body of Calculation

See detailed calculations and software output on pages 12-43.

Project Description

File Name .... GSA Cell 1 and 2.SPF
Description .... Plant Scherer Cell 1&2 Run-on Run-off Study

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... SCS TR-55
Time of Concentration (TOC) Method .... SCS TR-55
Link Routing Method .... Hydrodynamic
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On	Jul 06, 2016	00:00:00
End Analysis On	Jul 07, 2016	00:00:00
Start Reporting On	Jul 06, 2016	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	5	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins..	6
Nodes...	6
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	4
Links...	5
Channels	0
Pipes	3
Pumps	0
Orifices	0
Weirs	2
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Storm	Time Series	25 year	Cumulative	inches	Georgia	Monroe	25	6.80	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Cell1	34.40	91.00	6.80	5.74	197.52	265.41	0 00:08:26
2	Cell2	42.10	91.00	6.80	5.74	241.74	310.47	0 00:10:13
3	Clear	1.50	90.00	6.80	5.63	8.44	12.20	0 00:06:00
4	Emergency	2.50	89.44	6.80	5.56	13.91	20.23	0 00:06:00
5	NorthPond	5.20	90.52	6.80	5.69	29.57	42.66	0 00:06:00
6	South	3.80	92.11	6.80	5.87	22.31	31.74	0 00:06:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-02	Outfall	412.00					0.00	412.00					
2	Outfall	Outfall	412.00					0.00	412.00					
3	ClearPool	Storage Node	397.00	414.00	405.60		0.00	44.04	411.88				0.00	0.00
4	EmergencyPond	Storage Node	391.00	400.00	392.00		0.00	20.07	395.11				0.00	0.00
5	NPond	Storage Node	395.00	414.00	405.60		0.00	340.68	411.90				0.00	0.00
6	SouthPond	Storage Node	397.00	414.00	405.60		0.00	279.61	411.86				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (ft)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	CPtoSP	Pipe	ClearPool	SouthPond	84.00	400.00	400.00	0.0000	2.000	0.0120	18.52	0.85	21.90	5.89	2.00	1.00	1440.00	SURCHARGED
2	Link-03	Pipe	ClearPool	NPond	90.00	400.00	400.00	0.0000	2.000	0.0120	19.42	0.82	23.78	6.18	2.00	1.00	1440.00	SURCHARGED
3	SPtoEmerg	Pipe	SouthPond	EmergencyPond	121.00	411.47	396.04	12.7500	1.500	0.0120	4.93	40.64	0.12	14.45	0.37	0.25	0.00	Calculated
4	Spillway	Weir	SouthPond	Outfall		397.00	412.00				0.00							
5	Weir-02	Weir	NPond	Out-02		395.00	412.00				0.00							

Subbasin Hydrology

Subbasin : Cell1

Input Data

Area (ac) 34.40
Weighted Curve Number 91.00
Rain Gage ID .... Storm

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	36.81	-	91.00
Composite Area & Weighted CN	36.81		91.00

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.011	0.00	0.00
Flow Length (ft) :	101	0.00	0.00
Slope (%) :	2.7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.80	0.00	0.00
Velocity (ft/sec) :	1.69	0.00	0.00
Computed Flow Time (min) :	0.99	0.00	0.00

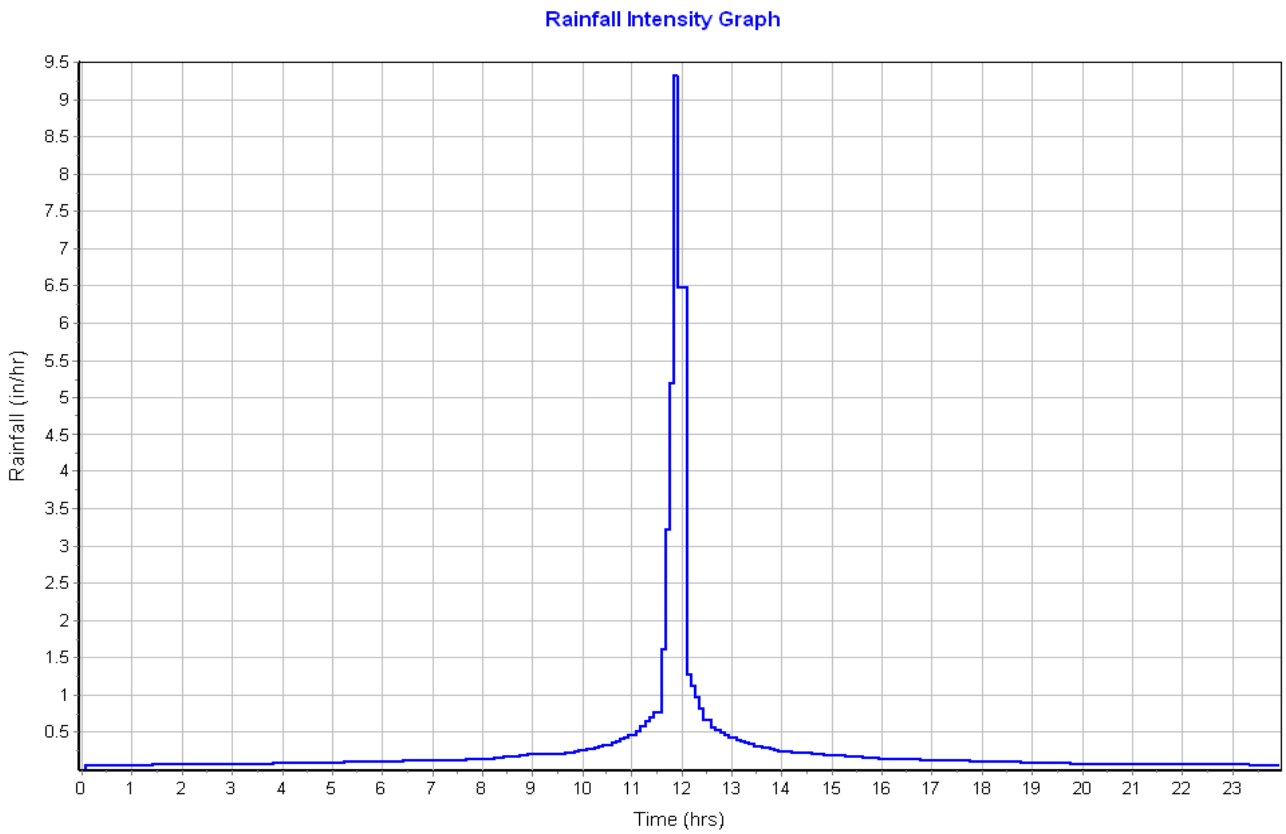
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.027	.012	.027
Flow Length (ft) :	301	619	1885
Channel Slope (%) :	0.50	24.2	1.06
Cross Section Area (ft^2) :	2.238	2.416	27.13
Wetted Perimeter (ft) :	5	8.72	22.29
Velocity (ft/sec) :	2.28	25.96	6.48
Computed Flow Time (min) :	2.20	0.40	4.85

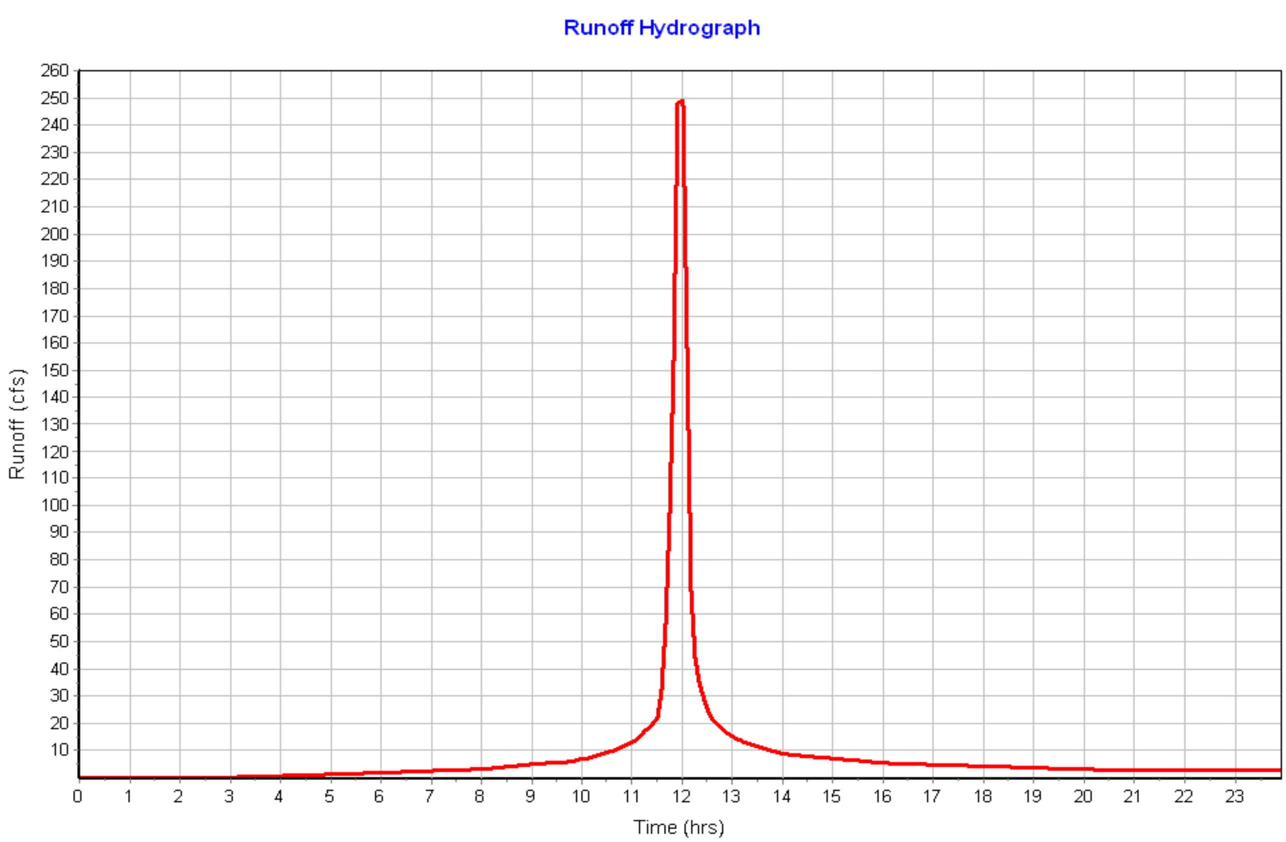
Total TOC (min) 8.44

Subbasin Runoff Results

Total Rainfall (in) 6.80
Total Runoff (in) 5.74
Peak Runoff (cfs) 265.41
Weighted Curve Number 91.00
Time of Concentration (days hh:mm:ss) 0 00:08:26

Subbasin : Cell1





Subbasin : Cell2

Input Data

Area (ac) 42.10
Weighted Curve Number 91.00
Rain Gage ID .... Storm

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	46.90	-	91.00
Composite Area & Weighted CN	46.90		91.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.011	0.00	0.00
Flow Length (ft) :	176	0.00	0.00
Slope (%) :	2.7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.80	0.00	0.00
Velocity (ft/sec) :	1.89	0.00	0.00
Computed Flow Time (min) :	1.55	0.00	0.00

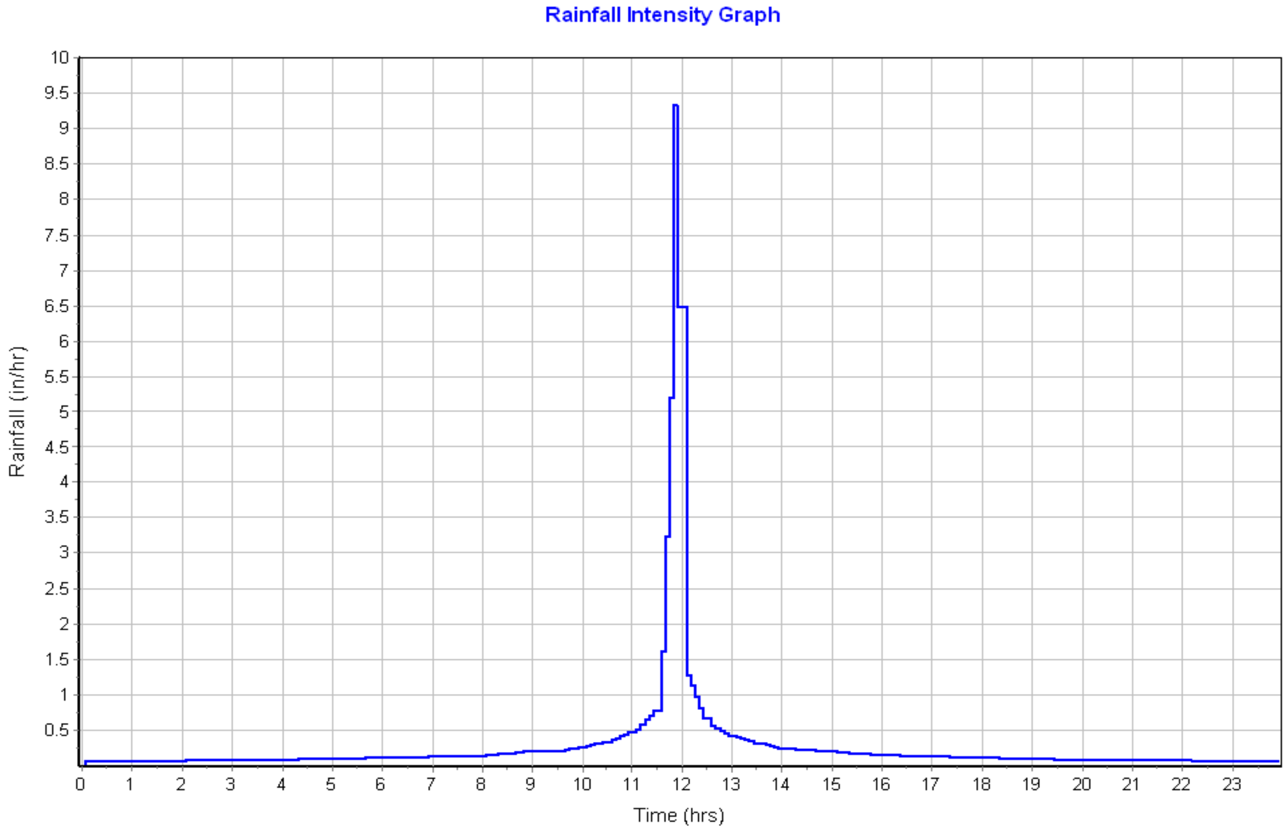
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.027	.012	.027
Flow Length (ft) :	115	464	3238
Channel Slope (%) :	0.50	24.2	0.85
Cross Section Area (ft²) :	2.238	2.416	42.7
Wetted Perimeter (ft) :	5	8.72	25.6
Velocity (ft/sec) :	2.28	25.96	7.16
Computed Flow Time (min) :	0.84	0.30	7.54

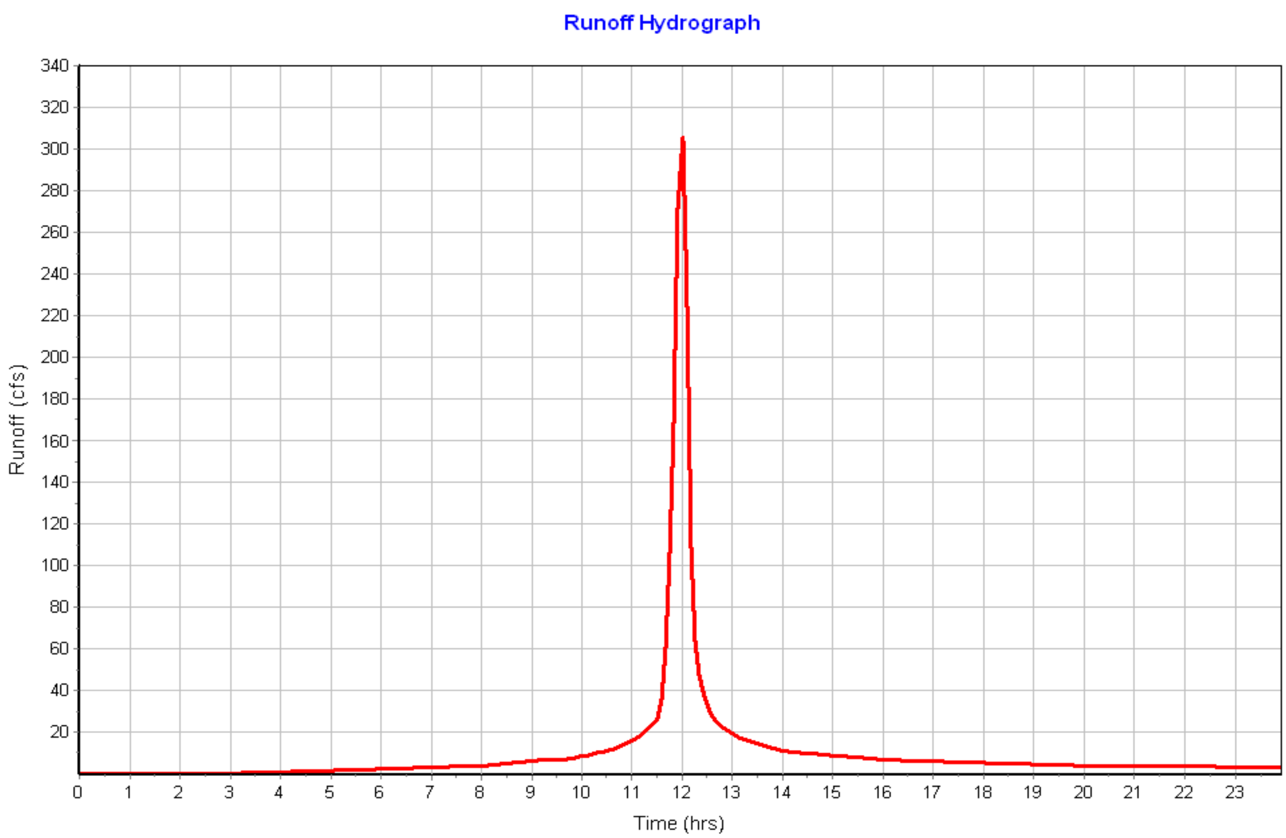
Total TOC (min) 10.23

Subbasin Runoff Results

Total Rainfall (in) 6.80
Total Runoff (in) 5.74
Peak Runoff (cfs) 310.47
Weighted Curve Number 91.00
Time of Concentration (days hh:mm:ss) 0 00:10:14

Subbasin : Cell2





Subbasin : Clear

Input Data

Area (ac) 1.50
Weighted Curve Number 90.00
Rain Gage ID .... Storm

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.50	-	100.00
Gravel roads	1.00	B	85.00
Composite Area & Weighted CN	1.50		90.00

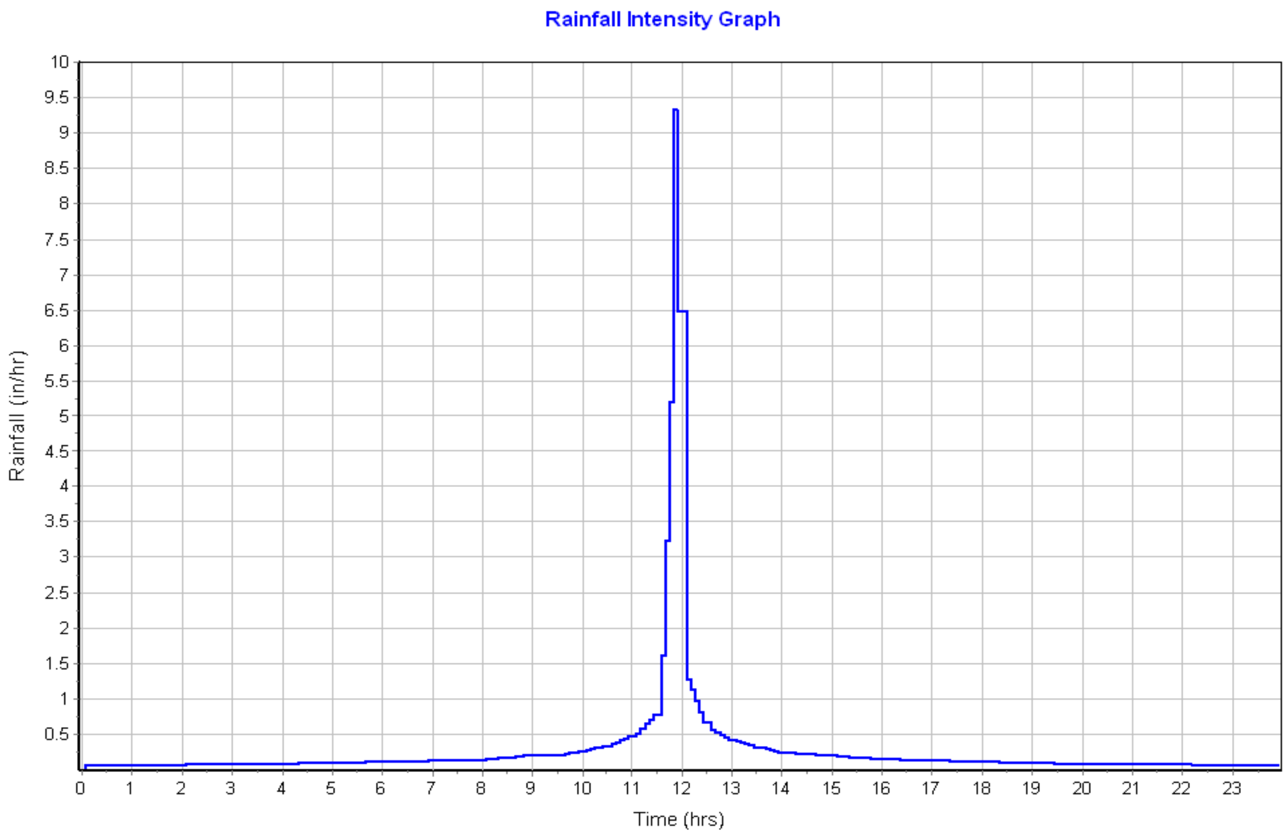
Time of Concentration

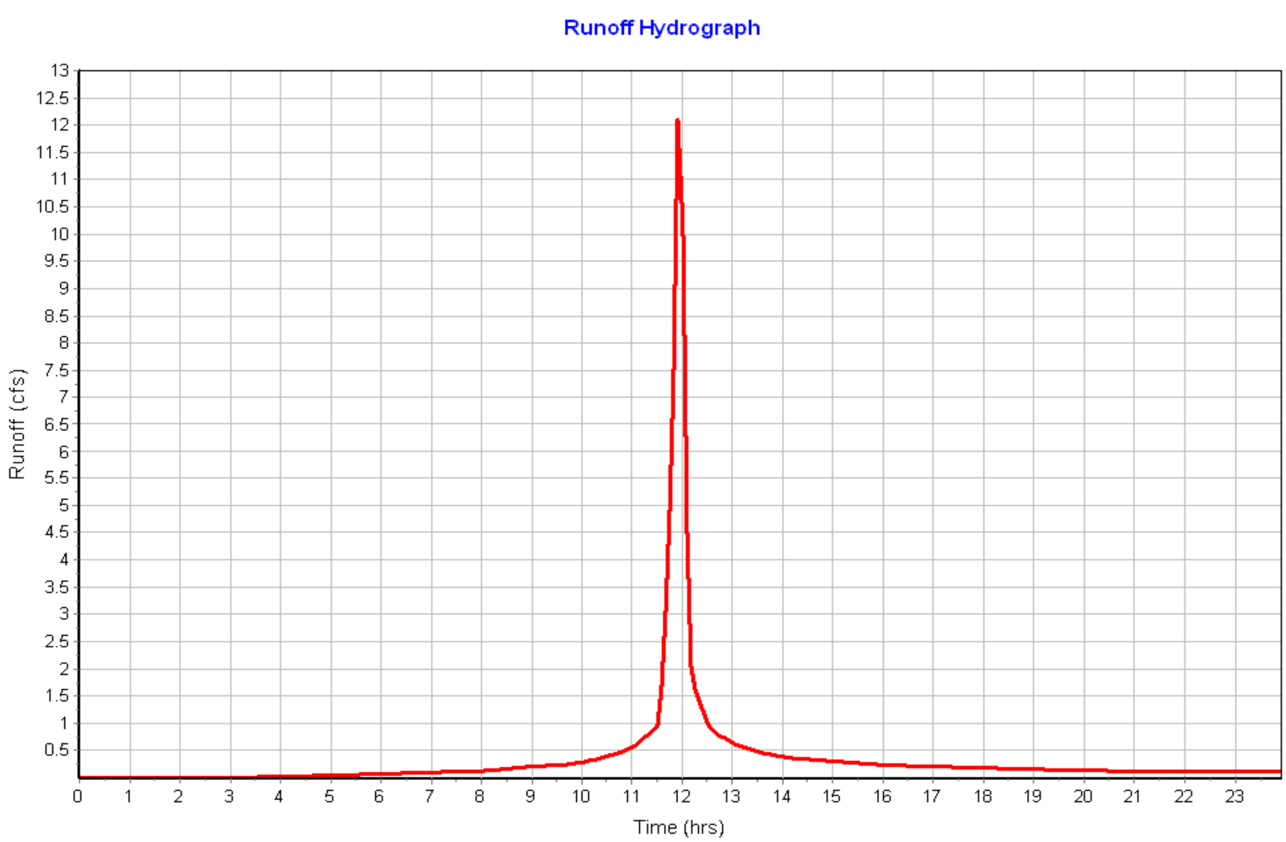
User-Defined TOC override (minutes): 6

Subbasin Runoff Results

Total Rainfall (in) 6.80
Total Runoff (in) 5.63
Peak Runoff (cfs) 12.20
Weighted Curve Number 90.00
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : Clear





Subbasin : Emergency

Input Data

Area (ac) 2.50
Weighted Curve Number 89.44
Rain Gage ID .... Storm

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.74	-	100.00
-	1.76	-	85.00
Composite Area & Weighted CN	2.50		89.44

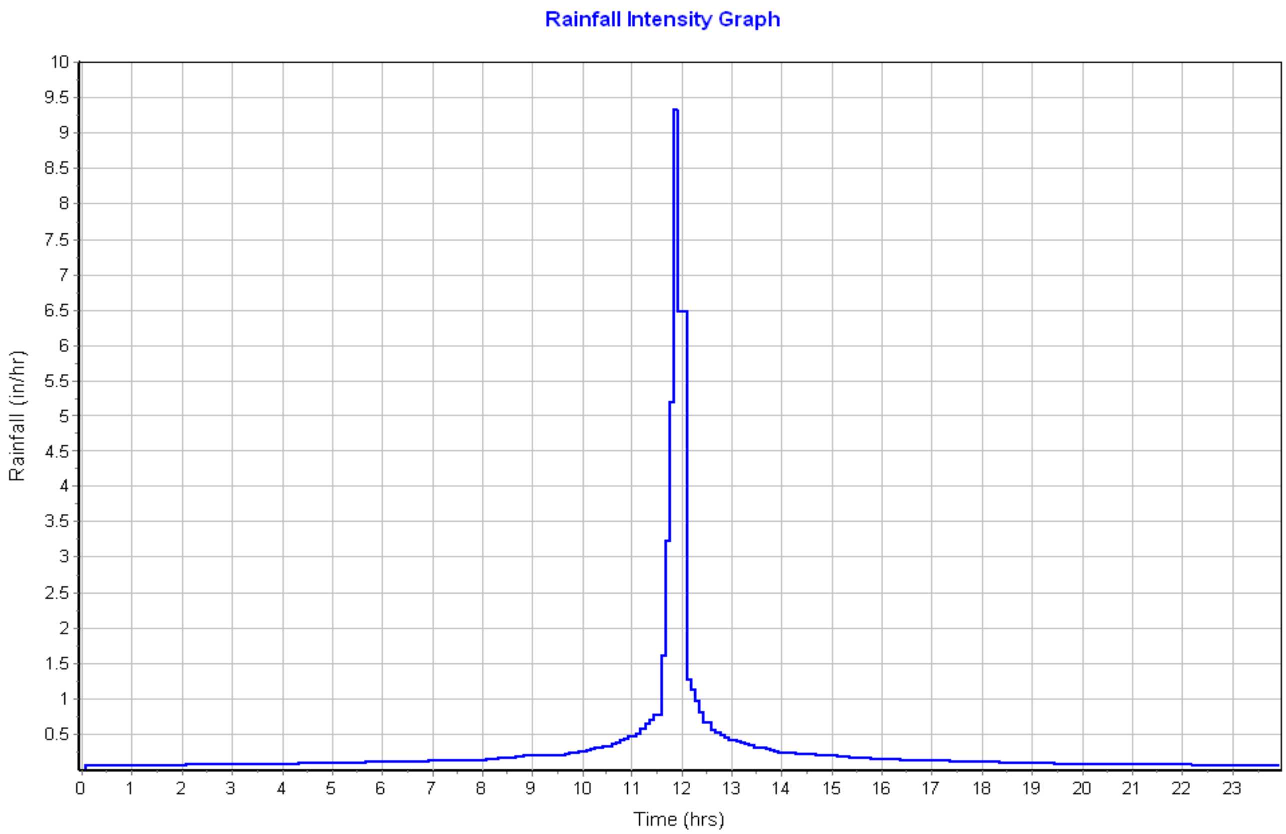
Time of Concentration

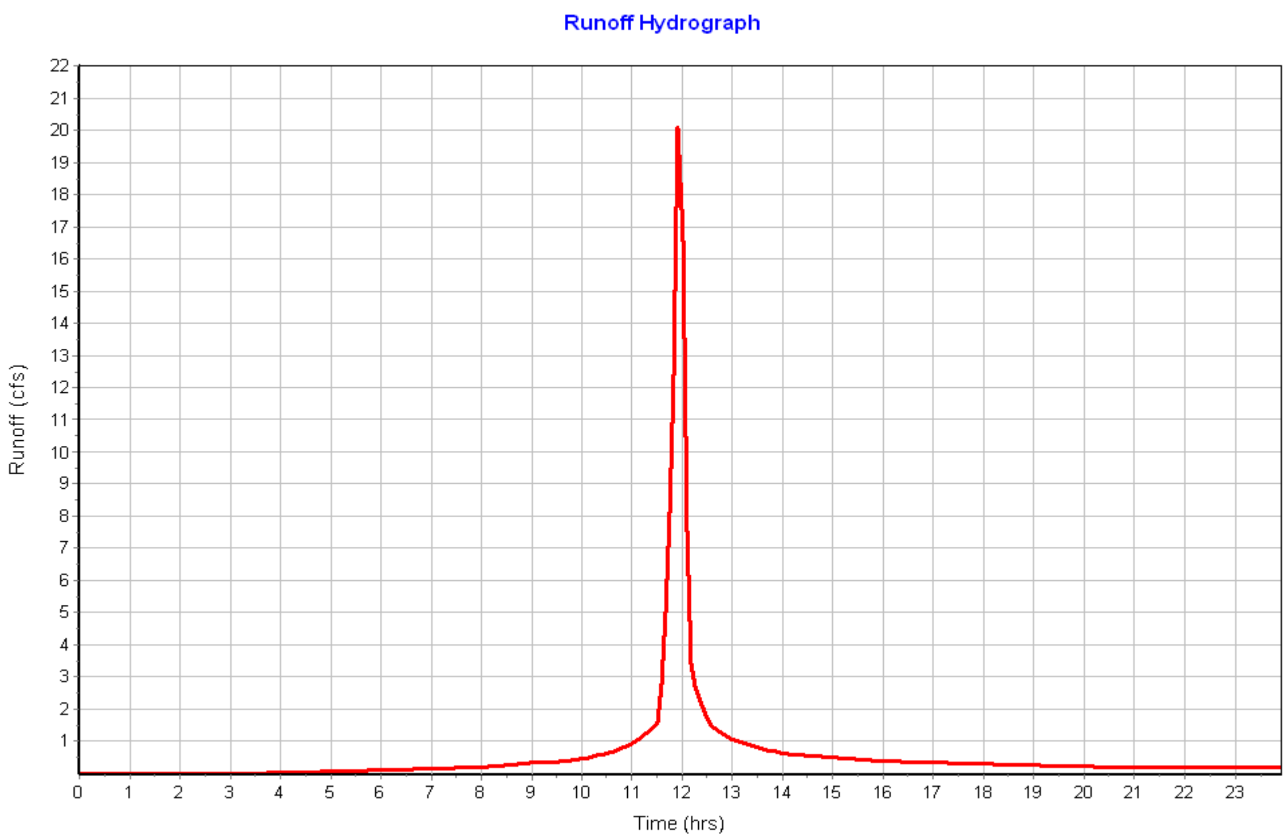
User-Defined TOC override (minutes): 6

Subbasin Runoff Results

Total Rainfall (in) 6.80
Total Runoff (in) 5.56
Peak Runoff (cfs) 20.23
Weighted Curve Number 89.44
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : Emergency





Subbasin : NorthPond

Input Data

Area (ac) 5.20
Weighted Curve Number 90.52
Rain Gage ID .... Storm

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
< 50% grass cover, Poor	1.50	B	79.00
Gravel roads	1.02	B	85.00
Pondedwater	2.70	B	99.00
Composite Area & Weighted CN	5.22		90.52

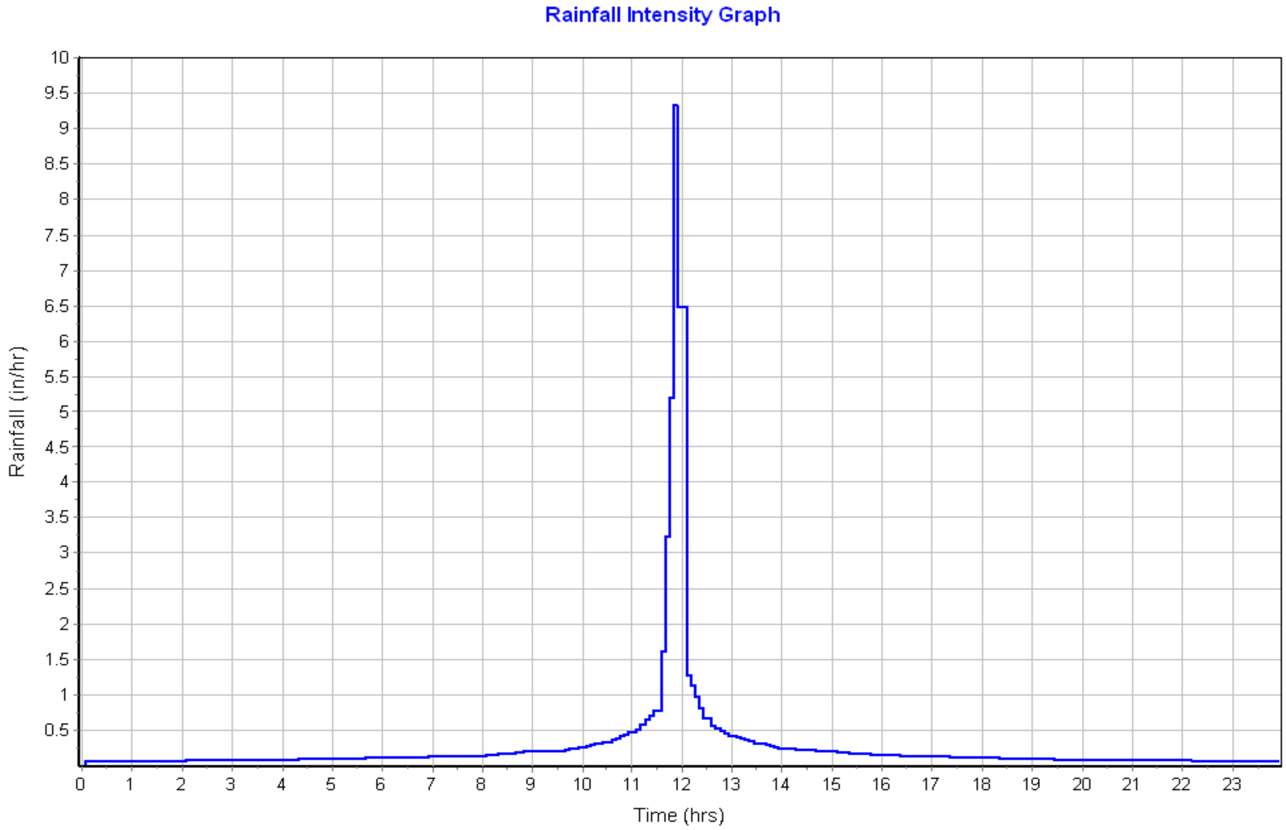
Time of Concentration

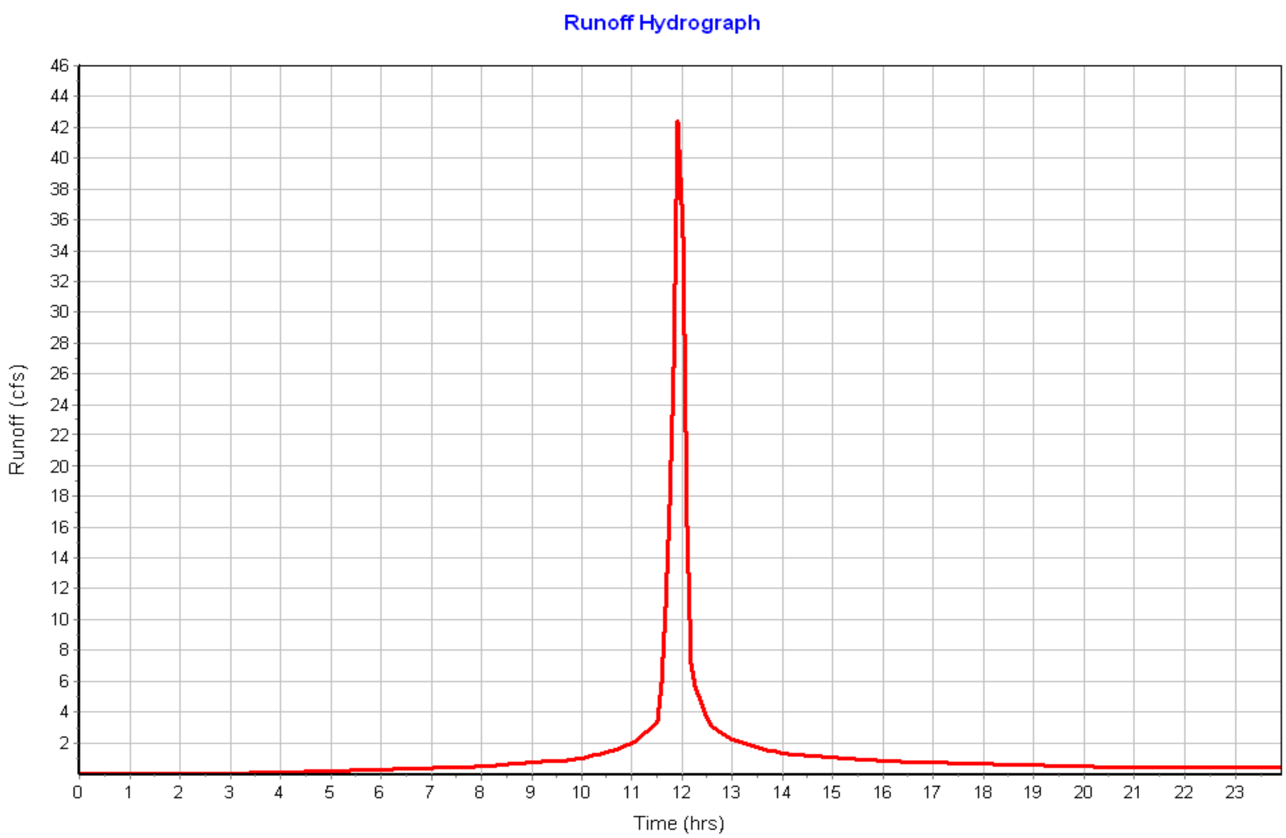
User-Defined TOC override (minutes): 6

Subbasin Runoff Results

Total Rainfall (in) 6.80
Total Runoff (in) 5.69
Peak Runoff (cfs) 42.66
Weighted Curve Number 90.52
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : NorthPond





Subbasin : South

Input Data

Area (ac) 3.80
Weighted Curve Number 92.11
Rain Gage ID .... Storm

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.80	-	100.00
-	2.00	-	85.00
Composite Area & Weighted CN	3.80		92.11

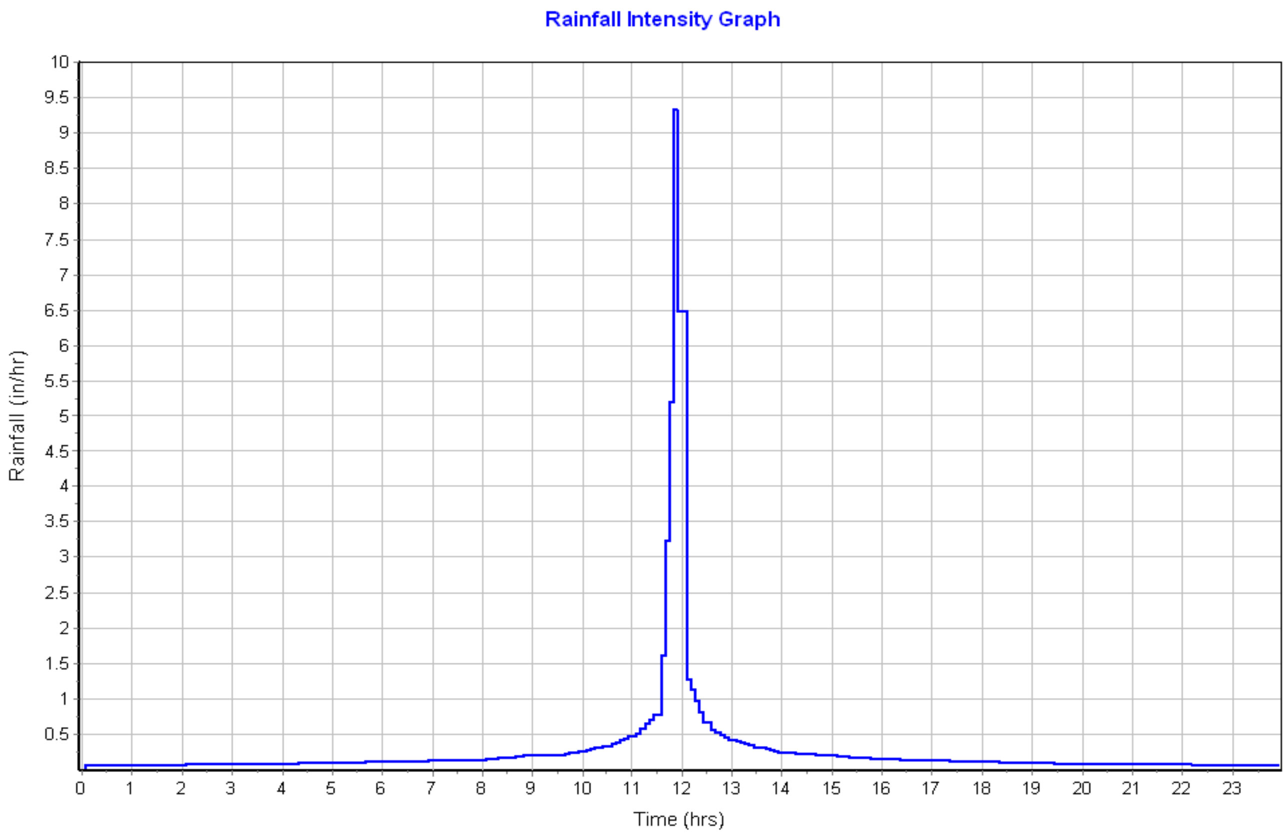
Time of Concentration

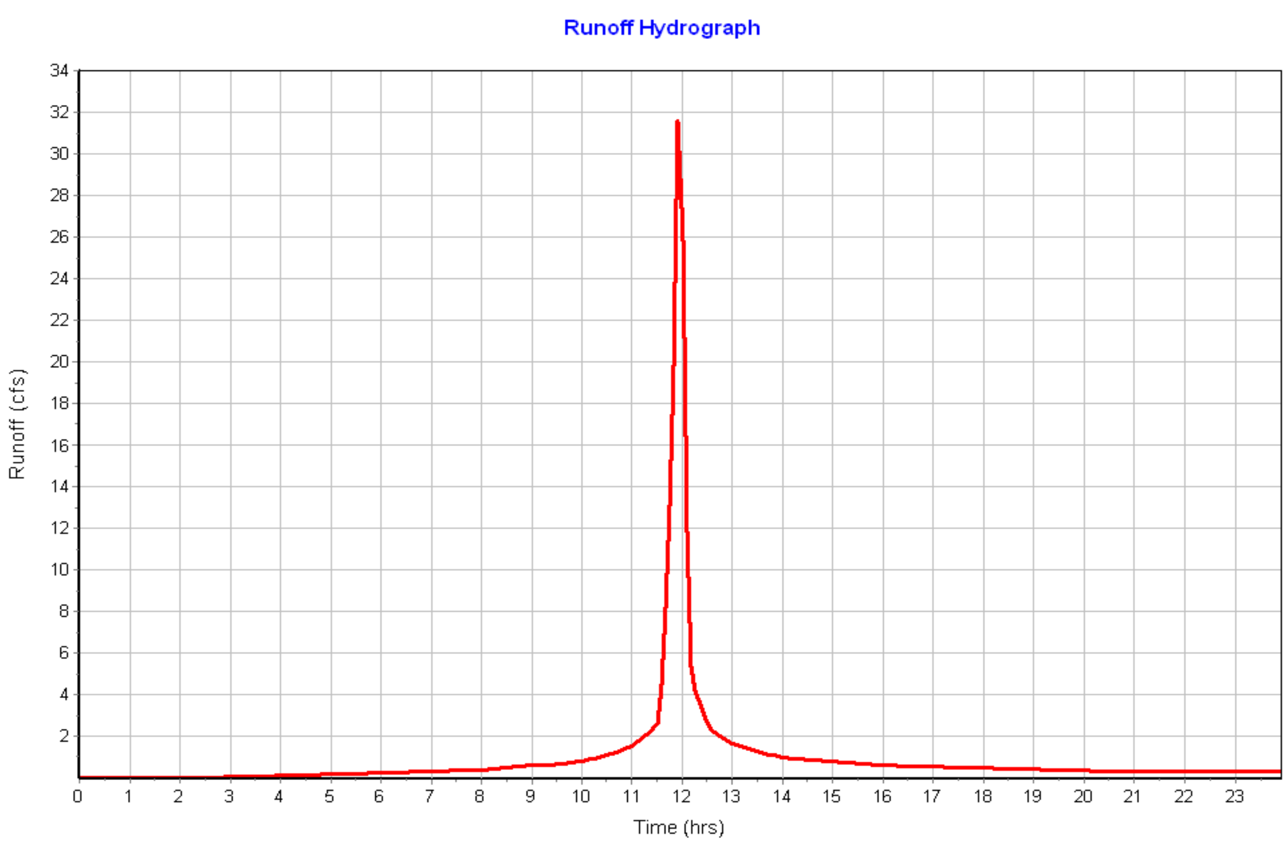
User-Defined TOC override (minutes): 6

Subbasin Runoff Results

Total Rainfall (in) 6.80
Total Runoff (in) 5.87
Peak Runoff (cfs) 31.74
Weighted Curve Number 92.11
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : South





Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (ft)	Pipe Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	CPtoSP	84.00	400.00	3.00	400.00	3.00	0.00	0.0000	CIRCULAR	2.000	2.000	0.0120	0.7000	0.7000	0.0000	0.00	No	1
2	Link-03	90.00	400.00	3.00	400.00	5.00	0.00	0.0000	CIRCULAR	2.000	2.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
3	SPtoEmerg	121.00	411.47	14.47	396.04	5.04	15.43	12.7500	CIRCULAR	1.500	1.500	0.0120	0.7000	0.7000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	CPtoSP	18.52	0 12:11	0.85	21.90	5.89	0.24	2.00	1.00	1440.00		SURCHARGED
2	Link-03	19.42	0 12:12	0.82	23.78	6.18	0.24	2.00	1.00	1440.00		SURCHARGED
3	SPtoEmerg	4.93	1 00:00	40.64	0.12	14.45	0.14	0.37	0.25	0.00		Calculated

Storage Nodes

Storage Node : ClearPool

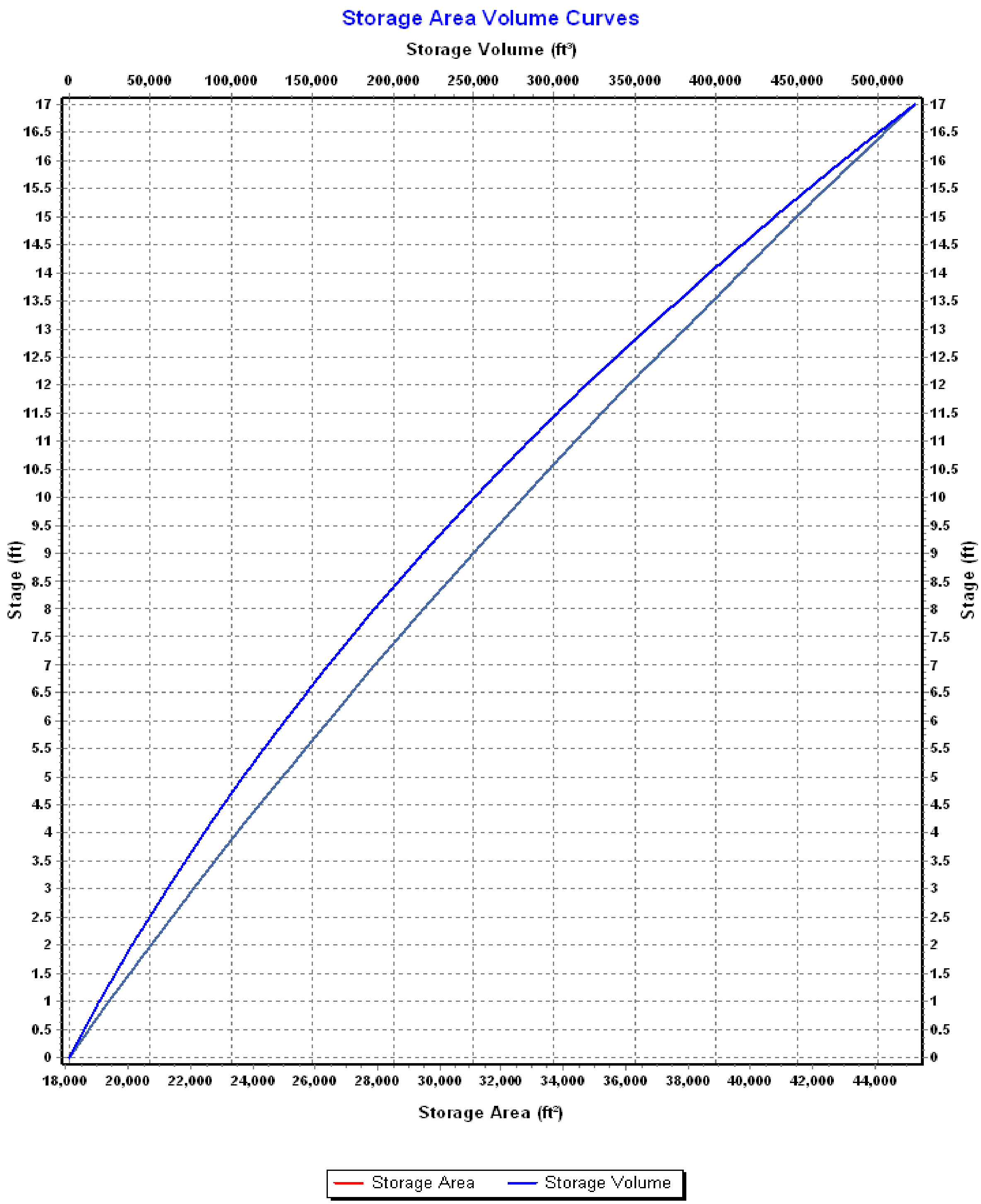
Input Data

Invert Elevation (ft) 397.00
Max (Rim) Elevation (ft) 414.00
Max (Rim) Offset (ft) 17.00
Initial Water Elevation (ft) 405.60
Initial Water Depth (ft) 8.60
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Clear Pool

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	18110	0.000
1	19395	18752.50
2	20720	38810.00
3	22083	60211.50
4	23485	82995.50
5	24927	107201.50
6	26407	132868.50
7	27927	160035.50
8	29486	188742.00
9	31084	219027.00
10	32721	250929.50
11	34397	284488.50
12	36112	319743.00
13	37866	356732.00
14	39659	395494.50
15	41492	436070.00
16	43363	478497.50
17	45278	522818.00



Storage Area Volume Curves
Storage Volume (ft³)
Stage (ft)
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : ClearPool (continued)

Output Summary Results

Peak Inflow (cfs) 44.04
Peak Lateral Inflow (cfs) 12.09
Peak Outflow (cfs) 2.54
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 411.88
Max HGL Depth Attained (ft) 14.88
Average HGL Elevation Attained (ft) 408.58
Average HGL Depth Attained (ft) 11.58
Time of Max HGL Occurrence (days hh:mm) 1 00:00
Total Exfiltration Volume (1000-ft^3) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Storage Node : EmergencyPond

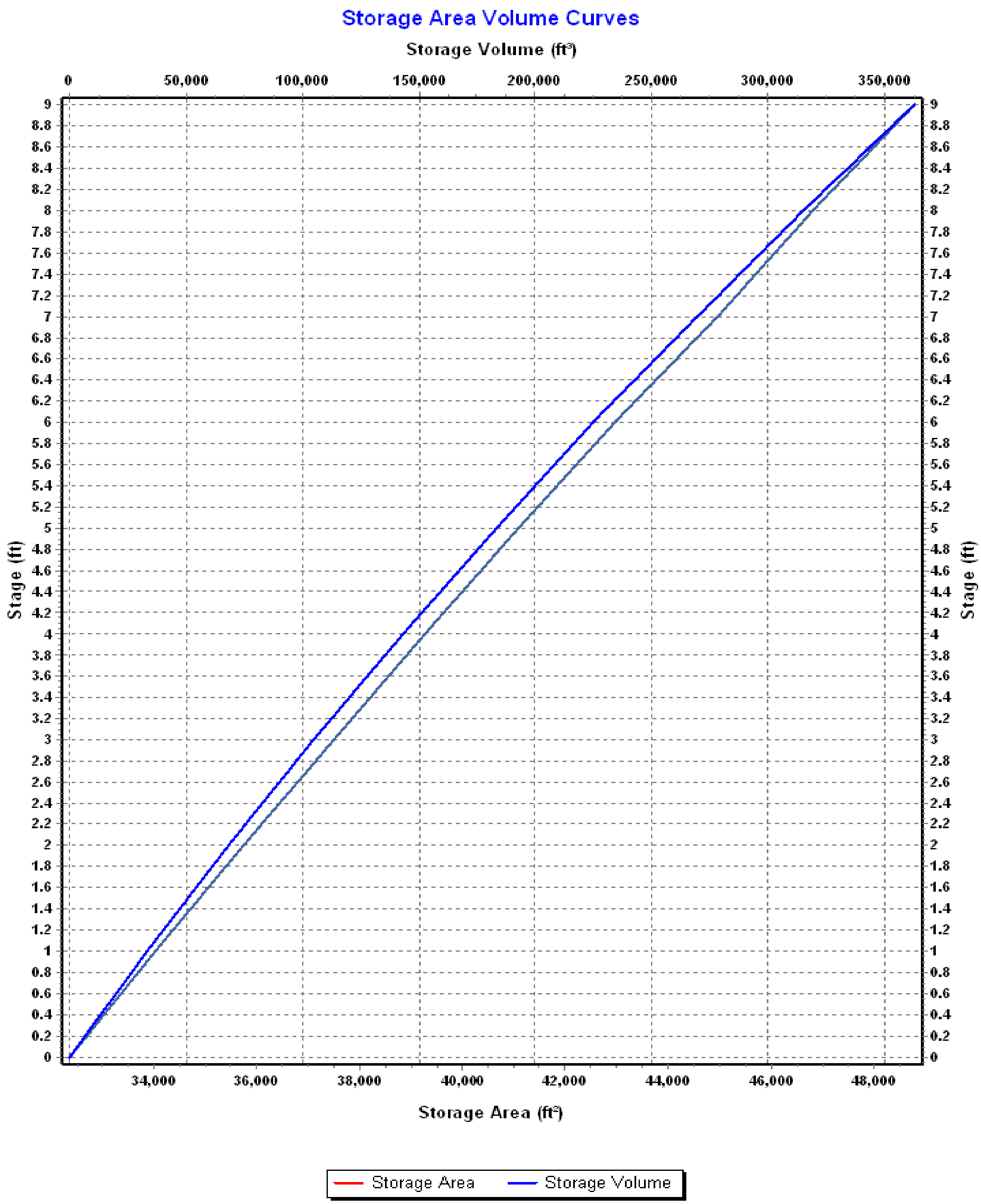
Input Data

Invert Elevation (ft) 391.00
Max (Rim) Elevation (ft) 400.00
Max (Rim) Offset (ft) 9.00
Initial Water Elevation (ft) 392.00
Initial Water Depth (ft) 1.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Emergency Pond

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	32371	0.000
1	34037	33204.00
2	35743	68094.00
3	37488	104709.50
4	39273	143090.00
5	41097	183275.00
6	42960	225303.50
7	44962	269264.50
8	46804	315147.50
9	48785	362942.00


Storage Area Volume Curves
Storage Volume (ft³)
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
Stage (ft)
Storage Area (ft²)
34,000
36,000
38,000
40,000
42,000
44,000
46,000
48,000
Storage Area
Storage Volume

Storage Node : EmergencyPond (continued)

Output Summary Results

Peak Inflow (cfs) 20.07
Peak Lateral Inflow (cfs) 20.07
Peak Outflow (cfs) 0.00
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 395.11
Max HGL Depth Attained (ft) 4.11
Average HGL Elevation Attained (ft) 392.81
Average HGL Depth Attained (ft) 1.81
Time of Max HGL Occurrence (days hh:mm) 1 00:00
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Storage Node : NPond

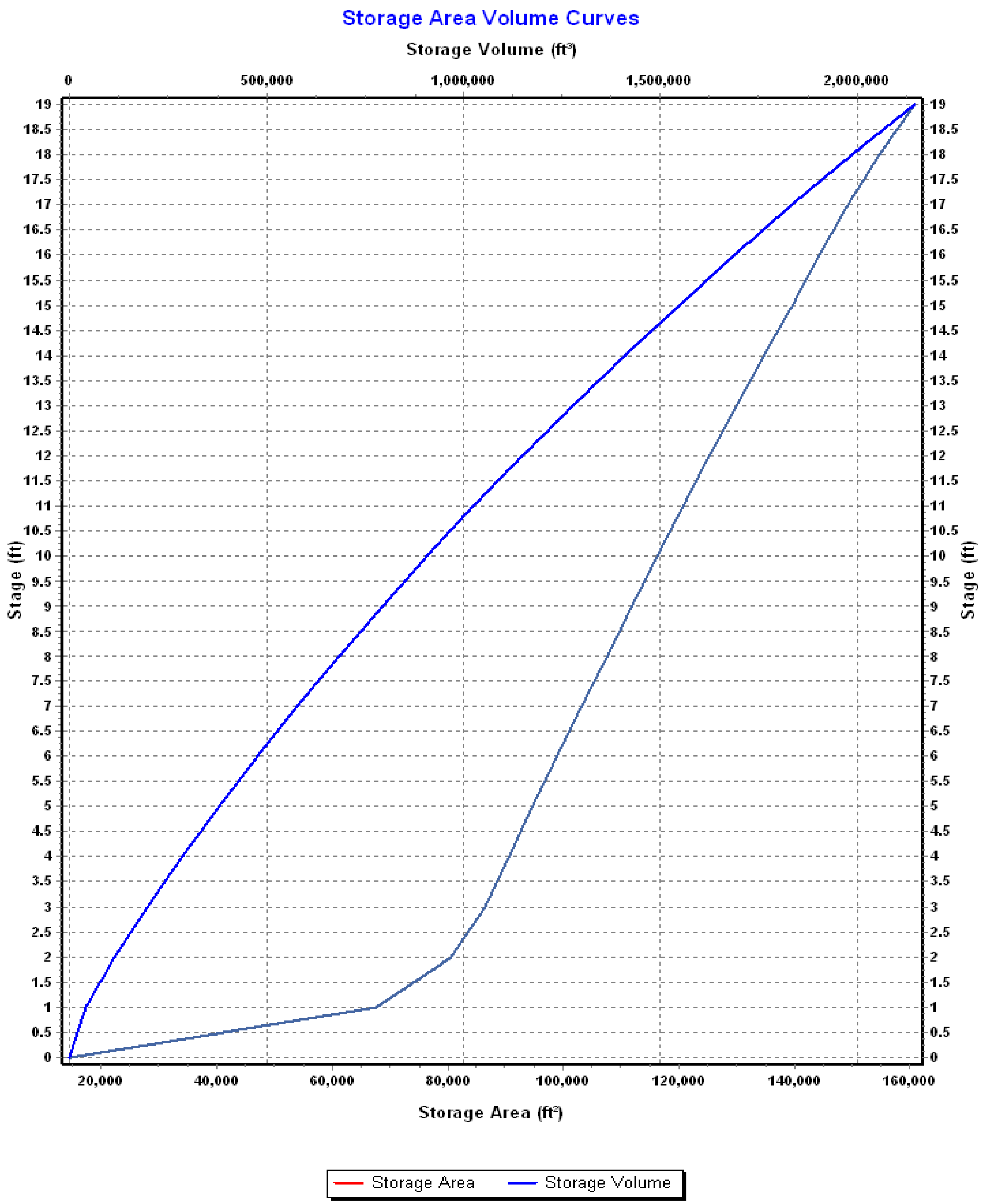
Input Data

Invert Elevation (ft) 395.00
Max (Rim) Elevation (ft) 414.00
Max (Rim) Offset (ft) 19.00
Initial Water Elevation (ft) 405.60
Initial Water Depth (ft) 10.60
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : North Pond

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	14476	0.000
1	67538	41007.00
2	80510	115031.00
3	86412	198492.00
4	90549	286972.50
5	94718	379606.00
6	98926	476428.00
7	103178	577480.00
8	107479	682808.50
9	111834	792465.00
10	116251	906507.50
11	120748	1025007.00
12	125336	1148049.00
13	130005	1275719.50
14	134742	1408093.00
15	139548	1545238.00
16	144428	1687226.00
17	149403	1834141.50
18	154620	1986153.00
19	160841	2143883.50



Storage Area Volume Curves
Storage Volume (ft³)
0
500,000
1,000,000
1,500,000
2,000,000
Stage (ft)
19
18.5
18
17.5
17
16.5
16
15.5
15
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : NPond (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-02	Trapezoidal	No	412.00	17.00	28.00	2.00	3.33

Output Summary Results

Peak Inflow (cfs) 340.68
Peak Lateral Inflow (cfs) 340.68
Peak Outflow (cfs) 19.42
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 411.90
Max HGL Depth Attained (ft) 16.9
Average HGL Elevation Attained (ft) 408.62
Average HGL Depth Attained (ft) 13.62
Time of Max HGL Occurrence (days hh:mm) 1 00:00
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Storage Node : SouthPond

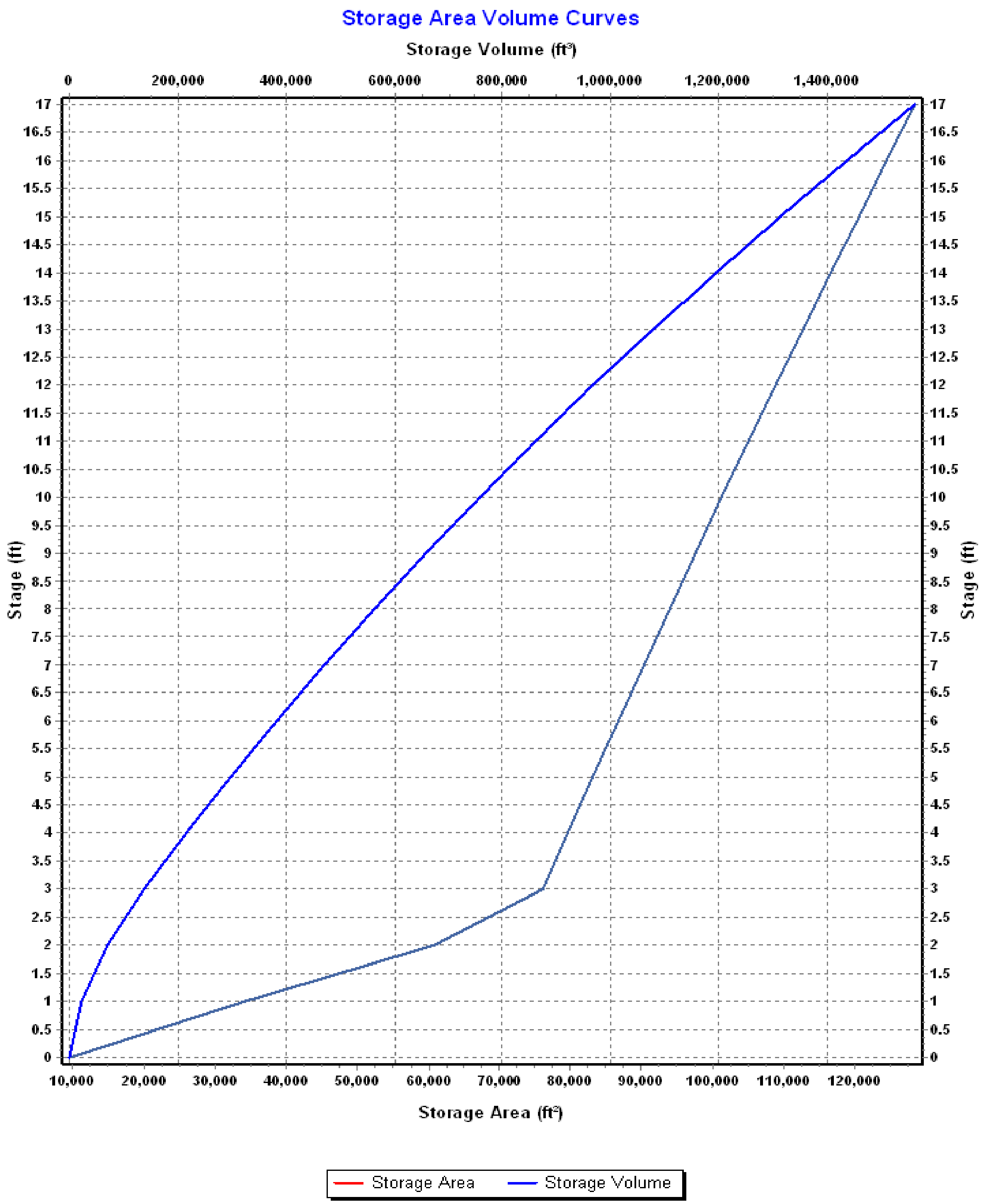
Input Data

Invert Elevation (ft) 397.00
Max (Rim) Elevation (ft) 414.00
Max (Rim) Offset (ft) 17.00
Initial Water Elevation (ft) 405.60
Initial Water Depth (ft) 8.60
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : South Pond

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	9541	0.000
1	34205	21873.00
2	60888	69419.50
3	76105	137916.00
4	79592	215764.50
5	83117	297119.00
6	86681	382018.00
7	90282	470499.50
8	93922	562601.50
9	97600	658362.50
10	101317	757821.00
11	105072	861015.50
12	108865	967984.00
13	112696	1078764.50
14	116565	1193395.00
15	120473	1311914.00
16	124419	1434360.00
17	128405	1560772.00



Storage Area Volume Curves
Storage Volume (ft³)
0
200,000
400,000
600,000
800,000
1,000,000
1,200,000
1,400,000
Stage (ft)
17
16.5
16
15.5
15
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : SouthPond (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Spillway	Trapezoidal	No	412.00	15.00	28.00	2.00	3.33

Output Summary Results

Peak Inflow (cfs) 279.61
Peak Lateral Inflow (cfs) 279.61
Peak Outflow (cfs) 18.52
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 411.86
Max HGL Depth Attained (ft) 14.86
Average HGL Elevation Attained (ft) 408.61
Average HGL Depth Attained (ft) 11.61
Time of Max HGL Occurrence (days hh:mm) 1 00:00
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)

Project Description

File Name .... GSA Cell 1 and 2.SPF
Description .... Plant Scherer Cell 1 Run-on Run-off Study

Analysis Options

Flow Units .... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Link Routing Method .... Hydrodynamic
Storage Node Exfiltration.. None
Starting Date JUL-06-2016 00:00:00
Ending Date JUL-07-2016 00:00:00
Report Time Step 00:05:00

Element Count

Number of rain gages 1
Number of subbasins 6
Number of nodes 6
Number of links 5

Raingage Summary

Gage ID	Data Source	Data Type	Recording Interval min
Storm	25 year	CUMULATIVE	6.00

Subbasin Summary

Subbasin ID	Total Area acres
Cell1	34.40
Cell2	42.10
Clear	1.50
Emergency	2.50
NorthPond	5.20
South	3.80

Node Summary

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Out-02	OUTFALL	412.00	431.00	0.00	
Outfall	OUTFALL	412.00	429.00	0.00	

ClearPool	STORAGE	397.00	414.00	0.00
EmergencyPond	STORAGE	391.00	400.00	0.00
NPond	STORAGE	395.00	414.00	0.00
SouthPond	STORAGE	397.00	414.00	0.00

****
Link Summary
****

Link ID	From Node	To Node	Element Type	Length ft	Slope %	Manning's Roughness
CPtoSP	ClearPool	SouthPond	CONDUIT	84.0	0.0012	0.0120
Link-03	ClearPool	NPond	CONDUIT	90.0	0.0011	0.0120
SPtoEmerg	SouthPond	EmergencyPond	CONDUIT	121.0	12.7521	0.0120
Spillway	SouthPond	Outfall	WEIR			
Weir-02	NPond	Out-02	WEIR			

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter ft	Width ft	No. of Barrels	Cross Sectional Area ft²	Full Flow Hydraulic Radius ft	Design Flow Capacity cfs
CPtoSP	CIRCULAR	2.00	2.00	1	3.14	0.50	0.85
Link-03	CIRCULAR	2.00	2.00	1	3.14	0.50	0.82
SPtoEmerg	CIRCULAR	1.50	1.50	1	1.77	0.38	40.64

****
Runoff Quantity Continuity
****

	Volume acre-ft	Depth inches
Total Precipitation	51.344	6.884
Surface Runoff	0.711	0.095
Continuity Error (%)	-0.000	

****
Flow Routing Continuity
****

	Volume acre-ft	Volume Mgallons
External Inflow	0.000	0.000
External Outflow	0.000	0.000
Initial Stored Volume	42.174	13.743
Final Stored Volume	84.792	27.631
Continuity Error (%)	0.000	

****
Composite Curve Number Computations Report
****

Subbasin Cell1

Area Soil

Soil/Surface Description	(acres)	Group	CN
-	36.81	-	91.00
Composite Area & Weighted CN	36.81		91.00

Subbasin Cell2

Soil/Surface Description	Area (acres)	Soil Group	CN
-	46.90	-	91.00
Composite Area & Weighted CN	46.90		91.00

Subbasin Clear

Soil/Surface Description	Area (acres)	Soil Group	CN
-	0.50	-	100.00
Gravel roads	1.00	B	85.00
Composite Area & Weighted CN	1.50		90.00

Subbasin Emergency

Soil/Surface Description	Area (acres)	Soil Group	CN
-	0.74	-	100.00
-	1.76	-	85.00
Composite Area & Weighted CN	2.50		89.44

Subbasin NorthPond

Soil/Surface Description	Area (acres)	Soil Group	CN
< 50% grass cover, Poor	1.50	B	79.00
Gravel roads	1.02	B	85.00
Pondedwater	2.70	B	99.00
Composite Area & Weighted CN	5.22		90.52

Subbasin South

Soil/Surface Description	Area (acres)	Soil Group	CN
-	1.80	-	100.00
-	2.00	-	85.00
Composite Area & Weighted CN	3.80		92.11

SCS TR-55 Time of Concentration Computations Report

Sheet Flow Equation

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where:

```
        Tc = Time of Concentration (hrs)
        n  = Manning's Roughness
        Lf = Flow Length (ft)
        P  = 2 yr, 24 hr Rainfall (inches)
        Sf = Slope (ft/ft)
```

Shallow Concentrated Flow Equation

```
        V  = 16.1345 * (Sf^0.5) (unpaved surface)
        V  = 20.3282 * (Sf^0.5) (paved surface)
        V  = 15.0 * (Sf^0.5) (grassed waterway surface)
        V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
        V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
        V  = 7.0 * (Sf^0.5) (short grass pasture surface)
        V  = 5.0 * (Sf^0.5) (woodland surface)
        V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
        V  = Velocity (ft/sec)
        Sf = Slope (ft/ft)
```

Channel Flow Equation

```
        V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
        R  = Aq / Wp
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
        R  = Hydraulic Radius (ft)
        Aq = Flow Area (ft²)
        Wp = Wetted Perimeter (ft)
        V  = Velocity (ft/sec)
        Sf = Slope (ft/ft)
        n  = Manning's Roughness
```

Subbasin Cell1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	101.00	0.00	0.00
Slope (%):	2.70	0.00	0.00
2 yr, 24 hr Rainfall (in):	3.80	3.80	3.80
Velocity (ft/sec):	1.69	0.00	0.00
Computed Flow Time (minutes):	0.99	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.03	0.01	0.03
Flow Length (ft):	301.00	619.00	1885.00
Channel Slope (%):	0.50	24.20	1.06
Cross Section Area (ft²):	2.24	2.42	27.13
Wetted Perimeter (ft):	5.00	8.72	22.29
Velocity (ft/sec):	2.28	25.96	6.48
Computed Flow Time (minutes):	2.20	0.40	4.85

===

Total TOC (minutes): 8.44

===

Subbasin Cell2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	176.00	0.00	0.00
Slope (%):	2.70	0.00	0.00
2 yr, 24 hr Rainfall (in):	3.80	3.80	3.80
Velocity (ft/sec):	1.89	0.00	0.00
Computed Flow Time (minutes):	1.55	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.03	0.01	0.03
Flow Length (ft):	115.00	464.00	3238.00
Channel Slope (%):	0.50	24.20	0.85
Cross Section Area (ft²):	2.24	2.42	42.70
Wetted Perimeter (ft):	5.00	8.72	25.60
Velocity (ft/sec):	2.28	25.96	7.16
Computed Flow Time (minutes):	0.84	0.30	7.54

===

Total TOC (minutes): 10.23

===

```
-----------------
Subbasin Clear
-----------------

        User-Defined TOC override (minutes):      6.00

---------------------
Subbasin Emergency
---------------------

        User-Defined TOC override (minutes):      6.00

---------------------
Subbasin NorthPond
---------------------

        User-Defined TOC override (minutes):      6.00

-----------------
Subbasin South
-----------------

        User-Defined TOC override (minutes):      6.00

***********************
Subbasin Runoff Summary
***********************
```

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	hh:mm:ss
Cell1	6.80	5.74	265.41	91.000	0	00:08:26
Cell2	6.80	5.74	310.47	91.000	0	00:10:13
Clear	6.80	5.63	12.20	90.000	0	00:06:00
Emergency	6.80	5.56	20.23	89.440	0	00:06:00
NorthPond	6.80	5.69	42.66	90.520	0	00:06:00
South	6.80	5.87	31.74	92.110	0	00:06:00

```
******************
Node Depth Summary
******************
```

Node ID	Average Depth Attained ft	Maximum Depth Attained ft	Maximum HGL Attained ft	Time of Max Occurrence days	hh:mm	Total Flooded Volume acre-in	Total Time Flooded minutes	Retention Time hh:mm:ss
Out-02	0.00	0.00	412.00	0	00:00	0	0	0:00:00
Outfall	0.00	0.00	412.00	0	00:00	0	0	0:00:00
ClearPool	11.58	14.88	411.88	1	00:00	0	0	0:00:00
EmergencyPond	1.81	4.11	395.11	1	00:00	0	0	0:00:00
NPond	13.62	16.90	411.90	1	00:00	0	0	0:00:00
SouthPond	11.61	14.86	411.86	1	00:00	0	0	0:00:00

```
*****************
Node Flow Summary
*****************
```

Node ID	Element Type	Maximum Lateral Inflow cfs	Peak Inflow cfs	Time of Peak Inflow Occurrence days hh:mm	Maximum Flooding Overflow cfs	Time of Peak Flooding Occurrence days hh:mm
Out-02	OUTFALL	0.00	0.00	0 00:00	0.00	
Outfall	OUTFALL	0.00	0.00	0 00:00	0.00	
ClearPool	STORAGE	12.09	44.04	0 12:05	0.00	
EmergencyPond	STORAGE	20.07	20.07	0 12:00	0.00	
NPond	STORAGE	340.68	340.68	0 12:05	0.00	
SouthPond	STORAGE	279.61	279.61	0 12:00	0.00	

****
Storage Node Summary
****

Storage Node ID	Maximum Ponded Volume 1000 ft³	Maximum Ponded Volume (%)	Time of Max Ponded Volume days hh:mm	Average Ponded Volume 1000 ft³	Average Ponded Volume (%)	Maximum Storage Node Outflow cfs	Maximum Exfiltration Rate cfm	Time of Max. Exfiltration Rate hh:mm:ss	Total Exfiltrated Volume 1000 ft³
ClearPool	431.184	82	1 00:00	311.473	60	2.54	0.00	0:00:00	0.000
EmergencyPond	147.241	41	1 00:00	61.890	17	0.00	0.00	0:00:00	0.000
NPond	1819.750	85	1 00:00	1375.198	64	19.42	0.00	0:00:00	0.000
SouthPond	1294.916	83	1 00:00	940.584	60	18.52	0.00	0:00:00	0.000

****
Outfall Loading Summary
****

Outfall Node ID	Flow Frequency (%)	Average Flow cfs	Peak Inflow cfs
Out-02	0.00	0.00	0.00
Outfall	0.00	0.00	0.00
System	0.00	0.00	0.00

****
Link Flow Summary
****

Link ID	Element Type	Time of Peak Flow	Maximum Velocity	Length Factor	Peak Flow during	Design Flow	Ratio of Maximum	Ratio of Maximum	Total Time	Reported Condition

```
                                          Occurrence  Attained            Analysis    Capacity   /Design
Flow  Surcharged
                                          days hh:mm    ft/sec                 cfs         cfs      Flow
Depth     minutes
------------------------------------------------------------------------------------------------
-------------------------------
  CPtoSP                CONDUIT      0  12:11      5.89    1.00        18.52        0.85     21.90
1.00       1440  SURCHARGED
  Link-03               CONDUIT      0  12:12      6.18    1.00        19.42        0.82     23.78
1.00       1440  SURCHARGED
  SPtoEmerg             CONDUIT      1  00:00     14.45    1.00         4.93       40.64      0.12
0.25          0  Calculated
  Spillway              WEIR         0  00:00                           0.00
0.00
  Weir-02               WEIR         0  00:00                           0.00
0.00


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.


  WARNING 004 : Minimum elevation drop used for Conduit CPtoSP.
  WARNING 004 : Minimum elevation drop used for Conduit Link-03.

  Analysis began on:  Wed Mar 02 14:47:00 2022
  Analysis ended on:  Wed Mar 02 14:47:01 2022
  Total elapsed time: 00:00:01
```

Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)

****
Project Description
****

File Name .... GSA Cell 1 Ramp Culverts.SPF
Description .... Plant Scherer Cell 1 Run-on Run-off Study

****
Analysis Options
****

Flow Units .... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Storage Node Exfiltration.. None
Starting Date JUL-06-2016 00:00:00
Ending Date JUL-07-2016 00:00:00
Report Time Step 00:05:00

****
Element Count
****

Number of rain gages 1
Number of subbasins 1
Number of nodes 1
Number of links 0

****
Raingage Summary
****

Gage ID	Data Source	Data Type	Recording Interval min
Storm	25 year	CUMULATIVE	6.00

****
Subbasin Summary
****

Subbasin ID	Total Area acres
Cell1	15.80

****
Node Summary
****

Node ID	Element Type	Invert Elevation ft	Maximum Elev. ft	Ponded Area ft²	External Inflow
Outfall	OUTFALL	412.00	412.00	0.00	

************************* Runoff Quantity Continuity *************************	Volume acre-ft	Depth inches
Total Precipitation	9.064	6.884
Surface Runoff	0.126	0.095

```
Continuity Error (%) .....        -0.000

*************************         Volume        Volume
Flow Routing Continuity          acre-ft      Mgallons
*************************       ---------     ---------
External Inflow ..........         0.000         0.000
External Outflow .........         7.533         2.455
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


******************************************
Composite Curve Number Computations Report
******************************************

-----------------
Subbasin Cell1
-----------------
                                                        Area          Soil
Soil/Surface Description                               (acres)        Group           CN
-----------------------------------------------------------------------------------------
-                                                       15.80            -         91.00
Composite Area & Weighted CN                            15.80                      91.00


***************************************************
SCS TR-55 Time of Concentration Computations Report
***************************************************

Sheet Flow Equation
-------------------

        Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

        Where:

        Tc = Time of Concentration (hrs)
        n  = Manning's Roughness
        Lf = Flow Length (ft)
        P  = 2 yr, 24 hr Rainfall (inches)
        Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation
----------------------------------

        V  = 16.1345 * (Sf^0.5) (unpaved surface)
        V  = 20.3282 * (Sf^0.5) (paved surface)
        V  = 15.0 * (Sf^0.5) (grassed waterway surface)
        V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
        V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
        V  = 7.0 * (Sf^0.5) (short grass pasture surface)
        V  = 5.0 * (Sf^0.5) (woodland surface)
        V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
        V  = Velocity (ft/sec)
        Sf = Slope (ft/ft)

Channel Flow Equation
---------------------
```

```
V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R  = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R  = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V  = Velocity (ft/sec)
Sf = Slope (ft/ft)
n  = Manning's Roughness
```

Subbasin Cell1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	101.00	0.00	0.00
Slope (%):	2.70	0.00	0.00
2 yr, 24 hr Rainfall (in):	3.80	3.80	3.80
Velocity (ft/sec):	1.69	0.00	0.00
Computed Flow Time (minutes):	0.99	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.03	0.01	0.03
Flow Length (ft):	301.00	619.00	1389.00
Channel Slope (%):	0.50	24.20	1.10
Cross Section Area (ft²):	2.24	2.42	20.43
Wetted Perimeter (ft):	5.00	8.72	20.72
Velocity (ft/sec):	2.28	25.96	5.73
Computed Flow Time (minutes):	2.20	0.40	4.04

===
Total TOC (minutes): 7.63
===

****
Subbasin Runoff Summary
****

Subbasin Total Total Peak Weighted Time of

ID	Precip in	Runoff in	Runoff cfs	Curve Number	Concentration days	Concentration hh:mm:ss
Cell1	6.80	5.74	124.55	91.000	0	00:07:37

Analysis began on: Wed Mar 02 16:45:11 2022
Analysis ended on: Wed Mar 02 16:45:12 2022
Total elapsed time: 00:00:01

```
Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)
-----------------------------------------------------------------------------------------

*******************
Project Description
*******************
File Name ................ GSA Cell 1 N Ditch Culverts.SPF
Description ............... Plant Scherer Cell 1 Run-on Run-off Study


****************
Analysis Options
****************
Flow Units ............... cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Storage Node Exfiltration.. None
Starting Date ............. JUL-06-2016 00:00:00
Ending Date ............... JUL-07-2016 00:00:00
Report Time Step .......... 00:05:00


*************
Element Count
*************
Number of rain gages ...... 1
Number of subbasins ....... 1
Number of nodes ........... 1
Number of links ........... 0


****************
Raingage Summary
****************
Gage               Data               Data        Recording
ID                 Source             Type         Interval
                                                              min
------------------------------------------------------------
Storm              25 year            CUMULATIVE      6.00


****************
Subbasin Summary
****************
Subbasin                Total
                         Area
ID                      acres
------------------------------
Cell1                   16.60


************
Node Summary
************
Node               Element            Invert   Maximum    Ponded    External
ID                 Type            Elevation     Elev.      Area      Inflow
                                          ft        ft       ft²
------------------------------------------------------------------------------
Outfall            OUTFALL            412.00    412.00      0.00


**************************         Volume         Depth
Runoff Quantity Continuity        acre-ft        inches
**************************      ---------       -------
Total Precipitation ......          9.523         6.884
Surface Runoff ...........          0.132         0.095
```

```
Continuity Error (%) .....        -0.000


*************************        Volume       Volume
Flow Routing Continuity         acre-ft     Mgallons
*************************     ---------    ---------
External Inflow ..........        0.000        0.000
External Outflow .........        7.911        2.578
Initial Stored Volume ....        0.000        0.000
Final Stored Volume ......        0.000        0.000
Continuity Error (%) .....        0.000


******************************************
Composite Curve Number Computations Report
******************************************

-----------------
Subbasin Cell1
-----------------
                                                        Area          Soil
Soil/Surface Description                              (acres)         Group          CN
-----------------------------------------------------------------------------------------
-                                                       25.20             -       91.00
Composite Area & Weighted CN                            25.20                     91.00


***************************************************
SCS TR-55 Time of Concentration Computations Report
***************************************************

Sheet Flow Equation
-------------------

        Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

        Where:

        Tc = Time of Concentration (hrs)
        n  = Manning's Roughness
        Lf = Flow Length (ft)
        P  = 2 yr, 24 hr Rainfall (inches)
        Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation
----------------------------------

        V  = 16.1345 * (Sf^0.5) (unpaved surface)
        V  = 20.3282 * (Sf^0.5) (paved surface)
        V  = 15.0 * (Sf^0.5) (grassed waterway surface)
        V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
        V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
        V  = 7.0 * (Sf^0.5) (short grass pasture surface)
        V  = 5.0 * (Sf^0.5) (woodland surface)
        V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
        V  = Velocity (ft/sec)
        Sf = Slope (ft/ft)

Channel Flow Equation
---------------------
```

```
V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R  = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R  = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V  = Velocity (ft/sec)
Sf = Slope (ft/ft)
n  = Manning's Roughness
```

Subbasin Cell1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	101.00	0.00	0.00
Slope (%):	2.70	0.00	0.00
2 yr, 24 hr Rainfall (in):	3.80	3.80	3.80
Velocity (ft/sec):	1.69	0.00	0.00
Computed Flow Time (minutes):	0.99	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.03	0.01	0.03
Flow Length (ft):	263.00	544.00	1012.00
Channel Slope (%):	0.50	23.40	1.00
Cross Section Area (ft²):	2.24	2.42	22.06
Wetted Perimeter (ft):	5.00	8.72	21.11
Velocity (ft/sec):	2.28	25.53	5.68
Computed Flow Time (minutes):	1.92	0.36	2.97

Total TOC (minutes): 6.24

****
Subbasin Runoff Summary
****

Subbasin Total Total Peak Weighted Time of

ID	Precip in	Runoff in	Runoff cfs	Curve Number	Concentration days	Concentration hh:mm:ss
Cell1	6.80	5.74	135.96	91.000	0	00:06:14

Analysis began on: Wed Mar 02 16:43:23 2022
Analysis ended on: Wed Mar 02 16:43:24 2022
Total elapsed time: 00:00:01

```
Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)
------------------------------------------------------------------------------------------

*******************
Project Description
*******************
File Name ................. GSA Cell 1 S Ditch Culverts.SPF
Description ............... Plant Scherer Cell 1 Run-on Run-off Study


****************
Analysis Options
****************
Flow Units ................ cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Storage Node Exfiltration.. None
Starting Date ............. JUL-06-2016 00:00:00
Ending Date ............... JUL-07-2016 00:00:00
Report Time Step .......... 00:05:00


*************
Element Count
*************
Number of rain gages ...... 1
Number of subbasins ....... 1
Number of nodes ........... 1
Number of links ........... 0


****************
Raingage Summary
****************
Gage               Data               Data       Recording
ID                 Source             Type        Interval
                                                       min
------------------------------------------------------------
Storm              25 year            CUMULATIVE      6.00


****************
Subbasin Summary
****************
Subbasin                 Total
                          Area
ID                       acres
------------------------------
Cell1                    25.20


************
Node Summary
************
Node               Element             Invert   Maximum    Ponded    External
ID                 Type             Elevation     Elev.      Area      Inflow
                                           ft        ft       ft²
------------------------------------------------------------------------------
Outfall            OUTFALL             412.00    412.00      0.00


**************************          Volume         Depth
Runoff Quantity Continuity         acre-ft        inches
**************************       ---------       -------
Total Precipitation ......          14.457         6.884
Surface Runoff ...........           0.201         0.095
```

```
Continuity Error (%) .....        -0.000


**************************        Volume        Volume
Flow Routing Continuity          acre-ft      Mgallons
**************************      ---------     ---------
External Inflow ..........        0.000         0.000
External Outflow .........       12.024         3.918
Initial Stored Volume ....        0.000         0.000
Final Stored Volume ......        0.000         0.000
Continuity Error (%) .....        0.000


******************************************
Composite Curve Number Computations Report
******************************************

-----------------
Subbasin Cell1
-----------------
                                                             Area           Soil
Soil/Surface Description                                   (acres)          Group            CN
-----------------------------------------------------------------------------------------
-                                                            25.20              -         91.00
Composite Area & Weighted CN                                 25.20                        91.00


***************************************************
SCS TR-55 Time of Concentration Computations Report
***************************************************

Sheet Flow Equation
-------------------

        Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

        Where:

        Tc = Time of Concentration (hrs)
        n  = Manning's Roughness
        Lf = Flow Length (ft)
        P  = 2 yr, 24 hr Rainfall (inches)
        Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation
----------------------------------

        V  = 16.1345 * (Sf^0.5) (unpaved surface)
        V  = 20.3282 * (Sf^0.5) (paved surface)
        V  = 15.0 * (Sf^0.5) (grassed waterway surface)
        V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
        V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
        V  = 7.0 * (Sf^0.5) (short grass pasture surface)
        V  = 5.0 * (Sf^0.5) (woodland surface)
        V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
        V  = Velocity (ft/sec)
        Sf = Slope (ft/ft)

Channel Flow Equation
---------------------
```

```
V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R  = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R  = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V  = Velocity (ft/sec)
Sf = Slope (ft/ft)
n  = Manning's Roughness
```

Subbasin Cell1

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	101.00	0.00	0.00
Slope (%):	2.70	0.00	0.00
2 yr, 24 hr Rainfall (in):	3.80	3.80	3.80
Velocity (ft/sec):	1.69	0.00	0.00
Computed Flow Time (minutes):	0.99	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.03	0.01	0.03
Flow Length (ft):	301.00	619.00	1885.00
Channel Slope (%):	0.50	24.20	1.06
Cross Section Area (ft²):	2.24	2.42	27.13
Wetted Perimeter (ft):	5.00	8.72	22.29
Velocity (ft/sec):	2.28	25.96	6.48
Computed Flow Time (minutes):	2.20	0.40	4.85

Total TOC (minutes):	8.44

****
Subbasin Runoff Summary
****

Subbasin	Total	Total	Peak	Weighted	Time of

ID	Precip in	Runoff in	Runoff cfs	Curve Number	Concentration days	Concentration hh:mm:ss
Cell1	6.80	5.74	194.46	91.000	0	00:08:26

Analysis began on: Wed Mar 02 16:46:13 2022
Analysis ended on: Wed Mar 02 16:46:14 2022
Total elapsed time: 00:00:01

```
Autodesk® Storm and Sanitary Analysis 2016 - Version 13.0.94 (Build 0)
----------------------------------------------------------------------------------------

*******************
Project Description
*******************
File Name ................. GSA Cell 2.SPF
Description ............... Plant Scherer Cell 1&2 Run-on Run-off
                            Study


****************
Analysis Options
****************
Flow Units ................ cfs
Subbasin Hydrograph Method. SCS TR-55
Time of Concentration...... SCS TR-55
Storage Node Exfiltration.. None
Starting Date ............. JUL-06-2016 00:00:00
Ending Date ............... JUL-07-2016 00:00:00
Report Time Step .......... 00:05:00


*************
Element Count
*************
Number of rain gages ...... 1
Number of subbasins ....... 1
Number of nodes ........... 1
Number of links ........... 0


****************
Raingage Summary
****************
Gage               Data                Data       Recording
ID                 Source              Type        Interval
                                                        min
------------------------------------------------------------
Storm              25 year             CUMULATIVE      6.00


****************
Subbasin Summary
****************
Subbasin                Total
                         Area
ID                      acres
------------------------------
Cell2                   42.10


************
Node Summary
************
Node               Element             Invert   Maximum    Ponded    External
ID                 Type             Elevation     Elev.      Area      Inflow
                                           ft        ft       ft²
------------------------------------------------------------------------------
Out-02             OUTFALL             412.00    412.00      0.00


**************************        Volume         Depth
Runoff Quantity Continuity      acre-ft        inches
**************************    ---------       -------
Total Precipitation ......        24.152         6.884
```

```
Surface Runoff ...........         0.335         0.095
Continuity Error (%) .....        -0.000


**************************        Volume        Volume
Flow Routing Continuity          acre-ft      Mgallons
**************************     ---------     ---------
External Inflow ..........         0.000         0.000
External Outflow .........        20.073         6.541
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


******************************************
Composite Curve Number Computations Report
******************************************

-----------------
Subbasin Cell2
-----------------
                                                              Area          Soil
Soil/Surface Description                                    (acres)         Group           CN
-----------------------------------------------------------------------------------------------
-                                                             46.90             -        91.00
Composite Area & Weighted CN                                  46.90                      91.00


***************************************************
SCS TR-55 Time of Concentration Computations Report
***************************************************

Sheet Flow Equation
-------------------

        Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

        Where:

        Tc = Time of Concentration (hrs)
        n  = Manning's Roughness
        Lf = Flow Length (ft)
        P  = 2 yr, 24 hr Rainfall (inches)
        Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation
----------------------------------

        V  = 16.1345 * (Sf^0.5) (unpaved surface)
        V  = 20.3282 * (Sf^0.5) (paved surface)
        V  = 15.0 * (Sf^0.5) (grassed waterway surface)
        V  = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
        V  = 9.0 * (Sf^0.5) (cultivated straight rows surface)
        V  = 7.0 * (Sf^0.5) (short grass pasture surface)
        V  = 5.0 * (Sf^0.5) (woodland surface)
        V  = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
        Tc = (Lf / V) / (3600 sec/hr)

        Where:

        Tc = Time of Concentration (hrs)
        Lf = Flow Length (ft)
        V  = Velocity (ft/sec)
        Sf = Slope (ft/ft)

Channel Flow Equation
---------------------
```

```
V  = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R  = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hrs)
Lf = Flow Length (ft)
R  = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V  = Velocity (ft/sec)
Sf = Slope (ft/ft)
n  = Manning's Roughness
```

Subbasin Cell2

Sheet Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.01	0.00	0.00
Flow Length (ft):	176.00	0.00	0.00
Slope (%):	2.70	0.00	0.00
2 yr, 24 hr Rainfall (in):	3.80	3.80	3.80
Velocity (ft/sec):	1.89	0.00	0.00
Computed Flow Time (minutes):	1.55	0.00	0.00

Channel Flow Computations

	Subarea A	Subarea B	Subarea C
Manning's Roughness:	0.03	0.01	0.03
Flow Length (ft):	115.00	464.00	3238.00
Channel Slope (%):	0.50	24.20	0.85
Cross Section Area (ft²):	2.24	2.42	42.70
Wetted Perimeter (ft):	5.00	8.72	25.60
Velocity (ft/sec):	2.28	25.96	7.16
Computed Flow Time (minutes):	0.84	0.30	7.54

===

Total TOC (minutes): 10.23

===

****
Subbasin Runoff Summary
****

Plant Scherer Cell 1&2 Run-on Run-off

Subbasin ID	Total Precip in	Total Runoff in	Peak Runoff cfs	Weighted Curve Number	Time of Concentration days	Time of Concentration hh:mm:ss
Cell2	6.80	5.74	310.47	91.000	0	00:10:13

```
Analysis began on:  Wed Mar 02 16:49:09 2022
Analysis ended on:  Wed Mar 02 16:49:10 2022
Total elapsed time: 00:00:01
```

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 3 2022

Ramp Ditch Culverts

Invert Elev Dn (ft)	=	413.30
Pipe Length (ft)	=	90.00
Slope (%)	=	1.22
Invert Elev Up (ft)	=	414.40
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	4
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

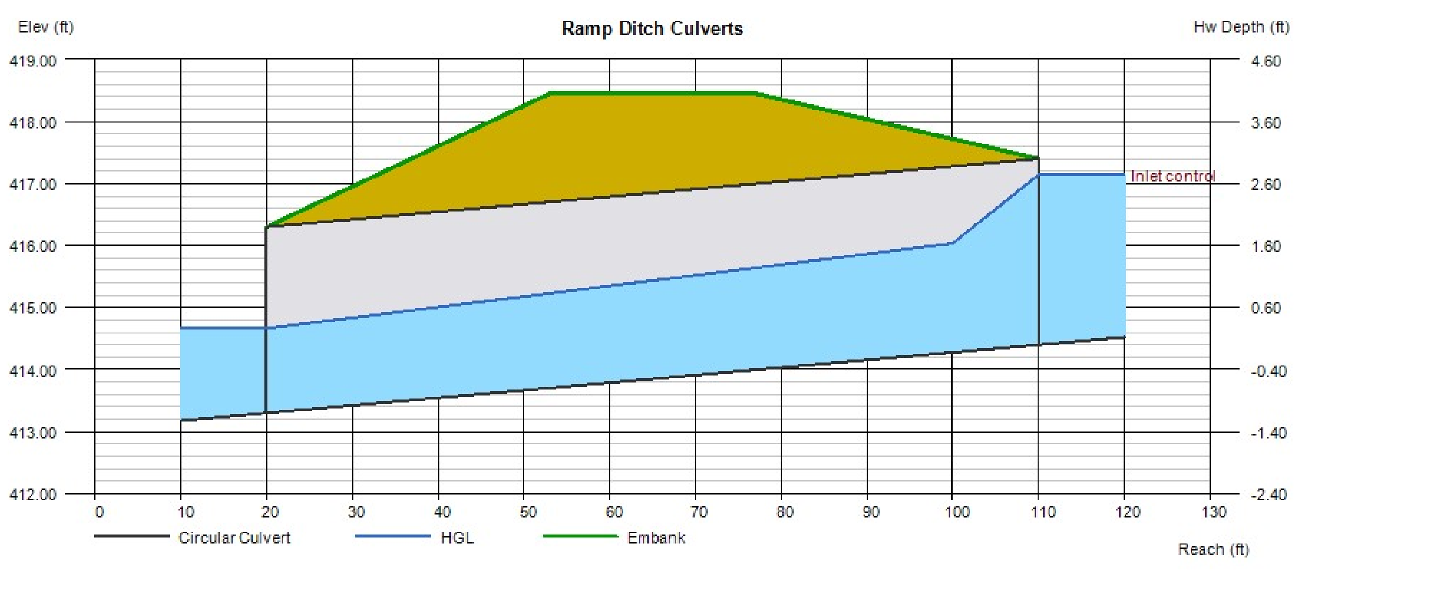
Top Elevation (ft)	=	418.45
Top Width (ft)	=	24.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	124.60
Qmax (cfs)	=	124.60
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	124.60
Qpipe (cfs)	=	124.60
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.96
Veloc Up (ft/s)	=	7.00
HGL Dn (ft)	=	414.66
HGL Up (ft)	=	416.21
Hw Elev (ft)	=	417.14
Hw/D (ft)	=	0.91
Flow Regime	=	Inlet Control



Culvert Report

N Ditch Culvert

Invert Elev Dn (ft)	=	410.60
Pipe Length (ft)	=	56.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	411.16
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	4
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

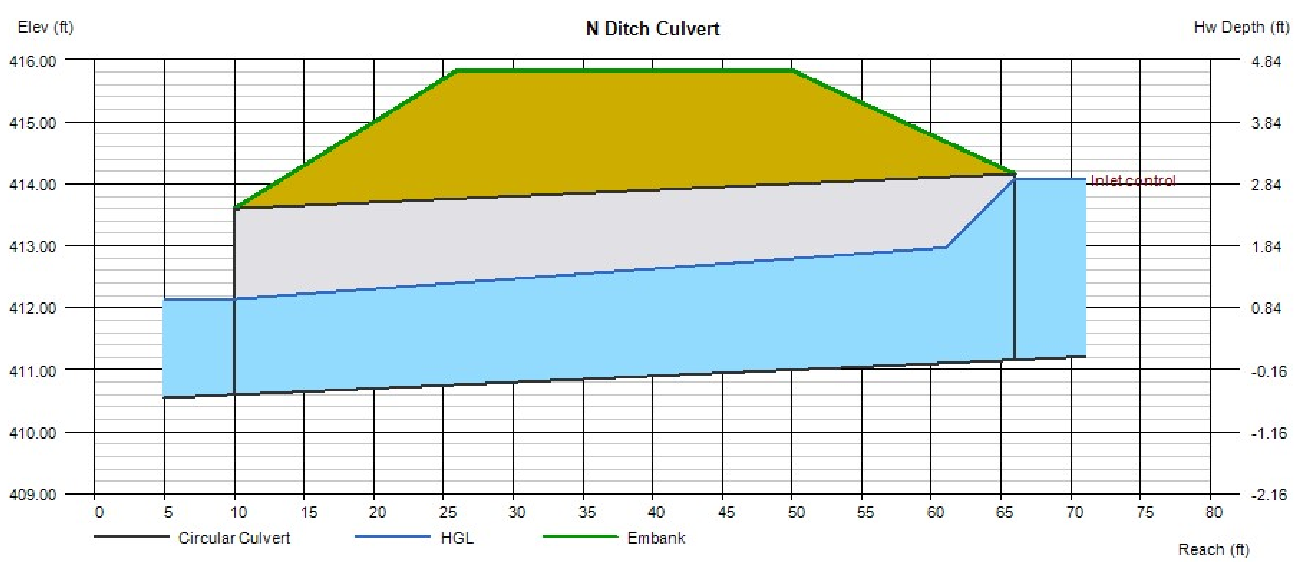
Top Elevation (ft)	=	415.83
Top Width (ft)	=	24.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	136.00
Qmax (cfs)	=	136.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	136.00
Qpipe (cfs)	=	136.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.28
Veloc Up (ft/s)	=	7.24
HGL Dn (ft)	=	412.14
HGL Up (ft)	=	413.05
Hw Elev (ft)	=	414.08
Hw/D (ft)	=	0.97
Flow Regime	=	Inlet Control



Culvert Report

S Ditch Culvert

Invert Elev Dn (ft)	=	408.77
Pipe Length (ft)	=	55.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	409.32
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	4
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

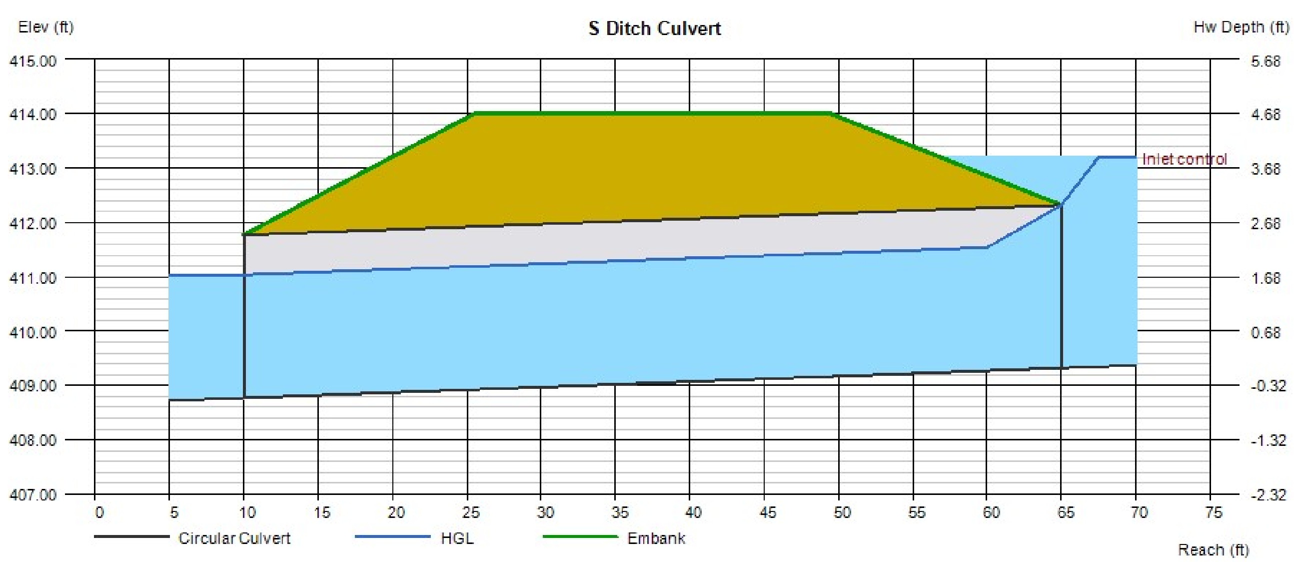
Top Elevation (ft)	=	414.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	194.50
Qmax (cfs)	=	194.50
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	194.50
Qpipe (cfs)	=	194.50
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.48
Veloc Up (ft/s)	=	8.48
HGL Dn (ft)	=	411.04
HGL Up (ft)	=	411.59
Hw Elev (ft)	=	413.20
Hw/D (ft)	=	1.29
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 3 2022

Cell 2 N Ditch Culverts - 4 culverts @ 38.8 cfs each

Invert Elev Dn (ft)	=	408.77
Pipe Length (ft)	=	55.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	409.32
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	4
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

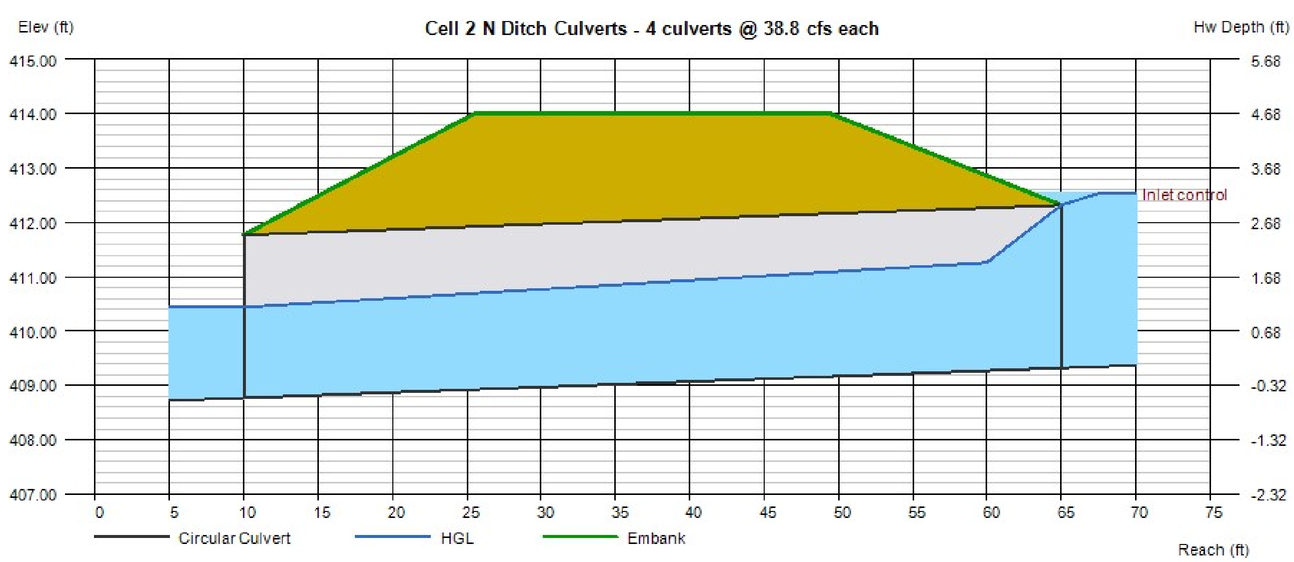
Top Elevation (ft)	=	414.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	155.25
Qmax (cfs)	=	155.25
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	155.25
Qpipe (cfs)	=	155.25
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.59
Veloc Up (ft/s)	=	7.64
HGL Dn (ft)	=	410.44
HGL Up (ft)	=	411.35
Hw Elev (ft)	=	412.53
Hw/D (ft)	=	1.07
Flow Regime	=	Inlet Control



Culvert Report

Cell 2 N Ditch Culverts - 2 culverts @ 38.8 cfs each (77.6 cfs)

Invert Elev Dn (ft)	=	408.77
Pipe Length (ft)	=	55.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	409.32
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	4
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

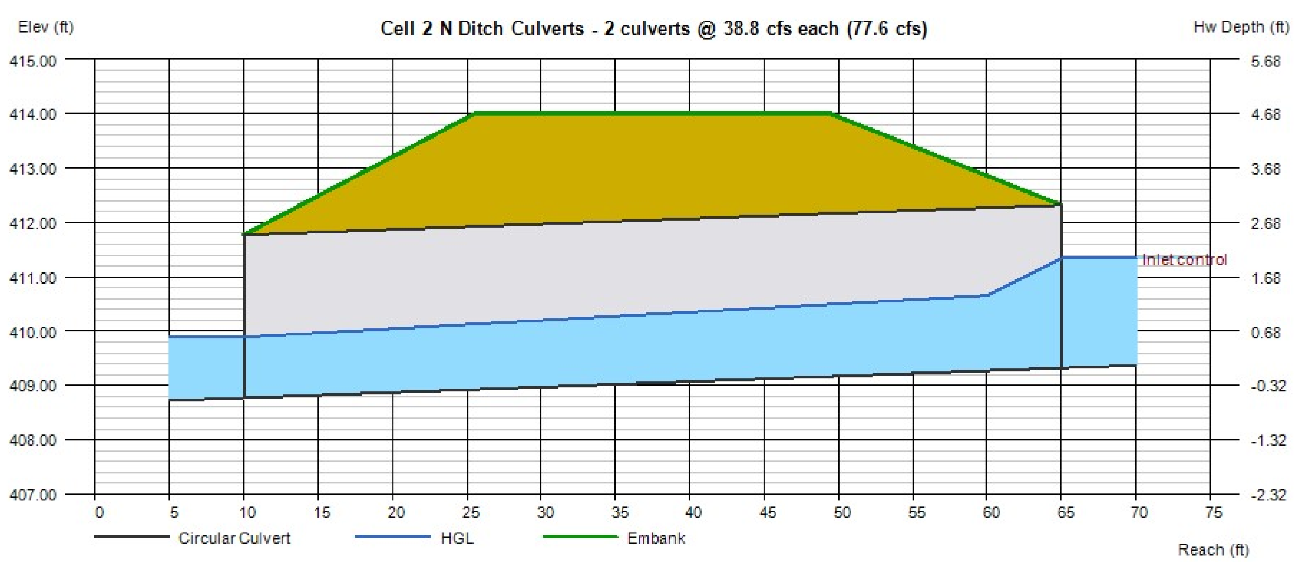
Top Elevation (ft)	=	414.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	77.60
Qmax (cfs)	=	77.60
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	77.60
Qpipe (cfs)	=	77.60
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.06
Veloc Up (ft/s)	=	5.94
HGL Dn (ft)	=	409.89
HGL Up (ft)	=	410.73
Hw Elev (ft)	=	411.34
Hw/D (ft)	=	0.67
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 3 2022

Cell 2 S Ditch Culverts - 2 culverts @ 38.8 cfs each (77.6 cfs total)

Invert Elev Dn (ft)	=	410.41
Pipe Length (ft)	=	56.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	410.97
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	2
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

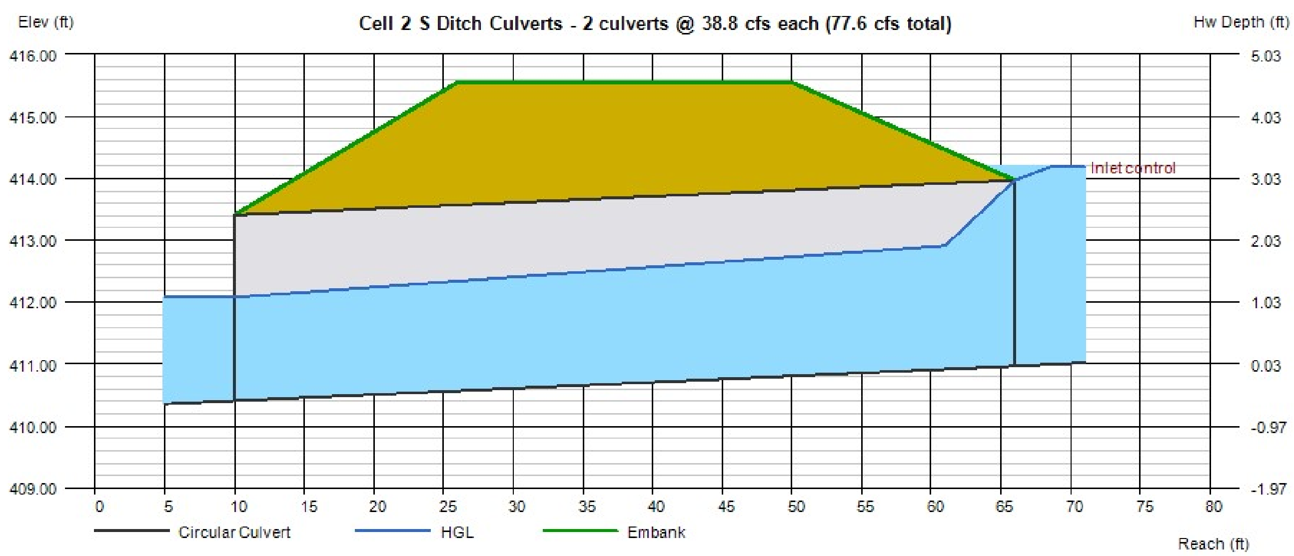
Top Elevation (ft)	=	415.55
Top Width (ft)	=	24.00
Crest Width (ft)	=	100.00

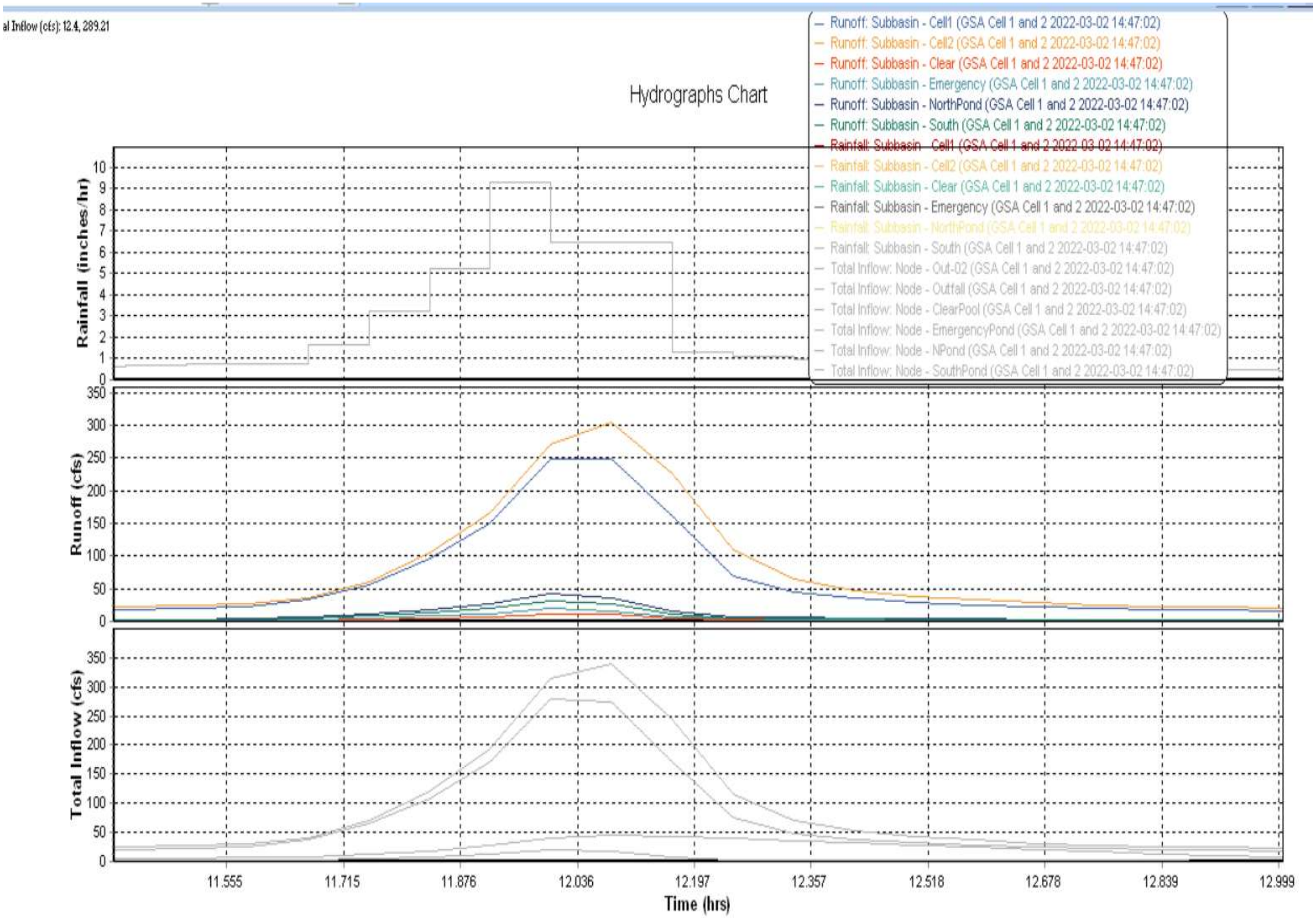
Calculations

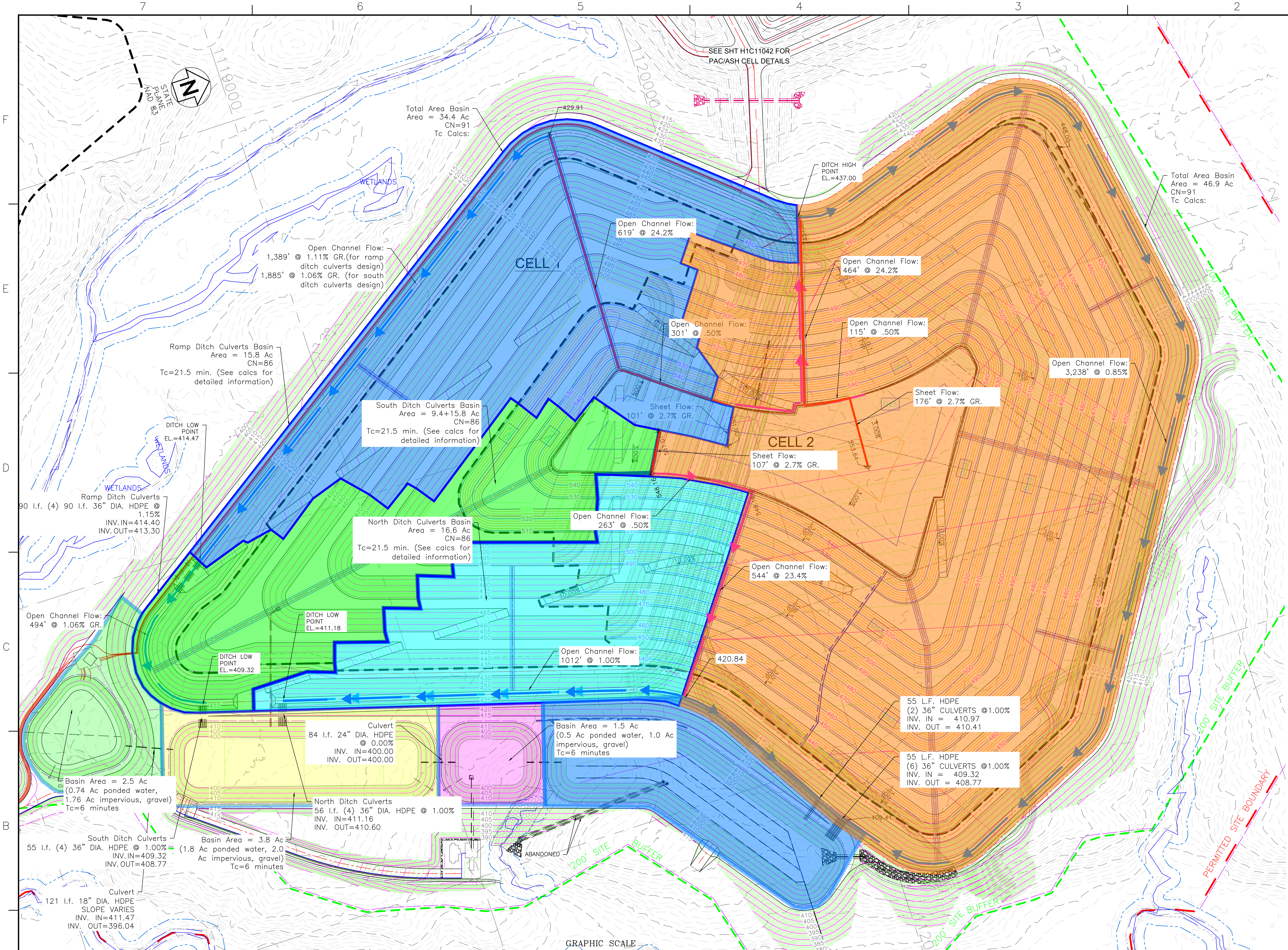
Qmin (cfs)	=	77.60
Qmax (cfs)	=	77.60
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	77.60
Qpipe (cfs)	=	77.60
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.59
Veloc Up (ft/s)	=	7.64
HGL Dn (ft)	=	412.08
HGL Up (ft)	=	413.00
Hw Elev (ft)	=	414.18
Hw/D (ft)	=	1.07
Flow Regime	=	Inlet Control




al Inflow (cfs): 12.4, 289.21
Hydrographs Chart
Runoff: Subbasin - Cell1 (GSA Cell 1 and 2 2022-03-02 14:47:02)
Runoff: Subbasin - Cell2 (GSA Cell 1 and 2 2022-03-02 14:47:02)
Runoff: Subbasin - Clear (GSA Cell 1 and 2 2022-03-02 14:47:02)
Runoff: Subbasin - Emergency (GSA Cell 1 and 2 2022-03-02 14:47:02)
Runoff: Subbasin - NorthPond (GSA Cell 1 and 2 2022-03-02 14:47:02)
Runoff: Subbasin - South (GSA Cell 1 and 2 2022-03-02 14:47:02)
Rainfall: Subbasin - Cell1 (GSA Cell 1 and 2 2022-03-02 14:47:02)
Rainfall: Subbasin - Cell2 (GSA Cell 1 and 2 2022-03-02 14:47:02)
Rainfall: Subbasin - Clear (GSA Cell 1 and 2 2022-03-02 14:47:02)
Rainfall: Subbasin - Emergency (GSA Cell 1 and 2 2022-03-02 14:47:02)
Rainfall: Subbasin - NorthPond (GSA Cell 1 and 2 2022-03-02 14:47:02)
Rainfall: Subbasin - South (GSA Cell 1 and 2 2022-03-02 14:47:02)
Total Inflow: Node - Out-02 (GSA Cell 1 and 2 2022-03-02 14:47:02)
Total Inflow: Node - Outfall (GSA Cell 1 and 2 2022-03-02 14:47:02)
Total Inflow: Node - ClearPool (GSA Cell 1 and 2 2022-03-02 14:47:02)
Total Inflow: Node - EmergencyPond (GSA Cell 1 and 2 2022-03-02 14:47:02)
Total Inflow: Node - NPond (GSA Cell 1 and 2 2022-03-02 14:47:02)
Total Inflow: Node - SouthPond (GSA Cell 1 and 2 2022-03-02 14:47:02)
Rainfall (inches/hr)
Runoff (cfs)
Total Inflow (cfs)
Time (hrs)
11.555
11.715
11.876
12.036
12.197
12.357
12.518
12.678
12.839
12.999



NOTES:

1. SEE CALCULATIONS OUTPUT FOR ADDITIONAL INFORMATION.

Southern Company Generation
Engineering and Construction Services
FOR
Georgia Power Company

PLANT SCHERER
COAL COMBUSTION BY-PRODUCT DISPOSAL FACILITY
CELL NO. 1 AND CELL NO. 2
FINAL STACKING PLAN
DRAINAGE BASIN DATA

REVISION	DATE
A	2-23-22
FOR REVIEW	

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
JWM	AAS	SSS				SSS

SCALE	PROJ I.D.	DRAWING NUMBER	SHEET	CONT'D	REV
1"=100'	010505	CS-SK-BASIN	1	FINAL	A

ANSI F: 40x28 Acad2004

SOUTHERN COMPANY

Environmental Solutions Calculation

Calculation Number: DC-SH-646612-002

Project/Plant: Scherer	Unit(s): 1 - 4	Discipline/Area: Civil
Title/Subject: Run-on and Run-off System Study for the PAC/Ash Cell.		
Purpose/Objective: Demonstrate compliance with the Title 40 CFR Part 257.81 and GA CCR Rule (391-3-4-.10).		
System or Equipment Tag Numbers: N/A	Originator: Jim Minor	

Contents

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Issued for Review	JWM 8/1/16	JKB 8/1/16	RCB 8/1/16
1	Issued for Review	JWM 4/26/22	JKB 4/26/22	SSS 4/26/22

Notes:

GEORGIA REGISTERED No. PE031968 PROFESSIONAL ENGINEER JIM W. MINOR

Jim W. Minor
4/28/22

Purpose of Calculation

The purpose of this report is to provide data that shows the Plant Scherer Coal Combustion By-Product (CCB) Disposal Facility for the PAC/Ash Cell is designed to meet the requirements in Title 40 CFR Part 257.81 and GA CCR Rule (391-3-4-.10) from a 24-hour, 25-year storm for the run-on and run-off control system.

Project Narrative

The CCB disposal facility consists of one PAC/Ash Cell that is currently in operation. The cell is constructed with a perimeter raised dike and diversion ditch that prevent run-on from entering the cell. Run-off within the cell is managed by a system of detention ponds and return water pumps that return stormwater run-off as process flows to the plant. An interior perimeter ditch directs run-off within the cell into this detention pond system through 24" diameter pipe culverts and leachate collection & removal system. The detention pond system includes two ponds (Sedimentation Pond and Clear Pool) that are interconnected by a 36" diameter HDPE pipe culvert, as shown on sketch CS-SK-071416-1 on page 26 of this report.

An emergency spillway is located in the Sedimentation Pond at elevation 434.00. The normal pool elevation for the Clear Pool and Sedimentation Pond is approximately 420.43. A value of 421.00 was used for this calculation.

Summary of Conclusions

Based on our analysis, the detention pond system is adequate to collect and control the volume of water resulting from a 24-hour 25-year storm, as required.

Storage Pond Name	Normal Pool Elevation (feet, NAVD 88)	Maximum 25 year pool elevation (feet, NAVD 88)	Spillway/Top of Dike Elevation (feet, NAVD 88)	Freeboard to Spillway (feet, NAVD 88)
Clear Pool	421.00	427.40	434.00/436.00	6.6/8.6
Sedimentation Pond	421.00	427.40	434.00/436.00	6.6/8.6

Methodology

The storm water flows have been calculated using the National Resources Conservation Service Method (also known as the Soil Conservation Service method-SCS Method) using the 24-hour 25-year storm event.

Drainage basin delineation was made using topographic survey data for the project and construction drawings for the project (SCS drawings E1C11080 through E1C11097 and as shown on sketch CS-SK-071416-1 on page 26 of this report).

The above data was used in Autodesk Storm and Sanitary Analysis 2015.

Assumptions/Criteria

Appendix B from the TR-55 reference was used to determine the following:

- Rainfall Distribution – Type II
- Precipitation Values (SCS 24-hour precipitation, obtained from NOAA, Atlas 14)
    - 2 yr-24 hr = 3.77 in (Autodesk SSA 2015 data provided is 3.8 in)
    - 5 yr-24 hr = 4.58 in (Autodesk SSA 2015 data provided is 5.0 in)
    - 10 yr-24 hr = 5.30 in (Autodesk SSA 2015 data provided is 5.8 in)
    - 25 yr-24 hr = 6.35 in (Autodesk SSA 2015 data provided is 6.8 in)
    - 50 yr-24 hr = 7.21 in (Autodesk SSA 2015 data provided is 7.6in)
    - 100 yr-24 hr = 8.11 in (Autodesk SSA 2015 data provided is 8.1 in)

The higher precipitation values were used for this calculation.

Time of concentration or each drainage basin was calculated using the topographic data and SCS TR-55 method. Several different contributing drainage basins (cell footprint and ponds) were delineated and the Tc values can be found in the detailed calculations attached.

Manning's roughness coefficients for time of concentration calculations were assumed based on Chow, 1959 as follows:

- Sheet flow, n = 0.02, see Manning's n for Channels table below for n value assumption.
- Channel flow, n = 0.027, see Manning's n for Channels table below for n value assumption.

Manning's n for Channels (Chow, 1959).

Type of Channel and Description	Minimum	Normal	Maximum
4. Excavated or Dredged Channels			
a. Earth, straight, and uniform			
1. clean, recently completed	0.016	0.018	0.020
2. clean, after weathering	0.018	0.022	0.025
3. gravel, uniform section, clean	0.022	0.025	0.030
4. with short grass, few weeds	0.022	0.027	0.033

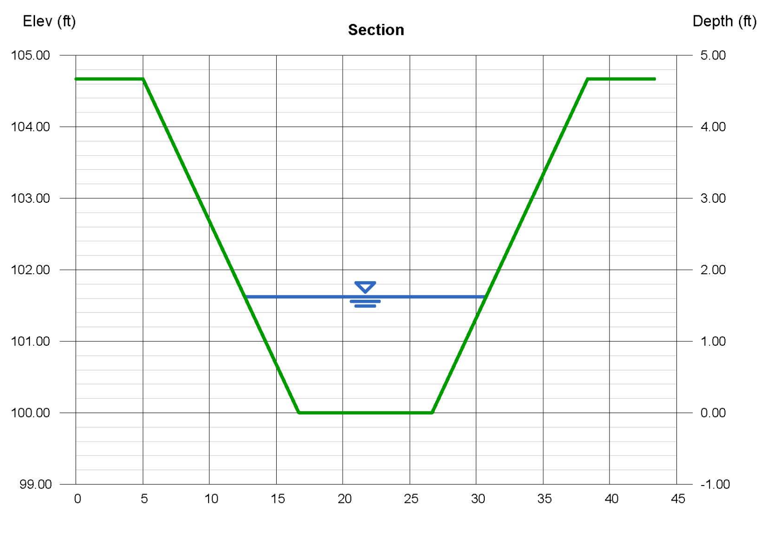
Channel geometry data was obtained from Hydraflow Express as follows (elevations shown are not reflective of field conditions; elevations were assumed to obtain channel flow data):

Channel Report

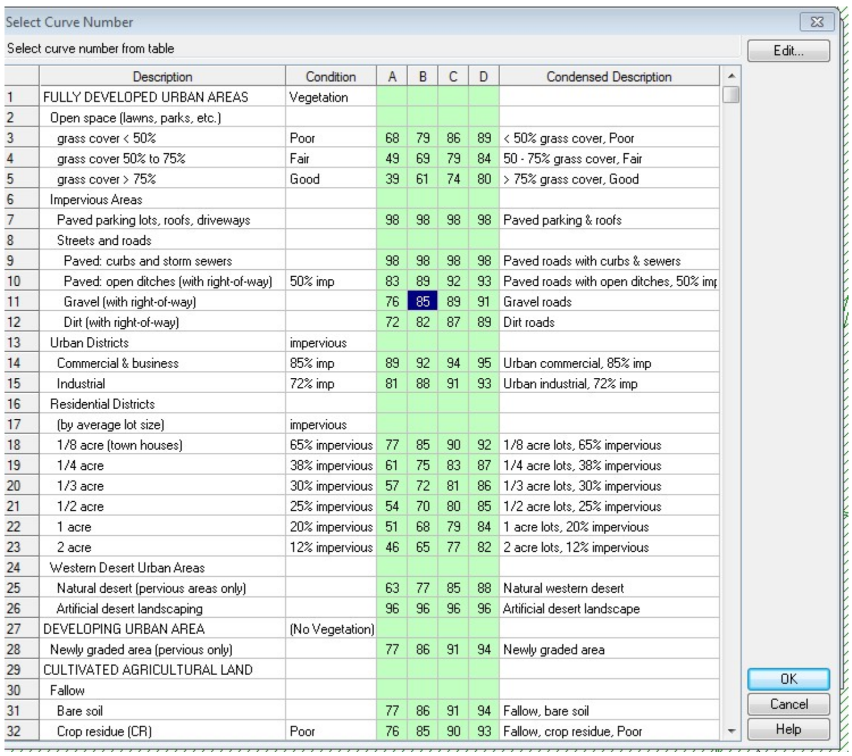
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Saturday, Jul 23 2016

Channel Flow Data

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.62
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 123.07
Total Depth (ft)	= 4.67	Area (sqft)	= 22.76
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 5.41
Slope (%)	= 0.76	Wetted Perim (ft)	= 18.72
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.48
		Top Width (ft)	= 18.10
Calculations		EGL (ft)	= 2.07
Compute by:	Known Q		
Known Q (cfs)	= 123.07		



Curve number data for each contributing drainage basin is provided in the detailed calculations attached. Generally, the curve number used is based on the Hydrologic Soil Group (HSG) and type of runoff potential. For the CCR by-product (gypsum), the HSG is assumed to be Group C, soils with moderately high runoff potential when thoroughly wet. For HSG C, the curve number for bare soil (similar to the gypsum) is assumed to be 91. For areas outside of the gypsum cell, HSG B is assumed and for the ponded area the curve number is 100 and for the impervious gravel areas around the ponds, the curve number is assumed to be 85.



Select Curve Number

Select curve number from table

	Description	Condition	A	B	C	D	Condensed Description
1	FULLY DEVELOPED URBAN AREAS	Vegetation					
2	Open space (lawns, parks, etc.)						
3	grass cover < 50%	Poor	68	79	86	89	< 50% grass cover, Poor
4	grass cover 50% to 75%	Fair	49	69	79	84	50 - 75% grass cover, Fair
5	grass cover > 75%	Good	39	61	74	80	> 75% grass cover, Good
6	Impervious Areas						
7	Paved parking lots, roofs, driveways		98	98	98	98	Paved parking & roofs
8	Streets and roads						
9	Paved: curbs and storm sewers		98	98	98	98	Paved roads with curbs & sewers
10	Paved: open ditches (with right-of-way)	50% imp	83	89	92	93	Paved roads with open ditches, 50% imp
11	Gravel (with right-of-way)		76	85	89	91	Gravel roads
12	Dirt (with right-of-way)		72	82	87	89	Dirt roads
13	Urban Districts	impervious					
14	Commercial & business	85% imp	89	92	94	95	Urban commercial, 85% imp
15	Industrial	72% imp	81	88	91	93	Urban industrial, 72% imp
16	Residential Districts						
17	(by average lot size)	impervious					
18	1/8 acre (town houses)	65% impervious	77	85	90	92	1/8 acre lots, 65% impervious
19	1/4 acre	38% impervious	61	75	83	87	1/4 acre lots, 38% impervious
20	1/3 acre	30% impervious	57	72	81	86	1/3 acre lots, 30% impervious
21	1/2 acre	25% impervious	54	70	80	85	1/2 acre lots, 25% impervious
22	1 acre	20% impervious	51	68	79	84	1 acre lots, 20% impervious
23	2 acre	12% impervious	46	65	77	82	2 acre lots, 12% impervious
24	Western Desert Urban Areas						
25	Natural desert (pervious areas only)		63	77	85	88	Natural western desert
26	Artificial desert landscaping		96	96	96	96	Artificial desert landscape
27	DEVELOPING URBAN AREA	(No Vegetation)					
28	Newly graded area (pervious only)		77	86	91	94	Newly graded area
29	CULTIVATED AGRICULTURAL LAND						
30	Fallow						
31	Bare soil		77	86	91	94	Fallow, bare soil
32	Crop residue (CR)	Poor	76	85	90	93	Fallow, crop residue, Poor

Design Inputs/References

- TR-55 – Urban Hydrology for Small Watersheds, Appendix B, National Resources Conservation Service, Conservation Engineering Division, 1986. (Used to generate Hydraflow Rainfall Report)
- Autodesk Storm and Sanitary Analysis 2015, version 9.1.140.1 Mar 03 2014, 08:09:20
- Georgia Power Company – Plant Scherer – Coal Combustion By-Product Disposal Facility Drawings E1C11050 through E1C11078.
- Metro Engineering & Surveying Co., Inc. – Georgia Power Company Plant Scherer Storage Facility Topographic Map dated October 29, 2010.
- SCS Calculation DC-SH-3511DE-001-C01A0.
- NOAA Atlas 14, Volume 9, Version 2 for Juliette, GA. (http://dipper.nws.noaa.gov/hdsc/pfds/pfds_printpage.html?lat=33.0775&lon=-83.7959&data=depth&units=english&series=pds#maps)
- Hydraflow Express Extension for Autodesk AutoCAD Civil 3D, version 10.4
- Hydraulic Engineering Circular No. 15, 3rd Edition.

Body of Calculation

See detailed calculations and software output.

Project Description

File Name .... PAC Ash Cell.SPF
Description ....
Plant Scherer Cell 1 Run-on Run-off Study

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... SCS TR-55
Time of Concentration (TOC) Method .... SCS TR-55
Link Routing Method .... Hydrodynamic
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On	Jul 06, 2016	00:00:00
End Analysis On	Jul 07, 2016	00:00:00
Start Reporting On	Jul 06, 2016	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	5	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins..	3
Nodes..	3
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	2
Links..	2
Channels	0
Pipes	1
Pumps	0
Orifices	0
Weirs	1
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Storm	Time Series	25 year	Cumulative	inches	Georgia	Monroe	25	6.80	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Clear Pool	1.03	87.33	6.80	5.32	5.48	8.09	0 00:06:00
2	PAC-Cell	16.60	91.00	6.80	5.74	95.32	123.07	0 00:10:01
3	SedPond	2.48	88.08	6.80	5.41	13.41	19.70	0 00:06:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Outfall	Outfall	434.00					0.00	434.00					
2	ClearPool	Storage Node	416.00	436.00	421.00		0.00	52.15	427.40				0.00	0.00
3	Sed	Storage Node	416.00	436.00	421.00		0.00	137.23	427.40				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (ft)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Culvert	Pipe	Sed	ClearPool	91.00	421.00	421.00	0.0000	3.000	0.0130	46.92	2.21	21.22	6.64	3.00	1.00	713.00	SURCHARGED
2	Spillway	Weir	Sed	Outfall		416.00	434.00				0.00							

Subbasin Hydrology

Subbasin : Clear Pool

Input Data

Area (ac) 1.03
Weighted Curve Number 87.33
Rain Gage ID .... Storm

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.87	-	85.00
-	0.16	-	100.00
Composite Area & Weighted CN	1.03		87.33

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

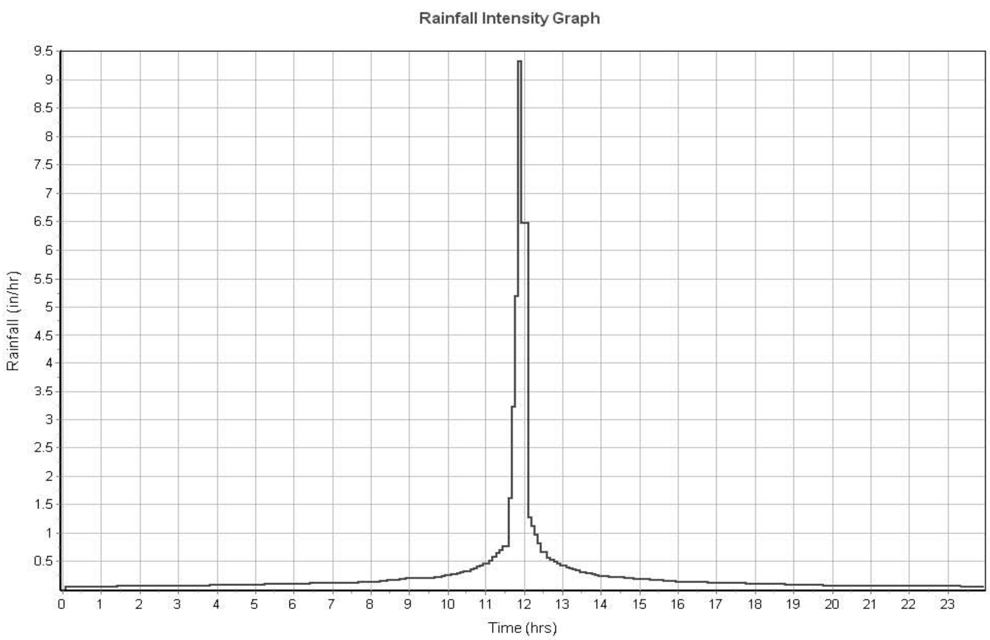
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

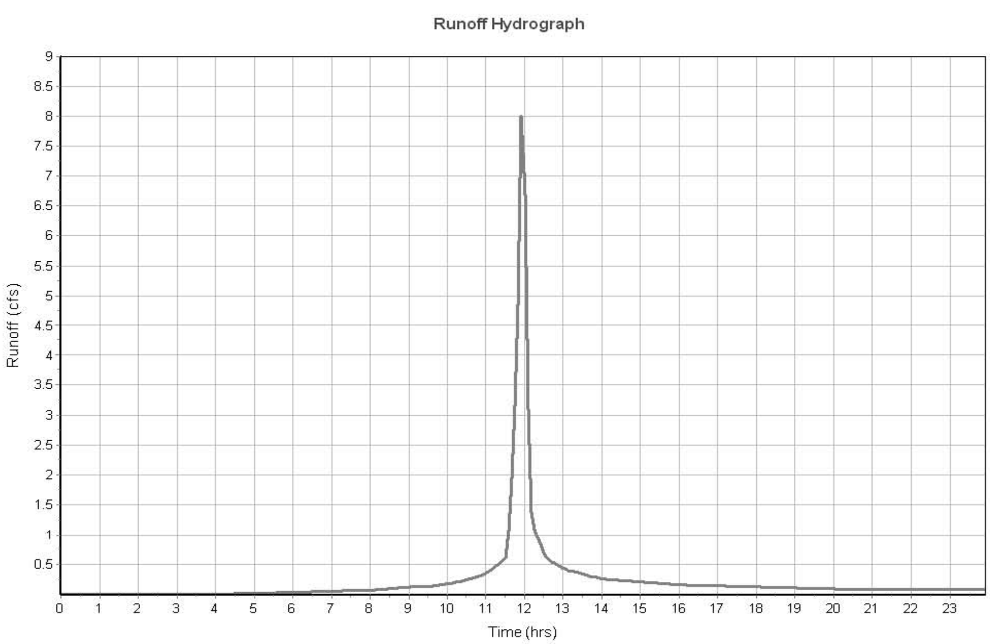
User-Defined TOC override (minutes): 6

Subbasin Runoff Results

Total Rainfall (in) 6.80
Total Runoff (in) 5.32
Peak Runoff (cfs) 8.09
Weighted Curve Number 87.33
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : Clear Pool





Subbasin : PAC-Cell

Input Data

Area (ac) 16.60
Weighted Curve Number 91.00
Rain Gage ID .... Storm

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	16.60	-	91.00
Composite Area & Weighted CN	16.60		91.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.02	0.00	0.00
Flow Length (ft) :	300	0.00	0.00
Slope (%) :	3.64	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.80	0.00	0.00
Velocity (ft/sec) :	1.47	0.00	0.00
Computed Flow Time (min) :	3.40	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	307	0.00	0.00
Slope (%) :	11.50	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	5.47	0.00	0.00
Computed Flow Time (min) :	0.94	0.00	0.00

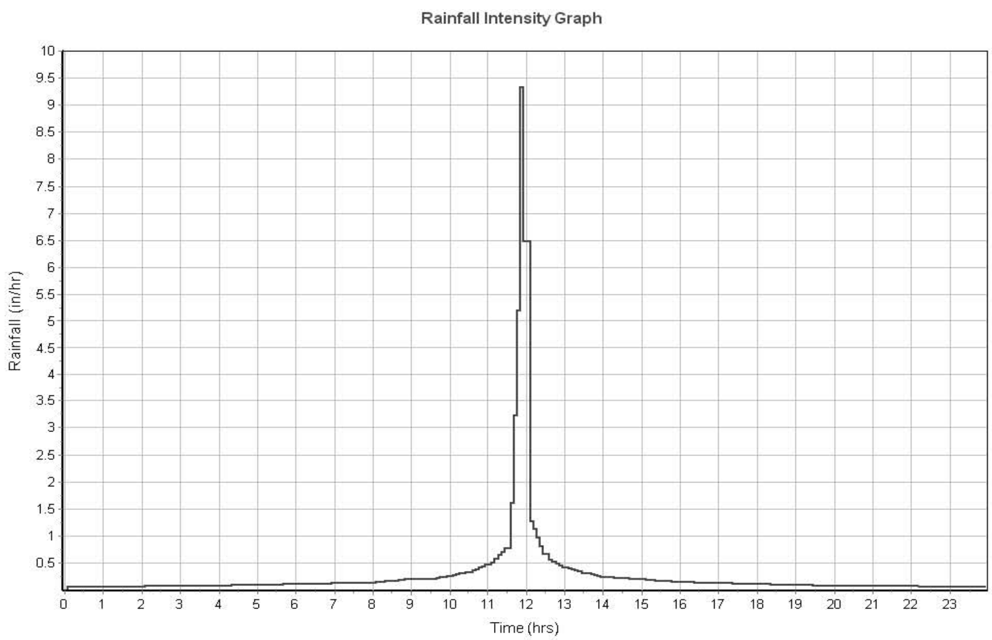
Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.038	0.00	0.00
Flow Length (ft) :	1331	0.00	0.00
Channel Slope (%) :	0.76	0.00	0.00
Cross Section Area (ft^2) :	22.8	0.00	0.00
Wetted Perimeter (ft) :	18.7	0.00	0.00
Velocity (ft/sec) :	3.90	0.00	0.00
Computed Flow Time (min) :	5.69	0.00	0.00

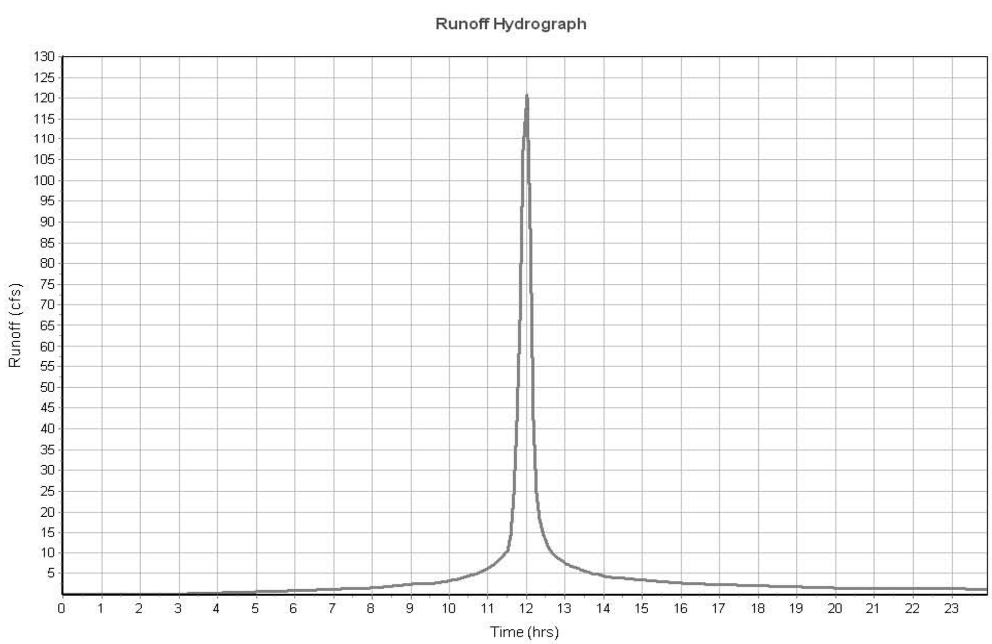
Total TOC (min) 10.02

Subbasin Runoff Results

Total Rainfall (in) 6.80
Total Runoff (in) 5.74
Peak Runoff (cfs) 123.07
Weighted Curve Number 91.00
Time of Concentration (days hh:mm:ss) 0 00:10:01

Subbasin : PAC-Cell





Subbasin : SedPond

Input Data

Area (ac) 2.48
Weighted Curve Number 88.08
Rain Gage ID .... Storm

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.97	-	85.00
-	0.51	-	100.00
Composite Area & Weighted CN	2.48		88.08

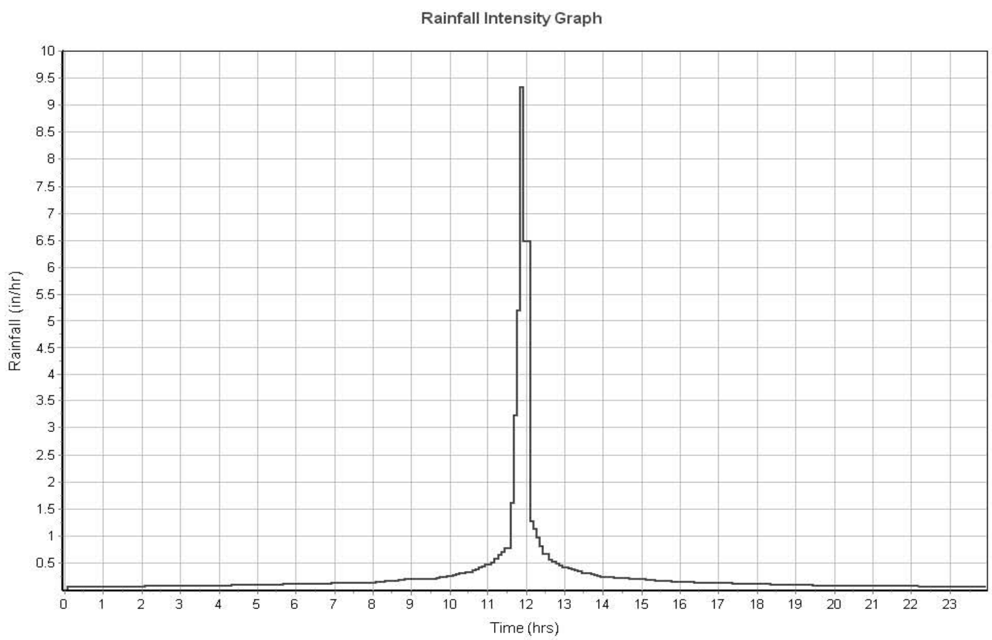
Time of Concentration

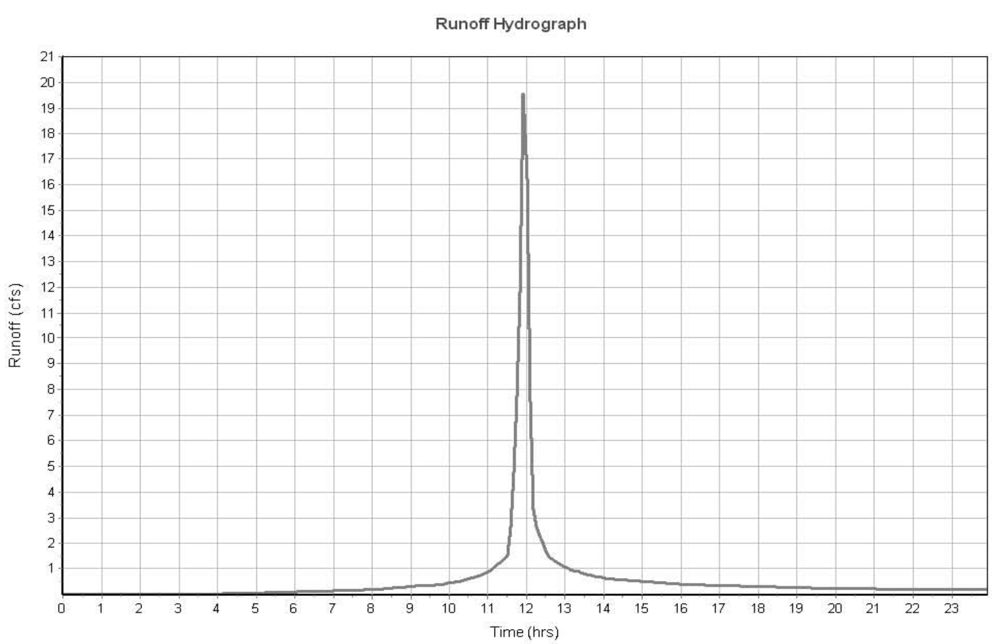
User-Defined TOC override (minutes): 6

Subbasin Runoff Results

Total Rainfall (in) 6.80
Total Runoff (in) 5.41
Peak Runoff (cfs) 19.70
Weighted Curve Number 88.08
Time of Concentration (days hh:mm:ss) 0 00:06:00

Subbasin : SedPond





Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (ft)	Pipe Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Culvert	91.00	421.00	5.00	421.00	5.00	0.00	0.0000	CIRCULAR	3.000	3.000	0.0130	0.7000	0.7000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Culvert	46.92	0 12:09	2.21	21.22	6.64	0.23	3.00	1.00	713.00		SURCHARGED

Storage Nodes

Storage Node : ClearPool

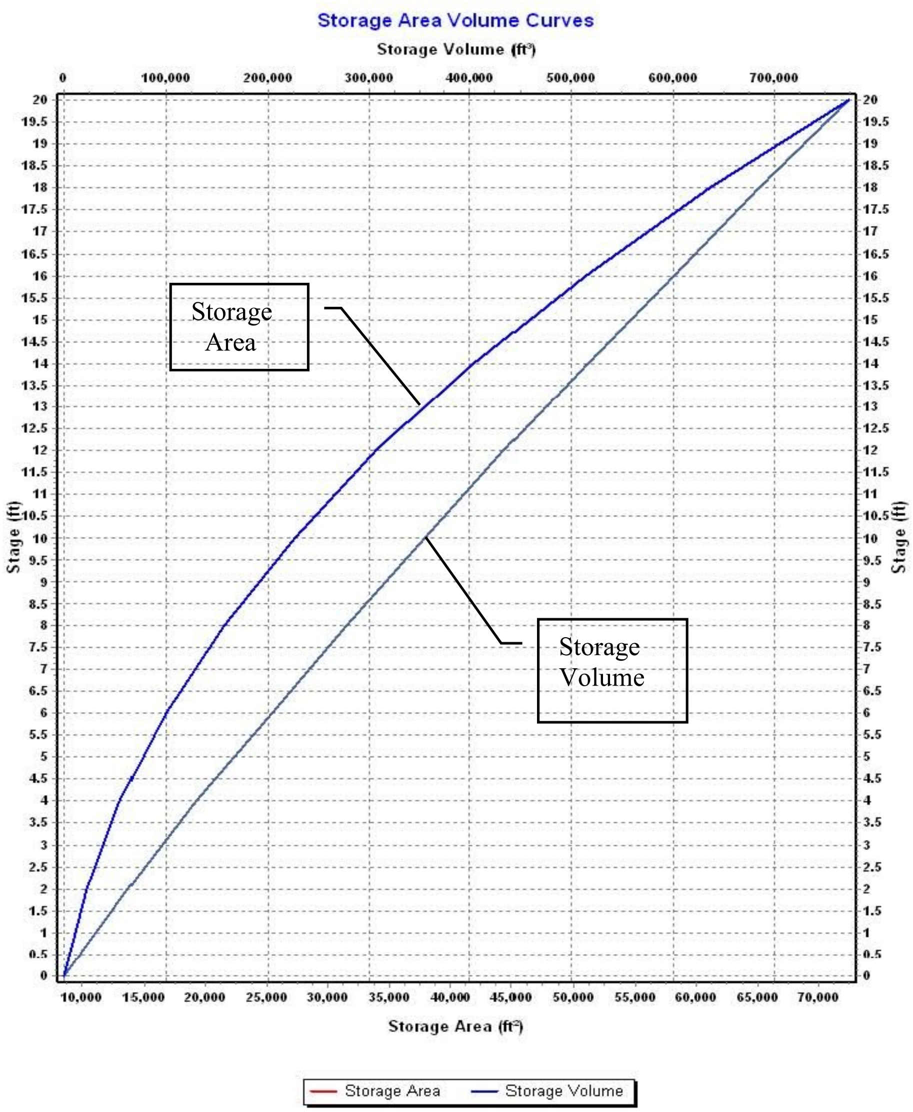
Input Data

Invert Elevation (ft) 416.00
Max (Rim) Elevation (ft) 436.00
Max (Rim) Offset (ft) 20.00
Initial Water Elevation (ft) 421.00
Initial Water Depth (ft) 5.00
Ponded Area (ft^2) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Sed Pond

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	8566	0.000
2	13665	22231.00
4	19308	55204.00
6	25388	99900.00
8	31516	156804.00
10	37844	226164.00
12	44369	308377.00
14	51094	403840.00
16	58088	513022.00
18	65113	636223.00
20	72426	773762.00



Storage Area Volume Curves
Storage Volume (ft³)
0
100,000
200,000
300,000
400,000
500,000
600,000
700,000
Stage (ft)
Storage Area
Storage Volume
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
70,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : ClearPool (continued)

Output Summary Results

Peak Inflow (cfs) 52.15
Peak Lateral Inflow (cfs) 8.00
Peak Outflow (cfs) 0.00
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 427.40
Max HGL Depth Attained (ft) 11.4
Average HGL Elevation Attained (ft) 424.01
Average HGL Depth Attained (ft) 8.01
Time of Max HGL Occurrence (days hh:mm) 1 00:00
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Storage Node : Sed

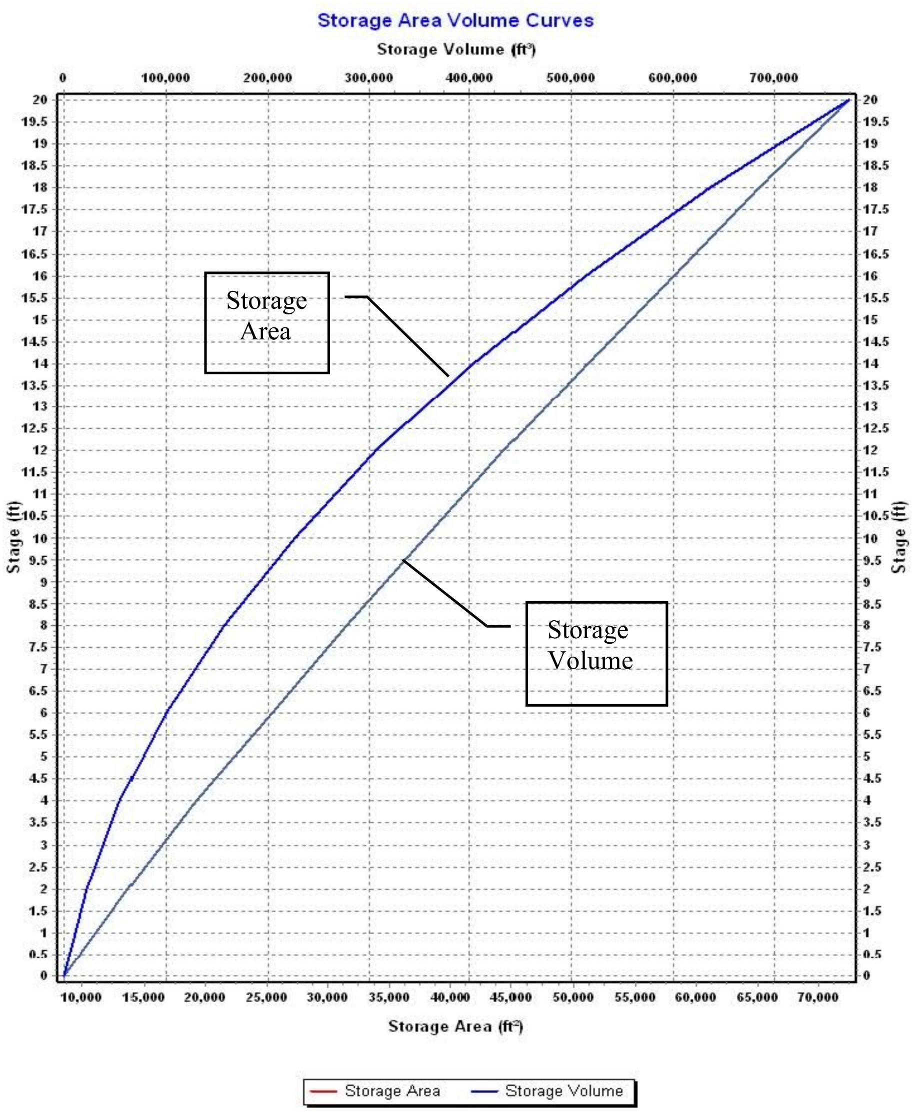
Input Data

Invert Elevation (ft) 416.00
Max (Rim) Elevation (ft) 436.00
Max (Rim) Offset (ft) 20.00
Initial Water Elevation (ft) 421.00
Initial Water Depth (ft) 5.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Storage Area Volume Curves

Storage Curve : Sed Pond

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	8566	0.000
2	13665	22231.00
4	19308	55204.00
6	25388	99900.00
8	31516	156804.00
10	37844	226164.00
12	44369	308377.00
14	51094	403840.00
16	58088	513022.00
18	65113	636223.00
20	72426	773762.00


Storage Area Volume Curves
Storage Volume (ft³)
0
100,000
200,000
300,000
400,000
500,000
600,000
700,000
Stage (ft)
Storage Area
Storage Volume
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
70,000
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : Sed (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Spillway	Trapezoidal	No	434.00	18.00	22.00	2.00	3.37

Output Summary Results

Peak Inflow (cfs) 137.23
Peak Lateral Inflow (cfs) 137.23
Peak Outflow (cfs) 46.92
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 427.40
Max HGL Depth Attained (ft) 11.4
Average HGL Elevation Attained (ft) 424.10
Average HGL Depth Attained (ft) 8.1
Time of Max HGL Occurrence (days hh:mm) 1 00:00
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Saturday, Jul 23 2016

Ditch Culverts - 25 year

Invert Elev Dn (ft)	= 434.56
Pipe Length (ft)	= 80.00
Slope (%)	= 0.50
Invert Elev Up (ft)	= 434.96
Rise (in)	= 36.0
Shape	= Circular
Span (in)	= 36.0
No. Barrels	= 2
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0018, 2, 0.0292, 0.74, 0.2

Embankment

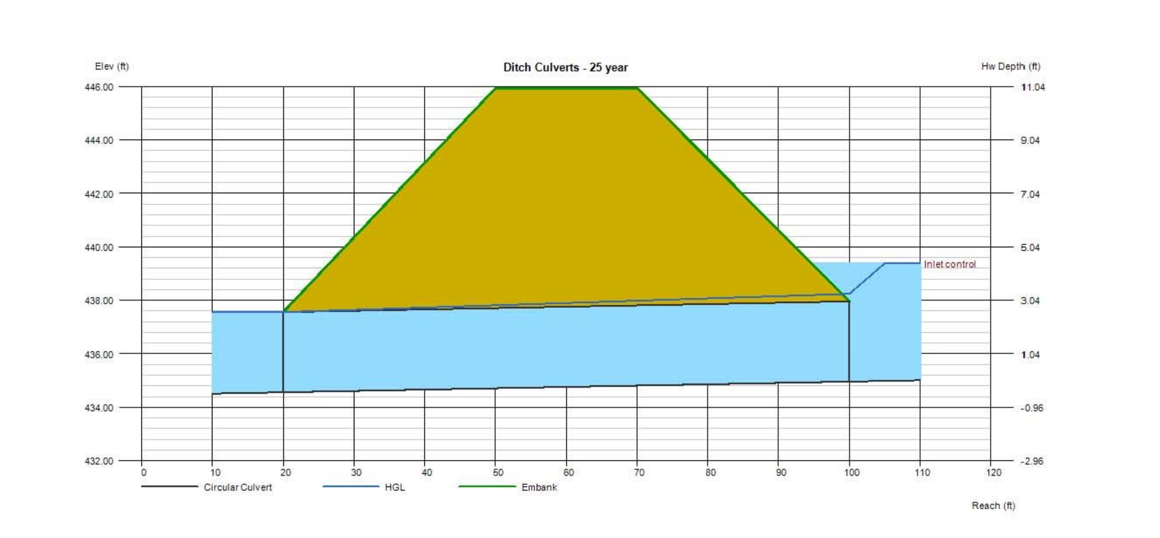
Top Elevation (ft)	= 445.94
Top Width (ft)	= 20.00
Crest Width (ft)	= 100.00

Calculations

Qmin (cfs)	= 123.07
Qmax (cfs)	= 123.07
Tailwater Elev (ft)	= Normal

Highlighted

Qtotal (cfs)	= 123.07
Qpipe (cfs)	= 123.07
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 8.71
Veloc Up (ft/s)	= 8.71
HGL Dn (ft)	= 437.56
HGL Up (ft)	= 438.24
Hw Elev (ft)	= 439.39
Hw/D (ft)	= 1.48
Flow Regime	= Inlet Control



Project	Prepared by	Date
Plant Scherer Run-on Runoff Control	Jim Minor	8/1/16
Subject/Title Provide run-on and run-off system calculations for the peak discharge from a 24-hr 25-year storm for the PAC/Ash Cell	Reviewed by Jeremy Brown	Date 8/1/16
	Calculation Number DC-SH- 646612-002	Sheet 27 of 27