CORRECTIVE ACTION DESIGN
ATTLEBORO LANDFILL – PHASE B
179 PECKHAM STREET
ATTLEBORO, MASSACHUSETTS

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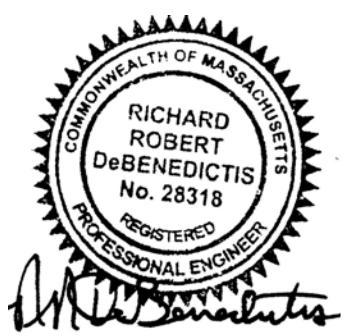

July 27, 2018 , Revised through September 24, 2018

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1.0 INTRODUCTION

This document, and the accompany drawings entitled, *“Attleboro Landfill – Phase B Closure Plan”* provide the components, method and construction activities of the corrective action design for closure of Phase B of the Attleboro Landfill located off 179 Peckham Street in Attleboro, Massachusetts. It was prepared to accompany the application to the Massachusetts Department of Environmental Protection (DEP) for approval of the Corrective Action Design, Form BWP SW 25 is included in Appendix A. This document was prepared by Richard R. DeBenedictis P.E., (the “Engineer”) on behalf of the Attleboro Landfill, Inc. and Enviro-Cycle, LLC, the landfill owner and closure contractor, respectively.

Attleboro Landfill, Inc. is contracting with Enviro-Cycle, LLC to cap and close the landfill in accordance with the requirements of the Massachusetts Solid Waste Management regulations at 310 CMR 19.000, and DEP’s July 6, 2001 *“Revised Guidelines for Determining Closure Activities at Inactive Unlined Landfill Sites.”* Attleboro Landfill, Inc. (ALI) and Enviro - Cycle, LLC (EC) have entered into an Administrative Consent Order (ACO) with the Massachusetts Department of Environmental Protection to facilitate the closure of the existing landfill (see Appendix I).

1.1 Site Description

The Attleboro Landfill is a 55-acre facility that was used for solid waste disposal since the early 1940’s. The City of Attleboro operated an open dump on the property from the 1940’s until 1975. From 1975 to 1995, Attleboro Landfill, Inc. operated a sanitary landfill on 32 of the 55 acres (Phase A); that area has been closed and capped. The remaining area (Phase B), which is the remainder of the City’s open dump, has about 7.5 acres of waste disposal area that needs to be capped (6.7 acres will be under the proposed cap, 0.8 acres will be excavated and relocated; the surface area of the final cap will be about 8.4 acres which will overlap a portion of the Phase A side slope). The Phase B area is referred to herein as the “Site”. Figure 1, Locus Plan, presents the location of the landfill site within the City.

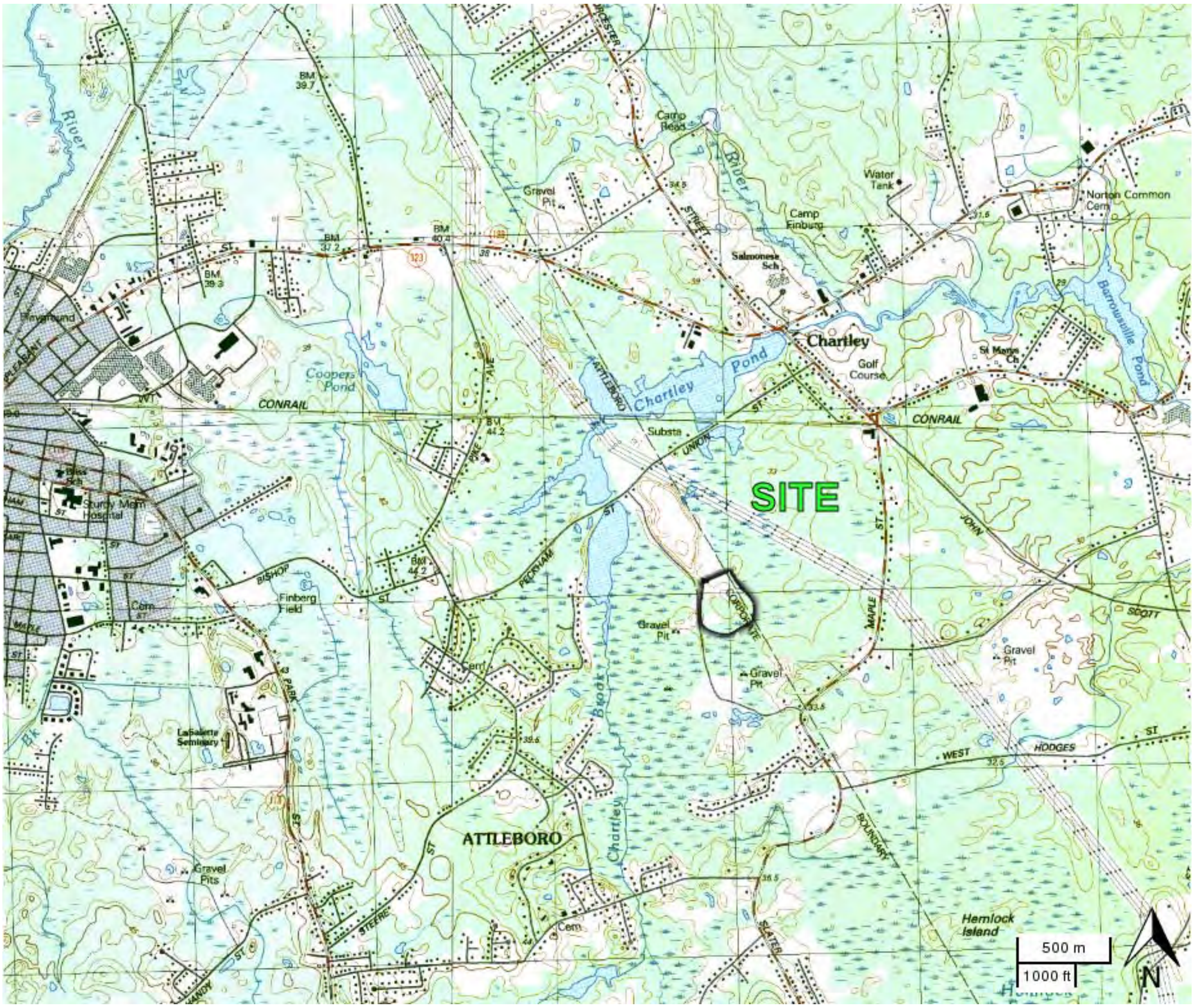


Figure 1 – Locus Map Phase B

2.0 FACILITY OPERATIONS DURING CLOSURE

This section of the document addresses the closure activities necessary to bring the existing Phase B area to final closure grades and the materials to be used for grading and shaping to achieve the final configuration of the landfill. Enviro-Cycle has contracted with the construction company of C.J. Mabardy, Inc. (CJM) who will be responsible for all construction activities relative to the closure operations at the Attleboro Landfill. A general Health and Safety Plan for on-site activities is included in Appendix E, each subcontractor will be required to develop their own specific plan for submission and review by Enviro-Cycle.

The Site will be re-contoured to closure sub-grades with Re-Crete™ that will be manufactured using construction and demolition (C&D) fines that are generated at the New Bedford Waste Services (NBWS) facility; all Re-Crete will be manufactured at the NBWS facility and subsequently transported to the Site for placement. Closure and use of these materials will be conducted in accordance with the Massachusetts Solid Waste Management Regulations at 310 CMR 19.000, DEP's Policy dated July 6, 2001 *"Revised Guidelines for Determine Closure Activities at Inactive Unlined Landfill Sites."*

2.1 Initial On-Site Activities

As part of getting the Site ready for placement of grading and shaping material, there are three tasks that need to be initiated. These tasks, as further described in the following subsections are: construction of a wheel cleaning system; installation of video cameras for remote monitoring; installation of temporary sediment and erosion control measures.

2.1.1 Wheel Cleaning System

CJM will implement measures to remove mud from vehicle tires before they leave the Site. It will consist of passive means (i.e., proper site roadway maintenance, stone and grating) with wheel wash as the last means of removal.

Proper site roadway maintenance relates primarily to the access road from Peckham Street to the Phase B area and the path that delivery vehicles follow in the active construction area. Crushed stone, trap rock and steel grates will be placed in strategic areas along the access road as shown on the project drawings (See Sheet 2 of 6). In addition, as the project proceeds, surface stabilizing material such as crushed concrete and asphalt grindings will be placed to minimize muddy conditions, both along the access road and in the active unloading area. Since the unloading area will change as the project proceeds, this placement will be a dynamic activity. A reduced version of the project drawings is included in Appendix J.

2.1.2 Video Camera Installation

In order to provide a means of monitoring traffic entering and leaving the site, video cameras will be installed at the Site entrance and positioned in such a manner that the direction of entering and exiting vehicles can be documented. The cameras will be set up to be accessible on-line and access to the cameras will be provided to designated state, city and town representatives.

2.1.3 Temporary Sediment and Erosion Control

Temporary sediment and erosion control will be placed as shown on the attached drawings to control erosion while the permanent measures are constructed and stabilized.

2.1.4 Flare System Inspection

The existing flare system for Phase A is operating in automatic mode. Once the CAD is approved, the installer of the flare system will be contracted to conduct an inspection of the system. The contractor will develop an operational checklist that on-site personnel can use to check on the operational status of the system. Additional inspections will be proposed after the initial inspection.

2.1.5 Phase A Mowing

After the CAD is approved, someone will be contracted to mow the surface of the closed Phase A area.

2.2 Initial Off-Site Activities

As part of the traffic mitigation, EC has agreed to provide temporary patches to areas of Bishop Street, Pike Avenue, Peckham Street and Union Road in order to help mitigate sounds from delivery vehicles. Work completed will be based on the specific areas, the time of year that the project starts and concurrence with the Attleboro or Norton (depending on location) public works director.

As the project is expected to span 1 to 2 years, the roadway conditions will be revisited during the course of the project. Patches will be supplemented as necessary to achieve a reasonable level of noise mitigation. Discussions with DPW personnel will be on-going.

2.3 Proposed Final Grades

Closure plans for the landfill surface indicate the creation of a “wedge” shape that will start at the far southern limit of the area to be capped and will slope upwards in a northerly direction at a minimum gradient of 5% (five feet in 100 feet). The shape of the wedge has been developed to contain the volume of material necessary to fund the project and to cap previously placed waste. The conceptual plan development and cost projections established the need to accept 230,000 tons of Re-Crete in order to be able to fund the project. This weight translates to about 230,000 cubic yards of material; the grades have been developed to accommodate this volume but may vary slightly to contain the weight of material necessary. A summary of the calculation of volume is included in Appendix J with the project plans.

Drawing No. 3 of 6, *"Final Grades"* depicts the proposed final grades for the landfill. Ground survey will be provided for horizontal and vertical control during landfill closure

2.4 Grading and Shaping Materials Management

As described above, Enviro-Cycle has an agreement with New Bedford Waste Services to provide all of the C&D Fines necessary to make Re-Crete and to conduct all mixing operations at the NBWS facility. NBWS will be mixing and delivering the material to the Site which simplifies the site management activities normally associated such operations. For example, on-site personnel will not have to be concerned with the contents of loads, inappropriate materials or whether loads need to be rejected since all mixing and screening is occurring at NBWS. They will be checking on the suitability of the mixing for placing. This simplifies site security and health and safety procedures. A description of the materials and the management and handling of them during closure operations is described in the Materials Management Plan contained in Appendix B and as generally described below.

2.4.1 Description of Re-Crete

The site will be closed by utilizing Re-Crete™ which is a mixture of Portland cement and recycled construction residuals. The density of finished and cured Re-Crete is generally around 1 ton per cubic yard, however varies based on the composition and corresponding density of the C&D Fines used to make the mixture. The Re-Crete will be used to regrade the site in support of a cap for the previously placed waste material. In order to make a simpler and more environmentally conscious operation, it has been decided to perform all mixing of Re-Crete at the NBWS facility and transport the mixed material in wet, uncured form to the site for placement. This eliminates the potential for dust generation from the Re-Crete, both during transport and during placement.

2.4.2 Delivery of Re-Crete

Re-Crete™ will be mixed at the NBWS and the wet mixture will be trucked to the site. These trailers can carry a payload of between 28 and 35 tons per load. Based on taking between 400 and 600 tons per day of raw material this will represent between a maximum of 36 truck trips per day (total in and out). This represents far fewer trucks involved than with other closure alternatives and will result in completing the project in about 400 working days. The incoming grading and shaping material will be accompanied by a weight ticket so that on-site personnel can verify quantities.

2.4.3 Monitoring of Re-Crete Production and Placement

The Engineer will oversee the mixing and placing of Re-Crete on behalf of Enviro-Cycle. Staff, trained in the proper mixing of Re-Crete and in the proper placement of the material will conduct random visits to NBWS as a quality control measure for producing Re-Crete and will be on-site to view material placement.

2.5 General Facility Operations

This section of the document provides the daily operations at the landfill during the closure process.

2.5.1 Construction Sequencing & Practices

The construction sequence will occur from the north to the south and then east to west. As the material enters the facility, it will be delivered to the designated work area to accommodate spreading and then spread and compacted. The material will be placed in lifts not greater than twelve (12) inches and compacted by multiple passes with the construction equipment; it is expected that two sequential lifts will be placed daily. The equipment used for compaction will have a minimal weight of fifty thousand pounds (50,000) to maximize compaction and minimize settlement.

Prior to placement of Re-Crete on the lower lifts, some of the existing surface soil will be rearranged to form a swale and a berm on the exterior portion of the site. This berm will help control runoff from the placement area and will serve to define the exterior portions of the area to be capped. Sequence of filling be conducted in a manner to bring approximately one third of the site (approximately 200 feet wide in an east to west direction) to finish grades before moving to the next segment in a westerly direction. This will accommodate containment of operations and will minimize unnecessary trafficking over completed areas.

The closure activities will be conducted in a manner to minimize erosion both during construction and final closure. It is intended to channel delivery vehicles over an area stabilized with granular material to minimize unnecessary tracking of mud. Conceptually, vehicles will arrive to the rear portion of the site, pull into a turning area and then back into the unloading area. This will minimize vehicles driving over potentially muddy areas and picking up dirt on the wheels. By moving operations in an east to west direction, the unloading corridor will be useful for the entire duration of the project.

In addition, granular material (i.e., crushed concrete or asphalt grindings will eventually be placed on the base of the roads used to transport the materials to the work area. If operations begin in the winter months, placement of granular material will probably not occur until springtime; if a fall start is possible, the material will be placed at the start of the project. Application of the granular material will minimize dust generation, tracking of mud on delivery vehicles and erosion of the soils.

2.5.2 Hours of Operation

Material deliveries will be limited to five (5) days per week (Monday-Friday) from 7:00 a.m. to 4:00 p.m. The placement and grading of material may continue beyond 4 PM as necessary.

2.5.3 Personnel

A representative of the Engineer will be on-site to direct closure operations, to ensure compliance with the design plans, and to provide recommendations for successful operations. In addition, an equipment operator will be on-site during a portion of the work hours as necessary to spread delivered material.

2.5.4 Employee Facilities

The existing garage located adjacent to Peckham Street will serve as a shelter for the on-site personnel when not at the work face.

2.5.5 Accident Prevention and Safety

Both CJM and NBWS maintain an ongoing company-wide Health and Safety programs. An on-site Health and Safety plan specific to the operations at the Attleboro Landfill will be prepared and available on-site in the garage/employee shelter. In addition, an emergency first aid kit and telephone will be available. The equipment operator will be provided with a communication device for communication purposes in case of an emergency.

2.5.6 Traffic and Site Access

As a result of meetings with the City of Attleboro and the Town of Norton representative's full traffic management plan has been developed (see Appendix C). As part of the development and review process, it has been agreed that all traffic will enter the landfill through Attleboro and leave the site through Norton. Through the exclusive agreement with NBWS and requiring all material to be mixed at NBWS, the material delivery to the project site can be strictly controlled.

The Attleboro inbound route will originate at the NBWS facility travel to Route 195 west to Route 118 and follow route 118 into Attleboro and turn right on Bishop Street, right on Pike Ave. and left onto Peckham Street to the site. The Norton outbound route will originate at the ALI site and travel easterly on Peckham Street which turns into Union Road in Norton; turn right on South Worcester Street which merges with John Scott Boulevard which changes to Eddy Street; right onto Route 140; left onto Harvey Street which runs through the Taunton Industrial Park; Left of Bay Road to Route 495 east to Route 24 South to Route 140 south to Hathaway Road and to New Bedford Waste Services.

2.5.7 Equipment

Equipment utilized for materials delivery and surface grading and shaping will consist mainly of a CAT D6 dozer. Also, depending on the season, a sweeper truck and water truck will be available. From time to time, additional pieces of equipment may be necessary to complete site construction activities or to replace equipment down for maintenance and C.J. Mabardy has such equipment available.

2.5.8 Dust Control

Dust control on the site will consist of regular maintenance of the access roadway to minimize dust generation. If crushed concrete and recycled asphalt are placed on roadway, dust generation will be minimized. The placement of Re-Crete and subsequent curing will not represent potential dust generation activity. When the material arrives, is moist and as it cures forms a non-erosive/non-dust producing surface. A water truck will be available on the project so that access roads can be sprinkled to prevent dust conditions.

2.5.9 Erosion, Sedimentation and Stormwater Control

Erosion and sedimentation control measures have been incorporated into the closure plans and interim measures will be implemented to control sedimentation as the area is brought to subgrade. Erosion control measures will consist of installing hay bales and silt fences around the perimeter access road as it is constructed. In addition, haybales and temporary sumps will be used along the interior of the perimeter access road to slow the flow of water during construction.

2.5.10 Odor Control/Monitoring

The only material used for grading and shaping material at the site will be Re-Crete. All experience and laboratory testing to date has shown that there are no odors emanating from the material. The only potential odor of concern is hydrogen sulfide due to the use of gypsum in the mixture. Laboratory testing of finished product has not shown generation of any significant quantity of hydrogen sulfide from properly mixed Re-Crete. Odor control activities therefore will consist of monitoring of mixing operations at NBWS and daily observations of conditions at the Site combined with a protocol to implement detailed air monitoring in the event that any odors are detected in the placement area. Descriptions of the individual measures are as follows:

1. **Monitoring of mixing** - The Engineer will conduct periodic and random site visits to NBWS to observe mixing procedures. In the formulation of Re-Crete, the most important factor to control potential odor generation is the percentage of Portland cement added to the mixture. Laboratory scale testing has shown that adding Portland cement as low as 4% by weight is effective in preventing the generation of hydrogen sulfide gas. In order to provide a factor of safety, this project is proposed to proceed with mixing at a 6% by weight Portland cement ratio. Observations will be made to ensure that the 6% mixture is being maintained (see Appendix B).

2. **Site observations -** The Engineer (and/or his representative) will conduct daily site visits and site walk overs specifically geared towards making observations whether or not hydrogen sulfide gas is present. A Jerome portable hydrogen sulfide analyzer will be used to collect real-time data. Sampling locations will be established, and measurements will be made at those locations twice daily (in the morning and at the end of the workday. Since hydrogen sulfide gas is heavier than air, observations will be made predominantly in the low areas and downwind immediately adjacent to material being placed as well as a general walkover covering all material that had been placed. Logs will be kept of observations. As hydrogen sulfide has a relatively low odor threshold (0.5 ppb) it will be apparent before it reaches actionable levels.

3. **Detailed Air Monitoring -** If hydrogen sulfide is detectable at the odor threshold for three consecutive days, a continuous monitoring device will be employed to determine whether there is a violation of air quality standards. Since the odor threshold of 0.5 ppb is well below is MassDEP actionable levels of 30 ppb (one-hour average) detailed air testing will need to be conducted in order to determine whether an actionable level exists

   The H2S Action Levels for hydrogen sulfide of 30 ppb for a one-hour average or 15 ppb for an eight-hour average constitutes an exceedance of the Action Levels. In order to determine if a Hydrogen Sulfide Action Level has been exceeded, air monitoring equipment must be employed. MassDEP recommends that continuous monitoring devices be used with the detection limits in the range of single parts per billion. Most continuous monitoring devices can be adjusted to collect readings on a set time interval (every few minutes-hours). MassDEP recommends that the meter initially be set to collect hydrogen sulfide readings every 10 minutes.

   The point of compliance is at the property line so a sampling location along the property line closest to the observed odors will be selected for detailed study.

   In order to have an exceedance of the H_2S Action Level, the following two criteria must be satisfied:

a. Hydrogen sulfide must be detected in ambient air at or beyond the point of compliance; and
b. The average concentration of hydrogen sulfide measured in ambient air at this location must be greater than or equal to 15 ppb averaged over 8 hours or 30 ppb averaged over one hour.

4. **Additional Air Monitoring in Response to Detected Hydrogen Sulfide –** While the detection of hydrogen sulfide at the odor threshold is not expected based on existing laboratory test data, if it is detected more comprehensive monitoring at the placement area will be conducted in addition to the detailed air monitoring described in item 3 above. The monitoring will be conducted beginning at the point of detection and working into the placement area at regular sampling intervals to better define where the source of the hydrogen sulfide is. If there is any detected odor, it will likely be to a bad batch of Re-Crete (which is not expected) being placed. The monitoring will be conducted so that the specific source area (or areas) can be identified.

5. **Response to Areas Where Gas generation is Observed –** If areas of gas generation are identified measures will be taken to prevent future generation and to control the migration of hydrogen sulfide from those areas. The nature of Re-Crete is not conducive to movement of gasses through the material so if gas is observed emanating from an area it will either be through a crack of some sort in the material or will be coming from the near surface material. Also, if gas is being generated it will have to be because water is getting into the Re-Crete matrix and that the matrix did not properly cure for some reason. Normally, cured Re-Crete has no free water because any water in the matrix is used as part of the concrete curing process. The production of hydrogen sulfide from gypsum normally needs water, an acid environment and the gypsum source. Properly cured Re-Crete creates an alkaline environment and has no water available to allow bacteria to survive.

   The initial response will be to seal the area with a cement sealing mixture where gas has been identified. This will prevent any water from entering, which in turn will cause the bacteria to die and odors stop. If there is not a response to sealing within a day or so, a collection system will be constructed using a 6” thick sand or peastone layer covered with a polyethylene material which in turn will be covered with soil to hold the plastic down and in place. A flexible 4” diameter suction line will be run from the collection layer and connected to the landfill gas header system located at the top of the Phase A slope that Phase B directly abuts. The blower at the flare will be turned on so that the gas will be directed to the flare where it can be burned with the landfill gas from Phase A.

   This line will be periodically monitored for hydrogen sulfide and if the hydrogen sulfide concentrations show that the production has ceased, the system will be turned off but monitored regularly. If hydrogen sulfide is detected again the system will be reactivated.

If hydrogen sulfide is detected in the vent system constructed as part of the final cap, the vent will be connected to the existing flare system and the blower set to move the gas to the flare for destruction. If hydrogen sulfide production is observed to persist after capping, application to the DEP will be made to install gas vent wells on a 200-foot grid. These wells will then be connected to the existing flares system (See sheet 4 of 6).

3.0 CORRECTIVE ACTION DESIGN

The capping of the Attleboro Landfill will be performed in accordance with the Massachusetts Solid Waste Management Regulations at 310 CMR 19.112. This section of the document provides the design analysis for the construction of the final cap system and addresses the final components of the cap design and construction methodologies.

The design construction drawings accompanying this document include the following: Sheet 1- *Cover Sheet;* Sheet 2-*Existing Conditions;* Sheet 3 - *Final Grade Plan;* Sheet 4 – *Vent and Relief Drains;* Sheet 5 - C*ross Sections*; Sheet 6 – *Details.*

3.1 Cap System

The components and/or systems of the final closure include:

- Preparation and final grading;
- Gas Venting System;
- Geomembrane Cap System
- Cap Drainage Components
- Lateral Drainage Layer;
- Vegetative Support and Vegetative Cover Components;
- Storm Water Management System: and
- Waste Relocation.

The lateral extent of the final cover system has been developed based on known location of buried material. Test pits have been conducted at various points in time that were used to develop the capping limits. In about 1999, Robert Cummings, then with East Coast Engineering, Inc., accompanied by Mr. Robert Johnson then of the MassDEP, excavated eight test pits to determine the extent of waste. Those test pits are shown as TP-1 through TP-8 on the existing conditions plan (Sheet 2 of 6). Six additional test pits were excavated in 2009 by Engineering & Management Services, Inc. for the purpose of generally classifying the types of material buried at the site; these test pits are shown as TP-BC1 through TP-BC6 on the aforementioned drawing. The test pit logs are contained in Appendix H.

Originally, there was no material that was planned to be excavated as part of landfill closure. In response to citizen comments regarding removal of trees along the easterly property line and to enhance the long-term buffer between the finished landfill and the wetlands to the east, the configuration of the landfill consolidation area was evaluated. As a result, the final configuration was redesigned by shifting the entire east slope of the landfill to the west an average of about 70 feet and eliminating the exterior access road on the east side of the site. This allows for the elimination of any visual or environmental impact in the easterly direction. It will however require selective excavation of existing buried waste material with an approximately 36,000 square foot area. Since on-site soil will be used as backfill, this activity will not increase traffic to and from the site. Based on test pits previously conducted, this area has between 3 feet and 5 feet of clean fill placed over a layer of construction and demolition material varying in thickness between 1 and 7 feet. More than half of the material is presently located below the groundwater table, which is generally between 5 and 6 feet below the ground surface.

Removing the material from this area and placing it in the landfill mass can be accomplished with no effect whatsoever on the wetland resource areas while maintaining mature trees as well as much of the recent understory growth. Material will be excavated and moved as described in section 3.1.8. Once confirmation that removal of the extent of waste material at an excavation site has been achieved, clean backfill from other portions of the property will be used to restore the area to its pre-excavation grades. The top 6 inches will be backfilled with a vegetative support material and seeded with an appropriate seed mix for the area.

It is expected that the excavation and relocation of material can be accomplished with the proper oversight of the engineer on a full-time basis and the agent from the city of Attleboro Conservation Commission as required. The project fits within the meaning and intent of a minor activity in the buffer zone as discussed in 310 CMR 10.02(2)(b)1. The removal of waste material that is located above and below the groundwater table is consistent with the interests of the Wetlands Protection Act. In any event, if the Commission decides to hold a more formal proceeding, the removal can be accomplished at any time before the capping is completed which will take between 2 and 3 years.

3.1.1 Site Preparation of Subgrade Layer

The landfill will be brought to subgrade elevations with the Re-Crete. The subgrade layer will be completed bringing the side slopes to the required maximum 3 horizontal to 1 vertical (3:1) and the plateau to 5%. The Re-Crete surface will be fine graded as the site progresses upward. Since the material hardens, subsequent fine grading prior to construction of the final cover system will not be required.

3.1.2 Venting System

The gas venting system will have two components: one that collects gas being generated by the previously placed waste material, if any; and a system that will primarily collect gas, if any, coming from the Re-Crete layer. The following is a general description of each component:

Previously Placed Waste Gas Vent System – Based on various observations at the site, the previously placed waste material consists largely of inert material (tires, cables, light stanchions, and concrete) or wooden material that has been in the ground for more than 43 years and is highly decomposed. It is unlikely that there will be any significant gas generation from this material, but provisions will be made to collect gas that may be generated. The primary mechanism to collect gas from the previously placed waste will be to install 4 wells as shown on the project plans (labelled EGVW -1 through EGVW-4).

These wells will be placed prior to placing any Re-Crete and will be screened PVC up to existing grades. A 1' thick by 6' diameter concrete collar will be placed at existing grade. From the concrete collar, upwards, solid PVC pipe will be used to extend the wells above the proposed finish grades. These wells will be connected by a header system and brought to a vent on the east side of the site. If monitoring after closure shows gas production from this well, it can be connected to the existing flare system.

Final Vent Layer Gas Vent System – This system has been designed as a conventional passive venting system meeting the regulatory requirements for a municipal solid waste facility designed for closure. This venting system will however be adaptable if necessary as an active system should odor nuisance becomes an issue.

The gas venting layer consisting of a 6-inch layer of sand (having a minimum hydraulic conductivity (k) of 1 x 10-3 cm/sec) will be placed on top of the Re-Crete layer of the landfill. The gas vent system is designed to allow the migration of any gases from the underlying Re-Crete layers as well as any of the previously placed solid waste. The gas vent system will include the installation of a header system that will be connected to vertical vents at five (5) locations as shown on sheet 3 of 6. The header system will be a 4" diameter perforated HDPE line that will cross the "plateau" portion of the site in two locations and will run along the base of the exterior slope.

The passive system will be monitored post-closure and can be connected to the existing gas collection system for Phase A if gases are detected. The Phase A system presently consists of a flare that runs intermittently.

3.1.3 Geomembrane Cap

The geomembrane cap will be placed over the gas vent layer. A 40-mil textured HDPE membrane is proposed as the impermeable membrane cap. GSE of Houston, Texas**,** or approved equal, will supply and install the membrane in accordance with their QA manual for the installation. An independent registered engineer or representative will observe the liner installation and provide QA/QC testing independently of the installer.

The seams will be either extrusion or fusion (hot wedge) welded. Fusion welding will produce a double seam with an enclosed space for air pressure testing. Extrusion welds will be vacuum box tested. GSE will field test all seams under the observation of the Engineer. Any defects indicated by seam testing or discovered during continuous inspection will be repaired and retested. Destructive seam testing for peel and shear strength will be performed at a minimum frequency of one per every 300 feet of seam for extrusion–welded seams and one per every 500 feet of seam for fusion-welded (double-wedge) seams. Destructive seam tests should be done not less than 2 times per day, including the beginning, middle, and end of each work day. GSE will conduct the testing in accordance with their QA Manual and with the specifications contained in Appendix D. When samples are taken for testing, a duplicate sample will be provided to the Engineer, acting as the independent QA Inspector, who will contract with an independent laboratory to conduct the same tests indicated in this document. If variability is observed, the Engineer will immediately notify the Client and GSE.

The geomembrane will be covered by the drainage sand layer as soon as testing is completed of the geomembrane to reduce exposure to the elements. Construction equipment will not be allowed to travel over the geomembrane until the sand drainage layer is placed.

3.1.4 Drainage Layer

The cap drainage layer will consist of a 12" layer of clean sand with a minimum saturated hydraulic conductivity (k) of 1 x 10^{-2} cm/sec. The drainage sand is to be smooth and rounded. Particle size will be limited to 3/8-inch to prevent damage to the geomembrane cap. The drainage layer will be a minimum of 12-inches in depth and be placed directly over the geomembrane; the drainage layer does not require compaction.

The cap drainage layer will extend to the perimeter of the final cover system where it will intersect surface water swales as detailed on the construction Drawings. Geotextile filters will be installed between the drainage sand and the crushed stone of these trenches or swales.

A non-woven geosynthetic filter fabric will be installed over the drainage sand to prevent migration of finer particles from the vegetative support layer into the drainage sand. The geosynthetic filter fabric is used in lieu of a soil filter layer so at least 9 inches of soil will be needed to be placed to provide adequate frost protection and the required total vegetative support layer thickness of 21 inches.

The US E.P.A.'s HELP model was run to verify that the buildup of water in the drainage layer will not exceed the depth of the layer. In order to conservatively ensure that the buildup is within acceptable limits, relief drains are proposed within the drainage layer on the plateau (5% slope area) at 70' intervals as shown on the plans. The HELP model output for the 3:1 side slope was also run with a maximum of a 60-foot-long un-drained length. The design plans contained in Appendix J show the proposed relief lines. The HELP Model output contained in Appendix F shows that the proposed drainage layer relief lines prevent any significant buildup of water in the drainage layer, thus eliminating the necessity for any further slope stability analysis as the design is more conservative than most. There are no additional lines specifically proposed for the Phase A sideslope, rather, a relief drain is incorporated into the subsequent joint between the Phase A and Phase B slopes.

In the event that alternative granular materials are proposed and used for drainage layers or gas vent layers, a "cushion and/or "filter-system" will be provided to ensure the integrity of the final cap. An application for the use of these alternative materials will be made independent of this CAD application.

3.1.5 Vegetative Support Layer

The vegetative support layer will consist of a combination of at least 9 inches of loam, the loam layer and the drainage sand layer total at least 21 inches above the geomembrane barrier layer. The detail of the vegetative support layer is provided on the Drawings (sheet 6 of 6).

In either case the materials used within the vegetative support layer will be capable of sustaining plant growth, will be free from large stones, large roots, sticks, clay, or debris, and must not be excessively acid or alkaline nor contain material detrimental to plant growth. Mixtures of inorganic soil with fully composted organic matter may be used provided the mixture meets the requirements of this section

3.1.6 Vegetative Cover

The vegetative support layer will be seeded soon after installation. Seeding will be limited to spring and late summer. The seed mixture is as follows:

40% Creeping Red Fescue
35% Pennent Perennial Ryegrass
15% Birdsfoot Tree Foil
10% Landino Clover

Fertilizer will be mixed with the seed as recommended by a USDA laboratory based on analyses on the specific topsoil to be used. Lime will be applied to the topsoil surface if soil tests indicate an acidic condition requiring adjustment; the pH of the topsoil should, unless otherwise recommended by the USDA laboratory, be between 5.0 and 7.5.

The seed mixture will be applied through hydroseeding which includes the simultaneous application of seed, fertilizer and mulch to stabilize slopes and facilitate germination.

3.1.7 Stormwater Management

Stormwater runoff from the landfill surface will be collected and directed via a series of swales along the top and bottom of the landfill. Drainage channels will be constructed with a minimum two percent (2%) grade to facilitate the drainage of runoff from the cover. In general, grass lined swales will be constructed at the top of the landfill and at the toe of the landfill.

The berms constructed along the east and west sides of the landfill are there simply to prevent water from running off of the “plateau area” and onto the side slopes in an uncontrolled manner. The swales on the inside of these berms will actually see little flow as the majority of the surface runoff occurs as “sheet flow” and runs to the berm at the south edge of the plateau, where it is controlled by stone lined swales directing the flow to one 18” diameter drop pipe.

Stormwater will flow along the perimeter swale which will be stone lined or through the drainage pipe and discharged to the detention basins on the northern, southeastern and southwestern corners of the landfill.

The storm water management system is designed to prevent an increase in runoff to adjacent property. The stormwater management system is designed to manage the 100-year storm**.** The HydroCAD analysis of the stormwater flow for the 10, 25, 50 and 100-year storm events accompanies this document and is provided in Appendix G.

3.1.8 Waste Relocation

The excavation of waste material will be accomplished using a track mounted excavator and one or more dump trucks. Prior to initiation of waste removal activities, erosion control measures shown on the project drawings will have already been installed as part of site preparation activities as described in other sections and as shown on contract drawings. Prior test pit activities have established that the majority of the material to be excavated is located at or below the existing groundwater table. The test pits have also shown that there is generally a 3 to 5-foot-thick layer of fill over the existing waste material.

The excavation of waste material will start at the north end of the area and will run along the line of the proposed anchor trench for the final cover system. Excavation will proceed from west to east until all-natural ground is observed and then from north to south. In order to minimize the intermingling of clean soil with soil containing waste material, the clean soil will be removed to within 6 inches of the waste material and stockpiled along the west side of the excavation area for 50-foot-wide increments as the excavation proceeds in the southerly direction. Once the clean soil has been removed, excavation into the waste material will be conducted. All material excavated above the groundwater table will be loaded directly into dump trucks and transported to the landfill closure area for compaction and placement. Material excavated from at or below the groundwater level will first be placed on top adjacent waste material where free draining water will be removed prior to loading the material into dump trucks and transporting into the landfill closure area. All material consolidated into the landfill will be covered with approved daily cover materials at the end of each day's operation.

All waste excavation activities will be conducted on the supervision of the engineer who is experienced in identification and handling of hazardous materials. During excavation process the engineer will examine the excavated materials for the presence of any restricted materials. In addition, if any odiferous material is encountered, it will be covered immediately after excavation to ensure that there are no off-site odor impacts. These operations will be monitored (visually and with instrumentation) for the presence of hazardous materials or obviously impacted soil or groundwater. Materials suspected as being hazardous will be fully investigated. These materials include but are not limited to: containers such as drums and paint cans; household chemicals; batteries; air conditioners; paints; electrical equipment and demolition debris. The Engineer will visually monitor the excavation for the presence of suspect hazardous materials or conditions.

Additionally, the Engineer will utilize monitoring equipment to further evaluate the materials and/or the excavation area.

Suspect materials and conditions to which actions should be taken include, but are not limited to:

1. Visual observation of drums, canisters, or other containers which may contain hazardous materials (e.g paint cans, gasoline containers, compressed gas tanks or canisters, household chemicals, etc.);

2. Visual observation of stained or discolored soils or refuse;

3. Observation of vapors or gases originating from the excavation;

4. Unusual odors emanating from the excavation;

5. Site personnel showing signs of chemical exposure;

6. Analytical testing to indicate whether a discovered material is hazardous; and/or

7. Direct monitoring results on the PID, LEL, oxygen or H2S monitor, to suggest a hazardous material or hazardous condition has been encountered (i.e., erratic measurements, decreasing/increasing measurements, etc.).

8. Visual observation of demolition debris for the presence of Asbestos Containing Materials (ACM). Suspect ACM includes, but is not limited to, thermal insulation, pipe wrapping material, flooring tiles, cement shingles, plaster, cement pipes, cement sheets, ceiling tiles, spray-on fire proofing, cement drywall or other suspect debris.

As previously stated, much of the material to be excavated is expected to consist of waste wood, logs, stumps, tires, and also minor amounts of cable and steel. In almost all cases, the lower limits of the material are expected to be below the groundwater table. Much of the excavation activity and determination of complete removal will have to be visual. The Engineer will observe excavation, indicate when in his opinion, that natural ground has been reached and then instruct the excavator to get a representative sample of the underlying native soil.

Following the excavation and relocation of waste and prior to backfilling the excavation the Engineer will conduct confirmatory sampling for subsequent laboratory analysis of the soil at the bottom of the excavation to confirm that no unacceptable contamination remains in the excavated area. A grid will be established consisting generally of two rows in an east/west direction, each generally 35 feet wide or less. In a north south direction, the grid will be at 20-foot intervals, so the area covered within each grid is generally 750 s.f. or less. After sampling, the excavation will be backfilled to within six inches of finish grade.

Discreet samples will be collected from each grid and sent to the laboratory following proper labelling and chain of custody protocol. At the laboratory, four samples will be composited for subsequent analysis, except for volatile petroleum hydrocarbons which must be analyzed individually. The discreet samples will be properly preserved, and analysis of the composite conducted in such a timeframe that if the results from the composite samples indicate contamination, the individual discreet samples can be analyzed to identify if a particular location contains contaminants exceeding allowable levels.

The confirmatory Soil Sampling and Analysis Plan is to be conducted to ensure that residual soils will meet the criteria of the Massachusetts Contingency Plan (MCP) of the applicable Method 1 Soil Category pursuant to 310 CMR 40.0975.

In order to determine whether soils will meet the applicable Method 1 Soil Category criteria, the soils will be analyzed for the following analytes:

- Volatile Petroleum Hydrocarbons - MA-VPH Method
- Extractable Petroleum Hydrocarbons - MA-EPH Method
- Poly-chlorinated Biphenyl's (PCBs) by EPA Method 8082
- MCP-14 Metals

Results of the Soil Sampling and Analysis Plan shall be reported to MassDEP within 30 days of completion of waste excavation and removal activities.

4.0 ENVIRONMENTAL MONITORING

The environmental monitoring program at the Attleboro Landfill will be conducted in accordance with the Massachusetts Solid Waste Management regulations at 310 CMR 19.132 and consist of groundwater, surface water, perimeter and landfill gas, and odor monitoring. An ISA/CSA Scope of Work is being submitted as a separate document as part of the closure process. When the CSA Scope of Work is approved, it will be implemented.

Until the CSA Scope of Work is approved by the Department, the Temporary Monitoring Program approved by the Department will be followed. The modified groundwater monitoring program proposed at the Attleboro Landfill streamlines the monitoring network by focusing on a select number of monitoring stations downgradient and cross-gradient of the landfill and for a select-set of analytes. This proposed short-term duration monitoring program will continue to provide solid environmental groundwater data at key locations without sacrificing environmental protection.

To demonstrate the effectiveness of closure, the temporary post-closure monitoring program includes groundwater sample collection and analysis from monitoring wells located down and cross gradient of the landfill. Monitoring wells MW-11D, MW-12a, MW-12b, MW-19b, MW-21S, MW-21I, MW-21D, MW-22I and MW-22D are included in the monitoring program Groundwater samples will be collected quarterly (October 2006 and January, April and July, 2007) for a period of one year, then semi-annually thereafter. At the completion of one year, a Comprehensive Site Assessment will be prepared providing an evaluation of the analytical data and recommendations for a final post-closure monitoring program. Groundwater samples will be field measured for: pH, temperature, conductivity, and dissolved oxygen; and laboratory analyzed for general chemistry parameters: alkalinity, chloride, sulfate, and TDS; metals: arsenic, barium and chromium, iron and manganese; and VOCs via EPA Method 8260B.

In addition, tap water samples will be collected annually from the residence at 59 Union Street and 106 Peckham Street and analyzed for VOCs via EPA Method 524.2.

5.0 POST-CLOSURE MAINTENANCE AND MONITORING PROGRAM

The post-closure maintenance program will include periodic grading and lawn maintenance to ensure proper surface runoff and vegetative growth. Lawn mowing, regrading and hydroseeding of the side slopes will be conducted, as deemed necessary.

A post-closure groundwater, surface water and gas monitoring program will be conducted. At this time, the post-closure monitoring program will be the same as the monitoring program conducted during closure and as addressed in Section 4 above. Once the landfill is closed and additional data is available to evaluate environmental conditions, as the Comprehensive Site Assessment (CSA) is completed the post-closure plan may be modified upon approval by DEP.

The exact monitoring program will be determined upon completion of the CSA for the site. In order to frame an estimate at this time however, the cost for the present program was used for the next 14 years and then a reduced monitoring program for the remaining 16 years. The estimate is as shown in the following table:

TABLE 1 -SUMMARY OF POST CLOSURE COSTS
ATTLEBORO LANDFILL CLOSURE
Total Post-Closure Monitoring/Maintenance Costs

Sequence	Year	Gas/Groundwater Anal. & Collection	Field Work, Inspections	Reporting (310 CMR 19.142(6))	Maintenance	Annual Cost
1	2018	$8,000.00	$550.00	$3,000.00	$2,500.00	$14,050.00
2	2019	$16,000.00	$550.00		$5,000.00	$21,550.00
3	2020	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
4	2021	$16,000.00	$550.00		$2,500.00	$19,050.00
5	2022	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
6	2023	$16,000.00	$550.00		$2,500.00	$19,050.00
7	2024	$16,000.00	$550.00	$3,000.00	$5,000.00	$24,550.00
8	2025	$16,000.00	$550.00		$2,500.00	$19,050.00
9	2026	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
10	2027	$16,000.00	$550.00		$2,500.00	$19,050.00
11	2028	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
12	2029	$16,000.00	$550.00		$5,000.00	$21,550.00
13	2030	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
14	2031	$16,000.00	$550.00	$3,000.00	$2,500.00	$22,050.00
15	2032	$16,000.00	$550.00	$0.00	$2,500.00	$19,050.00
16	2033	$5,000.00	$550.00	$3,000.00	$2,500.00	$11,050.00
17	2034	$5,000.00	$550.00	$0.00	$5,000.00	$10,550.00
18	2035	$5,000.00	$550.00	$3,000.00	$5,000.00	$13,550.00
19	2036	$5,000.00	$550.00	$0.00	$2,500.00	$8,050.00
20	2037	$5,000.00	$550.00	$3,000.00	$2,500.00	$11,050.00
21	2038	$5,000.00	$550.00	$0.00	$2,500.00	$8,050.00
22	2039	$5,000.00	$550.00	$3,000.00	$2,500.00	$11,050.00
23	2040	$5,000.00	$550.00	$0.00	$5,000.00	$10,550.00
24	2041	$5,000.00	$550.00	$3,000.00	$2,500.00	$11,050.00
25	2042	$5,000.00	$550.00	$0.00	$2,500.00	$8,050.00
26	2043	$5,000.00	$550.00	$3,000.00	$2,500.00	$11,050.00
27	2044	$5,000.00	$550.00	$0.00	$2,500.00	$8,050.00
28	2045	$5,000.00	$550.00	$3,000.00	$5,000.00	$13,550.00
29	2046	$5,000.00	$550.00	$0.00	$2,500.00	$8,050.00
30	2047	$5,000.00	$550.00	$3,000.00	$2,500.00	$11,050.00
		$307,000.00	$16,500.00	$48,000.00	$92,500.00	$464,000.00

1. The budget is based on 2018 fees
2. Maintenance budget includes lawn care, fence repair/replacement and access to the site, as necessary.

6.0 POST-CLOSURE USE

At this time there is no specific post-closure use anticipated at the landfill. An application to construct a solar array on the closed portion of Phase A and a non-landfilled portion of Phase B (area not covered by this CAD) may be submitted after approval of this CAD. The final grades at the Site have been designed to accommodate a solar array if it is feasible at the time of closure completion. Following capping and closure of the site, should any post-closure activity be anticipated, an application for such use will be prepared and presented to DEP for review and approval.

Appendix A

BWP SW25

Massachusetts Department of Environmental Protection
Bureau of Waste Prevention – Solid Waste Management

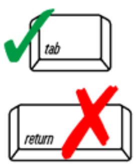
BWP SW 12 Initial Site Assessment
BWP SW 23 Comprehensive Site Assessment
BWP SW 24 Corrective Action Alternative Analysis
BWP SW 25 Corrective Action Design
Application for Landfill Assessment and Closure

X280902
Transmittal Number

SE 172303
Facility ID# (if known)

A. BWP SW 12 Initial Site Assessment: 310 CMR 19.150(4)

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



Directions: Specify the report/plan and page numbers in which the following information is located.

	Plan/Report #	Page #	DEP Use Only
1. Initial Site Assessment (310 CMR 19.150(4))			
a. Background information	N/A		
b. Historical Research	N/A		
c. Literature/Data Search	N/A		
d. Hydrogeological Description	N/A		
e. Site Visit	N/A		
f. Mapping	N/A		
g. Field Screening	N/A		
2. Comprehensive Site Assessment Scope of Work	N/A		
3. Funding			
a. Corrective action and/or closure-post closure cost estimate	N/A		
b. Funding mechanism and schedule	N/A		

B. BWP SW 23 Comprehensive Site Assessment: 310 CMR 19.150(5)

	Plan/Report #	Page #	DEP Use Only
a. ISA Summary	N/A		
b. Mapping	N/A		
c. Drilling Program	N/A		
d. Determination of Hydraulic Conductivity	N/A		
e. Sampling and Analysis Plan	N/A		
f. Health and Safety Plan	N/A		
g. Project Schedule	N/A		

X280902
Transmittal Number

SE 172303
Facility ID# (if known)

B. BWP SW 23 Comprehensive Site Assessment: 310 CMR 19.150(5) (cont.)

		Plan/Report #	Page #	DEP Use Only
h.	Baseline Risk Assessment	N/A		
i.	Corrective Action Alternative Analysis Scope of Work Outline	N/A		

C. BWP SW 24 Corrective Action Alternative Analysis: 310 CMR 19.150(6)

		Plan/Report #	Page #	DEP Use Only
a.	Corrective Action Objectives	N/A		
b.	Alternatives Analysis	N/A		
c.	Recommended Alternative	N/A		

Important Note: Engineering Plans must be stamped by a Registered Professional Engineer (PE). Property Line Location must be stamped by a Registered Land Surveyor (RLS).

D. BWP SW 25 Corrective Action Design: 310 CMR 19.151(2)(a)

		Plan/Report #	Page #	DEP Use Only
a.	Corrective Action Design and/or closure plans	CAD	All	
b.	Implementation schedule	ACO		

E. Post Closure Plans

Note: Part E is only applicable when a closure plan has been submitted and closure is being implemented.

		Plan/Report #	Page #	DEP Use Only
1.	Maintenance Plan {310 CMR 19.142(5)}	N/A		
2.	Monitoring Plan {310 CMR 19.142(5)}	N/A		
3.	Post-Closure Use Plans {310 CMR 19.143} (if applicable)	N/A		
4.	Record Notice of Landfill Operation {310 CMR 19.141}	N/A		

BWP SW 12 Initial Site Assessment
BWP SW 23 Comprehensive Site Assessment
BWP SW 24 Corrective Action Alternative Analysis
BWP SW 25 Corrective Action Design
Application for Landfill Assessment and Closure

X280902
Transmittal Number

SE 172303
Facility ID# (if known)

F. Certification & Engineer's Supervision: 310 CMR 19.011

Engineer's Supervision:

All papers pertaining to design, operation, or engineering of this site or facility shall be completed under the supervision of a Massachusetts registered professional engineer knowledgeable in solid waste facility design, construction and operation, and shall bear the seal, signature and discipline of said engineer. The soils, geology, air monitoring and groundwater sections of the application or monitoring report shall be completed by competent professionals experienced in the fields of soil science and soil engineering, geology, air monitoring and groundwater, respectively, under the supervision of a Massachusetts registered professional engineer. All mapping and surveying shall be completed by a registered surveyor.

Richard R. DeBenedictis
Print Name

Authorized Signature

Position/Title

Richard R. DeBenedictis, P.E.
Company

28318
P.E. #

June 20, 2018
Date (MM/DD/YYYY)

Responsible Official Certification:

I attest under the pains and penalties of perjury that:

(a) I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this certification statement;
(b) based on my inquiry of those persons responsible for obtaining the information, the information contained in this submittal is, to the best of my knowledge, true, accurate, and complete;
(c) I am fully authorized to bind the entity required to submit these documents and to make this attestation on behalf of such entity; and
(d) I am aware that there are significant penalties, including, but not limited to, possible administrative and civil penalties for submitting false, inaccurate, or incomplete information and possible fines and imprisonment for knowingly submitting false, inaccurate, or incomplete information.

Robert S. Cummings

Authorized Signature

Manager, Enviro-Cycle, LLC
Position/Title

June 20, 2018
Date (MM/DD/YYYY)

Enter your transmittal number → X280902
Transmittal Number

Your unique Transmittal Number can be accessed online:
http://www.mass.gov/eea/agencies/massdep/service/approvals/transmittal-form-for-payment.html

Massachusetts Department of Environmental Protection

Transmittal Form for Permit Application and Payment

1. Please type or print. A separate Transmittal Form must be completed for each permit application.

2. Make your check payable to the Commonwealth of Massachusetts and mail it with a copy of this form to: MassDEP, P.O. Box 4062, Boston, MA 02211.

3. Three copies of this form will be needed.

Copy 1 - the original must accompany your permit application.
Copy 2 must accompany your fee payment.
Copy 3 should be retained for your records

4. Both fee-paying and exempt applicants must mail a copy of this transmittal form to:

MassDEP
P.O. Box 4062
Boston, MA
02211

*** Note:**
For BWSC Permits, enter the LSP.

A. Permit Information

BWP SW 25
1. Permit Code: 4 to 7 character code from permit instructions

Corrective Action Design
2. Name of Permit Category

3. Type of Project or Activity

B. Applicant Information – Firm or Individual

Enviro Cycle, LLC
1. Name of Firm - Or, if party needing this approval is an individual enter name below:

2. **Last Name** of Individual
3. **First Name** of Individual
4. MI

50 Homers Wharf
5. Street Address

New Bedford	MA	02740	5087287805	
6. City/Town	7. State	8. Zip Code	9. Telephone #	10. Ext. #

Robert S. Cummings
11. Contact Person

bob@re-crete.us
12. e-mail address

C. Facility, Site or Individual Requiring Approval

Attleboro Landfill
1. Name of Facility, Site Or Individual

179 Peckham Street
2. Street Address

Attleboro	MA	02703		
3. City/Town	4. State	5. Zip Code	6. Telephone #	7. Ext. #

SE 172303		
8. DEP Facility Number (if Known)	9. Federal I.D. Number (if Known)	10. BWSC Tracking # (if Known)

D. Application Prepared by (if different from Section B)*

Richard R. DeBenedictis, P.E.
1. Name of Firm Or Individual

57 Sanderson Drive
2. Address

Plymouth	MA	02330	7812499435	
3. City/Town	4. State	5. Zip Code	6. Telephone #	7. Ext. #

Richard R. DeBenedictis
8. Contact Person

9. LSP Number (BWSC Permits only)

E. Permit - Project Coordination

1. Is this project subject to MEPA review? ☐ yes ☒ no
If yes, enter the project's EOEA file number - assigned when an Environmental Notification Form is submitted to the MEPA unit:

EOEA File Number

F. Amount Due

DEP Use Only

Permit No:

Rec'd Date:

Reviewer:

Special Provisions:

1. ☐ **Fee** Exempt (city, town or municipal housing authority)(state agency if fee is $100 or less).
There are no fee exemptions for BWSC permits, regardless of applicant status.
2. ☐ Hardship Request - payment extensions according to 310 CMR 4.04(3)(c).
3. ☐ Alternative Schedule Project (according to 310 CMR 4.05 and 4.10).
4. ☐ Homeowner (according to 310 CMR 4.02).

99	$4255.00	6-25-2018
Check Number	Dollar Amount	Date

Appendix B

Materials Management Plan

MATERIALS MANAGEMENT PLAN
FOR PRODUCING AND PLACING RE-CRETE
ATTLEBORO LANDFILL, PHASE B CLOSURE
ATTLEBORO, MASSACHUSETTS

1.0 INTRODUCTION

This document presents a plan that describes the procedures that will be followed in the mixing, delivering and placing Re-Crete as part of the Attleboro Landfill, Phase B Closure Project. This plan was developed to comply with specific requirement in the Administrative Consent Order issued for the completion of this project. All Re-Crete will be mixed at the New Bedford Waste Services (NBWS) facility and, delivered by NBWS vehicles in a premixed state that is ready for placement at the Site. The following sections describe each of the items.

2.0 MIXING

All mixing will take place at the NBWS facility using C&D fines generated at the NBWS facility and portland cement. The C&D fines generated at this facility presently have a BUD issued by the MassDEP for use at landfills as daily cover. This BUD requires regular testing of the C&D fines and has shown a consistency in the type of fines generated. Furthermore, the data evaluated shows that the fines are suitable for use in the Re-Crete process and as such no additional testing is proposed at the source. All C&D fines used in this project will be only the C&D fines generated at the NBWS facility.

For most of the outlets that NBWS presently has for their fines, they set their screen size to 2" for their fines. Enviro-Cycle prefers a smaller size and NBWS has agreed to screen material to a 3/4" – 1' screen size.

NBWS is modifying its operating permit to include equipment and procedures necessary to manufacture Re-Crete at its facility. The modifications include directing the material from its final screens into a modified trommel screen where the portland cement will be dry mixed with the C&D fines. A cement silo will be added at the NBWS facility that will have a screw feed so that a proportional feed can be set up to mix the portland cement at a ratio of 6% by weight to the fines. Initial setup of the equipment will require some calibration however, once calibrated this type of delivery of the cement is a reliable method. As a means of calibrating and for future verification, total weight of C&D fines will be recorded as well as the total weight of cement used on a daily basis. Based on the two weights, verification of the proper mixing ratio can be made. After the cement and the C&D fines are dry mixed, water will be added at the end of the mixing operation and prior to discharge into delivery vehicles. Additional details will be provided with the application for the mixing equipment.

As part of project startup, an Enviro-Cycle representative will be at the NBWS facility to observe calibration and to instruct operators on proper mixing techniques. After initial startup, periodic visits will be made to observe mixing and to collect data relative to composition of the mixture.

3.0 DELIVERY

The mixed Re-Crete will be placed in tractor-trailers delivered to the Site. It is expected that deliveries will be made every day, however it is possible, that during extreme storm events delivery of C&D material to the NBWS facility may drop off and accordingly, the generation of C&D fines at the NBWS facility may drop. In these circumstances, it may be preferable to avoid deliveries during periods of heavy snowfall and simply stockpile C&D fines at the NBWS facility for processing the next day.

In any event, delivery will follow schedules and routes specified in the document entitled *Traffic Control Plan, Attleboro Landfill Closure Project, Attleboro, MA* dated September 14, 2016 and presented as Appendix C. The traffic control plan specifies delivery routes and times for delivery. As the plan describes it is dynamic and can be modified to meet the needs of the communities involved.

Upon arrival at the Site, drivers will check in with the Enviro-Cycle representative who will direct the driver to the unloading area. A truck will follow the stable roads to the unloading area, turn around in the designated spot and back into empty their load. After emptying, the truck will exit along the stable roadway travel over the wheel grate where any remaining mud should be removed from the tires. If any mud remains on the tires, Enviro Cycle representative stationed at the existing garage at the gate, will use a pressure wash to remove any remaining material.

It should be noted that the traffic control plan specifies directions for entering and leaving the site. Remote video cameras will be placed to observe compliance with this requirement. In addition, a speed limit is imposed on entering and exiting vehicles that will be enforced.

4.0 PLACEMENT

Placement of Re-Crete is relatively simple. The water/C&D fines/Portland cement ratio used in this application will result in a material that is stable and easy to manage. The water content of the Re-Crete will provide material similar to the consistency of modeling clay. It will stand almost vertically and will not run as a normal concrete mixture would.

After unloading, the material will be moved using a dozer and spread and compacted. Spreading will be accomplished in lifts of 12 inches or less and compacted with multiple passes of the dozer. An area of about 80’ x 80’ x 2’ deep (placed in two sequential lifts) will be required to contain the expected daily volume of material (approximately 500 tons). This will require placement of the material in two or more lifts over the course of the day. The material will be shaped to conform to proposed final surface configuration. Sequencing of the daily working face will be accomplished in a manner to avoid placing a new set of lifts over a newly placed daily lift for a period of 48 hours; this will allow adequate curing and will provide a stable base for future lifts.

The Re-Crete can be placed in any weather. The process of Portland cement curing creates an exothermic reaction, causing heat to be released as the material cures. For this reason, placement of the material during cold weather and the subsequent curing is not of concern. Since the application of Re-Crete, in this case, is not to create structural grade concrete, some minor freezing within the mass is not of concern because as the mass is increased and material cures any frozen material will thaw and subsequently cure.

Precautions will be taken during extreme rainfall events to protect the placed material. Tarps will be used cover any material that is 48 hours or less old during a rainfall event producing an intensity greater than 1 inch per hour. If such a storm is expected to occur, the site operator will be instructed to place tarps over areas recently placed. To the extent practical, deliveries will not be made during a heavy rainfall.

Appendix C

Traffic Management Plan

Traffic Control Plan
Attleboro Landfill Closure Project
Attleboro, MA

Prepared By:

Robert S. Cummings, P.E.
Enviro-Cycle, LLC
PO Box 540
Bridgewater, MA

September 14, 2016

Table of Contents

Attachments

1.0 Background and Purpose

Background

The Attleboro Landfill is a 55 acre facility that was used for solid waste disposal since the early 1940's. The City of Attleboro operated an open dump on the property from the 1940's until 1975. From 1975 to 1995, Attleboro Landfill, Inc. operated a sanitary landfill on 32 of the 55 acres (Phase A); that area has been closed and capped. The remaining area (Phase B), which is the remainder of the City's open dump, has about 9.9 acres of waste disposal area that needs to be capped. The Phase B area is referred to herein as the site.

On March 10, 2015, a public informational meeting was held with residents and local officials of Norton and Attleboro to discuss details provided within a Conceptual Proposal for site closure that will utilize Re-Crete to shape the site in preparation for a standard landfill cap. Input was solicited from the general public at the meeting and through a formal comment period. It was announced at the public meeting that G. Lopes Construction Inc. would serve as the site operator and on-site contractor. At the time of the informational meeting New England Recycling (NER) had intended to be the construction contractor and operator at the site as well as the main supplier of C&D fines. With the passage of time since the meeting , NER has found other outlets for their C&D fines and will not be a participant in this project. Enviro-Cycle has reached agreement with New Bedford Waste Services (NBWS) who operates facilities in New Bedford, Rochester and Sandwich and have the resources to supply C&D Fines for this project.

In response to the concerns raised about potential dust generation during transport of the C&D fines and later during mixing and on-site and placing of Re-Crete, Enviro Cycle has decided to conduct all mixing of Re-Crete at the NBWS facility located at 1245 Shawmut Avenue in New Bedfrod,MA and transport it in a wet, uncured state to the site for placement. As a result, Enviro-Cycle will completely control all traffic to and from the Attleboro Landfill.

Purpose

The purpose of this document is to present a traffic control plan for comment and review and subsequent implementation by Enviro-Cycle and the working group comprised of Town of Norton and City of Attleboro officials.

2.0 Delivery Routes

The following sections provide details of the proposed delivery routes.

2.1 General Description of Delivery Process

The site will be closed by utilizing the Re-Crete™ to regrade the site in support of a cap for the previously placed waste material. In the Conceptual Proposal, it was proposed to deliver C&D fines and Portland cement to the site and mix and place the Re-Crete on-site. As discussed above, in response to the public's concerns and in order to make a simpler and more environmentally conscious operation, it has been decided to perform all mixing of Re-Crete at the NBWS facility and transport mixed material to the site for placement. This eliminates the potential for dust generation, both during transport and during placement.

Since Re-Crete™ is manufactured with a combination of cement and recycled materials, it will be mixed at NBWS. The wet mixture will be trucked to the site using a standard leak proof tractor trailer dump combination. These trailers can carry a payload of 35 tons per trailer. Based on taking between 500 and 600 tons per day of raw material this will represent between 30 and 36 truck trips per day (total in and out). This represents far fewer trucks involved than with other closure alternatives and will result in completing the project in about 400 working days.

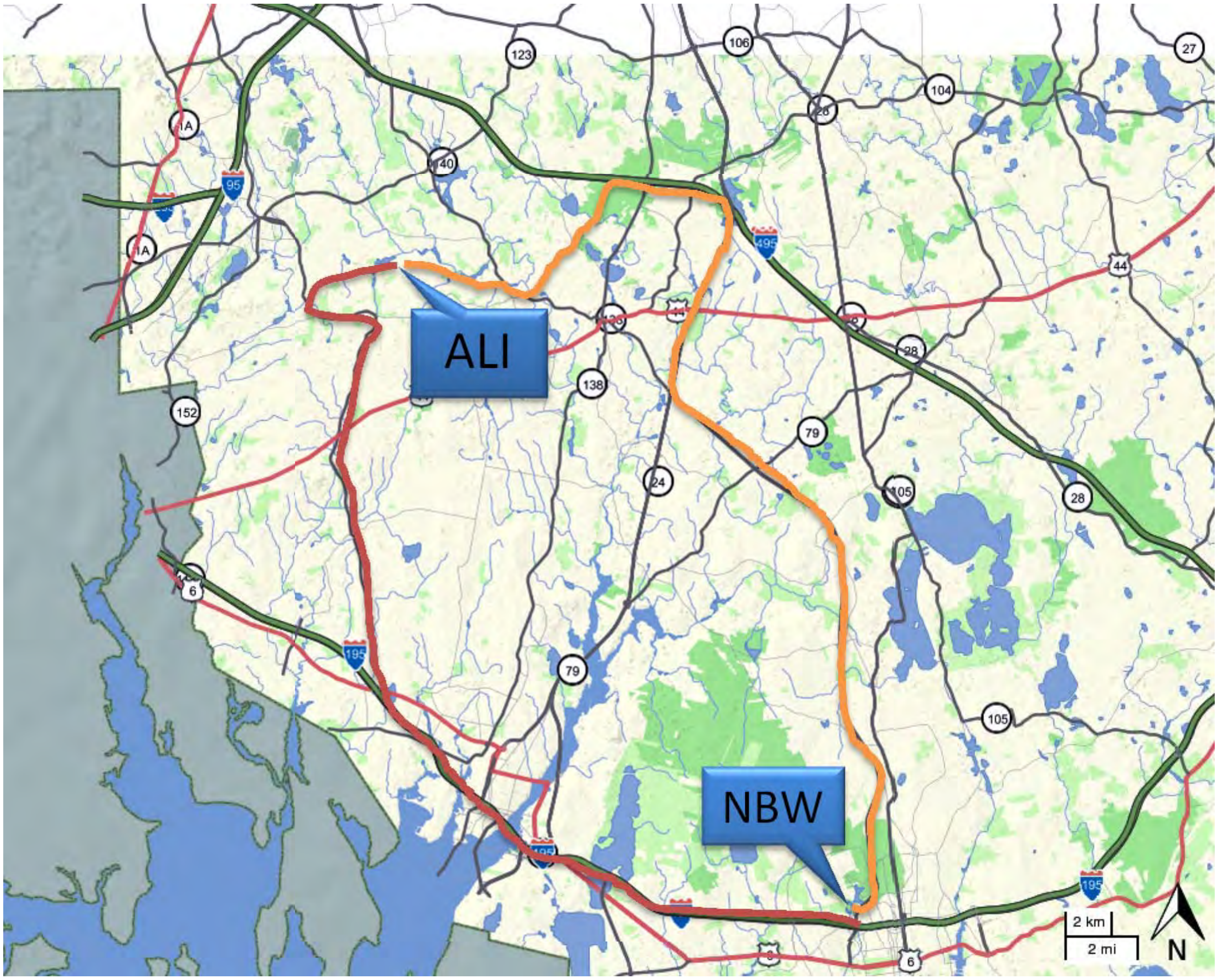
2.2 Proposed Delivery Routes

As a result of meetings with the City of Attleboro and the Town of Norton representatives, it has been agreed that all traffic will enter the landfill through Attleboro and leave the site through Norton. Through the exclusive agreement with NBWS and requiring all material to be mixed at NBWS, the material delivery to the project site can be strictly controlled. Two suitable traffic routes have been identified; one approaching the site on Peckham Street from the west on a route that would go through Attleboro and the other approaching the site on Peckham Street from the east on a route that would go through Norton.

The Attleboro inbound route will originate at the NBWS facility travel to Route 195 west to Route 118 and follow route 118 into Attleboro and turn right on Bishop Street, right on Pike Ave. and left onto Peckham Street to the site. The Norton outbound route will originate at the ALI site and travel easterly Peckham Street which turns into Union Road in Norton; turn right on South Worcester Street which merges with John Scott Boulevard which chenges to Eddy Street; right onto Route 140; left onto Harvey Street which runs through the Taunton Industrial Park; Left of Bay Road to Route 495 east to Route 24 South to Route 140 south to Hathaway Road and to New Bedford Waste Services. The two delivery routes are shown on Figure 2–1.

The City and the Town may recommend revisions to the traffic routes that involve their respective municipalities.

Figure 2-1 Delivery Routes



Incoming Route

Outbound Route

Based on feedback from both communities, the preference is to use the Attleboro route for incoming deliveries and the Norton route for outgoing empty trucks. This pattern will be followed unless otherwise requested by both communities or if there is some sort of unexpected emergency municipal shutdown of one of the roadways. In the event of an unplanned shutdown, any change to the plan will only be temporary, will be coordinated with community representatives and geared to address the immediate issue.

3.0 Proposed Traffic Controls

As stated above, the Re-Crete mixture will be delivered to the site pre-mixed and in standard trailers. All delivery vehicles will be owned or under the direct control of NBWS which will facilitate scheduling and control/enforcement of delivery times and methods. In order to oversee and control delivery operations, the City of Attleboro and Town of Norton will designate representatives to a working group that was charged with providing comments on the draft traffic management plan to be involved in oversight of traffic issues during the project. This information has been embodied into this plan and is enforceable as described in section 3.3.

3.1 Traffic Working Group

As previously stated, the city of Attleboro and the town of Norton appointed a traffic working group to act on behalf of the communities in establishing and overseeing the implementation of a traffic management plan in order to ensure minimal impacts on either community as a result of delivery operations. This working group met on an initial basis to review, and provide comments on the draft plan and will meet on an as needed basis, to adjust delivery schedules to meet activities occurring within each community.

3.2 Delivery Scheduling

The project as it is presently envisioned will be relatively easy to control. It is expected that between 15 and 18 tractor-trailers of premixed Re-Crete will be delivered to the site daily. This will result in a project completion time of about 400 working days Since all vehicles are originating from the same location scheduling of deliveries to avoid busy times on the streets or to address special activities can easily be done.

A "Sample Delivery Schedule" form has been developed that can be used to accomplish the scheduling, a copy of which is included as Attachment 1. Using this form, the working group can decide which routes the vehicles can use entering or leaving the site on any day of the week for anyone half-hour interval. This schedule can be issued for whatever time periods the committee chooses. Different schedules can be issued for different time periods making the adjustment easy. Under normal circumstances, the working group should give Enviro Cycle 30 days' notice of changes and delivery schedules

The following table is a portion of that attachment demonstrating how it can be used. In this example, inbound traffic is allowed through Attleboro and outbound traffic is through. This could be changed to show inbound traffic on a particular day through one community and outbound traffic through the other community, or any combination thereof. In addition, no traffic is shown on the sample form to be allowed between 9 AM and 10 AM and between 2 PM and 3:30 PM. This means that the operator will have to be sure to schedule deliveries so that vehicles can be in and out before the prohibited period, otherwise vehicles will have to wait at the site to leave. Similar adjustments can be made to accommodate school schedules or other special events. This sample schedule also shows deliveries only occurring from Monday to Friday as requested by community representatives.

In order to ensure safe access during winter storms, Enviro Cycle and NBWS will coordinate with designated community officials with regards to road conditions. There will be no deliveries at all during “snow emergencies”. On days that school has been cancelled, there will be no deliveries unless the designated officials agree that roadways have been sufficiently cleared. This scenario would only occur when the early morning conditions prevented school busses from safely travelling but as the day proceeded conditions improved.

Table 3-1 – Sample Delivery Schedule

TIME	INBOUND						OUTBOUND					
	M	T	W	T	F	S	M	T	W	T	F	S
7:00 – 7:30	X	X	X	X	X	X	X	X	X	X	X	X
7:30 – 8:00	A	A	A	A	A	X	N	N	N	N	N	X
8:00 – 8:30	A	A	A	A	A	X	N	N	N	N	N	X
8:30 – 9:00	A	A	A	A	A	X	N	N	N	N	N	X
9:00 – 9:30	X	X	X	X	X	X	X	X	X	X	X	X
9:30 – 10:00	X	X	X	X	X	X	X	X	X	X	X	X
10:00 – 10:30	A	A	A	A	A	X	N	N	N	N	N	X
10:30 – 11:00	A	A	A	A	A	X	N	N	N	N	N	X
11:00 – 11:30	A	A	A	A	A	X	N	N	N	N	N	X
11:30 – 12:00	A	A	A	A	A	X	N	N	N	N	N	X
12:00 – 12:30	A	A	A	A	A	X	N	N	N	N	N	X
12:30 – 1:00	A	A	A	A	A	X	N	N	N	N	N	X
1:00 – 1:30	A	A	A	A	A	X	N	N	N	N	N	X
1:30 – 2:00	A	A	A	A	A	X	N	N	N	N	N	X
2:00 – 2:30	X	X	X	X	X	X	X	X	X	X	X	X
2:30 – 3:00	X	X	X	X	X	X	X	X	X	X	X	X
3:00 – 3:30	X	X	X	X	X	X	X	X	X	X	X	X
3:30 – 4:00	A	A	A	A	A	X	N	N	N	N	N	X
4:00 – 4:30	A	A	A	A	A	X	N	N	N	N	N	X
4:30 – 5:00	A	A	A	A	A	X	N	N	N	N	N	X

Notes: "A" designates Attleboro Route; "N" designates Norton Route; "X" means no deliveries/return trips allowed

3.3 Enforcement

In order to further minimize noise levels in neighborhoods, speed controls will be put in place. Essentially, the speed limit of 20 mph for the delivery vehicles will be specified on Union Road and Peckham Street in Norton and on Bishop St., Pike Avenue and Peckham Street in Attleboro. As all vehicles will be under the direct control of NER, they will be responsible for any vehicles failing to comply with this requirement. In addition, NER will be responsible for ensuring that the delivery routes, hours and days specified by the committee are followed.

Any documented deviation from these rules will be subject to a fine of $500.00. Violations of speed limit violations will be verified by the Norton Police Department. A remote video camera (accessible by internet) will be set up at the landfill entrance and will be used to verify any complaints of vehicles entering or leaving during a prohibited time period.

As one means of monitoring and verification, video cameras will be mounted on the building at the entrance to the Landfill so that the direction of trucks arriving and departing can be recorded. These cameras will be monitored remotely and access can be provided to designated state and local officials.

In addition, the trucks used for delivery are equipped with GPS units. In the event of a need to verify direction or locations, limited access can be provided.

3.4 Mitigation

In addition to having the ability to vary the delivery schedule as discussed in previous sections, improvements can be made to the existing roads to minimize the noise of vehicles (limited patching); measures can be implemented to avoid tracking of dirt onto the street as vehicles leave the facility and certain roadways can receive an overlay pavement after the project is completed. The following sub-sections describe these measures. In addition, pre-construction photography (probably video) will be completed to document existing roadway conditions.

3.4.1 Pavement Patching

In order to smoothen the existing roads, there are a few select locations where limited grinding and overlay paving will be completed to correct existing surface imperfections that would represent a significant potential noise source. These areas will be viewed with the appropriate municipal official(s) and documented prior to construction. Work will be completed before any deliveries are made.

3.4.2 Wheel Cleaning

Proven methods will be used to prevent the tracking of mud from the site. C crushed stone (3/4” to 2”) will be placed as a road surface for the last 300 feet of the road from the work area to Peckham Street. This will remove most or all of the mud from the vehicle tires, depending on weather conditions. Some improvements to the remainder of the road to the work area will also be made to improve the surface and to minimize mud tracking. As a final measure, there will be high pressure wash-down capabilities at the exit point to Peckham Street so that any residual mud can be removed.

If necessary, Peckham Street and Union Road will be swept periodically.

3.4.3 Final Paving

At the completion of the project, grinding and overlay pavement will be completed in Attleboro from Park Street to the site and from the site to South Worcester Street in Norton. The project budget includes a “mitigation payment” of $0.50 per ton for each community. This is intended to be over and above the cost of pavement overlay. If either community wants road improvements beyond grinding and overlay, the cost will be deducted from the mitigation fund and the work completed provided that the requesting community provides all necessary permits to complete the work.

Attachment 1 – of ALI Closure Project Traffic Control Form

Delivery Schedule for the period from________________ to __________________ (1)

TIME	INBOUND						OUTBOUND					
	M	T	W	T	F	S	M	T	W	T	F	S
7:00 – 7:30												
7:30 – 8:00												
8:00 – 8:30												
8:30 – 9:00												
9:00 – 9:30												
9:30 – 10:00												
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1:30 – 2:00												
2:00 – 2:30												
2:30 – 3:00												
3:00 – 3:30												
3:30 – 4:00												
4:00 – 4:30												
4:30 – 5:00												

Notes: “A” designates Attleboro Route; “N” designates Norton Route; “X” means no deliveries allowed

Note 1: Unless another schedule is approved by the working group, the traffic routes established in this schedule shall remain in effect.

Appendix D

Technical Specifications

APPENDIX D
FINAL CAPPING SYSTEM TECHNICAL SPECIFICATIONS

This Appendix contains the technical specifications for the items necessary for the construction and quality assurance related to the final capping system at the Site. The following specification sections are included:

SPECIFICATION SECTION	TITLE
SECTION 01010	PROJECT SUMMARY
SECTION 01300	SUBMITTALS
SECTION 01400	QUALITY ASSURANCE / QUALITY CONTROL
SECTION 01566	SEDIMENT AND EROSION CONTROL
SECTION 02200	EARTHWORK
SECTION 02275	RIPRAP
SECTION 02720	STORMWATER SYSTEMS
SECTION 02733	HDPE MEMBRANE
SECTION 02750	GAS VENT LAYER
SECTION 02900	LOAM AND SEED
SECTION 02961	GAS COLLECTION HEADER SYSTEM

SECTION 01010

PROJECT SUMMARY

PART I – GENERAL

1.01 COMPONENTS OF THE WORK

The work to be accomplished by Contractor consists of the Final Closure/Capping of the Attleboro Landfill, Phase B located at 179 Peckham Street in Attleboro, Massachusetts. All work is to be performed in accordance with Massachusetts Solid Waste Regulations (310 CMR 19.000). Contractor's general contract with the Owner includes placement of grading and shaping materials to reach closure grades, and capping of the landfill as shown on the attached Drawings and the specifications described below.

The construction Drawings attached detail the following components and/or systems of the landfill closure:

A. • preparation and final grading;
B. • installation of a gas venting system;
C. • construction of a geomembrane cap;
D. • construction of cap drainage components;
E. • vegetative support, soil and vegetative cover components; and
F. • stormwater management system.

1.02 PROJECT OVERVIEW

General construction requirements are described below. The specifications and Drawings provide construction details and supersede this discussion. This overview is provided solely to aid the Contractor in understanding the entire project and the context of their subcontract within the overall project.

A. Site Preparation

In general, site preparation and grading prior to construction of the final cover system will be completed before the onset of site capping activities. The site will be re-graded using Re-Crete, a proprietary product. The gas vent layer will be placed on the Re-Crete surface; exterior roads and drainage detention basins will be generally shaped and closure activities will include final grading of these features.

B. Cap Barrier and Vent Layer

A gas collection and relief system will be installed below the barrier layer. It will consist of a sand venting layer supplemented by perforated HDPE pipes wrapped in geotextile fabric, with gas vent riser structures. The barrier layer will consists of a 40-ml high density polyethylene (HDPE) textured membrane installed over the entire landfill area.

C. Cap Drainage Components and Filter Layers

A clean sand drainage layer will be installed over the geomembrane barrier. Collection trenches or surface water swales as detailed on the construction Drawings will provide drainage relief.

D. Stormwater Management

The stormwater management system is designed to prevent an increase in runoff to adjacent property and to prevent silt from leaving the site. Stormwater will be directed through a series of swales along the slope of the landfill to three detention basins. Three detention basins will be constructed at the northern, southeastern and southwestern corners of the landfill.

Grass lined swales will be installed at the top and toe of the side slopes. Runoff collected within the swales at the top of the landfill will be channeled in a series of 12-inch corrugated PVC pipe "downspouts" and discharged at the toe of the slope to downspout outlet structures within the lower swales. From these points stormwater will be transported via either perimeter swale or drainage pipe and discharged to the detention basins.

E. Vegetative Support Layer

The vegetative support layer shall consist of a combination of at least 9 inches of topsoil. The materials used for topsoil will be capable of sustaining plant growth, will be free from large stones, large roots, sticks, clay or debris, and must not be excessively acid or alkaline nor contain material detrimental to plant growth. Mixtures of inorganic soil with fully composed organic matter may be used provided the mixture meets the requirements of this section. Seeding is to be accomplished as soon as practical after topsoil placement. Seeding will be limited to spring and late summer. The seed application method is hydroseeding which will include simultaneous applications of seed, fertilizer and mulch to stabilize slopes and facilitate germination.

F. Siltation and Dust Control

To minimize siltation of adjacent property and wetlands, erosion controls consisting of hay bale checks will be placed as required to intercept eroded sediment and reduce silt transport. All runoff will be routed into the three detention basins to drop any remaining suspended silt. Should dust occur during dry weather periods of cap construction, water will be applied to haul roads and construction areas to provide nuisance control.

PART II – PRODUCTS

Not Used.

PART III – EXECUTION

Not Used.

END OF SECTION

SECTION 01300

SUBMITTALS

PART I - GENERAL

1.01 SECTION INCLUDES

A. Submittal procedures.

B. Construction progress schedules.

C. Health and Safety Plan.

D. Proposed Products list.

E. Product Data.

F. Shop Drawings.

G. Samples.

H. Design data.

I. Test reports.

J. Certificates.

K. Manufacturer's instructions.

L. Manufacturer's field reports.

M. Erection Drawings.

N. Construction photographs.

O. Waste Management Documentation

1.02 REFERENCES

A. AGC (Associated General Contractors of America) publication "The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry".

1.03 SUBMITTAL PROCEDURES

A. Transmit each submittal with Owner accepted form.

B. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

C. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate.

D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

E. Schedule submittals to expedite the Project, and deliver to Owner and Engineer at business address. Coordinate submission of related items.

F. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

G. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.

H. Provide space for Contractor and Engineer review stamps.

I. When revised for resubmission, identify all changes made since previous submission.

J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

K. Submittals not requested will not be recognized or processed.

1.04 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial schedule in duplicate within 15 days after date established in Notice to Proceed.

B. Revise and resubmit as required.

C. Submit a horizontal bar chart with separate line for each major portion of Work or operation, identifying first workday of each week.

D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

E. Indicate estimated percentage of completion for each item of Work at each submission.

F. Indicate submittal dates required for shop Drawings, product data, samples, and product delivery dates, including those furnished by Owner and required by Allowances.

1.05 SITE HEALTH AND SAFETY PLAN

A. Contractor to hire Certified Industrial Hygienist to prepare Site Health and Safety Plan to address worker safety during construction activities.

B. Plan to contain/address:

1. Worker safety for the various chemical and physical hazards on the site.

2. Procedures to be followed to ensure worker safety, education and monitoring.

1.06 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.07 PRODUCT DATA

A. Product Data For Review:

1. Submitted to Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.

2. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes.

B. Product Data For Information:

1. Submitted for the Engineer's knowledge as contract administrator or for the Owner.

C. Product Data For Project Close-out:

1. Submitted for the Owner's benefit during and after project completion.

D. Submit the number of copies which the Contractor requires, plus two copies which will be retained by the Engineer.

E. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

F. Indicate Product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

G. After review distribute in accordance with the Submittal Procedures article above and provide copies for record documents.

1.08 SHOP DRAWINGS

A. Shop Drawings For Review:

1. Submitted to Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.

2. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes.

B. Shop Drawings For Information:

1. Submitted for the Engineer's knowledge as contract administrator or for the Owner.

C. Shop Drawings For Project Close-out:

1. Submitted for the Owner's benefit during and after project completion.

D. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

E. Submit in the form of one reproducible transparency and one opaque reproduction.

1.09 SAMPLES

A. Samples For Review:

1. Submitted to Engineer for review for the limited purpose of checking for

conformance with information given and the design concept expressed in the contract documents.

2. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes.

B. Samples For Information:

1. Submitted for the Engineer's knowledge as contract administrator or for the Owner.

1.10 DESIGN DATA

A. Submit for the Engineer's knowledge as contract administrator or for the Owner.

B. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

1.11 TEST REPORTS

A. Submit for the Engineer's knowledge as contract administrator or for the Owner.

B. Submit test reports for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

1.12 CERTIFICATES

A. When specified in individual specification sections, submit certification by the manufacturer, installation/application subcontractor, or the Contractor to Engineer, in quantities specified for Product Data.

B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

1.13 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.14 MANUFACTURER'S FIELD REPORTS

A. Submit reports for the Owner’s benefit as contract administrator or for the Owner.

B. Submit report in duplicate within 30 days of observation to Engineer for information.

C. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

1.15 CONSTRUCTION PHOTOGRAPHS

A. Take photographs of the work area prior to construction start-up.

B. Photographs: One print; color, glossy; 8 x 10 inch size; mounted on 8-1/2 x 11 inch soft card stock, with left edge binding margin for three hole punch.

C. Identify photographs with date, time, orientation, and project identification.

PART II - PRODUCTS

Not Used.

PART III - EXECUTION

Not Used.

END OF SECTION

SECTION 01400

QUALITY ASSURANCE / QUALITY CONTROL

PART I - GENERAL

1.01 SECTION INCLUDES

A. Quality assurance - control of installation.

B. Tolerances.

C. References and standards.

D. Manufacturers' field services.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals: Submission of manufacturers' instructions and certificates.

B. Section 02200 – Earthwork: Requirements for material and work quality.

1.03 QUALITY ASSURANCE - CONTROL OF INSTALLATION

A Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop Drawings or as instructed by the manufacturer.

G. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.04 TOLERANCES

A. Monitor fabrication and installation tolerance control of Products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust Products to appropriate dimensions; position before securing Products in place.

1.05 REFERENCES AND STANDARDS

A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents, except where a specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect/Engineer shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.06 TESTING SERVICES

A. Contractor will appoint and employ services of an independent firm to perform testing specified in these contract documents to ensure that work products conform to Engineer’s specifications.

1.07 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Owner 30 days in advance of required observations. Observer subject to approval of Owner.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

D. Refer to Section 01300 - SUBMITTALS.

PART II - PRODUCTS

Not Used.

PART III - EXECUTION

3.01 QUALITY CONTROL / QUALITY ASSURANCE PLAN

A. A Quality Control / Quality Assurance (QA/QC) Plan has been prepared for this project and is included as part of this section. This QA/QC Plan outlines the responsibilities of the various parties involved in Quality Control / Quality Assurance activities and indicates the types and frequency of testing, inspection and observations required.

3.02 RESPONSIBILITIES

A. The QA/QC officer and field representative required by the QA/QC Plan shall perform observations and testing indicated, and shall compile the final construction documentation report.

B. An independent, licensed surveyor shall be engaged for final confirmation of as-built grades, locations, and slopes as so indicated in the QA/QC Plan. The surveyor will establish appropriate benchmarks and baseline(s) at the start of construction. The reference benchmarks and baseline(s) must be maintained and protected by the contractor during construction.

C. The Contractor shall be responsible for all testing, inspections and observations indicated in the QA/QC Plan to be accomplished by the Contractor and/or Supplier/Manufacturer/Installer, and shall provide all test reports and certifications thereby required by the QA/QC Plan.

D. The Contractor is responsible for all quality control methods and procedures to ensure that the work is accomplished in accordance with the requirements of the Contract Documents. Testing, inspections and observations are performed for the benefit of the Owner and shall in no way relieve the Contractor of his responsibility under the Contract Documents. Neither the presence of the QA/QC Officer, nor any observations or testing performed by him shall excuse the Contractor from defects discovered in this work.

3.03 INTRODUCTION

A. This Quality Assurance/Quality Control (QA/QC) Plan was developed for monitoring of the construction of the landfill components of the Marion Sanitary Landfill in Marion, MA.

3.04 ACTIVITIES COVERED

A. This plan is intended to provide for monitoring of construction activities. Construction activities covered by this plan include work under the following sections of the specifications:

Section 01566 - Sediment and Erosion Control
Section 02200 - Earthwork
Section 02275 - Riprap
Section 02720 - Site Stormwater Systems
Section 02733 - HDPE Membrane
Section 02936 - Loam & Seeding
Section 02961 - Gas Collection Header System

3.05 QA/QC PERSONNEL QUALIFICATIONS

A. The QA/QC Officer will be responsible for completion of the QA/QC program and will sign and seal the "Construction Documentation Report" at the completion of construction. The QA/QC Officer will have a representative on-site at all times.

3.06 TYPES OF SAMPLING

A. Three types of sampling will be employed for this project. Sampling will vary depending on the nature and quantity of the material being monitored. These different sampling strategies include:

1. Continuous Sampling;
2. Observational Sampling; and
3. Periodic Testing.

Each of these are further discussed below.

3.07 CONTINUOUS SAMPLING

Continuous sampling and testing techniques will be employed for critical components of the landfill construction. Since continuous samples requires that 100 percent of the materials tested, only non-destructive testing techniques can be used. Continuous sampling and testing will be limited to seams for the synthetic membranes and other geosynthetic materials.

Seams for the synthetic membrane will be tested on a continuous basis by the membrane installer. The test method used will depend on the jointing method used. Non-destructive test methods include vacuum box tests, pressurization tests and electronic (ultra-sonic) methods. The contractor will be required to repair any leaks indicated by the continuous seam testing.

The seams for the geotextile fabrics will be continuously monitored and measured to ensure that the installation procedures specified by the manufacturer or by the project specifications are followed.

3.08 OBSERVATIONAL TESTING

A. Observational testing will be performed to evaluate the contractor's procedures to determine whether the component observed is being constructed consistent with the intent of the project specifications. The field engineer will make continuous observations of most geomembrane and earth components of the cap. For the placement of earth materials these observations will be supplemented by the periodic testing described below.

B. Observations will be made by the QA/QC personnel and documented in the daily field reports. The reports will be kept on-site and will be available to Department of Environmental Protection personnel. Photographs will be taken periodically during construction. Selected photographs demonstrating important observations will be included in a documentation report to be prepared at the completion of construction.

3.09 PERIODIC TESTING

A. Periodic field and laboratory testing will be performed on various components of the landfill including: synthetic membranes, seams between synthetic membrane panels, and soil materials.

B. Prior to installation, the contractor will be required to show compliance with certain minimum properties of the HDPE membrane outlined in the specifications. To check manufacturers data the engineer will collect one sample from each fifth membrane roll and analyze each for nine properties including thickness, strength, elongation, and carbon black content. Samples will be collected from membranes during installation. Field tests on the synthetic membrane and seams will include:

1. Thickness measurements (by micrometer);
2. Tensile tests (on seams); and
3. Peel tests (on seams).

C. Field samples will be analyzed by both the installer and field engineer.

D. Tests for cast-in-place concrete will include:

1. Slump;
2. Air content; and
3. Compressive strength.

E. Test for earth materials will include:

1. Grain size distribution analyses including hydrometer analysis;
2. Laboratory permeability testing including Atterburg Limits and establishment of Proctor Curves;
3. Layer thickness measurements; and
4. In-place density tests.

F. Periodic testing is considered appropriate because destructive test procedures are required (for synthetic membranes and concrete) or because of the inherent variability in material properties (as is the case with any soil mass). For soil materials, the large volumes of material also make continuous testing impractical. Where appropriate, ASTM test methods will be utilized.

3.10 SAMPLING FREQUENCY FOR PERIODIC TESTING

A. The proposed sampling frequency for each landfill component is given in later sections describing testing by component.

3.11 CRITERIA FOR REQUIRING CORRECTIVE ACTION

A. Acceptance/rejection criteria for periodic testing are provided in the project specifications. All material rejected on-site shall be marked and removed immediately. For the continuous testing of membrane seams any leaks will be repaired. The contractor will be required to provide manufacturer's data indicating that manufactured products meet properties required in the specifications. Materials damaged during shipping to or storage on the site will be rejected unless repaired to the satisfaction of the field engineer.

3.12 CORRECTIVE MEASURES

A. When materials or work do not meet the project specifications, corrective measures will be implemented. Corrective actions to be taken will be dependent on the component involved and nature of the deficiency. Corrective actions for several common deficiencies are discussed below.

B. If test performed on the synthetic membrane by the manufacturer (thickness, tensile strength and tear strength) do not meet project specifications the Contractor will not be allowed to install the membrane materials.

C. One hundred percent of the membrane seams will need to pass the installers field integrity tests. If any leaks are detected, the workmanship will be rejected and that portion of the seam failing the test will have to be redone. The contractor will not be allowed to cover any layers until all seams and overlaps in that area of the project have been checked and signed by QA/QC officer.

D. For each borrow materials, samples for grain size analyses and permeability testing will be collected at the following time:

1. From the source area (i.e., gravel pit) prior to the start of hauling operations; and
2. From delivery trucks periodically throughout construction.

E. Natural sources of soil fill are variable by nature, therefore a source material which initially meets gradation and/or permeability requirements may no longer meet the requirements after some quantity of material is removed. If testing performed during the course of the work indicates the material no longer meets project specifications the contractor will be instructed to stop delivery and find an alternative source. The need for additional testing or remedial activities for soils already placed will be evaluated by the field engineer.

F. If earth fills do not meet project requirements for thickness or density, corrective actions will also be taken. Anticipated actions include the removal and replacement of the fill or additional compaction of that fill layer.

G. If the contractor is unable to make corrective action to satisfy the project specifications, appropriate project design modifications may have to be developed so that the overall performance criteria can be met. The regulatory agency will be notified of any variations from the project specifications. Where appropriate, regulatory agency's input and/or approval will be solicited.

3.13 DOCUMENTATION

A. Documentation will be provided in the form of daily field inspection reports and a final construction documentation report. The documentation report will include:

1. A summary of QA/QC activities;
2. Daily field inspection reports which will include a summary of that day's activities;
3. Data sheets for all laboratory and field tests;
4. All contractor Quality Assurance/Quality Control submittals;
5. A summary of tests not meeting the project specifications and the corrective actions made;
6. A summary of any deviations from the project design and material specifications; and
7. As-built plans.

B. The final documentation report will be signed and sealed by the QA/QC Officer.

3.14 HIGH DENSITY POLYETHYLENE MEMBRANE

A. The HDPE membrane is to be installed by the membrane subcontractor using their quality control procedures which consist of material and manufacturing conformance testing as well as startup, nondestructive and destructive seam testing. The Subcontractors QA manual must be submitted and approved by the Engineer prior to starting work. Subcontractor will maintain detailed quality control documentation and certify the membrane installation prior to its acceptance. The Engineer will provide full-time observation of the membrane installation and perform independent

QA/QC testing to verify the installers program. The Engineer will provide documentation of the installation process and the independent QA/QC testing in daily field reports and the final certification report. Minimum frequencies of destructive seam samples will be one for every 300 feet for extrusion-welded seams, and one every 500 feet for fusion-(double wedge) welded seams.

B. Anchor trenches shall be constructed where required. Anchor trenches shall be constructed just prior to installation of the HDPE membrane. The trench shall be at least 2 feet deep and 1 foot wide. The membrane shall be extended down the anchor trench and across the bottom of the trench such that it is at least 2 feet below grade and extended at least one foot across the bottom of the trench. Backfilling of the trench with the specified thickness of the appropriate final cover materials shall be accomplished as described in this section except that hand-operated vibratory plate compactors shall be used.

3.15 SAND DRAINAGE LAYER AND GAS VENT SAND

A. Representative samples of the sand to be used to form the sand drainage layer and gas vent layer will be collected from the proposed borrow area and tested for grain-size distribution (ASTM D422) and permeability (ASTM D2434). If the results of the initial testing indicate the material is acceptable, backup testing will be performed on representative truckloads of material delivered to the landfill during construction. The minimum frequency for this testing will be one grain-size every 1,500 yd^3 and one permeability test every 3,000 yd^3.

B. The twelve – inch (12”) thickness of the drainage layer and of the six-inch (6”) vent layer will be verified by random hand-excavated shallow test holes. Measurement results will be documented in the Engineer's daily report. Sand will be added if the thickness is found to be deficient.

3.16 TOPSOIL LAYER

A. Suitability of material to be used to support vegetation will be tested for grain-size, pH and organic content (ignition test) and permeability at a frequency of at least one test every 1,000 yd^3 per source. If necessary, additives recommended by the topsoil testing agency will be mixed into the topsoil prior to placement on the slope so as to reduce disturbance of the clay/sand portions of the system. Topsoil thickness will be randomly checked by the Engineer during placement and documented in the Engineer's daily field report. Topsoil will be added if the thickness is found deficient.

3.17 GEOTEXTILE FILTER FABRIC

A. Geotextile filter fabric will be used in various installations shown on the Drawings to prevent the migration of fines into permeable layers. The manufacturer of the material shall provide a list of guaranteed minimum average roll properties for the specific geotextile installed. Delivered materials shall be inspected to ensure that they have not been damaged during transit or storage at the landfill site. Torn or damaged fabric shall not be used. Geotextile exposed to ultraviolet radiation for more than 15 days shall not be installed.

END OF SECTION

SECTION 01566

SEDIMENT AND EROSION CONTROL

PART I – GENERAL

1.01 SECTION INCLUDES

A. Furnishing, installing, inspecting, maintaining, replacing and removing haybale.

B. Furnishing, installing, inspecting, maintaining, replacing and removing Geotextile Barrier Fence.

C. Construction Implementation.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

1.03 DEFINITIONS

A. Haybale Barrier: a temporary barrier of straw or hay material installed along the northern portion of the landfill as shown on Contract Drawings or as directed by the Engineer or the Town of Marion.

B. Silt Fence: a temporary fence made up of a geotextile fabric and set at the base of a slope below disturbed soil areas. The fence is designed to remove suspended particles from the water passing through it.

1.04 DELIVERY, HANDLING AND STORAGE

A. Haybales will be inspected upon delivery to ensure that all haybales have been properly baled.

B. Any haybale not properly baled upon delivery will not be accepted.

1.05 SCHEDULING

A. All erosion and sediment control measures will be in place and operational before the commencement of any soil placement activities.

B. Once the erosion and sediment controls are installed, the Contractor shall notify the Engineer for inspection.

PART II– MATERIALS

2.01 MATERIALS

A. Haybales will be bound tightly with baling wire, rope or nylon ties. Any haybales not properly baled will not be accepted. Any haybale that comes unbaled during the installation process or while in place will be replaced immediately.

B. Stakes shall be wood and 1"x1"x36" in length or number 5 reinforcing bar 36" minimum length for haybales.

C. Silt fence:

1. Fibers used in the manufacturer of steel wire reinforced geotextiles shall consist of long chain synthetic polymers, composed of at least 85% by weight polyolefins, polyesters or polyamides. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other.
2. Post shall be wood and 1-1/4"x1-1/4"x48" in length and be of sufficient strength to resist damage installation and to support applied loads.

PART III – EXECUTION

3.01 PURPOSE

A. The purpose of the haybale and silt fabric fence barrier is to reduce runoff velocity and effect deposition of the transported sediment load.

3.02 INSTALLATION

A. Haybales
1. Haybales shall be placed in a row with ends tightly abutting the adjacent bale.
2. Each bale will be embedded into the soil a minimum of 4 inches.
3. Bales shall be securely anchored in place by 2 stakes driven through the bales at least 6 inches into the underlying soil.
4. Soil removed from the trench shall be firmly compacted on the upslope side of the silt fence.

B. Silt Fence
1. Silt fences shall be placed on the upgrade side of a haybale.
2. Fence stakes shall be placed a minimum of 6 feet apart and driven to a depth of 12 inches minimum.
3. Fabric at the bottom of the fence shall be buried a minimum of 6 inches into a trench 6 inches wide so that no flow can pass under the fence.

4. The trench shall be backfilled and soil compacted over the fabric.
5. When two sections of filter fabric cloth adjoin each other, they shall be overlapped 6 inches, folded and stapled to the post.

3.03 MAINTENANCE, INSPECTION AND REPLACEMENT

A. Haybales
1. Haybales shall be inspected weekly and immediately after any rain fall.
2. Disintegrated haybales shall be replaced before they are breached by runoff.
3. Sediment build up shall be removed periodically whenever the deposits exceed 1/3 the height of the barrier.

B. Silt Fence
1. Silt fences shall be inspected immediately after a rainfall and daily during a prolonged rainfall.
2. Inspection for physical damage, which may result from fallen branches, animal activity, vandalism, etc., shall occur at least weekly.
3. Sediment deposits shall be removed after each significant storm event or whenever deposits exceed 1/3 the height of the barrier.
4. All sediment deposits remaining after the removal of the silt fence shall be placed in the landfill.

3.04 REMOVAL OF SEDIMENT AND EROSION CONTROL MEASURES

A. Haybales shall remain in place until the Engineer directs that they may be removed.

B. Upon removal of the haybales and silt fence, the Contractor shall remove and dispose of any excess silt accumulation.

C. The haybales and silt fence will remain property of the Contractor and will be removed from the site.

PART II – PRODUCTS

Not Used.

PART III – EXECUTION

Not Used.

END OF SECTION

SECTION 02200

EARTHWORK

PART I- GENERAL

1.01 DESCRIPTION OF WORK

A. The scope of work under this Section includes the furnishing of all labor, materials, equipment, and appurtenances; and performing all operations required for grading and preparation of the site prior to construction; performing all operations required for the installation and construction of the various earth components; performing various functions in support of the membrane subcontractor; and general site earthwork as shown on the Drawings and specified. Work will include, but not be limited to:

1. Cutting, filling, grading excavation and compaction to achieve specified site preparation grades.
2. Cutting and grading, excavation and maintaining the temporary sedimentation basins.
3. Fine grading and proof-compaction of subgrade.
4. Furnishing and placing gas vent collection piping and appurtenances, crushed stone fill and geotextile filter fabric.
5. Preparation of the cap geomembrane subgrade, excavation, filling, and compaction the membrane anchor trench.
6. Placement and compaction of a minimum 6" thick drainage sand layer over the geomembrane.
7. Placement and compaction of a minimum 12” thick vegetative support layer over the drainage layer.
8. Management of the site stormwater system.
9. Monitoring and control of earthwork compaction to ensure required fill shear strengths are achieved.

B. Related work specified elsewhere includes, but is not limited to:

1. Section 01400 - Quality Assurance/Quality Control
2. Section 02275 - Riprap
3. Section 02733 - HDPE Membrane
4. Section 02900 - Loam & Seeding
5. Section 02961 - Gas Collection Header System

C. Provide adequate pumping and drainage to keep all excavations and work sufficiently dry from groundwater and/or surface runoff so as not to adversely affect construction product nor cause excessive disturbance of underlying ground. Water shall be disposed in accordance with NPDES Permit and the Order of Conditions issued by the Attleboro Conservation Commission and other applicable local, state and federal permits and in such a manner as will not cause injury to public health, nor damage to public or private property, existing work or work in progress. The Contractor shall comply with all applicable environmental protection and/or sediment/erosion control regulations.

D. Throughout the work, the Contractor shall take all necessary precautions, including installation of temporary drainage swales, diversion berms, siltation sumps, check dams, hay bales, or silt fence barriers, and temporary pipe to direct and control drainage from disturbed areas on the site so that erosion and siltation is effectively mitigated.

E. The Contractor shall take all necessary measures to minimize dust from rising and blowing across the site. The Contractor shall control all dust created by construction operations and movement of construction vehicles, both on site and on paved ways. At a minimum, the Contractor shall employ a full-time water truck for the duration of the project.

F. Specified earth materials which are placed and subsequently disturbed by construction activities or contaminated by mud, silt, clay or organic matter shall be removed and replaced with materials meeting specification requirements. The Contractor shall take all necessary precautions to prevent the base liner system components from siltation and contamination.

1.02 QUALITY ASSURANCE

A. Codes and Standards: Comply with all rules, regulations, laws and ordinances of the Commonwealth of Massachusetts, the City of Attleboro, and of all other governing authorities having jurisdiction.

B. Observation and Testing: Quality Assurance/Quality Control testing and observation shall be accomplished as specified in Section 01400 - Quality Assurance/Quality Control.

C. Supervision of the earthwork operations shall be under the control of a registered professional civil engineer with at least 5 years experience in earthworks.

1.03 SUBMITTALS

A. The Subcontractor shall submit samples and manufacturers data for all manufactured products proposed for use in conjunction with the work described in this section. Sufficient information shall be provided to allow determination of whether the proposed product meets the requirements specified herein. Products shall not be installed until the QA/QC officer has approved the submittal in writing.

B. The Contractor shall provide minimum 50-pound samples of all off-site borrow, earth, and crushed stone materials. Testing shall be as described in Section 01400.

C. Submittals will be reviewed and responded to within seven (7) working days. Contractor will not proceed with installation of submitted items until approval by the Engineer and the QA/QC officer.

1.04 JOB CONDITIONS

A. Site Information

1. Information on the Contract Drawings and in the Specifications relating to subsurface conditions, existing utilities and structures is from the best sources presently available. Such information is furnished only for the information and convenience of the Subcontractor and the accuracy and completeness of the information is not guaranteed. It is expressly understood that the Owner or the engineer will not be responsible for interpretations of conclusions drawn there from by Contractor.
2. Plans, surveys, measurements, and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period, as no additional compensation will be made for errors and inaccuracies that may be found therein. By submitting a bid, the Contractor affirms that he has carefully examined the Site, all available information pertinent thereto, and all conditions affecting work under this Section.

B. Presence of Combustible Gas

1. The Contractor is also alerted that combustible gas could be generated in the former landfilled materials and that such combustible gas may be encountered in excavations and may collect in manholes, piping, or other enclosed spaces. The Contractors shall take all necessary precautions to guard against explosive hazards where combustible gas is present. Such precautions shall include, but not be limited to monitoring for the presence of combustible gas, the use of non-sparking tools, and the elimination of ignition sources in the presence of explosive concentrations of combustible gas.
2. It is solely the Contractor's responsibility to maintain the health and safety of his workers.

C. Protection of Persons and Property

1. The work shall be executed in such a manner as to prevent any damage to adjacent property and any other property and existing improvements.
2. In the case of any damage or injury caused in the performance of work, the Contractor shall, at his own expense, make good such damage or injury to the satisfaction of, and without cost to, the Owner.
3. Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights during hours from dusk to dawn each day and otherwise as required.

D. Protection of Existing Landfill

1. Perform all operations, direct and control all construction traffic, and operate and maintain all haul roads to ensure that the existing landfill upon which fill materials will be placed is not damaged.

E. Work During Periods of Poor Weather
1. Earthwork operations will be performed year-round. During periods of wet and/or freezing weather, when compaction is difficult or impossible, direct all fill materials to areas as specified herein and shown on the Drawings, where required shear strengths and compaction criteria are less stringent. Modify construction operations to accommodate changes in the weather.
2. Control areas that become excessively wet or rutted by the use of lime or addition of rip rap as specified herein.

1.05 GEOTECHNICAL DESIGN CRITERIA

A. Fill shall be placed and compacted to the grades shown on the Drawings and specified herein.

B. Finished slopes shall be no steeper than 3H:1V unless otherwise directed by the Engineer.

C. Cohesive fill material placed beneath finished slope areas shall be compacted as specified herein to achieve an undrained shear strength of 1500 psf at a confining pressure of 2500 psf. Undisturbed samples shall be taken during the initial fill placement stages and unconsolidated undrained triaxial tests performed to verify that field compaction is achieving required shear strengths. Modify compaction procedures based on the results of the initial testing, as necessary to achieve required shear strength.

D. Fill materials which are not located beneath finished slope areas shall be compacted to achieve the maximum practicable density in due consideration of the field moisture content and ambient weather conditions. No compaction or other geotechnical testing of these fill materials is necessary. Add lime, rip rap or use other means, as necessary to maintain a surface suitable for earthwork operations.

E. In order to prevent raw fill from causing a slide along the existing liner, the final toe location of the new slope shall be located a minimum of twenty feet outside the toe of the existing landfill liner.

PART II - PRODUCTS

2.01 EARTH MATERIALS

A. Gravel Fill shall consist of hard, durable sand and gravel and /or durable crushed stone and shall be free from ice, and snow, roots, sod, lumps of clay, rubbish and other deleterious or organic matter and shall conform to the following gradation requirements:

Sieve Size	Percent Finer by Weight
6"	100
1-1/2"	55 - 95
½"	50 - 85
No. 4	40 - 75
No. 40	10 - 35
No. 200	0 - 10

B. Drainage Sand for use as sand for the drainage layer above the membrane cap, shall consist of inorganic soil free from ice, snow, roots, sod, lumps of clay, rubbish, and other deleterious or organic matter. The drainage sand shall have a permeability equal to or greater than $1x10^{-2}$ cm/sec when compacted to 98-percent of its maximum dry density as determined by ASTM D1557. It shall have no stones larger than 3/8 " and no more than 5% passing the #200 sieve.

C. Crushed Stone shall consist of durable crushed rock or durable crushed gravel stone, free from ice and snow, clay, loam, and organic or otherwise deleterious material and shall conform to the following gradation requirements for the nominal size indicated:

Sieve Size	Percent Passing by Weight	
	3/4" Nominal Size	1-1/4" Nominal Size
1-1/2"	---	100
1-1/4"	---	85 - 100
1"	100	35 - 70
3/4"	90 - 100	0 - 25
½"	20 - 50	0 - 5
3/8"	0 - 20	---
No. 4	0 - 5	---

D. 3/8" Peastone shall consist of washed, rounded gravel stone derived from crushing, screening and washing of gravel from a natural bank. Crushed quarry products shall not be used. 3/8" Peastone shall be free from ice, snow, roots, sod, rubbish, debris or other deleterious matter and shall contain no angular stone or other material potentially injurious to the membrane liner. 3/8" Peastone shall conform to the following gradation requirements:

Sieve Size	Percent Finer by Weight
3/4"	100
½"	95 - 100
3/8"	80 - 100
No. 4	5 - 30
No. 8	0 - 10
No. 100	0 - 3

E. Clay or Till Soil for use as soil barrier layers and for interior berms as indicated on the Drawings shall be well graded inorganic soil free of rubble, debris, rock fragments, cobbles, boulders or gravel in excess of 2 inches in diameter, snow, ice, organic matter, pockets of sand, gravel crushed stone or other pervious or deleterious matter. Clayey soil shall contain a minimum of 30 percent (by weight) the No. 200 sieve and shall provide as permeability of $1x10^{-7}$ cm/sec or less when compacted to

92 percent of maximum dry density at three percent above optimum moisture content as determined by ASTM D1557.

F. Common Fill for use where other materials are not indicated or specified shall be friable non-plastic inorganic soil containing no stone greater than 2/3 of the required loose lift thickness. Common fill shall be free of refuse, trash, ice, snow, stumps, roots, and organic materials. Where placed more than three feet below finished grade, ordinary fill may include concrete, masonry, or asphaltic concrete rubble.

G. Topsoil shall be organic soil capable of sustaining plant growth, free from large stones, large roots, sticks, clay, or debris. It shall not be excessively acid or alkaline nor contain material toxic to plant growth. Surficial organic soils stockpiled in the course of the work may be used. Mixtures of inorganic soil with fully composed organic matter may be used provided the mixture meets the requirements of this Section. The minimum organic content for topsoil shall be between 8% and 9%. The maximum hydraulic conductivity shall be no more than 7.2×10^{-4} cm/sec. Vegetative support layer materials shall be well graded within the following limits:

Sieve Size	Percent Finer by Weight
4"	100
1"	90 - 100
No. 4	70 - 100
No. 40	20 - 85
No. 100	10 - 50
No. 200	5 - 40

2.02 FILTER FABRIC

A. Filter Fabric shall be Mirafi® 140N, or equal, which is a nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Mirafi® 140N is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Mirafi® 140N meets AASHTO M288 Class 3 for Elongation > 50%.

PART III - EXECUTION

3.01 GENERAL

B. Excavated materials shall remain the property of the Owner and shall be reused for the work when suitable. Unsuitable materials and excess suitable materials shall be stockpiled as directed.

C. Take the precautions described in Part 1.01 C, D, E, and F of this Section.

3.02 PROTECTION OF ADJACENT WORK

A. Protect all adjacent structures which may be damaged by excavation work, including service utilities and pipe chases. All construction induced damage shall be repaired by the Contractor at no additional expense to the Owner.

B. Grade excavation top perimeter to prevent surface water run-off into and adjacent wetlands.

3.03 EXCAVATION

A. Excavate to the lines and grades indicated on the Drawings or as otherwise required for the work.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Engineer. Unauthorized excavation, as well as any remedial work directed, shall be at the Subcontractor's expense. Refill unauthorized excavation with specified earth materials as directed by Engineer and compact same in accordance with the requirements of this Section.

C. In the case that unsuitable bearing, as determined by Engineer is encountered at the specified subgrade level, Engineer may direct additional authorized excavation and refill with suitable material. Payment for such additional excavation and/or refill shall be made on a unit price basis.

D. Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials or obstructions encountered.

3.04 PLACEMENT AND COMPACTION OF FILL AND BACKFILL

A. Products specified in paragraph 2.01 of this Section shall be employed in the various fill and backfill applications indicated on the Drawings or specified herein. Provide required additional fill material if a sufficient quantity of suitable material is not available from the required excavation on the project site.

B. Clearing, grubbing, and stripping shall be accomplished as specified in this Section prior to placement of fill or backfill.

C. All fill and backfill materials shall be placed in horizontal layers. Each layer shall be spread evenly and thoroughly mixed during spreading to ensure uniformity of material in each layer.

D. Where horizontal fill layers meet an exiting slope, the layer shall be keyed into the slope by cutting a bench. The surface of benches shall be compacted to the same requirements as apply to the area being filled. Where an existing landfill liner is present beneath the slope, exercise all necessary caution to prevent damage to the liner.

E. Fill materials placed beneath finished slopes shall be compacted to 90% of the modified Proctor dry density.

F. Fill materials placed outside finished slope areas shall be compacted to the maximum practicable density achievable with the field moisture content of the soil and the ambient weather conditions. As a minimum, such fill materials shall be placed in loose lift heights of maximum thickness 12", and shall be compacted with 4 passes of a roller.

G. Fill shall not be placed beneath finished slope areas during unfavorable weather conditions. In periods of poor weather, all fill materials shall be directed to other areas of the site where no compaction testing is necessary. In such areas, material may be placed and the soil compacted to the maximum practicable density achievable. Stabilize soil which are excessively wet by the addition of lime or rip rap to enable construction traffic to operate effectively.

H. Compaction shall be by mechanical means designed specifically for compaction and approved by the Engineer. The Engineer reserves the right to disapprove any device of inadequate capacity, or, in his opinion, of type unsuited to the character of the material being compacted. In areas which are too restricted to permit the use of mechanical compactors, fill may be placed in 3" layers and compacted by hand rammer or pneumatic tools to the specified densities.

I. When fill materials outside finished slope areas are required to be placed in the wet or over soft subgrades such that compaction of lifts of the specified thickness is impractical, alternative methods of placement and compaction will be acceptable. Such methods would normally involve placement of thicker lifts and compaction by thorough tracking with tracked construction equipment.

J. Where the Engineer determines that fill or backfill does not conform to the compacted density specified, or did not receive the minimum compactive effort specified, and upon written direction of the Engineer, such fill shall be removed and replaced with conforming materials.

K. Remove from spaces to be filled, or backfilled, all unsuitable material, including rubbish, organic materials, debris, forms, snow, ice and frozen earth. Do not commence backfilling operations until the condition of the area to be backfilled has been reviewed and approved by the Engineer.

3.05 SAND DRAINAGE LAYERS

A. Sand drainage layers shall be constructed to the lines and grades indicated on the Drawings utilizing the materials specified in Part 2.01 of this section.

B. Sand drainage layers shall be placed in a layers of a minimum of 12 inch thickness in a single lift. Procedures employed shall be such as to avoid damage to underlying geosynthetic membrane. A minimum of 12 inches of granular soil shall be maintained between placement equipment and the underlying geosynthetic materials at all times. Equipment used for placement of the granular soil layer shall be subject to the Engineer's approval, which will be based on the geosynthetic material supplier recommendations. Lightweight equipment (with weights of 40,000 pounds or less) specially designed to have low ground pressure are preferred. Tracking machines with deep grousers will not be allowed. The Contractor shall not attempt to push large stockpiles of materials in front of the placement equipment. Equipment placing the granular soil shall not execute abrupt turns, stops, or starts nor be permitted to spin tracks or wheels.

C. When placing sand drainage layers on side slopes, the granular soils shall be placed from the bottom of the slope up.

D. Sand drainage layers shall be placed in such a manner to avoid progressive accumulation of slack in geosynthetic materials in front of the soil layer. Placement of granular soil layers shall be suspended when thermal expansion creates excessive slack in the geosynthetic material. The Contractor shall plan his operations to utilize cooler periods of the day for spreading granular soil layers over synthetic membranes as necessary.

E. The completed surface of the granular soil layers shall be static rolled with a smooth drum or pneumatic tired roller to provide a smooth, firm surface for subsequent layers. No vibratory rolling shall be employed. Rolling maybe omitted on steeper side slopes if so directed by the Engineer.

3.06 GEOTEXTILE FILTER FABRIC INSTALLATION

A. Geotextile Filter Fabric shall be installed at the various locations shown on the Drawings and in accordance with the requirements of the manufacturer and these Specifications. In the event of a conflict between the requirements of this Specification and the manufacturer's recommendation, the more stringent requirement shall be assumed to apply unless otherwise directed by the Engineer.

B. Geotextile Filter Fabric shall be protected from exposure to sunlight during transport and storage. At the time of installation, the fabric shall be free of rips, holes, or other defects or damage.

C. The subgrade for the Geotextile Filter Fabric shall be smooth and free of rocks, stones, sticks, roots, sharp objects or other debris.

D. Anchor trenches for the Geotextile Filter Fabric shall be provided as shown on the Drawings.

E. The Geotextile Filter Fabric shall be placed over the prepared subgrade in such a manner as to minimize disturbance of underlying materials. Adequate anchorage, sand bags, or other approved measures shall be provided to prevent uplift of or damage to the Geotextile Filter Fabric. Any portion of the Geotextile Filter Fabric damaged during installation shall be removed and replaced or repaired as directed by the Engineer.

F. Tears, holes, punctures or other defects in the Geotextile Filter Fabric shall be repaired by an overlying patch of Geotextile Filter Fabric material. The patch shall extend a minimum of 12 inches beyond the edge of the defect.

END OF SECTION

SECTION 02275

RIPRAP

PART I - GENERAL

1.01 SECTION INCLUDES

A. Riprap

1.02 RELATED SECTIONS

A. Section 02200 - Earth Materials

1.03 QUALITY ASSURANCE

A. Control of gradation shall be by visual inspection.

B. The Contractor shall provide at the locations specified a mass of rock meeting the gradation for the class specified.

C. The sample at the construction site may be a part of the final riprap, providing the rock has not been damaged and meets all requirements.

D. At the quarry an additional sample shall be provided. These samples shall be used as a frequent reference for judging the gradation of the riprap supplied.

E. Any difference of opinion between the Engineer and Contractor shall be resolved by dumping and checking the gradation of two random loads of stone. Mechanical equipment, a sorting site and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost to the owner.

PART II - PRODUCTS

2.01 RIPRAP

A. Riprap in drainage swales:
   1. Stone used for riprap shall be hard, durable, angular in shape, resistant to weathering and meeting gradation requirements specified.
   2. Neither breadth nor width of a single stone shall be less than one third of its length.
   3. Rounded stones or boulders will not be accepted unless authorized by special provisions.
   4. Stones shall be free from overburden, spoil, shale and organic material.

5. At least 75 percent of the volume shall consist of stones weighing at least 200 pounds each.
6. The remainder of the stones shall be so graded that when placed with the larger stone a compact mass will result.

B. Stones shall meet the following gradation requirements:

Size of Stone	Maximum Percent of Total Weight Smaller Than Given Size
500 lbs.	100
400 lbs.	100
300 lbs.	100
200 lbs.	50
25 lbs. (no more than 5% by weight shall pass a 2-inch sieve)	10

C. Geotextile Filter Fabric: Non-biodegradable and woven material as specified in Section 02200.

PART III - EXECUTION

3.1 EXAMINATION

A. Verify that the surface has been properly prepared to receive riprap.

3.2 PLACEMENT

A. Stone shall be placed or dumped as appropriate upon an approved bed to the lines and grades shown on the plans.

B. The larger stones shall be securely bedded and laid so the exposed surfaces will be approximately parallel to and within 3 inches of the grades shown on the plan.

C. The larger stones shall be placed as closely together as possible through out the surface.

D. The finished product shall present a container and uniform surface of stone work.

END OF SECTION

SECTION 02720

STORMWATER SYSTEMS

PART I - GENERAL

1.01 DESCRIPTION OF WORK

A. The scope of work under this section includes the furnishing of all labor, equipment, materials and appurtenances, and performing all operations required for the installation and construction of stormwater management facilities as shown on the Drawings and specified herein to include, but not be limited to:

1. Furnishing and installation of storm drain piping, including trench excavation and backfill.
2. Construction of end walls, outlet structures and other appurtenances as shown on the Drawings.
3. Excavating, filling, compacting and grading to construct stormwater sedimentation/detention basins as shown on the Drawings.

B. The Contractor shall coordinate installation of stormwater facilities with all earthwork and related work. Coordinate work with that of all other sections affecting, or affected by the work of this section.

C. Related work specified elsewhere includes, but is not limited to:

1. Section 02200 – Earthwork
2. Section 02275 – Rip Rap

1.02 QUALITY ASSURANCE

A. Codes and Standards: Comply with all rules, regulations, laws and ordinances of the Commonwealth of Massachusetts, and of all other governing authorities having jurisdiction.

B. Observation and Testing: Quality Control/Quality Assurance testing and observation shall be accomplished as specified in Section 01400 - Quality Control/Quality Assurance.

C. Neither the presence of Owner's representative(s), nor any observations and testing performed by the Engineer shall excuse the Contractor from defects discovered in his work.

1.03 SUBMITTALS

A. The Contractor shall provide minimum 50 pound samples of all off-site borrow, earth and crushed stone materials.

B. Concrete mix data shall be submitted as required herein.

C. Submittals will be reviewed within fifteen (15) working days. Contractor will not proceed with installation of submitted items until approved by the Engineer.

1.04 JOB CONDITIONS

A. Site Information
1. Information on the Contract Drawings and in the Specifications relating to subsurface conditions, existing utilities and structures is from the best sources presently available. Such information is furnished only for the information and convenience of the Contractor and the accuracy and completeness and this information is not guaranteed. It is expressly understood that the Engineer and the Owner will not be responsible for interpretations or conclusions drawn by Contractor.
2. Plans, surveys, measurements and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period, as no additional compensation will be made for errors and inaccuracies that may be found therein. By submitting a bid, the Contractor affirms that he has carefully examined the site, all available information pertinent thereto, and all conditions affecting work under this section.

B. Presence of Solid Waste and Combustible Gas
1. The Contractor is alerted that, due to the past use of portions of the site as a solid waste landfill, materials constituting a solid waste under applicable Massachusetts law may be encountered in excavations.
2. The Contractor is also alerted that combustible gas may be generated in the former landfilled materials and that such combustible gas may be encountered in excavations and may collect in manholes, piping, or other enclosed spaces. The Contractor shall take all necessary precautions to guard against explosive hazards where combustible gas is present. Such precautions shall include, but not be limited to monitoring for the presence of combustible gas, the use of non-sparking tools, and the elimination of ignition sources in the presence of explosive concentrations of combustible gas.
3. It is solely the Contractor's responsibility to maintain the health and safety of his workers.

C. Protection of Persons and Property
1. The work shall be executed in such a manner as to prevent any damage to adjacent property and any other property and existing improvements.

2. In the case of any damage or injury caused in the performance of the work, the Contractor shall, at his own expense, make good such damage or injury to the satisfaction of, and without cost to, the Engineer or the Owner.
3. Barricade open excavations occurring as part of this work and post with warning lights. Operate warning light during hours from dusk to dawn each day and otherwise as required.
4. The Contractor is solely responsible for compliance with applicable federal and state occupational health and safety laws and regulations.

1.2 LAYOUT AND GRADES

A. Lay out all lines and grade work not presently established at the site in accordance with Drawings and Specifications. Established permanent bench marks determined by a Registered Land Surveyor. Maintain all established bounds and bench marks and replace as directed any which are destroyed or disturbed.

PART II - PRODUCTS

2.01 STORM DRAINAGE PIPING

Storm drainage piping shall consist of the following products, as indicated on the Drawings:

A. <u>Corrugated Polyethylene Pipe with Smooth Inner Liner</u> and fittings shall meet the requirements of ASTM Standard F 892-90 or F 894-89a. Pipe and fittings shall be made of polyethylene compounds which meet or exceed the requirements of Type III, Category 4 or 5, Grade P33 or P34, Class C per ASTM D-1248. The pipe and fittings shall be free of foreign inclusions, cracks, creases, unpigmented or non-uniformly pigmented areas, or other visible defects. Only gasketed fittings shall be used. Fittings supplied by manufacturers other than the manufacturer of the pipe shall not be used. Storm drainage pipe shall not be perforated.

B. <u>Corrugated Polyethylene Pipe</u> and fittings shall meet the requirements of ASTM Standard F 667-85. Pipe and fittings shall be made of polyethylene compounds which meet or exceed the requirements of Type III, Category 4 or 5, Grade P33 or P34, Class C per ASTM D-1248. The pipe and fittings shall be free of foreign inclusions, cracks, creases, unpigmented or non-uniformly pigmented areas, or other visible defects. Only gasketed fittings shall be used. Fittings supplied by manufacturers other than the manufacturer of the pipe shall not be used. Storm drainage pipe shall not be perforated.

2.02 EARTH MATERIALS

A. Earth materials shall be as specified in Sections 02200 - Earthwork unless otherwise specified in this Section.

B. Backfill for stormwater pipes and structures shall be the same as specified for surrounding materials except that backfill within 12 inches of stormwater pipe and structures shall not contain any stone in excess of 3 inches maximum dimension.

C. Rip-Rap shall meet the requirements of Section 02275.

D. Crushed Stone shall consist of durable crushed rock or durable crushed gravel stone, free from ice and snow, clay, loam and organic or otherwise deleterious material and shall conform to the following gradation requirements for the nominal size indicated:

	Percent Passing by Weight	
Sieve Size	**3/4" Nominal Size**	**1-1/4" Nominal Size**
1-1/2"	---	100
1-1/4"	---	90 - 100
1"	100	35 - 70
3/4"	90 - 100	0 - 25
1/2"	20 - 50	0 - 5
3/8"	0 - 20	---
No. 4	0 - 5	---

PART III - EXECUTION

3.01 TRENCH EXCAVATION, PIPE LAYING AND BACKFILL

A. Excavate trenches to the uniform width required for the pipe or structure to be installed and sufficiently wide to provide ample working room. Provide minimum 6 inches clearance. Carry depth of trenches to establish indicated flow lines and invert elevations. Grade bottom of trenches to conform to shape of pipe or structure to provide solid bearing.

B. Excavated materials shall be reused as backfill if suitable for such. Excavated refuse shall be disposed of in the landfill at locations designated by the Engineer.

C. In the case unsuitable bearing, as determined by the Engineer, is encountered at the specified subgrade elevation, the Engineer may direct the removal of the unsuitable material and refill with appropriate materials.

D. Provide sheeting, shoring, bracing or other protective systems as required to assure safety against collapse of earth or rock at sides of excavations; as required for support of adjacent structures, streets or utilities; or as required to comply with Federal, State or Local regulations, codes or ordinances.

E. Provide adequate pumping and drainage of facilities to keep all excavations and work dry from groundwater and/or surface runoff so as to not cause excessive disturbance of underlying ground. Water from trenches and excavations shall be disposed in such a manner as will not cause injury to public health, nor damage to public or private property, existing work or work in progress. The Contractor shall comply with all applicable environmental protection and/or sediment/erosion control regulations.

F. Whenever practical, laying of pipe shall start at the lowest point in the drainage system of pipe run. Immediately before laying the interior surfaces and ends of the sections of pipe shall be cleaned by wiping or other procedures as necessary. Bell and Spigot pipe shall be laid with the bell end upgrade. Joints shall be made up in accordance with the approved manufacturers procedures. Completed pipe lines shall be true to line and grade. Misaligned pipe, leaks, broken pipe or other defects shall be repaired or replaced as directed by the Engineer.

G. Pipes and structures shall be backfilled with specified materials placed in lifts not exceeding nine inches in thickness and each lift compacted to at least 92 percent of maximum dry density as determined by ASTM Method D1557.

3.02 STRUCTURES

A. Catch basins, manholes, endwalls and other drainage structures shall be built to the lines, grades, dimensions and design shown on the Drawings with necessary frames, grating, covers, steps, and appurtenances as shown on the Drawings or specified herein.

B. Frame castings for all drainage structures shall be set in full mortar beds. Frames may be adjusted to grade with course of brick or precast adjusting rings. Maximum adjustment to grade with brick or precast adjusting rings shall be 12 inches.

C. Inlet and outlet pipes shall extend through the walls for a sufficient distance to allow for satisfactory connections. Pipe ends shall be neatly trimmed. Pipe penetrations shall be neatly filed with cement mortar to prevent leakage.

3.2 CONSTRUCTION OF SEDIMENTATION/DETENTION BASINS

A. <u>Sequence of Work:</u> Construction of Sedimentation/Detention Basin shall proceed according to the following sequence:
   1. Establish temporary erosion and sediment controls. Erosion and sediment controls to include, but not limited to, a double row (both silt fence and hay

bale barriers) silt barrier between the work site and adjacent wetlands or watercourses.

2. Excavate as required to achieve grades and as indicated on the Drawings.
3. Install outlet structure and discharge piping.
4. Construct overflow spillways as indicated.
5. Loam and seed basin.
6. Construct drainage works (pipe, endwalls, energy dissipators, etc.) once vegetation is well established in basin.

B. Placement of Fill: Filling shall be in general accordance with requirements of Section 02200 - Earthwork. All fill material placed in conjunction with sediment/detention basin construction shall be granular fill (Section 02200, 2.01.B.) Fill shall be placed in lifts not exceeding twelve inches in thickness. Each lift shall be compacted to at least 95 percent of maximum dry density as determined by ASTM Method D1557. The moisture content of the soil at the time of compaction shall be within 3 percentage points of optimum moisture.

C. Loam (vegetative support material) and seed shall be applied in accordance with the requirements of Section 02900 - Loam and Seed.

END OF SECTION

SECTION 02733

HDPE MEMBRANE

PART I - GENERAL

1.01 DESCRIPTION OF WORK

A. The scope of work under this Section includes the furnishing of all labor, materials equipment and appurtenances; and performing all operations required for the installation and construction of the High Density Polyethylene (HDPE) membrane as shown on the Drawings and specified herein to include, but not be limited to:

1. Installation of the textured HDPE membrane cap, boot penetrations at the gas vent system and stormwater collection system.

B. The Contractor shall coordinate installation of the cap geomembrane with all site preparation grading, and related work. Coordinate work with that of all other Sections affecting, or affected by the work of this Section.

C. Related work specified elsewhere includes, but it not limited to:

1. Section 02200 – Earthwork

1.02 QUALIFICATIONS

A. Installation Contractor:

The subcontractor proposed to perform the geomembrane cap installation shall have demonstrated by previous experience his ability to do the work. The required previous experience shall consist of the following:

1. The Subcontractor shall have successfully installed not less than ten synthetic membrane liners or caps totaling a minimum of 2,000,000 square feet similar to the type specified herein now giving satisfactory service in the United States.
2. The Subcontractor shall have successfully installed at least one liner or cap for similar design requiring a minimum of 200,000 square feet of continuous, flexible, membrane liner.
3. The Subcontractor shall be approved and licensed by the HDPE membrane material suppliers.

B. Membrane Manufacturer

The manufacturer of the HDPE synthetic membrane sheet shall have manufactured, fabricated, and supervised the installation of not less than 2,000,000 square feet of HDPE liners or caps for hydraulic lining installations.

C. Technical Representative

The HDPE membrane manufacturer or his authorized installation Subcontractor shall provide the services of a competent field technical representative throughout the installation of the membrane, all appurtenant structures and soils contacting the membrane following its installation. The field technical representative shall have personally supervised and directed the installation of a minimum of 1,000,000 square feet of HDPE lining or capping material.

1.03 QUALITY ASSURANCE

A. Codes and Standards: Comply with all rules, regulations, laws and ordinances of the Commonwealth of Massachusetts and of all other governing authorities having jurisdiction.

B. Observation and Testing: Quality Control/Quality Assurance testing and observation shall be accomplished as specified in Section 01400 - Quality Control/Quality Assurance.

C. The Engineer's presence shall not include supervision or direction of the actual work by the Subcontractor, his employees or agents. Neither the presence of the Engineer or his representative(s), nor any observations and testing performed by him shall excuse the Contractor from defects discovered in his work.

1.04 SUBMITTALS

A. The Subcontractor shall submit evidence of the qualifications required by paragraph 1.02 of this Section and any other such prequalification data, references, and project experience information.

B. Two prints and one mylar (reproducible) copy of shop drawings shall be submitted to the Engineer for review and shall include, but not be limited to the following:
   1. Panel layout drawings for each synthetic membrane.
   2. Details for sealing penetrations, anchorages, and other fabrications.
   3. Within 30 days of the completion of the work under this Section the Subcontractor shall provide an "as-built" version of the panel layout drawings which shall indicate the location of the all test samples, repairs and the "as-built" panel layout.

C. The Subcontractor shall submit three copies of his proposed Operations Plan/Quality Control manual for this project. The Operations Plan shall describe, in detail, the

Subcontractor’s proposed method of completing liner system work to include: sequence of construction; welding and seaming equipment and techniques; methods of deploying materials; proposed equipment; method of protecting against wind damage; dewatering and drainage measures; erosion and sediment control measures; and material storage and handling. The Quality Control manual shall describe, in detail, the Subcontractor’s proposed methods for complying with the requirements of Section 01400 - Quality Control/Quality Assurance.

D. The Subcontractor shall submit samples and manufacturers data for all manufactured products proposed for use in the base liner system. Sufficient information shall be provided to allow determination of whether the proposed product meets the requirements specified herein.

E. Quality Control test data generated by the Subcontractor shall be submitted to the Engineer as such data is generated.

F. Submittals will be reviewed within fifteen (15) working days. Subcontractor will not proceed with installation of submitted items until approval by the Engineer.

PART II - PRODUCTS

2.1 Geomembrane Sheet for use as cap barrier layer shall be textured High Density Polyethylene (HDPE) geomembrane manufactured by GSE of Houston, Texas, or approved equal and meets the following requirements:

Property	Test Method	Textured Membrane
Thickness (mils)	ASTM D 5994	40 (min.)
Density (g/cm^3)	ASTM D 1505	0.940 (min.)
Melt Flow Index (g/10 minutes)	ASTM D 1238	$\leq$ 1.0
Tensile Properties	ASTM D6693	
Tensile Strength Yield (lbs./in.)		84 (min.)
Tear Resistance Initiation (lbs.)	ASTM D1004	28 (min.)
Dimensional Stability (percent change)	ASTM D1204 NSF Mod.	$\pm$ 2 (max)
Permeability (cm/sec)	ASTM E96	$1x10^{-11}$ (max.)
Resistance to Soil Burial (% change)	ASTM 3083 NSF Mod.	10 min

Property	Test Method	Textured Membrane
Puncture Resistance (lbs.)	ASTM D4833	72
Carbon Black Content (%)	ASTM D1603	2.0
Carbon Black Dispersion (rating)	ASTM D5596	Category 1 or 2

A. Geomembrane sheet shall consist of high density polyethylene with no more than three percent (3%) by weight additives, fillers or extenders. The geomembrane sheet shall be free of holes, blisters, undispersed raw materials, striations, folds, creases, pinholes, bubbles, or any signs of contamination by foreign matter.

B. Geomembrane sheet shall be provided in a roll width of 15 feet or greater, specified for geomembrane sheet.

PART III - EXECUTION

3.01 GENERAL

A. Cap Liner System installation shall not begin until required site preparation activities to include cutting, filling, compaction, and testing are complete in the area of the proposed cap liner system as specified in Section 02200 - Earthwork. Minimum area to be prepared ahead of the cap installation shall be one phase.

B. The subgrade sand layer shall be prepared.

C. Boot connections shall be made at all landfill gas vent piping and vents and as indicated on the Drawings.

3.02 MEMBRANE LINER INSTALLATION

A. Surfaces on which membrane liners are to be installed shall be smooth and free of ruts, rocks, stones, sticks, roots, sharp objects, debris, or any materials potentially injurious to the membrane. The surface shall provide a firm, unyielding foundation for the membrane with no sudden sharp or abrupt changes or breaks in grade. Standing water or excessive moisture shall not be allowed.

B. Geomembrane installed as shown on the Drawings and in accordance with the requirements of the manufacturer and these Specifications. In the event of a conflict between the requirements of this Specification and the manufacturer's recommendations, the more stringent requirement shall be assumed to apply unless otherwise directed by the Engineer.

C. Required anchor trenches shall be excavated to the line, grade and width shown on the Drawings prior to liner system placement. No more than the amount of trench required for the day's work shall be excavated at one time. Slightly rounded corners shall be provided in the trench to avoid sharp bends in the membrane liner.

D. Geomembrane deployment shall proceed between ambient temperatures of 40°F to 105°F. Placement may proceed beyond this temperature range only if the Contractor can demonstrate to the Engineer that satisfactory seams may be accomplished in accordance with these specifications and the manufacturer's recommendations. Geomembrane liner placement shall not be done during precipitation, in the presence of excessive moisture (e.g. fog, rain, or dew) or in the presence of excessive winds, as determined by the Engineer.

E. The geomembrane material shall be placed over the prepared surfaces in such a manner as to minimize handling. The liner shall neither be placed taunt or so loose that excessive wrinkles or folds develop. The method used to unroll the panels shall not cause scratches, crimps, or creases in the membrane or disturb the underlying materials.

F. Vehicles or equipment shall not travel directly on the geomembrane. No personnel working on the membrane liner shall smoke, wear damaging shoes, or engage in any activity that could damage the membrane liner. Adequate anchorage, sand bags, or other approved measures shall be provided to prevent uplift of or damage to the membrane liner by wind. Any portion of the geomembrane damaged during installation shall be removed or repaired as directed by the Engineer.

END OF SECTION

SECTION 02750

GAS VENT LAYER

PART I - GENERAL

1.01 DESCRIPTION OF WORK

A. The scope of work under this Section includes the furnishing of all labor, materials, equipment and appurtenances, and performing/all operations required for the installation and construction of the gas venting layer, as shown on the Drawings and specified herein to include, but not be limited to:

1. Placement and compaction of a minim of a 6 inch thick gas vent layer.

B. The Contractor shall coordinate installation of the gas venting system with all cap installation and site preparation work, and related work. Coordinate work with that of all other Sections affecting, or affected by the work of this Section.

C. Related work specified elsewhere included, but is not limited to:

1. Section 02200 - Site Clearing
2. Section 02733 - HDPE Membrane

1.02 QUALITY ASSURANCE

A. Codes and, Standards: Comply with all rules, regulations, laws and ordinances of the Town of Attleboro and the Commonwealth of Massachusetts and of all other governing authorities having jurisdiction.

B. Observation and Testing: Quality Control/Quality Assurance testing and observation shall be accomplished as specified in Section 01400 - Quality Control/Quality Assurance.

C. Neither the presence of the Engineer or his representative(s), nor any observations and testing performed by him shall excuse the Contractor from defects discovered in his work.

1.03 SUBMITTALS

A. The Contractor shall submit samples and manufacturers data for all manufactured products proposed for use in the landfill cap. Sufficient information shall be provided to allow determination of whether the proposed product meets the requirements specified herein.

B. Quality Control test data generated by the Contractor shall be submitted to the Engineer as such data is generated.

C. The Contractor shall provide minimum 50 pound samples of all borrow, earth and crushed stone materials not furnished by the owner.

D. Submittals will be reviewed within fifteen (15) working days. Contractor will not proceed with installation of submitted items until approval by the Engineer.

PART II - PRODUCTS

2.01 EARTH MATERIALS

A. Gas Venting Sand shall consist of inorganic sand free from ice, snow, roots, sod, rubbish, debris or other deleterious matter. The material shall not contain sharp angular stone or any other substance potentially injurious to the membrane cap. Drainage layer material shall conform to the following gradation requirements for gas venting sand. Section 02200, 2.01.D as follows:

Sieve Size	Percent Finer by Weight
3/8”	100
No. 4	70 - 100
No. 40	5 - 65
No. 200	0 - 15

In addition, the Gas Venting Sand Material shall have a permeability equal to or greater than 1×10^{-3} cm/sec when compacted to 95 percent of its maximum dry density as determined by ASTM D-1557. Materials satisfying the specified gradation, but not satisfying permeability requirements shall not be used. Materials satisfying permeability requirements but not satisfying gradation requirements may be used at the discretion of the Engineer.

B. All earth materials furnished for use under this Section shall be free of grease, oil, solvents, pesticides and herbicides.

PART III - EXECUTION

3.01 GENERAL

A. Unsuitable materials and excess suitable materials shall be stockpiled or disposed of in the landfill as directed.

B. Specified earth materials which are placed and subsequently disturbed by construction activities or contaminated by mud, silt, clay or organic matter shall be removed and replaced with materials meeting specification requirements.

3.02 GAS VENT LAYER

A. Surfaces which the gas sand layer is to be installed shall be smooth and free of ruts and debris. The surface shall provide a firm foundation for the sand placement with no sudden sharp or abrupt changes or break in grade.

B. Vehicles or equipment shall not travel directly on the gas vent layer. Any portion of the gas vent layer damaged during the subsequent cap installation shall be removed or repaired by the Subcontractor as directed by the Engineer at no cost to the Owner or Engineer.

C. Sand layer shall be place in one 6 inch thick lift. Equipment used for placement of the sand layer shall be subject to the Engineer's approval. Lightweight, low ground pressure equipment is preferred. Tracked machines with deep grousers will not be allowed. The Contractor shall not attempt to push large stockpiles of materials in front of the placement equipment. Equipment placing the soil shall not execute abrupt turns, stops or starts nor be permitted to spin tracks or wheels.

D. The gas vent layer shall be installed continuous with all adjacent layers for adjacent or previously capped areas.

E. The completed surface of the gas vent layer shall be graded smooth and true to line and grade with a minimum of equipment trafficking.

END OF SECTION

SECTION 02900

LOAM AND SEED

PART I - GENERAL

1.01 DESCRIPTION OF WORK

A. The scope of work under this Section includes the furnishing of all labor, materials, equipment and appurtenances, and performing all operations required for the placement of loam and seeding of all slope and cap areas as shown on the Drawings and specified herein to include loaming and seeding of final graded areas and all related work.

B. The Subcontractor shall coordinate site loam and seeding work with that of all other Sections affecting, or affected by the work of this Section.

C. Related work specified elsewhere includes, but is not limited to:
   1. Section 02200 - Earthwork
   2. Section 02720 - Stormwater Systems

D. Maintenance of seeded areas.

1.02 QUALITY ASSURANCE

A. Codes and Standards: Comply with all rules, regulations, laws and ordinances of the Commonwealth of Massachusetts and of all other governing authorities having jurisdiction.

B. Observation and Testing: Quality Control/Quality Assurance testing and observation shall be accomplished as specified in Section 01400 - Quality Control/Quality Assurance.

C. Neither the presence of the Owner or its' representative(s), nor any observations and testing performed by them shall excuse the Subcontractor from defects discovered in his work.

1.03 SUBMITTALS

A. The Subcontractor shall submit manufacturer's information on lime, fertilizer, seed mix and mulch. Subcontractor shall submit information on hydroseeding, equipment and procedures that will be employed.

B. Submittals will be reviewed within seven (7) working days. Subcontractor will not proceed with installation of submitted items until approval by the Engineer.

1.04 JOB CONDITIONS

A. Site Information

1. Plans, surveys, measurements and dimensions under which the work is to be performed are believed to be correct, but the Subcontractor shall be examined them for himself during the bidding period, as no additional compensation will be made for errors and inaccuracies that may be found therein. By submitting a bid, the Subcontractor affirms that he has carefully examined the Site, all available information pertinent thereto, and all conditions affecting work under this Section.
2. It is expressly understood that the Engineer and the Owner will not be responsible for interpretations or conclusions drawn there from by Subcontractor.

B. Protection of Persons and Property

1. The work shall be executed in such a manner as to prevent any damage to adjacent property and any other property and existing improvements.
2. In the case of any damage or injury caused in the performance of work, the Subcontractor shall, at his own expense, make good such damage or injury to the satisfaction of, and without cost to, the Engineer or the Owner.

PART II - PRODUCTS

2.01 TOPSOIL

A. Topsoil will be supplied by the Contractor as specified in Section 02200.

2.02 FERTILIZER AND LIME

A. Fertilizer shall be a commercial fertilizer, grade 10 percent nitrogen, 10 percent phosphorous and 10 percent potash (Grade 10-10-10).

B. Lime shall be ground limestone containing not less than eighty-five percent (85%) calcium and magnesium carbonates.

2.03 GRASS SEED

A. Grass seed shall be from the same or previous year's crop; each variety of seed shall have a percentage of germination not less than 90 percent; a percentage of purity of not less than 85 percent and shall not have no more than 1 percent weed content. Grass seed shall consist of the varieties indicated below substantially in the proportions specified unless otherwise approved by the Engineer.

Variety	Percent Content by Weight
40%	Creeping Red Fescue
35%	Pennant Perennial Ryegrass
15%	Birdsfoot Tree Foil
10%	Landino Clover

B. Grass seed for temporary establishment of vegetative cover over stockpiles and as otherwise directed by the Engineer shall be a mixture of annual and perennial Ryegrass subject to approval by the Engineer.

C. The grass seed shall be furnished and delivered premixed in the proportions specified. A supplier's certificate of compliance to the specified mix shall be provided indicating the guaranteed percentages of purity, weed content and germination of the seed.

2.03 MULCH

A. Mulch for use in hydroseeding applications shall be a specially processed cellulose fiber containing no growth or germination inhibiting factors. It shall be manufactured such that, after addition and agitation in slurry tanks with water, the fibers become uniformly suspended to form a homogenous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture.

PART III - EXECUTION

3.01 GENERAL

A. Seeding, mulching and conditioning shall only be performed during those periods and within the seasons which are normal for such work as determined by the prevailing weather and locally accepted practice, as approved by the Engineer.

In general, those seasons are from April to end of June and from late August to mid-October.

B. Fertilizing, liming, seeding and mulching shall normally be accomplished in one operation by hydraulic application (hydroseeding). Separate hand or mechanical application of fertilizer, lime, seed, and mulch shall be employed only for small areas and repairs.

C. Application rates shall be as follows:

1. Lime:
   Powdered: 50 pounds per 1,000 square feet
   Pelletize: 15 pounds per 1,000 square feet
2. Fertilizer: 15 pounds per 1,000 square feet
3. Seed: 4 pounds per 1,000 square feet, minimum
4. Fiber Mulch: 20 pounds per 1,000 square feet, minimum

Lime application may be reduced on the basis of soil test which indicate that a lesser amount is required.

D. Seeding shall be done within five days following surface preparation. The hydroseeding equipment shall be so designed that when the mixture is sprayed over an area the required application rates are uniformly achieved.

E. Immediately following hydroseeding, the topsoil surface shall be lightly tracked with one pass of a low ground pressure dozer to "set" the seed and mulch and leave grouser impressions to reduce surface erosion. Tracking shall be up and down on slopes, not laterally.

F. All seeded areas shall be kept watered and in good condition, reseeding if and when necessary, during the entire construction period. This will include furnishing pumps, pipe and labor to accomplish adequate watering.

G. Seeded areas shall be protected against washout by the use of silt fences, hay bales or other methods necessary. Any washout which occurs shall be regraded and reseeded.

H. The vegetative cover and supporting vegetative layer shall be maintained for one year after construction including repairing of erosion, reseeding, watering and mowing at least three times during the growing season.

END OF SECTION

SECTION 02961

GAS COLLECTION HEADER SYSTEM

PART I - GENERAL

This section includes the furnishing of all labor materials, equipment and appurtenances, and performing all operations required for the installation and construction of the gas collection header system and pipe material necessary to connect each of the gas collection wells to the gas collection header system and to the gas venting structure as shown on the Drawings and specified herein to include, but not limited to:

1. Furnishing and installation of 4-inch perforated HDPE gas collection header system including all pipe materials, fittings and appurtenances;

3. Furnishing and installation of nine -4 -inch PVC"goose-neck" gas venting structure.

1.01 SECTION INCLUDES

A. Pipe and fittings for gas collection header system.

B. Pipe and fittings for gas venting structure.

C. Backfill material.

1.02 RELATED SECTIONS

A. Section 02200 - Earth Materials.

B. Section 02733 – HDPE Membrane

C. Section 02750 – Gas Vent Layer

1.03 REFERENCES

A. ASTM F-714 - Pipe Standard.

B. ASTM D3261 - Fittings Standards.

C. ASTM D3350 - PE345434C - Cell Classification.

D. ASTM D1248 - Type III Class C Category S. Grade P34.

E. EPA 9090.

F. PE3408 - PPI Designation.

G. NSF - Listed Standard #14 (by size, per order).

H. CGSB41 - GP 23M - Pipe Standard.

I. AWWA CG01 - Potable Water Pipe and Tubing.

J. The backfill material shall consist of suitable material uniformly distributed and thoroughly compacted.

K Fill type as specified in Section 02200.

1.04 SUBMITTALS FOR REVIEW

A. Product Data: Provide data indicating pipe and pipe accessories.

1.05 SUBMITTALS FOR INFORMATION

A. Manufacturer's Instructions: Indicate special procedures required to install Products specified.

B. Certificates: Certify that products meet or exceed specified requirements.

1.06 SUBMITTALS AT PROJECT CLOSEOUT

A. Record location of pipe runs, connections, and invert elevation.

1.07 REGULATORY REQUIREMENTS

A. Contractor must comply with all applicable federal, state and local regulations during the completion of work in this section.

PART II - PRODUCTS

2.01 PIPE MATERIALS

All collection line and header system piping is to be HDPE pipe; or approved equal.

A. Pipe –ASTM F-2619, High Density Polyethylene, inside nominal diameter 4 inches.

B. Fittings - Same material as pipe molded or formed to suit pipe size and end design in required tees, bends, elbows, cleanouts, reducers, traps and any other configurations required. All fittings and accessories shall be manufactured and furnished by ADS or approved equal and have bell and/or spigot configurations comparative with material of the pipe.

2.02 GAS VENTING STRUCTURE

A. Gas Venting Structure – 4-inch PVC solid, or approved equal, core wall pipe with “goose-neck” vent.

PART III - EXECUTION

3.01 EXAMINATION

A. Verify dimensions and elevation are as indicated on drawings.

3.02 PREPARATION

A. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling.

3.03 INSTALLATION

A. Install pipe, fittings, and accessories in accordance with manufacturer's instructions.

B. Lay pipe on 40 mil HDPE membrane at locations shown on Drawings.

C. Install bedding at sides and over top of pipe. Do not damage or displace pipe when placing backfill.

D. Where noted on Drawings, the Contractor is responsible for connecting the solid HDPE pipe to the gas vents. The use of excessive force or blunt instruments is prohibited in connecting the gas collection pipe to the gas vents.

3.04 FIELD QUALITY CONTROL

A. Request inspection prior to and immediately after backfilling.

B. Compaction testing will be performed in accordance with ASTM D 1557.

C. Moisture content testing will be performed in accordance with ASTM D 1557.

D. Pressure and vacuum testing of header system.

E. Contractor shall be considerate of the potential for a release of gaseous methane vapors; and must take all precautions to avoid accidents resulting in the release of gasses into the environment.

3.05 PROTECTION OF FINISHED WORK

A. Protect pipe and cover from damage or displacement until final backfilling operation is completed.

END OF SECTION

Appendix E

Health and Safety Plan

HEALTH AND SAFETY PLAN
FORTHE
ATTLEBORO LANDFILL, PHASE B CLOSURE ACTIVITIES
ATTLEBORO, MASSACHUSETTS

Prepared by

Richard R. DeBenedictis, P.E.
57 Sanderson Drive
Plymouth, MA

July 27, 2018

HEALTH AND SAFETY PLAN
FORTHE
ATTLEBORO LANDFILL, PHASE B CLOSURE ACTIVITIES
ATTLEBORO, MASSACHUSETTS

Table of Contents

HEALTH AND SAFETY PLAN
FOR THE
ATTLEBORO LANDFILL, PHASE B CLOSURE ACTIVITIES
ATTLEBORO, MASSACHUSETTS

1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been developed for use in the implementation of closure activities at the Phase B portion of the Attleboro Landfill, Inc facility in Attleboro, Massachusetts. This type of activity is included under the jurisdiction of the Occupational Safety and Health Act (OSHA) regulations codified at 29 CFR 1910. The purpose of this HASP is to establish site specific health and safety requirements to be followed by Richard R. DeBenedictis and his employees and/or subcontractors as well as Enviro-Cycle, LLC representatives and site contractors in completeing activities necessary to complete Phase B site closure for this project.

1.1 Site Description

The Attleboro Landfill is a 55-acre facility that was used for solid waste disposal since the early 1940's. The City of Attleboro operated an open dump on the property from the 1940's until 1975. From 1975 to 1995, Attleboro Landfill, Inc. operated a sanitary landfill on 32 of the 55 acres (Phase A); that area has been closed and capped. The remaining area (Phase B), which is the remainder of the City's open dump, has about 9.9 acres of waste disposal area that needs to be capped. The Phase B area is referred to herein as the "Site".

1.2 Project Description

This Corrective Action Design (CAD) has been prepared by Richard R. DeBenedictis for the Department of Environmental Protection's (MassDEP) approval of the final closure construction of Phase B of the Attleboro Landfill (Landfill). The CAD seeks the approval of the use of Re-Crete for grading and shaping the site to achieve final grades for the Landfill, under the DEP's July 6, 2001 Revised Guidelines for Determining Closure Activities at Inactive Unlined Landfill Sites (Unlined Landfill Policy). The materials that are to be accepted at the facility and the methods of accepting and screening the materials are described in Section 3.0 Materials Management Plan of the CAD.

2. Description of Work

Various activities will be completed at the site as part of site closure. The activities are in three man categories consisting of Site Assessment, Re-Crete Placement and Final Capping. Specific work items for each activity include but are not limited to:

A. Site Assessment
    a. Groundwater and surface water sampling
    b. Soil Gas sampling (including gas well installation)
    c. Confirmatory Test Pits
B. Re-Crete Placement
    a. Re-Crete grading and shaping
    b. Construction Oversight By Engineer
C. Final Capping
    a. Cap Construction
    b. Stormwater Controls
    c. Construction Oversight by Engineer

3. Project Organization

Oversight of the project is as at the direction of:

Mr. Richard R. DeBenedictis, P.E.
Project Engineer/Health and Safety Coordinator
(781) 249-9435

Contractors working at the Site will be required to review this HASP and then to prepare a site specific HASP for their employees to follow when completing activities within their responsibility. The individual contractors HASPs will be submitted to the H&S Coordinator prior to working at the Site.

The Health & Safety Coordinator can be consulted for health and safety advice and guidance as the project proceeds. The HASP was prepared by staff familiar with the Site-specific project aspects and reviewed by the above-listed Health & Safety Coordinator. In addition, any project-related injuries or accidents shall be reported to the Health & Safety Coordinator within 24 hours of occurrence.

4. Project Staff

All personnel are responsible for their personal health and safety and that of their colleagues, and must adhere to the procedures established in this plan. Personnel shall maintain an awareness of site conditions and exercise sound judgment when confronted with an unsafe and/or (potentially) hazardous condition. If the procedures identified in this HASP do not address an unsafe and/or (potentially) hazardous condition present at the project Site, then they shall follow a safe course of action and contact their individual Health & Safety Coordinator as well as the Project Engineer/ Health & Safety Coordinator.

5. Hazard Evaluation and Control

During construction activities, personnel have the potential to experience varying weather conditions (temperature and wind variations), trip and fall conditions, and levels of methane gas above the Lower Explosive Limit of five (5) percent (%) by volume of methane. During monitoring, if the concentration of methane reaches 10% of the Lower Explosive Limit (LEL), workers will cease activities and allow methane concentrations to subside before construction activities continue. Employees should dress appropriately (Level D) including safety glasses, steel-toe boots, and outerwear consistent with the anticipated temperatures. All personnel should wear a hardhat when working.

6. Monitoring/Contaminants of Concern

Based on the past use of the site, the main contaminant of concern is methane gas resulting from degradation of previously placed waste material. Most often, methane is accompanied by other gases (mercaptans) that have a distinctive smell at very low odor thresholds so on-site workers will be instructed to be alert for these odors as they may indicate the presence of other gases. Ambient air quality will be monitored on a scheduled basis at the excavation work area and in the immediate vicinity of personnel who are conducted soil screening activities. Air quality will be monitored for hydrogen sulfide (H2S) during Re-Crete placement and Final Capping activities. During any subsurface investigative activities (i.e., gas well installation, test pits) air quality will be monitored for Lower Explosive Limit (LEL), oxygen (O2), hydrogen sulfide (H2S) and total volatile organic compounds (VOCs).

Further information regarding methane, hydrogen sulfide and volatile organic compounds is summarized in the table below.

Contaminant	Physical	OSHA PEL	Exposure	Signs/ Symptoms of
Methane	Colorless, odorless,	1,000 ppm over	Inhalation	Suffocation
Hydrogen Sulfide	Colorless gas with a strong odor of rotten eggs.	20 ppm over an 8 hour period	Inhalation	Eye and breathing irritation

Volatile Organic Compounds	any chemical compound based on carbon chains	> 5 ppm in breathing zone sustained for 30 seconds	Inhalation	sensory irritation symptoms

Personnel should adhere to the following safe work practices:

Avoid open flames and sparks

Avoid closed systems

Other Physical Hazards

Wet weather conditions can present slip, trip, and fall hazards. Springtime conditions could also involve bee and tick bites. Roadway vehicular traffic and other vehicles can potentially contact personnel and equipment, and can impair visual communications. Employees shall carefully observe walking surfaces in their work areas and equipment shall be inspected prior to use to assess that it is safe and in good operating condition.

7. Communication Methods

Site personnel shall have ready access to a mobile telephone or other means of communication (e.g., cellular telephone, two-way radio) for external emergency contact purposes during work activities.

8. Personal Protective Equipment

Personal protective equipment (PPE) will be used when necessary to reduce exposures to worksite hazards. PPE is used when engineering and/or work practice controls cannot eliminate or minimize the hazard to an acceptable safe level. Optional items are identified but may become mandatory PPE as site hazard conditions change.

Level D protection shall be used during site activities. This PPE has been selected based on hazards associated with scheduled work activities and anticipated site conditions. Level D protection includes the mandatory use of the following PPE:

American National Standards Institute (ANSI) approved safety glasses with side shields

Steel-toed safety shoes

Traffic safety vests as required

Nitrile gloves

Hard hats (not required level D protection, but must be used during all drilling operations)

The following are required equipment for on-site activities but are not PPE or Level D requirements:

Travel first aid kits

If action levels described in section 5 are exceeded, the site will be evacuated and appropriate additional PPE will be donned (Level C protection).

9. Training

Personnel conducting site work shall be instructed by the Health and Safety Coordinator regarding the precautions that must be taken. Site employees will be provided with a copy of this HASP. Site employees are expected to thoroughly read and understand information contained in the HASP prior to conducting site activities.

10. Site Control Measures

a. General Control Measures

The following general site control measures shall be implemented personnell working on this project:

The work area shall be carefully assessed for safety hazards prior to conducting work. Visibly contaminated areas should be avoided when possible.

No eating, drinking, or smoking is allowed in the work areas.

Chemicals brought to the work area shall be properly stored and labeled.

b. Safety Briefings

The Health and Safety Coordinator shall conduct a site safety briefing before starting field activities or as tasks and/or site conditions change.

Site safety briefings will consist of a general discussion of the HASP, site-specific hazards, location of work zones, PPE requirements, equipment, special procedures, emergency procedures, and any other pertinent health and safety information.

c. Worksite Set Up

When setting up the worksite, employees shall review these procedures. However, based on location, a work set-up zone as described may not be necessary. Therefore, portions of the section will be used as appropriate:

- Secure area from unauthorized entry by erecting traffic cones around work zone and placing warning tape.
- Establish decontamination procedures.
- Utilize access control at the entry and exit from the work zone.
- Establish on-site communications, as appropriate.These consist of line-of-sight signals, hand signals, and verbal communication.
- Establish emergency signals, as appropriate. Establish a "buddy system."
- Establish procedures for disposal of waste materials generated on site.

The Health and Safety Coordinator will conduct periodic assessments of work practices to evaluate the effectiveness of this HASP, as necessary. Deficiencies in personnel adherence to work practices identified in this HASP will immediately be corrected. Deficiencies in the HASP itself will be corrected by the Health & Safety Coordinator prior to implementation.

Personnel shall wash hands and other affected body parts with soap and water prior to breaks, when leaving the site, and when potentially contaminated equipment/material comes in direct contact with the skin.

Wastes (e.g., PPE – gloves, safety glasses, etc.) generated from decontamination activities shall be bagged and properly disposed.

11. Emergency Response

a. Pre-Planning Activities

The On-Site Coordinator shall perform the following pre-planning activities prior to the initiation of field activities:

- Locate nearest telephone to the work site and assess on-site communications. Identify chemical and safety hazards.
- Confirm emergency telephone numbers and route(s) to hospital.
- Review project plan for anticipated site conditions, any alterations in on-site operations, and personnel availability.
- Ensure that project team has travel first aid kit and portable eyewash. Check site emergency equipment operational status and supply inventory.
- Locate emergency information (e.g., evacuation routes) and designated assembly point on site map.

- Assemble emergency contact, hospital route, evacuation route, and assembly point information.

Emergency pre-planning information is detailed in Attachment A of this HASP.

b. Evacuation Procedures

In the event of an emergency at the worksite, personnel will immediately evacuate the work area and proceed to the designated assembly point (the on-site maintenance garage at Peckham Street). Site personnel shall then begin notifying appropriate emergency contacts as identified in this HASP.

c. Medical Emergencies

The following procedures shall be implemented by employees in the event of a medical emergency:

- Stop field work activities.
- Summon assistance (on and off site), as necessary.
- Prevent further injury and maintain personal safety.
- If the scene is safe, and if trained in and comfortable with performing first aid tasks, initiate first aid, as appropriate.
- Supply medical providers with information about the accident/incident.
- Notify the Project Manager and the Health & Safety Coordinator of the accident/incident.

d. Accident/Incident Reports

The On-Site Coordinator shall complete an Incident Report Form as soon as possible, but no later than 24 hours, after any accident/incident occurrence. Copies of these forms shall be sent to the Health & Safety Coordinator and the Human Resources Manager.

12. Plan Approval

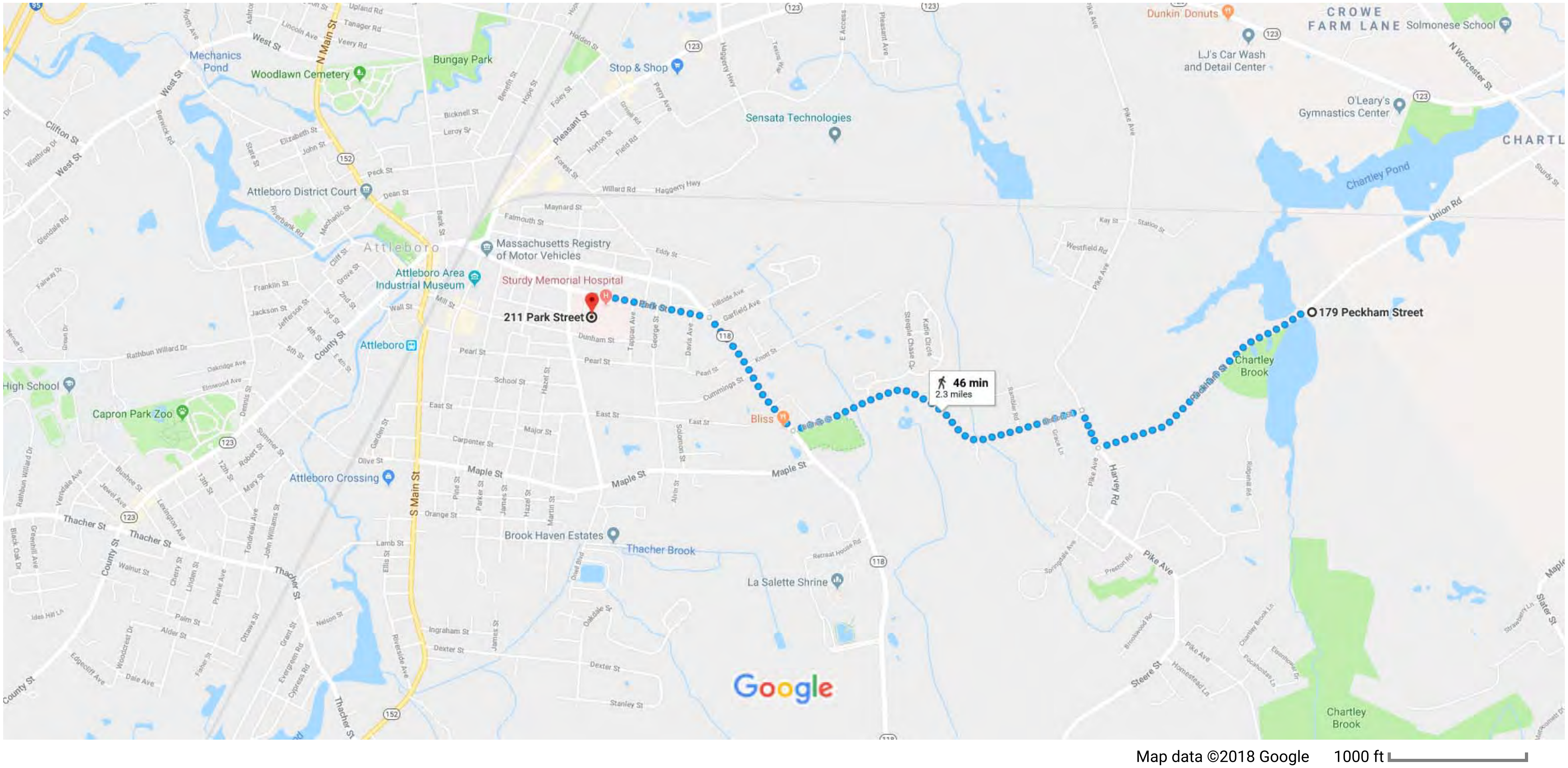
This Health and Safety Plan (HASP) for the Attleboro Landfill, Phase B Closure Activities project has been written for use by Project Engineer employees. Richard R. DeBenedictis claims no responsibility for its use by others, unless specified and defined in project or contract documents. This HASP is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if these conditions change.

ATTACHMENT A

EMERGENCY PRE-PLANNING INFORMATION

Nearest Telephone:	Cell phone
Chemical and Safety Hazards Not Covered in General HASP:	None
Utility Clearance Permit Number:	
Emergency Telephone Numbers:	
Local Police:	911
Fire Department:	911
Ambulance:	911
State Police (Foxboro, MA)	(508) 543-8550
Hospital (Sturdy Memorial Hospital)	(508) 222-5200
Project Health & Safety Coordinator/Project Manager:	Richard R. DeBenedictis, P.E.
Directions from Site to Hospital: Sturdy Memorial Hospital Emergency Care Center 211 Park St, Attleboro, MA 02703 See Attached Map and Driving Directions	

Google Maps 179 Peckham St, Attleboro, MA 02703 to 211 Park St, Attleboro, MA 02703 Walk 2.3 miles, 46 min



179 Peckham St

Attleboro, MA 02703

⚠ Use caution–walking directions may not always reflect real-world conditions

1. Head southwest on Peckham St toward Pike Ave

0.7 mi

2. Turn right onto Pike Ave

0.1 mi

3. Turn left onto Bishop St

0.9 mi

4. Turn right onto Park St

0.4 mi

5. Slight left to stay on Park St

0.3 mi

211 Park St

Attleboro, MA 02703

ATTACHMENT B

EMPLOYEE HASP REVIEW SIGNATURE SHEET

"By signing this form, I verify that I have been provided with a copy of this HASP, and have read it. I understand and agree to abide by the provisions of this HASP."

EMPLOYEE NAME (print)	EMPLOYEE SIGNATURE	DATE

Appendix F

HELP Model Calculations

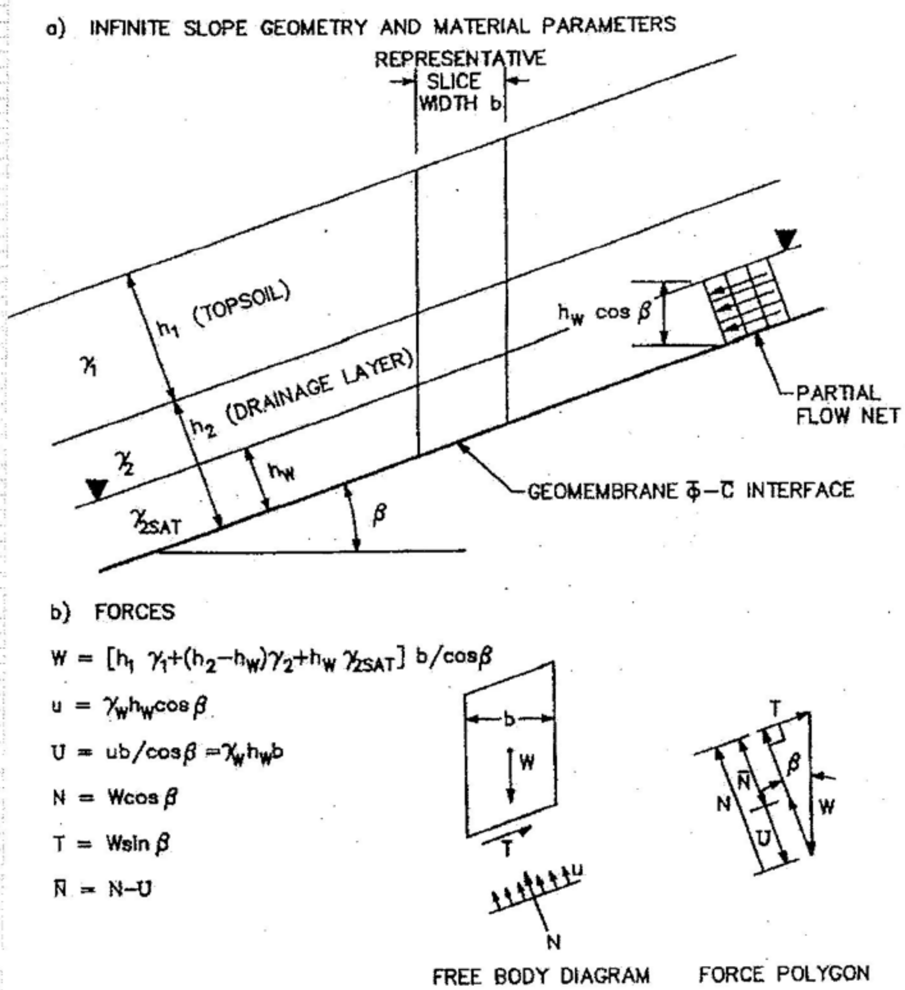
Richard R. DeBenedictis, P.E.
57 Sanderson Drive
Plymouth, MA 02360

Project: ALI - PHASE B
Calc. By: RSC
Date: 9/24/18

- PHASE B - SIDESLOPE STABILITY ANALYSIS

THE FOLLOWING CALCULATIONS ARE BASED ON THE METHODOLOGY PRESENTED IN THE PUBLICATION "GEOSYNTHETIC LANDFILL COVER DESIGN METHODOLOGY AND CONSTRUCTION EXPERIENCE IN THE PACIFIC NORTHWEST" by THIEL & STEWART-1993

DIAGRAM FROM THIEL & STEWART:



WHERE:

γ_1 = SATURATED UNIT WT. OF TOPSOIL = 120 pcf.

γ_2 = MOIST UNIT WT. OF DRAINAGE LAYER = 115 pcf

γ_{2SAT} = SATURATED UNIT WT. OF DRAINAGE LAYER = 120 pcf

γ_W = WT. WATER = 62.4 pcf

ϕ = EFFECTIVE FRICTION PARAMETER FOR SHEAR STRENGTH AT BASE OF DR. LAY

c = EFFECTIVE COHESION PARAMETER FOR SHEAR STR. AT BASE OF DR. LAYER

β = SLOPE ANGLE = 18.4° (3:1 SLOPE)

h_1 = TOPSOIL THICKNESS = 9 in.

Richard R. DeBenedictis, P.E.

57 Sanderson Drive

Plymouth, MA 02360

WHERE:

h_2 = THICKNESS OF DRAINAGE LAYER = 12 INCH

h_w = AVG. HT. OF WATER IN DRAINAGE LAYER = $\frac{MAX}{2} = \frac{4.828}{2} = 4.14''$

CALCULATE MIN. FRICTION ANGLE TO ACHIEVE FACTOR OF SAFETY OF 1.5 -

ASSUME C = 0 (NO COHESION IN COVER SOIL - WORST CASE)

F.S. = 1.5

$$F.S. = \frac{c + (h_1 \gamma_1 - h_w \gamma_w) \cdot \tan\phi}{(h_1 \cdot \gamma_1) \tan\beta}$$

$$\phi = \tan^{-1}\left[\frac{F.S. \cdot (h_1 \gamma_1) \cdot \tan\beta - C}{h_1 \gamma_1 - h_w \gamma_w}\right]$$

$$= \tan^{-1}\left[\frac{1.5 \cdot (\frac{9}{12} \cdot 120) \cdot \tan(18.4^\circ) - 0}{(9/12 \cdot 120) - (\frac{4.12}{12} \cdot 62.4)}\right]$$

$\phi = 33.21^\circ$

```
↑
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\DATA4.D4
TEMPERATURE DATA FILE:      C:\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\DATA10.D10
OUTPUT DATA FILE:           C:\ali 2.OUT


TIME:  15:30     DATE:   8/30/2018


******************************************************************************

     TITLE:  ALI Ph B Plateau

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
            COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                         TYPE 1 - VERTICAL PERCOLATION LAYER
```

```
              MATERIAL TEXTURE NUMBER   6
THICKNESS                   =      9.00   INCHES
POROSITY                    =      0.4530 VOL/VOL
FIELD CAPACITY              =      0.1900 VOL/VOL
WILTING POINT               =      0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.2326 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.720000011000E-03 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
       FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                         LAYER  2
                         --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   1
THICKNESS                   =     12.00   INCHES
POROSITY                    =      0.4170 VOL/VOL
FIELD CAPACITY              =      0.0450 VOL/VOL
WILTING POINT               =      0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0931 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC
SLOPE                       =      5.00   PERCENT
DRAINAGE LENGTH             =     70.0    FEET


                         LAYER  3
                         --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.00   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      0.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      0.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  4 - POOR
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER	=	74.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	10.870	ACRES
EVAPORATIVE ZONE DEPTH	=	9.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.094	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.077	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.765	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	3.210	INCHES
TOTAL INITIAL WATER	=	3.210	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BOSTON MASSACHUSETTS

STATION LATITUDE	=	42.37	DEGREES
MAXIMUM LEAF AREA INDEX	=	1.00	
START OF GROWING SEASON (JULIAN DATE)	=	118	
END OF GROWING SEASON (JULIAN DATE)	=	295	
EVAPORATIVE ZONE DEPTH	=	9.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	12.50	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	62.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	65.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	68.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BOSTON MASSACHUSETTS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.99	3.70	4.13	3.73	3.52	2.92

2.68	3.68	3.41	3.36	4.21	4.48

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BOSTON MASSACHUSETTS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
29.60	30.70	38.40	48.70	58.50	68.00
73.50	71.90	64.60	54.80	45.20	33.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BOSTON MASSACHUSETTS
AND STATION LATITUDE = 42.37 DEGREES

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.11	4.09	2.71	2.70	2.90	3.00
	2.69	2.78	4.69	1.63	6.27	3.11
RUNOFF	0.329	0.577	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.623	1.224	2.653	2.158	2.107	3.039
	3.137	2.468	3.302	0.986	2.203	1.306
LATERAL DRAINAGE COLLECTED	0.8123	1.9266	2.2083	0.8374	0.1517	0.0073

FROM LAYER 2	0.0011	0.0170	1.2375	0.1815	3.3665	1.8200
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000
LAYER 3	0.0000	0.0000	0.0001	0.0000	0.0001	0.0001

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.649	1.703	1.764	0.691	0.121	0.006
TOP OF LAYER 3	0.001	0.014	1.021	0.145	2.778	1.453
STD. DEVIATION OF DAILY	0.459	1.505	0.716	0.433	0.112	0.005
HEAD ON TOP OF LAYER 3	0.001	0.018	0.880	0.129	1.774	0.511

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.68	1526239.120	100.00
RUNOFF	0.906	35756.156	2.34
EVAPOTRANSPIRATION	25.206	994594.562	65.17
DRAINAGE COLLECTED FROM LAYER 2	12.5671	495875.062	32.49
PERC./LEAKAGE THROUGH LAYER 3	0.000529	20.892	0.00
AVG. HEAD ON TOP OF LAYER 3	0.8622		
CHANGE IN WATER STORAGE	0.000	-6.773	0.00
SOIL WATER AT START OF YEAR	3.750	147984.734	
SOIL WATER AT END OF YEAR	3.750	147977.953	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

ANNUAL WATER BUDGET BALANCE 0.0000 -0.799 0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.37	3.99	7.17	5.78	4.93	4.47
	0.52	4.57	2.13	1.36	8.60	4.68
RUNOFF	0.000	0.273	8.427	0.000	0.000	0.000
	0.000	0.023	0.000	0.000	0.001	0.322
EVAPOTRANSPIRATION	1.150	0.737	1.371	3.582	3.837	4.107
	0.359	2.636	1.699	1.652	1.518	1.205
LATERAL DRAINAGE COLLECTED	0.8044	0.0337	1.2720	4.7842	2.2197	0.7922
FROM LAYER 2	0.2175	1.7745	0.1988	0.0080	4.6628	3.4584
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0001	0.0002	0.0001	0.0000
LAYER 3	0.0000	0.0001	0.0000	0.0000	0.0002	0.0001

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.642	0.030	1.016	3.948	1.773	0.654
TOP OF LAYER 3	0.174	1.417	0.164	0.006	3.848	2.762
STD. DEVIATION OF DAILY	0.457	0.025	2.101	2.090	0.699	0.243

HEAD ON TOP OF LAYER 3	0.160	1.305	0.147	0.005	3.340	1.628

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	53.57	2113770.000	100.00
RUNOFF	9.046	356941.625	16.89
EVAPOTRANSPIRATION	23.850	941094.437	44.52
DRAINAGE COLLECTED FROM LAYER 2	20.2261	798082.812	37.76
PERC./LEAKAGE THROUGH LAYER 3	0.000852	33.612	0.00
AVG. HEAD ON TOP OF LAYER 3	1.3694		
CHANGE IN WATER STORAGE	0.446	17618.035	0.83
SOIL WATER AT START OF YEAR	3.750	147977.953	
SOIL WATER AT END OF YEAR	4.197	165596.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.460	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.77	4.28	7.23	9.00	3.60	1.67
	3.00	3.18	1.77	3.53	6.73	3.61
RUNOFF	0.774	0.985	0.009	0.249	0.000	0.000
	0.000	0.000	0.000	0.000	0.024	1.132
EVAPOTRANSPIRATION	0.335	1.167	2.659	4.585	3.769	1.157
	3.003	2.935	1.557	2.370	1.928	0.755
LATERAL DRAINAGE COLLECTED	0.2464	1.6445	4.2856	3.9753	3.1431	0.3898
FROM LAYER 2	0.4531	0.0359	0.0025	0.9123	3.0103	1.4819
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0001	0.0002	0.0002	0.0001	0.0000
LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.197	1.454	3.422	3.280	2.510	0.322
TOP OF LAYER 3	0.362	0.029	0.002	0.729	2.484	1.183
STD. DEVIATION OF DAILY	0.181	1.540	0.729	1.604	1.423	0.288
HEAD ON TOP OF LAYER 3	0.279	0.022	0.002	0.435	1.320	0.963

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.37	1948046.500	100.00
RUNOFF	3.173	125195.961	6.43

EVAPOTRANSPIRATION	26.220	1034577.940	53.11
DRAINAGE COLLECTED FROM LAYER 2	19.5805	772611.125	39.66
PERC./LEAKAGE THROUGH LAYER 3	0.000825	32.538	0.00
AVG. HEAD ON TOP OF LAYER 3	1.3312		
CHANGE IN WATER STORAGE	0.396	15628.712	0.80
SOIL WATER AT START OF YEAR	4.197	165596.000	
SOIL WATER AT END OF YEAR	4.161	164184.375	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.432	17040.332	0.87
ANNUAL WATER BUDGET BALANCE	0.0000	0.214	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.76	2.57	4.74	3.52	1.73	2.66
	1.55	1.93	0.63	3.25	4.94	4.74
RUNOFF	1.895	1.251	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.731	1.121	1.879	4.220	1.245	2.827
	1.772	1.546	0.715	1.605	2.005	1.065

LATERAL DRAINAGE COLLECTED	0.0567	1.2981	3.0042	0.7453	0.0394	0.1730
FROM LAYER 2	0.0203	0.0021	0.0003	0.2993	3.0105	1.4492
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000
LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.045	1.108	2.399	0.615	0.031	0.143
TOP OF LAYER 3	0.016	0.002	0.000	0.239	2.484	1.157
STD. DEVIATION OF DAILY	0.042	1.522	1.287	0.537	0.029	0.118
HEAD ON TOP OF LAYER 3	0.015	0.001	0.000	0.615	0.981	0.436

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	35.02	1381823.120	100.00
RUNOFF	3.146	124122.742	8.98
EVAPOTRANSPIRATION	20.730	817955.250	59.19
DRAINAGE COLLECTED FROM LAYER 2	10.0983	398461.562	28.84
PERC./LEAKAGE THROUGH LAYER 3	0.000426	16.801	0.00
AVG. HEAD ON TOP OF LAYER 3	0.6867		
CHANGE IN WATER STORAGE	1.046	41266.062	2.99
SOIL WATER AT START OF YEAR	4.161	164184.375	
SOIL WATER AT END OF YEAR	3.598	141971.391	
SNOW WATER AT START OF YEAR	0.432	17040.332	1.23

SNOW WATER AT END OF YEAR	2.041	80519.375	5.83
ANNUAL WATER BUDGET BALANCE	0.0000	0.694	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.76	4.40	3.56	4.25	4.08	2.74
	2.72	2.49	2.05	1.76	4.22	2.72
RUNOFF	0.503	2.649	1.150	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.489	0.426	2.165	3.783	4.250	2.293
	2.534	2.081	2.880	1.221	1.699	1.412
LATERAL DRAINAGE COLLECTED	4.5410	0.3387	1.5653	0.9715	0.6869	0.3937
FROM LAYER 2	0.0309	0.0020	0.0814	0.0046	1.2409	1.8250
PERCOLATION/LEAKAGE THROUGH	0.0002	0.0000	0.0001	0.0000	0.0000	0.0000
LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	3.626	0.299	1.250	0.802	0.549	0.325
TOP OF LAYER 3	0.025	0.002	0.067	0.004	1.024	1.457

STD. DEVIATION OF DAILY	2.432	0.253	1.190	0.469	0.220	0.166
HEAD ON TOP OF LAYER 3	0.020	0.001	0.050	0.003	1.014	0.497

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.75	1529001.620	100.00
RUNOFF	4.302	169740.234	11.10
EVAPOTRANSPIRATION	25.235	995720.625	65.12
DRAINAGE COLLECTED FROM LAYER 2	11.6819	460945.687	30.15
PERC./LEAKAGE THROUGH LAYER 3	0.000492	19.420	0.00
AVG. HEAD ON TOP OF LAYER 3	0.7858		
CHANGE IN WATER STORAGE	-2.469	-97424.414	-6.37
SOIL WATER AT START OF YEAR	3.598	141971.391	
SOIL WATER AT END OF YEAR	3.170	125066.352	
SNOW WATER AT START OF YEAR	2.041	80519.375	5.27
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.073	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.15	3.87	5.08	5.05	3.45	2.91
	2.10	2.99	2.25	2.31	6.15	3.77
STD. DEVIATIONS	1.45	0.74	2.06	2.48	1.21	1.01
	1.04	0.99	1.49	1.00	1.70	0.91
RUNOFF						
TOTALS	0.700	1.147	1.917	0.050	0.000	0.000
	0.000	0.005	0.000	0.000	0.005	0.291
STD. DEVIATIONS	0.725	0.919	3.673	0.111	0.000	0.000
	0.000	0.010	0.000	0.000	0.010	0.491
EVAPOTRANSPIRATION						
TOTALS	0.666	0.935	2.145	3.665	3.042	2.685
	2.161	2.333	2.031	1.567	1.870	1.149
STD. DEVIATIONS	0.309	0.343	0.546	0.928	1.296	1.079
	1.140	0.538	1.050	0.527	0.268	0.254
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	1.2921	1.0483	2.4671	2.2627	1.2482	0.3512
	0.1446	0.3663	0.3041	0.2811	3.0582	2.0069
STD. DEVIATIONS	1.8468	0.8250	1.2149	1.9553	1.3705	0.2949
	0.1933	0.7873	0.5280	0.3741	1.2224	0.8309
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
STD. DEVIATIONS	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	1.0318	0.9190	1.9702	1.8672	0.9968	0.2898
	0.1155	0.2925	0.2510	0.2245	2.5236	1.6027
STD. DEVIATIONS	1.4746	0.7266	0.9702	1.6135	1.0945	0.2433
	0.1544	0.6287	0.4357	0.2987	1.0087	0.6636

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.08 (7.948)	1699776.1	100.00
RUNOFF	4.115 (3.0197)	162351.34	9.551
EVAPOTRANSPIRATION	24.248 (2.1399)	956788.56	56.289
LATERAL DRAINAGE COLLECTED FROM LAYER 2	14.83080 (4.71977)	585195.250	34.42778
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00062 (0.00020)	24.652	0.00145
AVERAGE HEAD ON TOP OF LAYER 3	1.007 (0.320)		
CHANGE IN WATER STORAGE	-0.116 (1.3674)	-4583.68	-0.270

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	3.27	129027.984

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RUNOFF                                    3.269       128999.2730

DRAINAGE COLLECTED FROM LAYER  2          0.37342      14734.35840

PERCOLATION/LEAKAGE THROUGH LAYER  3      0.000016         0.61962

AVERAGE HEAD ON TOP OF LAYER  3           9.233

MAXIMUM HEAD ON TOP OF LAYER  3          12.252

LOCATION OF MAXIMUM HEAD IN LAYER  2
      (DISTANCE FROM DRAIN)              23.5 FEET

SNOW WATER                                6.39        252074.5620


MAXIMUM VEG. SOIL WATER (VOL/VOL)                 0.4183

MINIMUM VEG. SOIL WATER (VOL/VOL)                 0.0850


 ***  Maximum heads are computed using McEnroe's equations.  ***

      Reference:  Maximum Saturated Depth over Landfill Liner
                  by Bruce M. McEnroe, University of Kansas
                  ASCE Journal of Environmental Engineering
                  Vol. 119, No. 2, March 1993, pp. 262-270.
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FINAL WATER STORAGE AT END OF YEAR   5

LAYER	(INCHES)	(VOL/VOL)
1	1.8122	0.2014
2	0.8174	0.0681
3	0.0000	0.0000

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**                                                                        **
**                                                                        **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                 **
**                    USAE WATERWAYS EXPERIMENT STATION                   **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY            **
**                                                                        **
**                                                                        **
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PRECIPITATION DATA FILE:    C:\DATA4.D4
TEMPERATURE DATA FILE:      C:\DATA7.D7
SOLAR RADIATION DATA FILE:  C:\DATA13.D13
EVAPOTRANSPIRATION DATA:    C:\DATA11.D11
SOIL AND DESIGN DATA FILE:  C:\DATA10.D10
OUTPUT DATA FILE:           C:\ali ss.OUT


TIME:  15:45     DATE:   8/30/2018


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     TITLE:  ALI Ph B Sideslope

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                 LAYER  1
                                 --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
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ALISS
MATERIAL TEXTURE NUMBER 6

```
THICKNESS                   =     9.00   INCHES
POROSITY                    =     0.4530 VOL/VOL
FIELD CAPACITY              =     0.1900 VOL/VOL
WILTING POINT               =     0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT  =     0.2326 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.720000011000E-03 CM/SEC
NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
       FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 1

```
THICKNESS                   =    12.00   INCHES
POROSITY                    =     0.4170 VOL/VOL
FIELD CAPACITY              =     0.0450 VOL/VOL
WILTING POINT               =     0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT  =     0.0546 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC
SLOPE                       =    33.00   PERCENT
DRAINAGE LENGTH             =    60.0    FEET
```

LAYER 3

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

```
THICKNESS                   =     0.00   INCHES
POROSITY                    =     0.0000 VOL/VOL
FIELD CAPACITY              =     0.0000 VOL/VOL
WILTING POINT               =     0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =     0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =     0.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =     0.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  4 - POOR
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER	=	74.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	10.870	ACRES
EVAPORATIVE ZONE DEPTH	=	9.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.094	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.077	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.765	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	2.749	INCHES
TOTAL INITIAL WATER	=	2.749	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BOSTON MASSACHUSETTS

STATION LATITUDE	=	42.37	DEGREES
MAXIMUM LEAF AREA INDEX	=	1.00	
START OF GROWING SEASON (JULIAN DATE)	=	118	
END OF GROWING SEASON (JULIAN DATE)	=	295	
EVAPORATIVE ZONE DEPTH	=	9.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	12.50	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	62.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	65.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	68.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BOSTON MASSACHUSETTS

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.99	3.70	4.13	3.73	3.52	2.92

ALISS

2.68	3.68	3.41	3.36	4.21	4.48

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BOSTON MASSACHUSETTS

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
29.60	30.70	38.40	48.70	58.50	68.00
73.50	71.90	64.60	54.80	45.20	33.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BOSTON MASSACHUSETTS
AND STATION LATITUDE = 42.37 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.11	4.09	2.71	2.70	2.90	3.00
	2.69	2.78	4.69	1.63	6.27	3.11
RUNOFF	0.329	0.577	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.623	1.224	2.653	2.158	2.107	3.039
	3.137	2.468	3.302	0.986	2.203	1.306
LATERAL DRAINAGE COLLECTED	0.3864	2.8306	1.5091	0.7539	0.0000	0.0025
FROM LAYER 2	0.0012	0.0228	1.4156	0.0196	4.2704	1.3553

PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.044	0.360	0.173	0.089	0.000	0.000
TOP OF LAYER 3	0.000	0.003	0.168	0.002	0.506	0.155
STD. DEVIATION OF DAILY	0.065	0.494	0.134	0.212	0.000	0.001
HEAD ON TOP OF LAYER 3	0.000	0.007	0.324	0.013	0.598	0.215

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.68	1526239.120	100.00
RUNOFF	0.906	35756.156	2.34
EVAPOTRANSPIRATION	25.206	994594.562	65.17
DRAINAGE COLLECTED FROM LAYER 2	12.5675	495890.500	32.49
PERC./LEAKAGE THROUGH LAYER 3	0.000077	3.031	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1251		
CHANGE IN WATER STORAGE	0.000	-4.215	0.00
SOIL WATER AT START OF YEAR	3.289	129773.906	
SOIL WATER AT END OF YEAR	3.289	129769.695	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

ANNUAL WATER BUDGET BALANCE	0.0000	-0.926	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.37	3.99	7.17	5.78	4.93	4.47
	0.52	4.57	2.13	1.36	8.60	4.68
RUNOFF	0.000	0.273	8.427	0.000	0.000	0.000
	0.000	0.023	0.000	0.000	0.001	0.322
EVAPOTRANSPIRATION	1.150	0.737	1.371	3.582	3.837	4.107
	0.359	2.636	1.699	1.652	1.518	1.205
LATERAL DRAINAGE COLLECTED	0.3782	0.0000	3.4309	3.5806	1.4437	0.8355
FROM LAYER 2	0.0010	1.9736	0.0000	0.0007	6.3521	2.0223
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.043	0.000	0.394	0.424	0.166	0.099
TOP OF LAYER 3	0.000	0.226	0.000	0.000	0.753	0.232
STD. DEVIATION OF DAILY	0.064	0.000	0.882	0.509	0.212	0.127
HEAD ON TOP OF LAYER 3	0.000	0.553	0.000	0.000	0.849	0.405

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	53.57	2113770.000	100.00
RUNOFF	9.046	356941.625	16.89
EVAPOTRANSPIRATION	23.850	941094.437	44.52
DRAINAGE COLLECTED FROM LAYER 2	20.0186	789895.187	37.37
PERC./LEAKAGE THROUGH LAYER 3	0.000122	4.798	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1948		
CHANGE IN WATER STORAGE	0.655	25834.508	1.22
SOIL WATER AT START OF YEAR	3.289	129769.695	
SOIL WATER AT END OF YEAR	3.944	155604.203	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.470	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.77	4.28	7.23	9.00	3.60	1.67

	ALISS					
	3.00	3.18	1.77	3.53	6.73	3.61
RUNOFF	0.774	0.985	0.009	0.249	0.000	0.000
	0.000	0.000	0.000	0.000	0.024	1.132
EVAPOTRANSPIRATION	0.335	1.167	2.659	4.585	3.769	1.157
	3.003	2.935	1.557	2.370	1.928	0.755
LATERAL DRAINAGE COLLECTED	0.0016	2.4460	4.8255	4.6444	1.5269	0.0024
FROM LAYER 2	0.4718	0.0049	0.0001	1.1340	4.0208	0.3083
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.311	0.554	0.551	0.175	0.000
TOP OF LAYER 3	0.054	0.001	0.000	0.130	0.477	0.035
STD. DEVIATION OF DAILY	0.001	0.600	0.564	0.780	0.276	0.001
HEAD ON TOP OF LAYER 3	0.110	0.002	0.000	0.149	0.577	0.048

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.37	1948046.500	100.00
RUNOFF	3.173	125195.961	6.43
EVAPOTRANSPIRATION	26.220	1034577.940	53.11
DRAINAGE COLLECTED FROM LAYER 2	19.3866	764960.250	39.27
PERC./LEAKAGE THROUGH LAYER 3	0.000118	4.656	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1906		

CHANGE IN WATER STORAGE	0.591	23307.355	1.20
SOIL WATER AT START OF YEAR	3.944	155604.203	
SOIL WATER AT END OF YEAR	4.102	161871.219	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.432	17040.332	0.87
ANNUAL WATER BUDGET BALANCE	0.0000	0.343	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.76	2.57	4.74	3.52	1.73	2.66
	1.55	1.93	0.63	3.25	4.94	4.74
RUNOFF	1.895	1.251	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.731	1.121	1.879	4.220	1.245	2.827
	1.772	1.546	0.715	1.605	2.005	1.065
LATERAL DRAINAGE COLLECTED	0.0000	1.9381	3.0766	0.0695	0.0024	0.1923
FROM LAYER 2	0.0004	0.0016	0.0000	0.8500	2.9075	1.5021
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.238	0.353	0.008	0.000	0.023
TOP OF LAYER 3	0.000	0.000	0.000	0.098	0.345	0.172
STD. DEVIATION OF DAILY	0.000	0.602	0.458	0.016	0.001	0.043
HEAD ON TOP OF LAYER 3	0.000	0.001	0.000	0.280	0.426	0.208

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	35.02	1381823.120	100.00
RUNOFF	3.146	124122.742	8.98
EVAPOTRANSPIRATION	20.730	817955.250	59.19
DRAINAGE COLLECTED FROM LAYER 2	10.5405	415906.719	30.10
PERC./LEAKAGE THROUGH LAYER 3	0.000064	2.537	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1031		
CHANGE IN WATER STORAGE	0.604	23835.164	1.72
SOIL WATER AT START OF YEAR	4.102	161871.219	
SOIL WATER AT END OF YEAR	3.098	122227.344	
SNOW WATER AT START OF YEAR	0.432	17040.332	1.23
SNOW WATER AT END OF YEAR	2.041	80519.375	5.83
ANNUAL WATER BUDGET BALANCE	0.0000	0.696	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.76	4.40	3.56	4.25	4.08	2.74
	2.72	2.49	2.05	1.76	4.22	2.72
RUNOFF	0.503	2.649	1.150	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.489	0.426	2.165	3.783	4.250	2.293
	2.534	2.081	2.880	1.221	1.699	1.412
LATERAL DRAINAGE COLLECTED	4.3957	0.0000	1.9548	0.9595	0.4583	0.2585
FROM LAYER 2	0.0026	0.0006	0.0861	0.0001	1.6033	1.7239
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.504	0.000	0.224	0.114	0.053	0.031
TOP OF LAYER 3	0.000	0.000	0.010	0.000	0.190	0.198
STD. DEVIATION OF DAILY	1.038	0.000	0.503	0.191	0.071	0.061
HEAD ON TOP OF LAYER 3	0.001	0.000	0.020	0.000	0.341	0.237

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ANNUAL TOTALS FOR YEAR 5

	ALISS INCHES	CU. FEET	PERCENT
PRECIPITATION	38.75	1529001.620	100.00
RUNOFF	4.302	169740.234	11.10
EVAPOTRANSPIRATION	25.235	995720.625	65.12
DRAINAGE COLLECTED FROM LAYER 2	11.4432	451528.750	29.53
PERC./LEAKAGE THROUGH LAYER 3	0.000070	2.765	0.00
AVG. HEAD ON TOP OF LAYER 3	0.1103		
CHANGE IN WATER STORAGE	-2.230	-87991.031	-5.75
SOIL WATER AT START OF YEAR	3.098	122227.344	
SOIL WATER AT END OF YEAR	2.908	114755.687	
SNOW WATER AT START OF YEAR	2.041	80519.375	5.27
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.302	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.15	3.87	5.08	5.05	3.45	2.91
	2.10	2.99	2.25	2.31	6.15	3.77
STD. DEVIATIONS	1.45	0.74	2.06	2.48	1.21	1.01
	1.04	0.99	1.49	1.00	1.70	0.91

RUNOFF

TOTALS	0.700	1.147	1.917	0.050	0.000	0.000
	0.000	0.005	0.000	0.000	0.005	0.291
STD. DEVIATIONS	0.725	0.919	3.673	0.111	0.000	0.000
	0.000	0.010	0.000	0.000	0.010	0.491

EVAPOTRANSPIRATION

TOTALS	0.666	0.935	2.145	3.665	3.042	2.685
	2.161	2.333	2.031	1.567	1.870	1.149
STD. DEVIATIONS	0.309	0.343	0.546	0.928	1.296	1.079
	1.140	0.538	1.050	0.527	0.268	0.254

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	1.0324	1.4429	2.9594	2.0016	0.6862	0.2582
	0.0954	0.4007	0.3004	0.4009	3.8308	1.3824
STD. DEVIATIONS	1.8898	1.3547	1.3068	1.9908	0.7535	0.3422
	0.2104	0.8793	0.6246	0.5489	1.7607	0.6509

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.1184	0.1816	0.3395	0.2373	0.0787	0.0306
	0.0109	0.0460	0.0356	0.0460	0.4541	0.1586
STD. DEVIATIONS	0.2168	0.1713	0.1499	0.2360	0.0864	0.0406
	0.0241	0.1009	0.0740	0.0630	0.2087	0.0747

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.08 (7.948)	1699776.1	100.00
RUNOFF	4.115 (3.0197)	162351.34	9.551
EVAPOTRANSPIRATION	24.248 (2.1399)	956788.56	56.289
LATERAL DRAINAGE COLLECTED FROM LAYER 2	14.79129 (4.54604)	583636.250	34.33607
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00009 (0.00003)	3.557	0.00021
AVERAGE HEAD ON TOP OF LAYER 3	0.145 (0.044)		
CHANGE IN WATER STORAGE	-0.076 (1.2335)	-3003.64	-0.177

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	3.27	129027.984
RUNOFF	3.269	128999.2730
DRAINAGE COLLECTED FROM LAYER 2	1.28072	50534.64450
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000008	0.30567
AVERAGE HEAD ON TOP OF LAYER 3	4.555	
MAXIMUM HEAD ON TOP OF LAYER 3	8.288	

ALISS

LOCATION OF MAXIMUM HEAD IN LAYER 2
(DISTANCE FROM DRAIN) 0.0 FEET

SNOW WATER 6.39 252074.5620

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4183

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0850

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	1.8122	0.2014
2	0.5561	0.0463
3	0.0000	0.0000
SNOW WATER	0.000	

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ALI2
SNOW WATER 0.000

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Appendix G

Stormwater Calculations

Drainage Report and Operation and Maintenance Plan
Attleboro Landfill – Phase B Closure

Prepared By:

Richard R. DeBenedictis, PE
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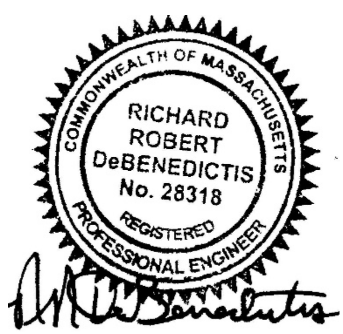
Plymouth, MA 02360



Revised Sept 12, 2018

Contents

Attachments

1.0 Purpose

This report has been prepared to accompany engineering plans and applications submitted to the MassDEP for the closure of Phase B of the Attleboro Landfill (the Site). The following sections of this document presents a description of the method of hydrologic analysis of the property, a discussion of compliance with the DEP storm water regulations, and the general operation and maintenance program for the storm water system.

2.0 Hydrologic Calculations

This section presents the results of a hydrologic analysis conducted to evaluate the design of stormwater control systems proposed as part of a plan to complete closure operations at the Site. The following presents the basis for the results of calculations conducted as part of this analysis which includes a discussion of the watershed area; a discussion of the watershed characteristics (i.e., soil types, slopes, land use); a brief presentation regarding the methodology of the calculations; and finally a discussion of the results of the calculations.

Watershed

This analysis and the accompanying design are both confined to the Phase B portion of the Attleboro Landfill. This area presently drains in three directions to wetland areas to the west, south and east in a radially direction. The rear portion of the closed Phase A area serves as the northern boundary and runoff comes from the Phase A area onto the Site.

Stormwater Control System

The proposed stormwater system will consist of creating a series of surface swales to direct the surface runoff from the surface of the capped area to one strategically located stormwater detention basin along the west side of the capped area. At the present time most of the surface runoff from this area discharges directly into the adjacent wetland systems. By using features of the closure construction (berms, swales and perimeter roadway) to contain and redirect the water, the majority of the runoff can be successfully attenuated in the stormwater detention basin. Runoff will decrease in all of the existing drainage areas by diverting the flow to the detention basin, decreasing the flow in the existing drainage areas and attenuating the flow through the basin. In addition, construction of the capping system on the landfill will create a layer that will absorb runoff into the drainage layer which will discharge a day or so later. This helps to attenuate the peak rate of runoff from the site, which at this time is primarily a compacted gravel surface

Method of Calculation

HydroCAD® software, Version 10 was used to perform hydrologic and hydraulic calculations. HydroCAD uses the US Department of Agriculture Soil Conservation Service (SCS) methodologies to generate synthetic unit hydrographs that are then used to estimate runoff hydrographs from the watershed area. The software is also capable of modeling travel times in streams and performing flood routing calculations through culverts and pond systems to properly model flood water rates and elevations throughout the watershed.

The soil across the entire area has been previously reworked and an Interim cap of semi impervious material was used throughout much of the area. As a result, the type of soil at the surface is generally hydrologic soil group C which was subsequently used in the calculations.

Results

The results of the Stormwater modeling conducted as part of this hydrologic evaluation are included in Attachment 1. The following table present the peak rate of runoff and total volume of runoff from the site and adjacent watersheds that exist and those are proposed to exist after the construction of the project and its improvements. Modeling was completed to identify the total rate and volume of runoff from the developed area both before and after development. For ease of comparison, the existing discharge points are labelled E-1 through E-5. The proposed discharge points are the at the same locations same and are labelled R-1 through R-5 (i.e., E-1 is the same location as R-1, etc.)

Location	**10 Year – 24 Hour Storm**		**25 Year – 24 Hour Storm**		**100 Year – 24 Hour Storm**	
	Q (cfs)	**Vol (Ac. –Ft.)**	**Q (cfs)**	**Vol (Ac. –Ft.)**	**Q (cfs)**	**Vol (Ac. –Ft.)**
E-1	9.69	0.73	12.5	0.95	19.42	1.52
E-2	4.14	0.50	5.57	0.68	9.21	1.14
E-3	7.73	0.45	10.20	0.60	16.33	0.99
E-4	29.87	1.78	38.50	2.32	59.70	3.68
E-5	16.47	1.23	21.76	1.64	34.91	2.69
TOTAL EXIST.	**53.5**	**4.67**	**69.89**	**6.18**	**110.45**	**10.02**
R-1	3.16	0.20	4.41	0.27	7.61	0.48
R-2	4.49	0.35	6.47	0.50	11.70	0.91
R-3	1.39	0.10	1.97	0.13	3.48	0.24
R-4	7.33	0.55	9.46	0.73	14.70	1.16
R-5	8.24	1.65	11.41	2.1	19.46	3.77
TOTAL PROP.	**23.62**	**2.29**	**32.35**	**3.74**	**54.59**	**6.56**

As can be seen, the design reduces the rate of runoff from the developed site as well as the total volume of runoff. That number however is somewhat misleading, in the sense that the reduction is during the storm however some of the rainfall that infiltrates the loam layer and enters the drainage layer will eventually discharge from the property with likely a lag time of 24 to 48 hours.

3.0 Compliance with Stormwater Standards

The MassDEP Stormwater Management Regulations identified Stormwater Management Standards that were developed with the intention of establishing clear and consistent guidelines for stormwater management projects. The Standards address both water quantity and quality by establishing a level of required controls, which can presumptively be achieved through site planning processes, non-structural measures and the use of Best Management Practices (BMPs). All of these standards were evaluated for their applicability to the stormwater management system that is proposed to be constructed as part of the final closure of the Site.

Following is a discussion of each of the standards and how the design addresses each standard.

1. No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

All runoff from the closure area is directed to new stormwater detention basins that properly attenuate peak flows.

2. Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

Post-development peak discharge rates are lower than existing peak discharge rates.

3. Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

The design provides more opportunity for safe groundwater recharge then at the present time.

4. Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;

b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and

c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

I properly vegetating the new ground surface, managing runoff in a proper manner and directing the runoff through stormwater detention basins, the post-construction total suspended solids loading has been drastically reduced.

5. For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

By placing a proper landfill final cover system over previously placed waste, the standard is in effect met.

6. Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314

CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

The site is not located in a water supply protection Area.

7. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

The project is not considered to be a redevelopment project.

8. A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

Construction related impacts are controlled through erosion and sedimentation control.

9. A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

The long-term plan is included

10. All illicit discharges to the stormwater management system are prohibited.

There will be no illicit discharges to the stormwater system.

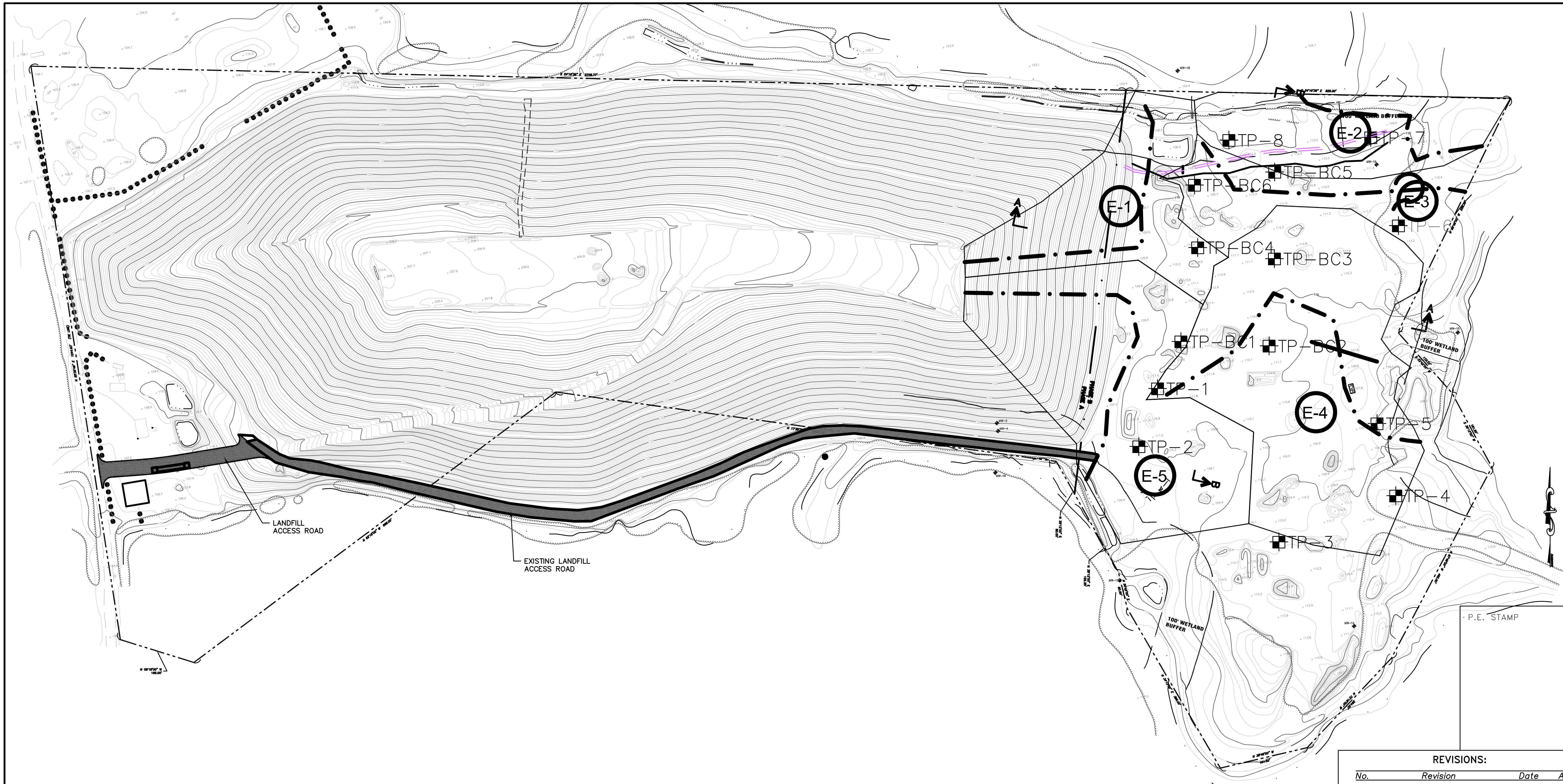
4.0 System Operation and Maintenance Program

As described in the foregoing, the system is designed to be operationally simple and relatively low maintenance. The key to the proper function of the various components of the system is directly connected to the proper stabilization of Site. Equally as important, is implementation of proper erosion and sedimentation control measures during construction. Both of these items are addressed as part of this design.

With respect to ongoing operation and maintenance items the following are key to ensuring proper operational integrity:

- Sediment Removal -inspections should be conducted in the spring and fall to insure that the storm water detention area is able to function as intended. These areas need to be inspected for sediment buildup and as appropriate sediment removed.

- Erosion and Prevention /Correction Program - during construction, measures will be implemented to prevent unnecessary erosion and sedimentation.



P.E. STAMP

LEGEND

	PROPERTY LINE
250	EXISTING CONTOURS
	PROPOSED CONTOURS
EC	PROPOSED EROSION CONTROL
WL 12	EXISTING WETLAND

REVISIONS:

No.	Revision	Date	Appr. By

RICHARD R. DEBENEDICTIS, P.E.

57 SANDERSON DRIVE, PLYMOUTH MASSACHUSETTS (781) 249-9435

	DRAWN	CHECKED	CAD FILE NO.
BY	JMC	RRD	
DATE	11/15/17	10/20/16	

ATTLEBORO LANDFILL CLOSURE PROJECT

EXISTING DRAINAGE AREAS

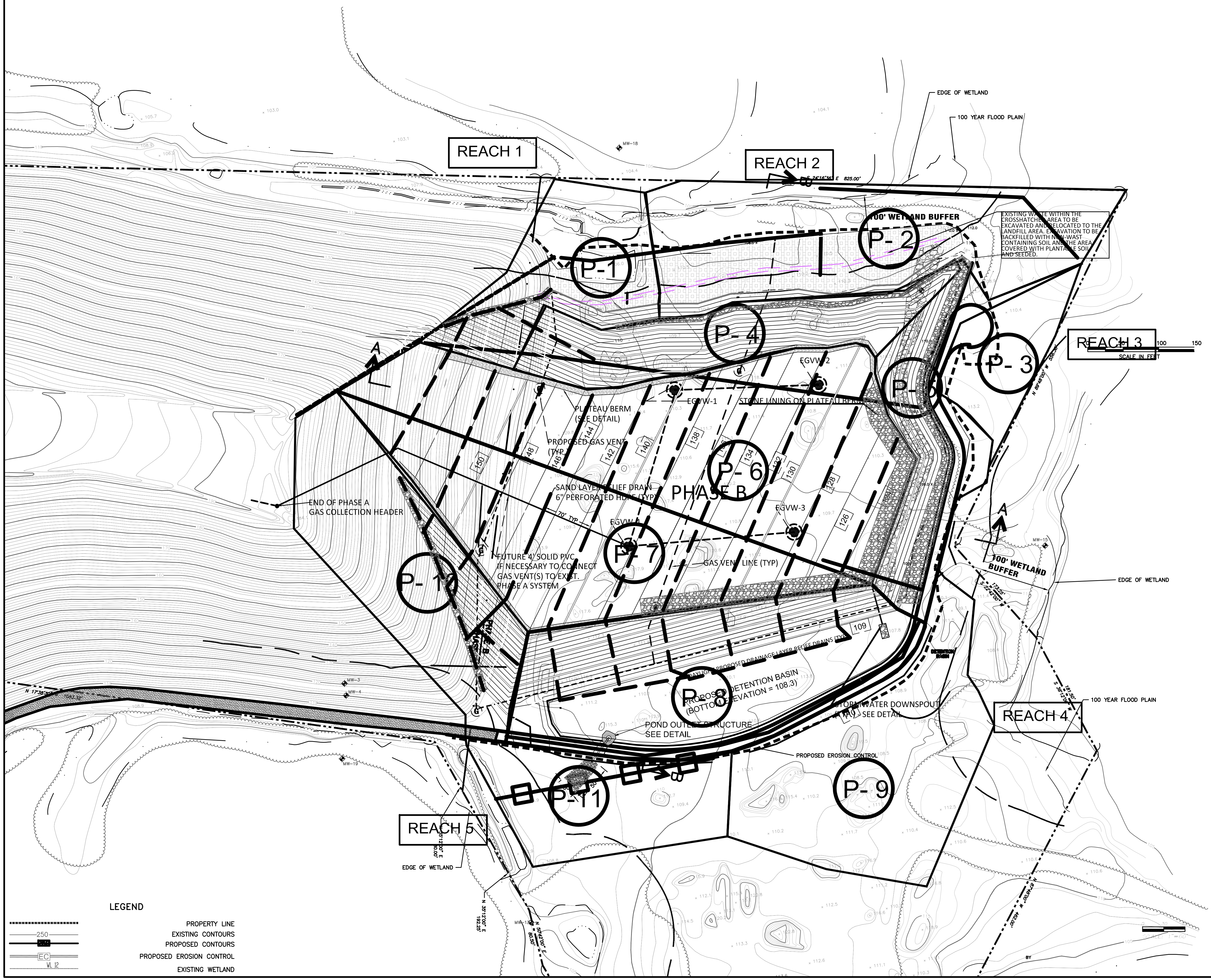
179 PECKHAM STREET

Attleboro, Massachusetts

PREPARED FOR:

ENVIRO-CYCLE, LLC
50 HOMERS WHARF
NEW BEDFORD, MASSACHUSETTS 02740

SCALE	PROJECT NO.	SHEET NUMBER
AS NOTED		Existing DA



LEGEND

	PROPERTY LINE
250	EXISTING CONTOURS
250	PROPOSED CONTOURS
EC	PROPOSED EROSION CONTROL
WL 12	EXISTING WETLAND

P.E. STAMP

REVISIONS:

No.	Revision	Date	Appr. By

RICHARD R. DEBENEDICTIS, P.E.

57 SANDERSON DRIVE, PLYMOUTH MASSACHUSETTS (781) 249-9435

	DRAWN	CHECKED	CAD FILE NO.
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PROP. DRAINAGE AREAS
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SCALE	PROJECT NO.	SHEET NUMBER
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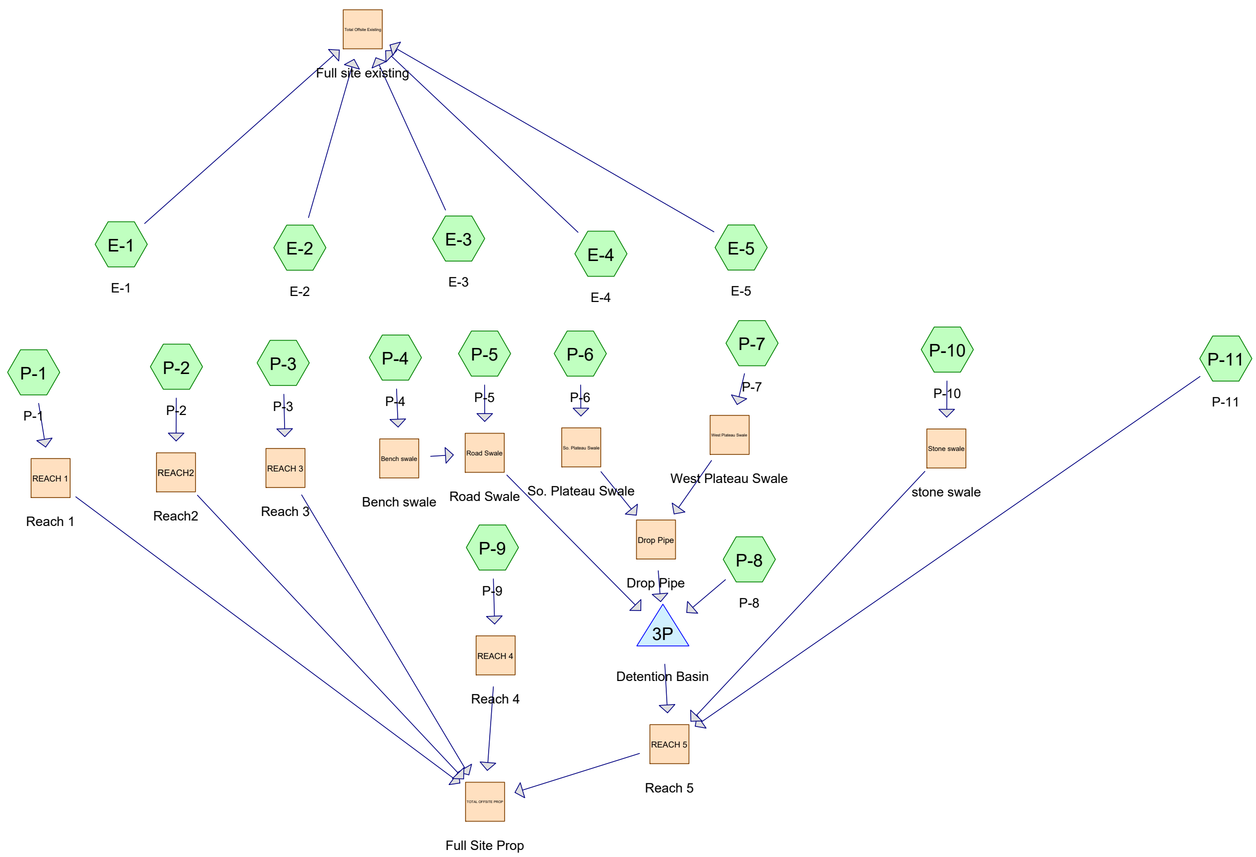
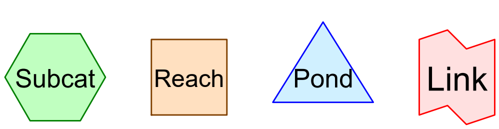
Attachment 1

Stormwater Calculations





Routing Diagram for ALI CAD August 2018
Prepared by HP, Printed 9/3/2018
HydroCAD® 10.00-15 s/n 02179 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.509	79	50-75% Grass cover, Fair, HSG C (P-5)
15.899	86	<50% Grass cover, Poor, HSG C (E-1, E-2, E-3, E-4, E-5, P-11)
11.818	74	>75% Grass cover, Good, HSG C (E-5, P-1, P-10, P-4, P-6, P-7, P-8)
0.482	87	Dirt roads, HSG C (P-5)
0.223	96	Gravel surface, HSG C (P-8)
1.267	98	Water Surface, HSG C (P-8)
3.658	70	Woods, Good, HSG C (E-2, E-3, P-2)
0.545	72	Woods/grass comb., Good, HSG C (P-3)
34.402	**80**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
34.402	HSG C	E-1, E-2, E-3, E-4, E-5, P-1, P-10, P-11, P-2, P-3, P-4, P-5, P-6, P-7, P-8
0.000	HSG D	
0.000	Other	
34.402		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.509	0.000	0.000	0.509	50-75% Grass cover, Fair	P-5
0.000	0.000	15.899	0.000	0.000	15.899	<50% Grass cover, Poor	E-1, E-2, E-3, E-4, E-5, P-11
0.000	0.000	11.818	0.000	0.000	11.818	>75% Grass cover, Good	E-5, P-1, P-10, P-4, P-6, P-7, P-8
0.000	0.000	0.482	0.000	0.000	0.482	Dirt roads	P-5
0.000	0.000	0.223	0.000	0.000	0.223	Gravel surface	P-8
0.000	0.000	1.267	0.000	0.000	1.267	Water Surface	P-8
0.000	0.000	3.658	0.000	0.000	3.658	Woods, Good	E-2, E-3, P-2
0.000	0.000	0.545	0.000	0.000	0.545	Woods/grass comb., Good	P-3
0.000	**0.000**	**34.402**	**0.000**	**0.000**	**34.402**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	Drop Pipe	122.00	108.50	30.0	0.4500	0.013	18.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: E-1 Runoff Area=114,240 sf 0.00% Impervious Runoff Depth>3.33"
Flow Length=630' Tc=8.6 min CN=86 Runoff=9.69 cfs 0.728 af

Subcatchment E-2: E-2 Runoff Area=98,290 sf 0.00% Impervious Runoff Depth>2.65"
Flow Length=488' Slope=0.0100 '/' Tc=32.5 min CN=79 Runoff=4.14 cfs 0.499 af

Subcatchment E-3: E-3 Runoff Area=79,629 sf 0.00% Impervious Runoff Depth>2.96"
Tc=0.0 min CN=82 Runoff=7.73 cfs 0.450 af

Subcatchment E-4: E-4 Runoff Area=277,162 sf 0.00% Impervious Runoff Depth>3.33"
Flow Length=550' Slope=0.0100 '/' Tc=9.2 min CN=86 Runoff=22.93 cfs 1.766 af

Subcatchment E-5: E-5 Runoff Area=217,437 sf 0.00% Impervious Runoff Depth>2.95"
Flow Length=760' Tc=8.8 min CN=82 Runoff=16.47 cfs 1.227 af

Subcatchment P-1: P-1 Runoff Area=45,494 sf 0.00% Impervious Runoff Depth>2.25"
Flow Length=523' Tc=3.6 min CN=74 Runoff=3.16 cfs 0.196 af

Subcatchment P-10: P-10 Runoff Area=72,105 sf 0.00% Impervious Runoff Depth>2.25"
Flow Length=409' Slope=0.3300 '/' Tc=1.7 min CN=74 Runoff=5.15 cfs 0.311 af

Subcatchment P-11: P-11 Runoff Area=46,241 sf 0.00% Impervious Runoff Depth>3.33"
Flow Length=330' Slope=0.0100 '/' Tc=5.5 min CN=86 Runoff=4.29 cfs 0.295 af

Subcatchment P-2: P-2 Runoff Area=95,039 sf 0.00% Impervious Runoff Depth>1.93"
Flow Length=390' Tc=10.5 min CN=70 Runoff=4.49 cfs 0.350 af

Subcatchment P-3: P-3 Runoff Area=23,731 sf 0.00% Impervious Runoff Depth>2.09"
Flow Length=190' Slope=0.0100 '/' Tc=6.3 min CN=72 Runoff=1.39 cfs 0.095 af

Subcatchment P-4: P-4 Runoff Area=45,575 sf 0.00% Impervious Runoff Depth>2.25"
Flow Length=605' Tc=3.7 min CN=74 Runoff=3.15 cfs 0.196 af

Subcatchment P-5: P-5 Runoff Area=43,177 sf 0.00% Impervious Runoff Depth>3.02"
Flow Length=535' Tc=31.1 min CN=83 Runoff=2.09 cfs 0.250 af

Subcatchment P-6: P-6 Runoff Area=139,221 sf 0.00% Impervious Runoff Depth>2.25"
Flow Length=707' Slope=0.0500 '/' Tc=7.5 min CN=74 Runoff=8.49 cfs 0.599 af

Subcatchment P-7: P-7 Runoff Area=90,811 sf 0.00% Impervious Runoff Depth>2.25"
Flow Length=750' Slope=0.0500 '/' Tc=8.0 min CN=74 Runoff=5.44 cfs 0.391 af

Subcatchment P-8: P-8 Runoff Area=110,418 sf 50.00% Impervious Runoff Depth>3.54"
Flow Length=310' Slope=0.3300 '/' Tc=1.3 min CN=88 Runoff=11.94 cfs 0.747 af

Subcatchment P-9: P-9
Runoff=0.00 cfs 0.000 af

Reach Bench swale: Bench swale Avg. Flow Depth=0.87' Max Vel=0.33 fps Inflow=3.15 cfs 0.196 af
n=0.300 L=570.0' S=0.0100 '/' Capacity=8.41 cfs Outflow=1.31 cfs 0.188 af

Reach Drop Pipe: Drop Pipe Avg. Flow Depth=0.36' Max Vel=27.45 fps Inflow=9.07 cfs 0.973 af
18.0" Round Pipe n=0.013 L=30.0' S=0.4500 '/' Capacity=70.47 cfs Outflow=9.07 cfs 0.972 af

Reach REACH 1: Reach 1 Inflow=3.16 cfs 0.196 af
Outflow=3.16 cfs 0.196 af

Reach REACH 3: Reach 3 Inflow=1.39 cfs 0.095 af
Outflow=1.39 cfs 0.095 af

Reach REACH 4: Reach 4 Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach REACH 5: Reach 5 Inflow=8.24 cfs 1.649 af
Outflow=8.24 cfs 1.649 af

Reach REACH2: Reach2 Inflow=4.49 cfs 0.350 af
Outflow=4.49 cfs 0.350 af

Reach Road Swale: Road Swale Avg. Flow Depth=1.20' Max Vel=0.26 fps Inflow=2.89 cfs 0.438 af
n=0.300 L=550.0' S=0.0040 '/' Capacity=6.19 cfs Outflow=2.04 cfs 0.415 af

Reach So. Plateau Swale: So. Plateau Avg. Flow Depth=1.02' Max Vel=0.49 fps Inflow=8.49 cfs 0.599 af
n=0.300 L=330.0' S=0.0242 '/' Capacity=35.49 cfs Outflow=5.90 cfs 0.590 af

Reach Stone swale: stone swale Avg. Flow Depth=1.08' Max Vel=1.15 fps Inflow=5.15 cfs 0.311 af
n=0.300 L=351.0' S=0.1282 '/' Capacity=21.01 cfs Outflow=4.07 cfs 0.309 af

Reach Total Offsite Existing: Full site existing Inflow=54.26 cfs 4.671 af
Outflow=54.26 cfs 4.671 af

Reach TOTAL OFFSITE PROP: Full Site Prop Inflow=16.30 cfs 2.290 af
Outflow=16.30 cfs 2.290 af

Reach West Plateau Swale: West Avg. Flow Depth=0.75' Max Vel=0.53 fps Inflow=5.44 cfs 0.391 af
n=0.300 L=477.0' S=0.0419 '/' Capacity=46.67 cfs Outflow=3.45 cfs 0.383 af

Pond 3P: Detention Basin Peak Elev=109.53' Storage=57,859 cf Inflow=13.60 cfs 2.135 af
Outflow=1.71 cfs 1.045 af

Total Runoff Area = 34.402 ac Runoff Volume = 8.101 af Average Runoff Depth = 2.83"
96.32% Pervious = 33.135 ac 3.68% Impervious = 1.267 ac

Summary for Subcatchment E-1: E-1

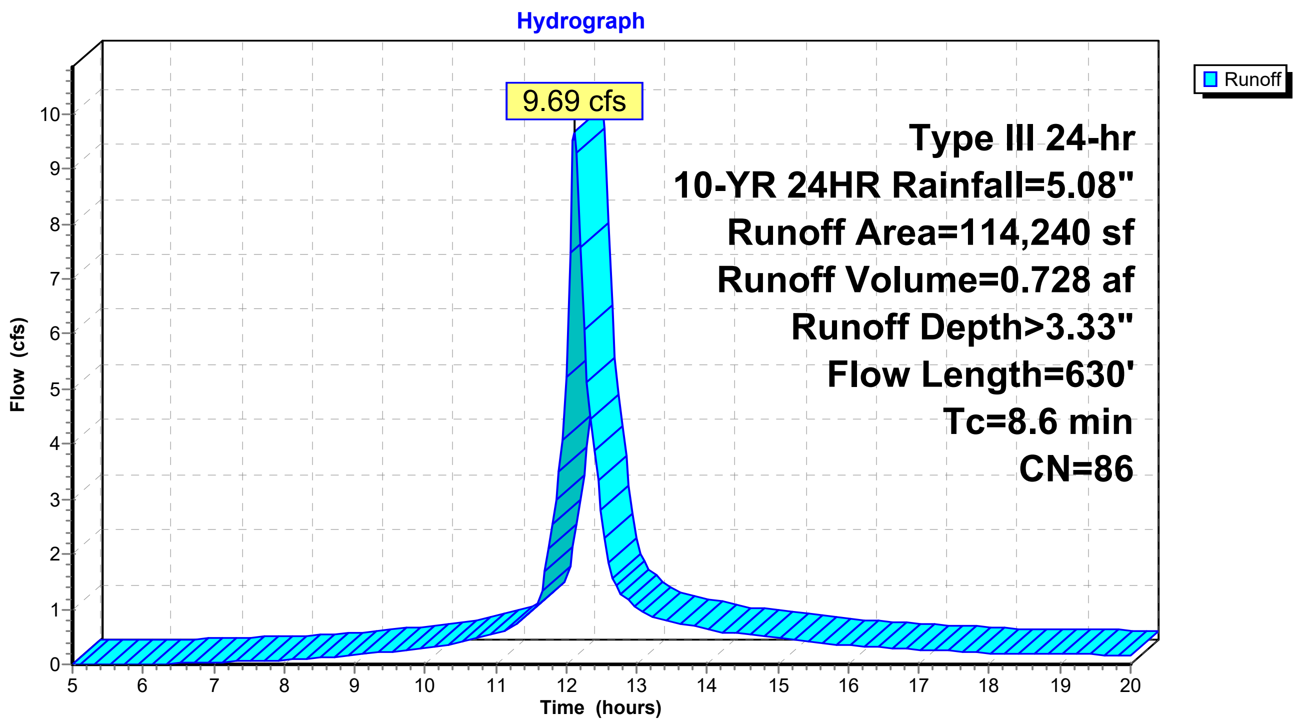
Runoff = 9.69 cfs @ 12.12 hrs, Volume= 0.728 af, Depth> 3.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
114,240	86	<50% Grass cover, Poor, HSG C
114,240		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	320	0.3300	4.02		**Shallow Concentrated Flow, e1 1** Short Grass Pasture Kv= 7.0 fps
7.3	310	0.0050	0.71		**Shallow Concentrated Flow, e1 2** Nearly Bare & Untilled Kv= 10.0 fps
8.6	630	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

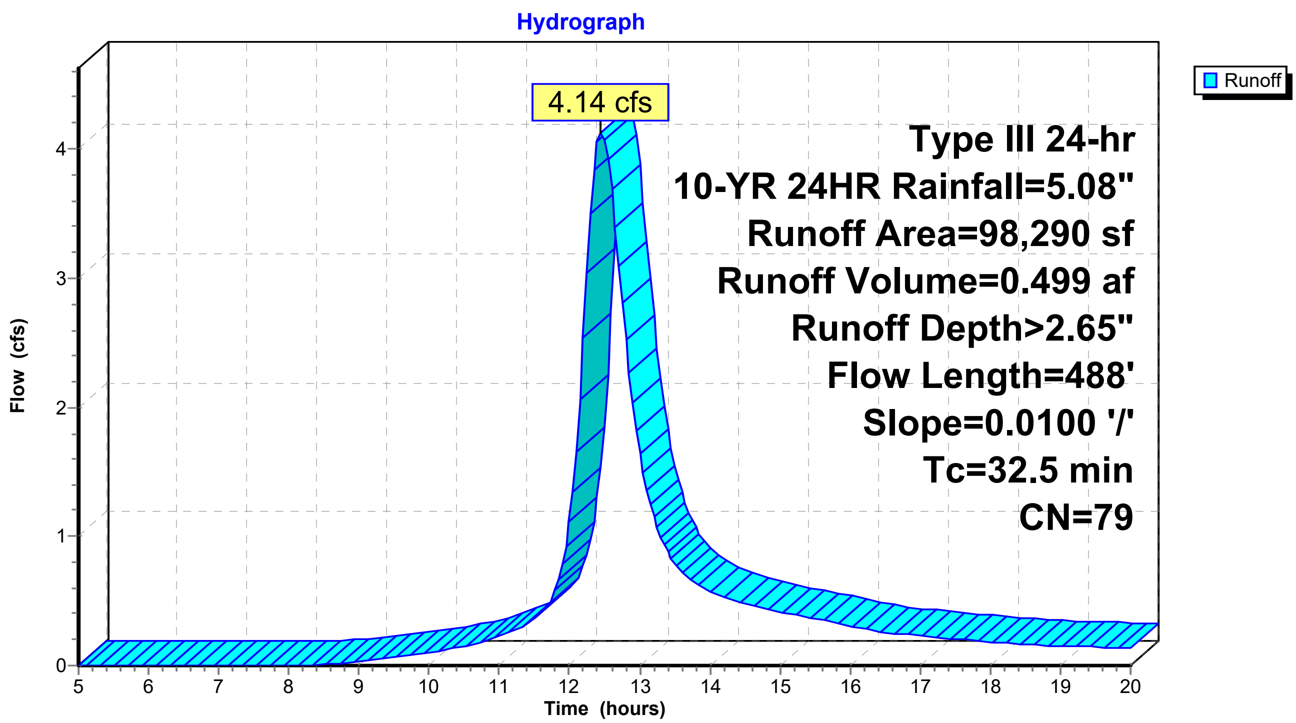
Runoff = 4.14 cfs @ 12.45 hrs, Volume= 0.499 af, Depth> 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
54,000	86	<50% Grass cover, Poor, HSG C
44,290	70	Woods, Good, HSG C
98,290	79	Weighted Average
98,290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.5	488	0.0100	0.25		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps

Subcatchment E-2: E-2



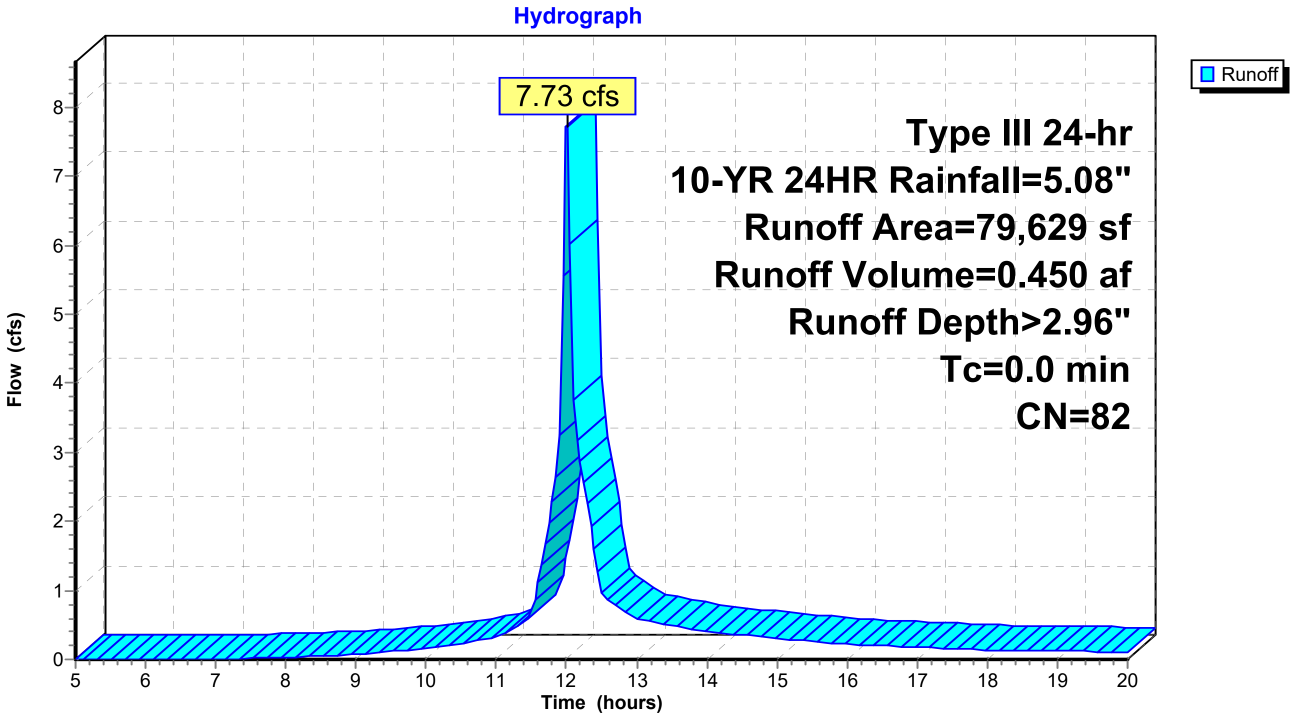
Summary for Subcatchment E-3: E-3

Runoff = 7.73 cfs @ 12.00 hrs, Volume= 0.450 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
59,600	86	<50% Grass cover, Poor, HSG C
20,029	70	Woods, Good, HSG C
79,629	82	Weighted Average
79,629		100.00% Pervious Area

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

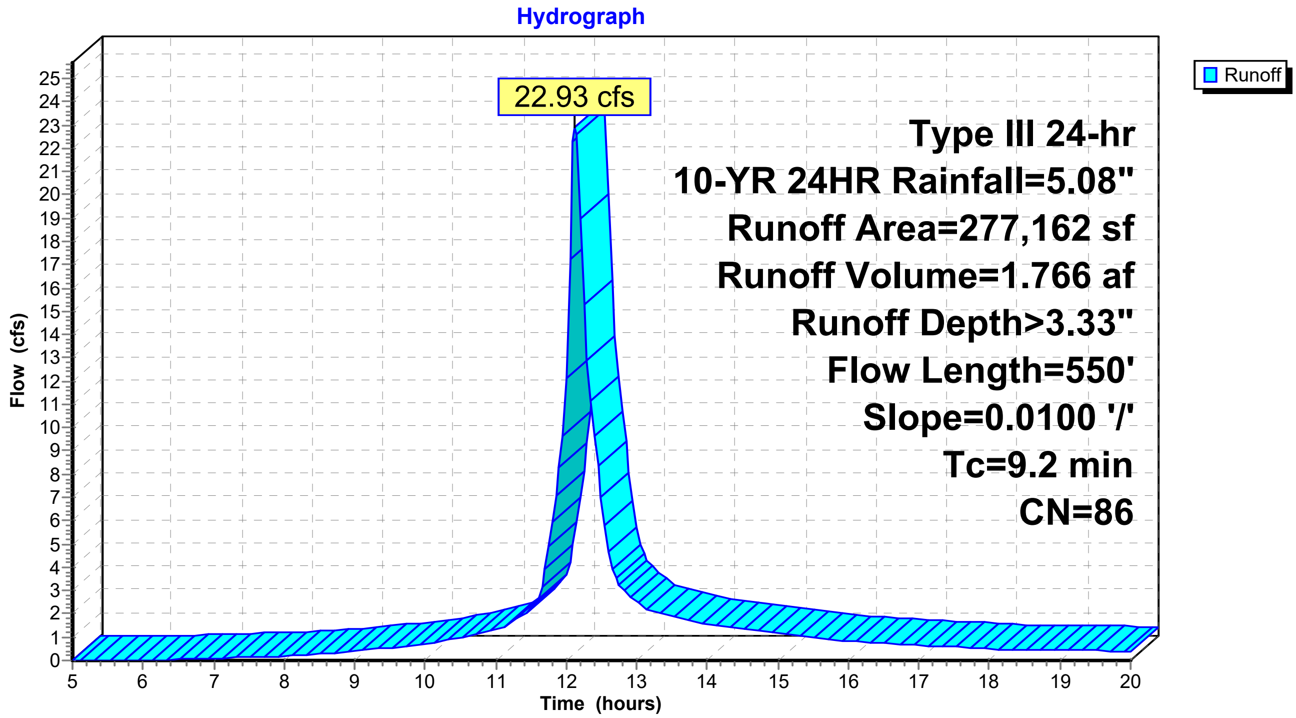
Runoff = 22.93 cfs @ 12.13 hrs, Volume= 1.766 af, Depth> 3.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
277,162	86	<50% Grass cover, Poor, HSG C
277,162		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	550	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment E-4: E-4



Summary for Subcatchment E-5: E-5

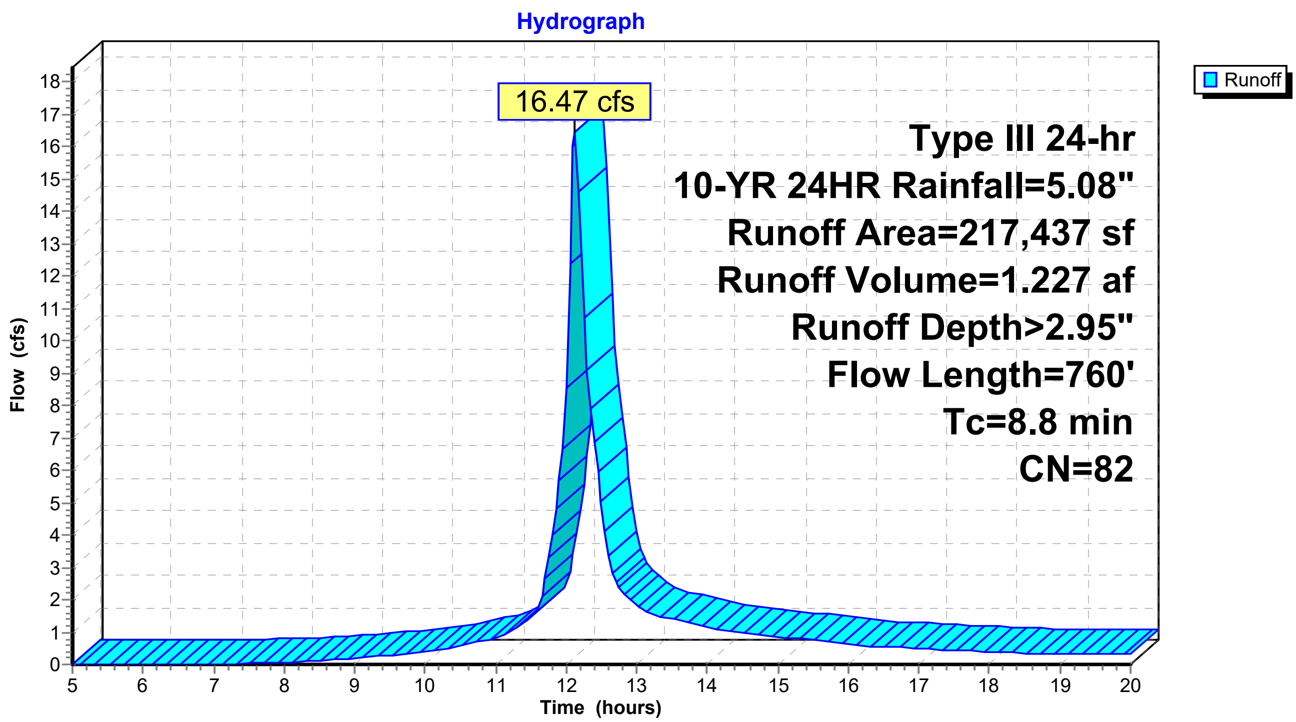
Runoff = 16.47 cfs @ 12.12 hrs, Volume= 1.227 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
76,103	74	>75% Grass cover, Good, HSG C
141,334	86	<50% Grass cover, Poor, HSG C
217,437	82	Weighted Average
217,437		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	310	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.5	450	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
8.8	760	Total			

Subcatchment E-5: E-5



Summary for Subcatchment P-1: P-1

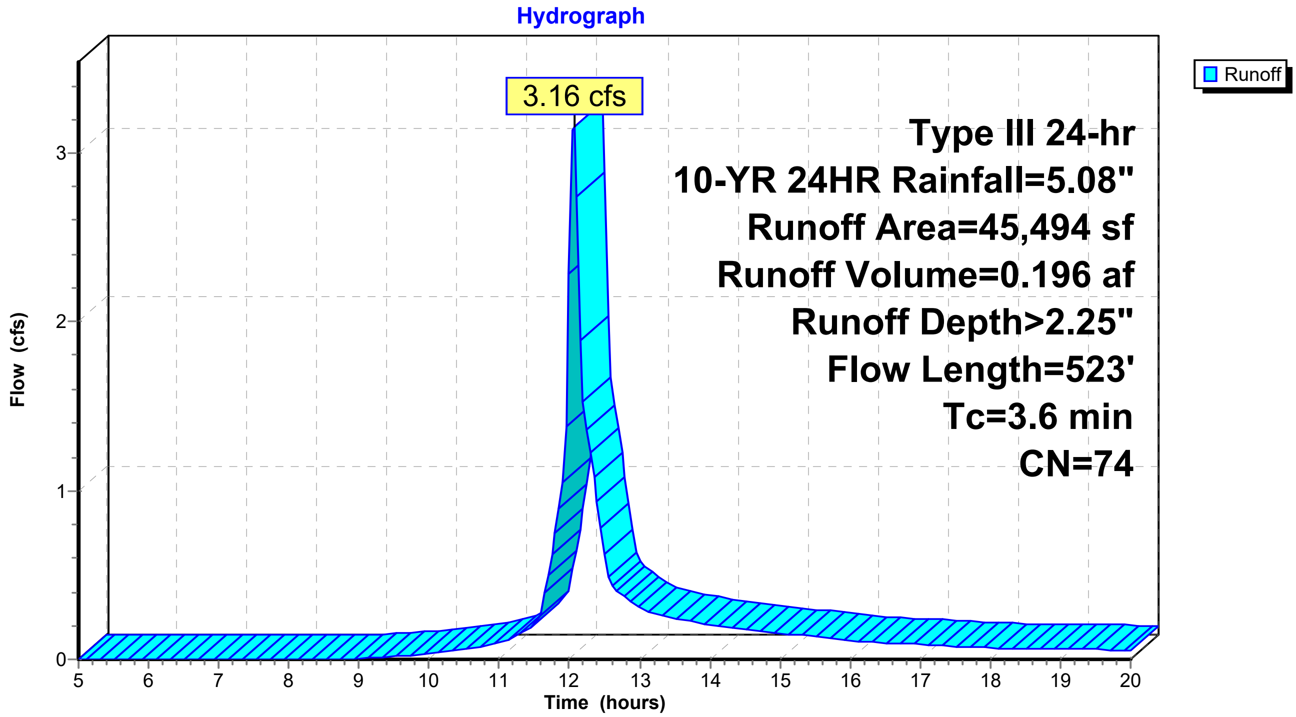
Runoff = 3.16 cfs @ 12.06 hrs, Volume= 0.196 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
45,494	74	>75% Grass cover, Good, HSG C
45,494		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	328	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.2	195	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.6	523	Total			

Subcatchment P-1: P-1



Summary for Subcatchment P-10: P-10

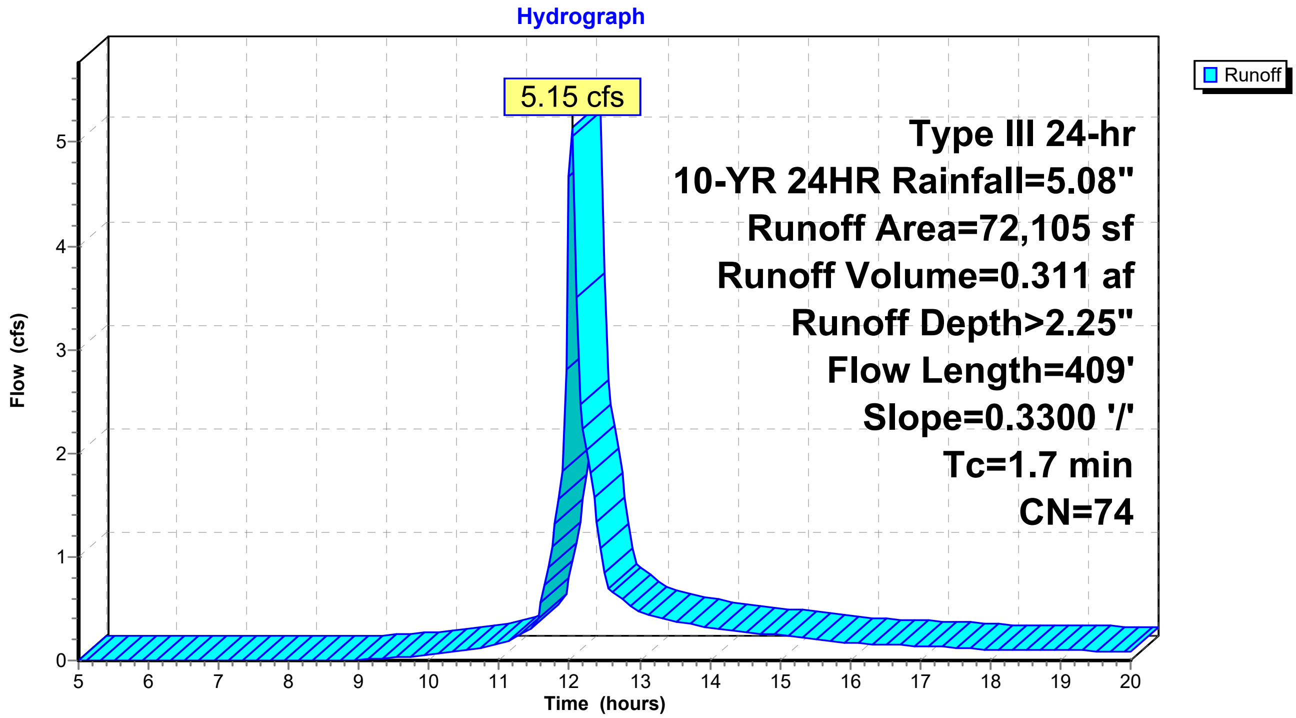
Runoff = 5.15 cfs @ 12.03 hrs, Volume= 0.311 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
72,105	74	>75% Grass cover, Good, HSG C
72,105		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	409	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-10: P-10



Summary for Subcatchment P-11: P-11

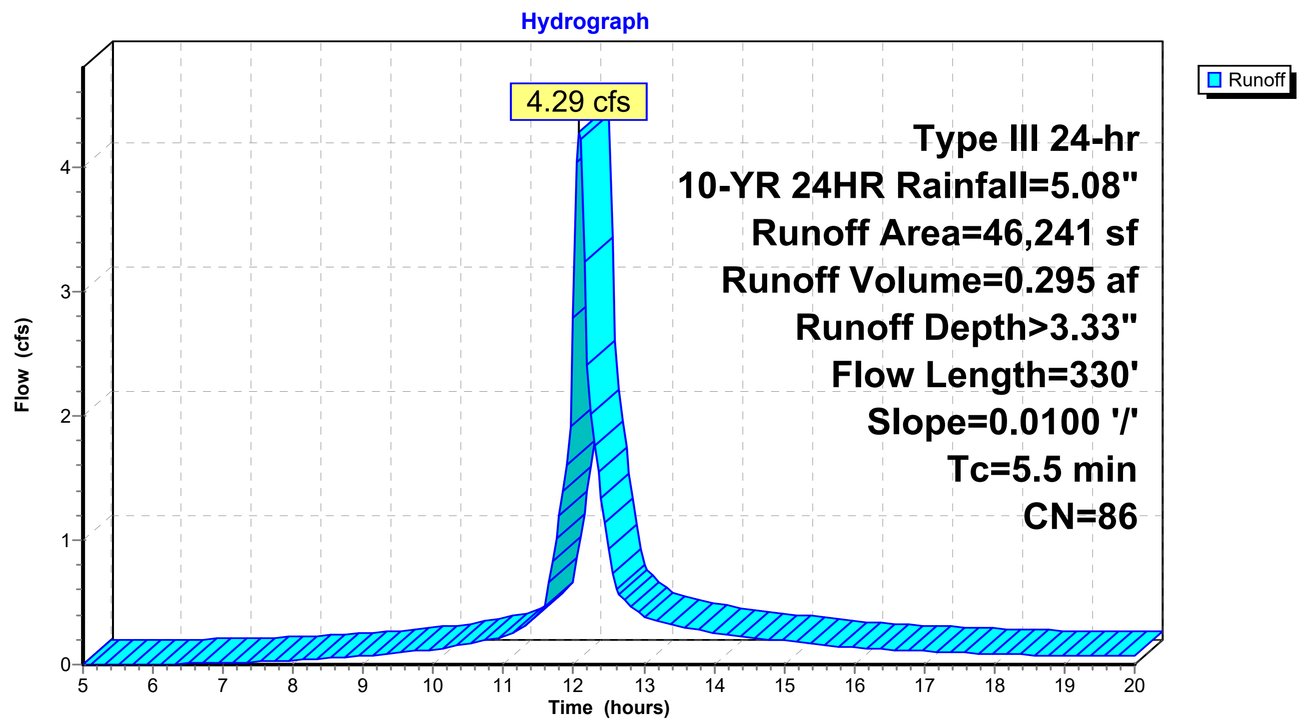
Runoff = 4.29 cfs @ 12.08 hrs, Volume= 0.295 af, Depth> 3.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
46,241	86	<50% Grass cover, Poor, HSG C
46,241		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	330	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment P-11: P-11



Summary for Subcatchment P-2: P-2

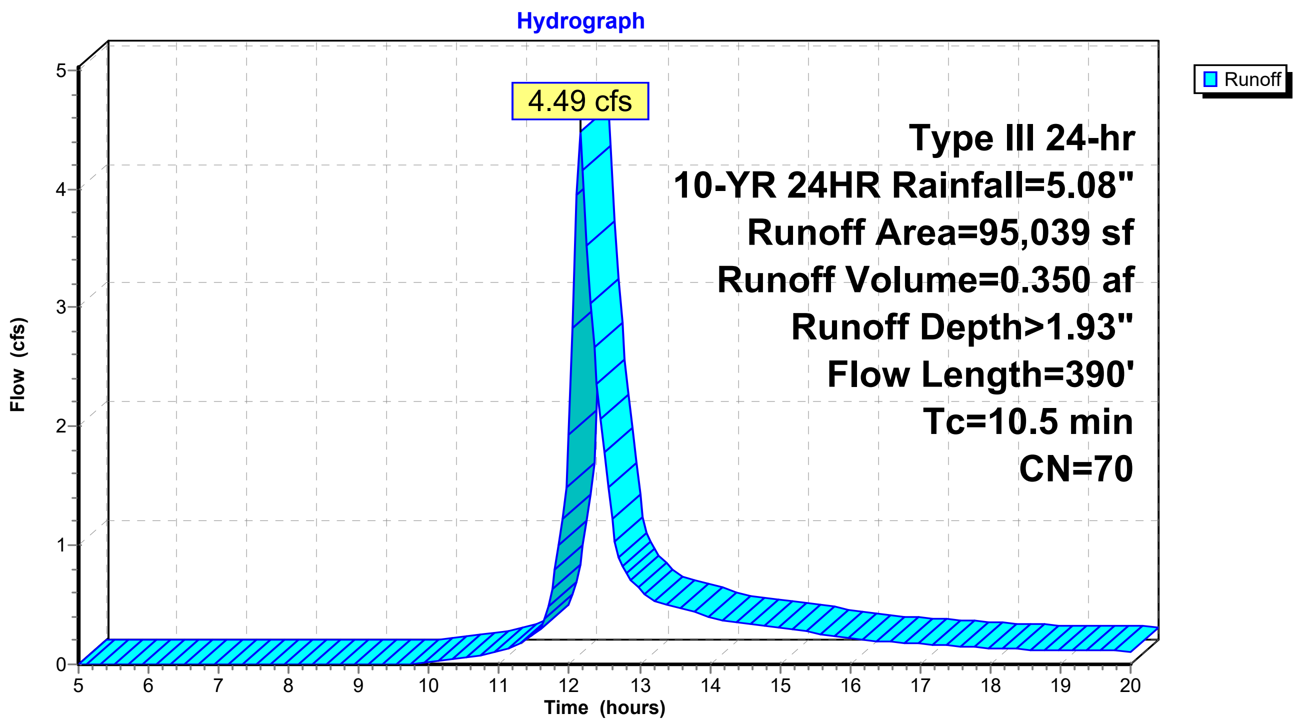
Runoff = 4.49 cfs @ 12.16 hrs, Volume= 0.350 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
95,039	70	Woods, Good, HSG C
95,039		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	110	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.3	280	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.5	390	Total			

Subcatchment P-2: P-2



Summary for Subcatchment P-3: P-3

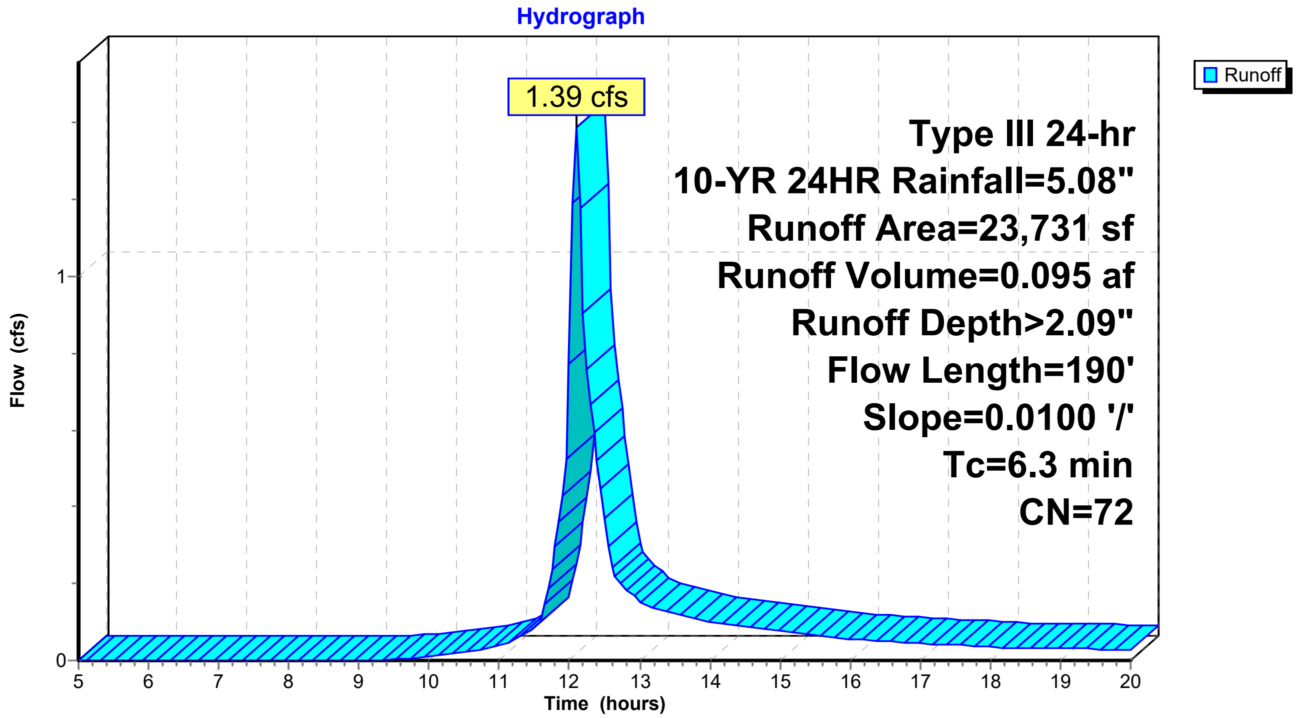
Runoff = 1.39 cfs @ 12.10 hrs, Volume= 0.095 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
23,731	72	Woods/grass comb., Good, HSG C
23,731		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	190	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment P-3: P-3



Summary for Subcatchment P-4: P-4

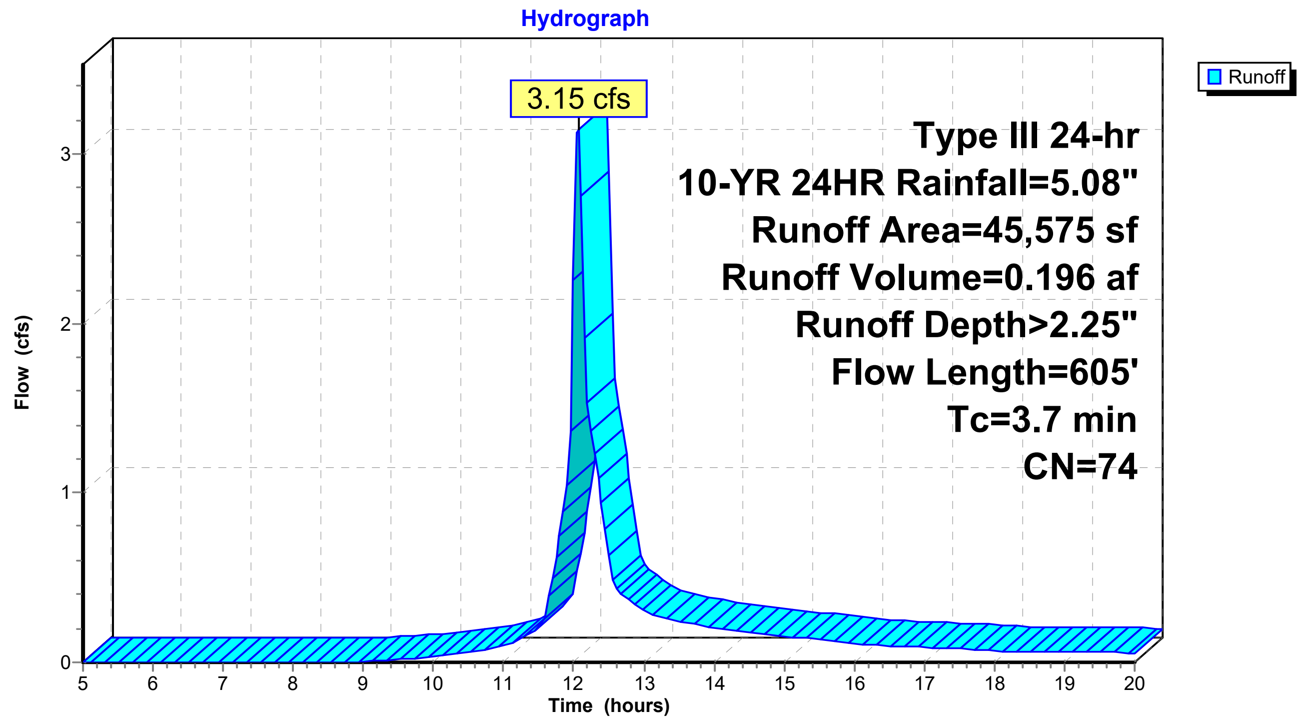
Runoff = 3.15 cfs @ 12.06 hrs, Volume= 0.196 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
45,575	74	>75% Grass cover, Good, HSG C
45,575		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	45	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.5	560	0.0100	2.70	10.78	**Trap/Vee/Rect Channel Flow, bench swale** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.040 Earth, cobble bottom, clean sides
3.7	605	Total			

Subcatchment P-4: P-4



Summary for Subcatchment P-5: P-5

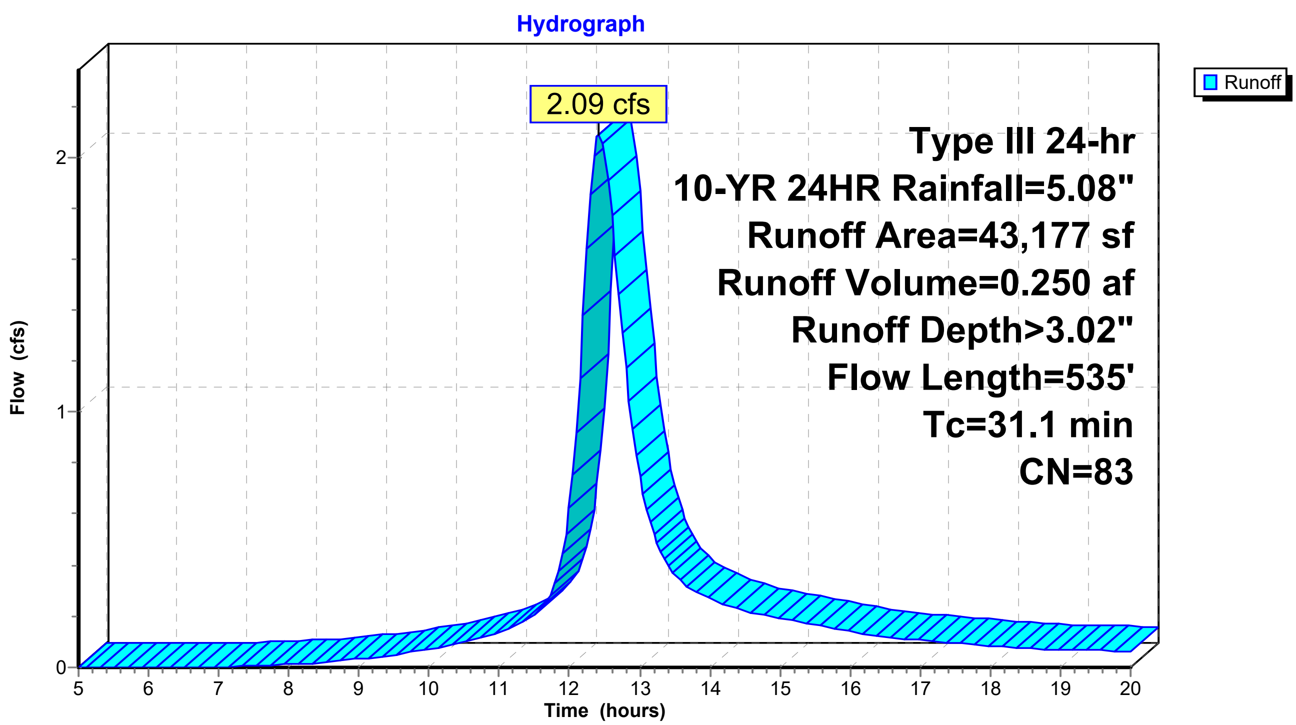
Runoff = 2.09 cfs @ 12.42 hrs, Volume= 0.250 af, Depth> 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
22,177	79	50-75% Grass cover, Fair, HSG C
21,000	87	Dirt roads, HSG C
43,177	83	Weighted Average
43,177		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	35	0.3000	0.28		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
29.0	500	0.0030	0.29	4.60	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=2.00' Z= 3.0 '/' Top.W=14.00' n= 0.300
31.1	535	Total			

Subcatchment P-5: P-5



Summary for Subcatchment P-6: P-6

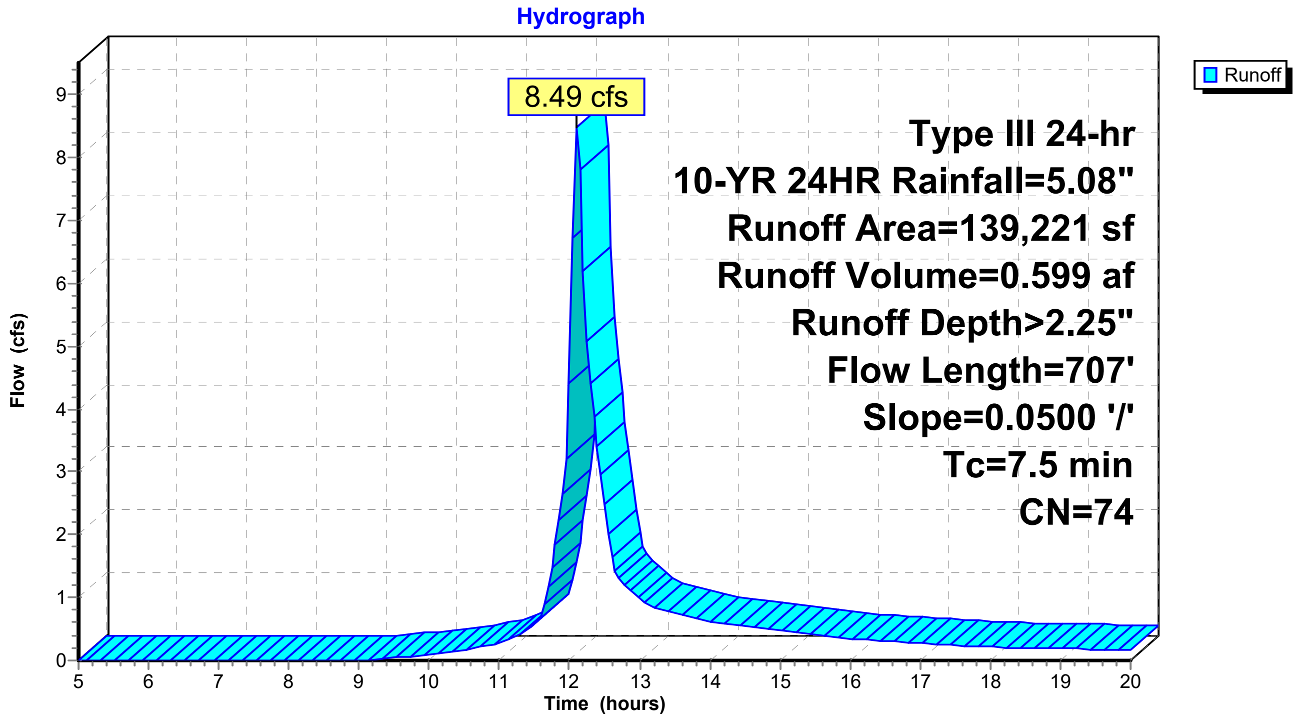
Runoff = 8.49 cfs @ 12.11 hrs, Volume= 0.599 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
139,221	74	>75% Grass cover, Good, HSG C
139,221		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	707	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-6: P-6



Summary for Subcatchment P-7: P-7

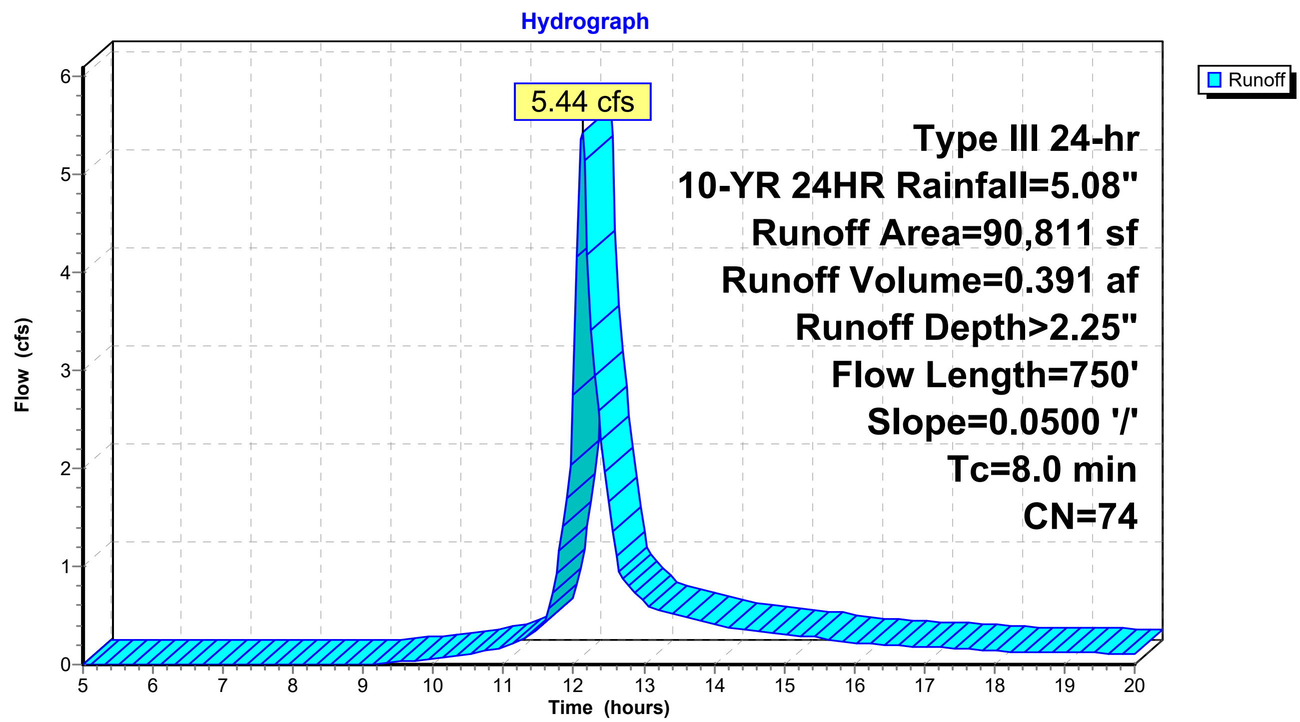
Runoff = 5.44 cfs @ 12.12 hrs, Volume= 0.391 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
90,811	74	>75% Grass cover, Good, HSG C
90,811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	750	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-7: P-7



Summary for Subcatchment P-8: P-8

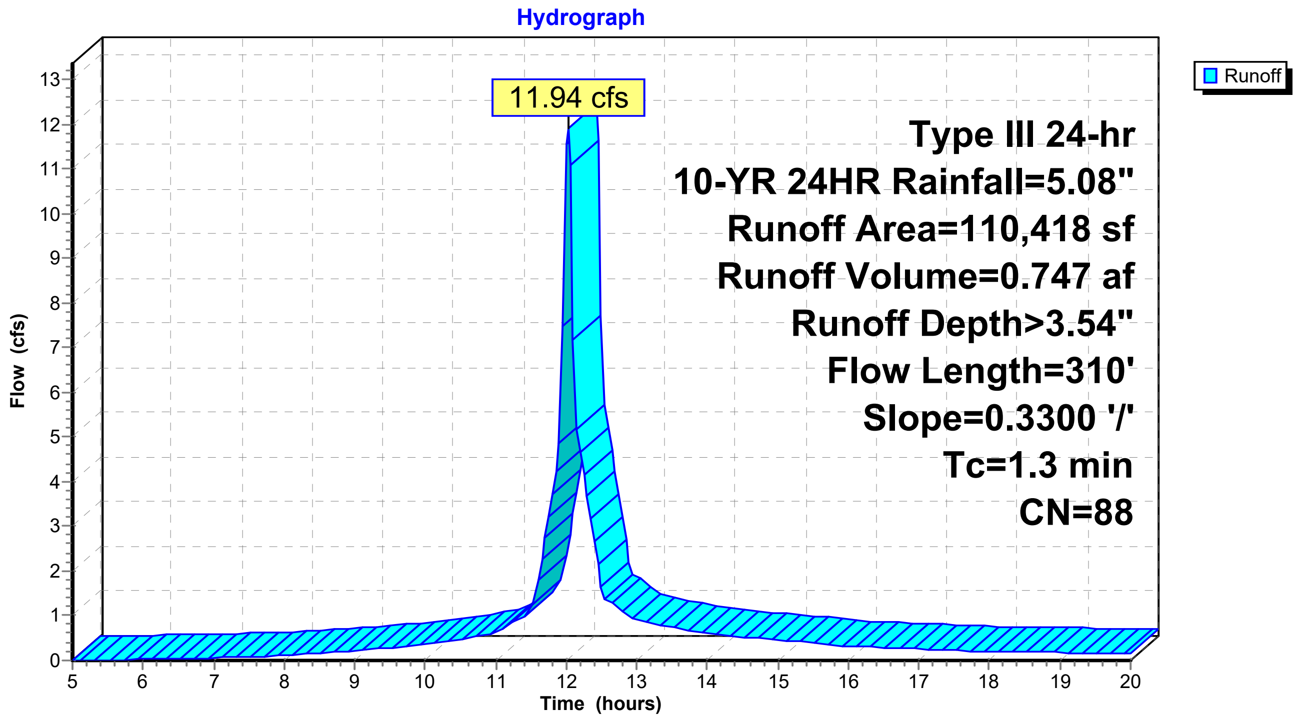
Runoff = 11.94 cfs @ 12.02 hrs, Volume= 0.747 af, Depth> 3.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
45,474	74	>75% Grass cover, Good, HSG C
9,735	96	Gravel surface, HSG C
55,209	98	Water Surface, HSG C
110,418	88	Weighted Average
55,209		50.00% Pervious Area
55,209		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	110	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	200		4.01		**Lake or Reservoir,** Mean Depth= 0.50'
1.3	310	Total			

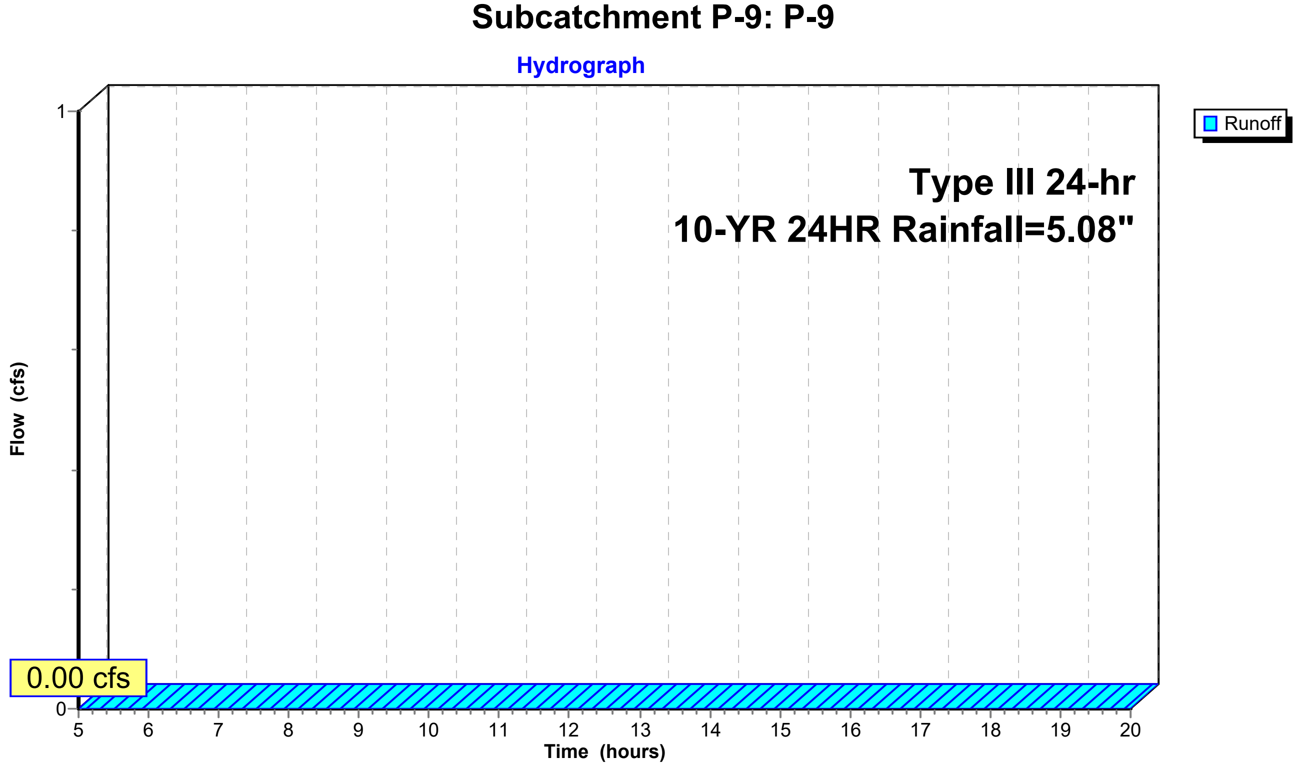
Subcatchment P-8: P-8



Summary for Subcatchment P-9: P-9

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"



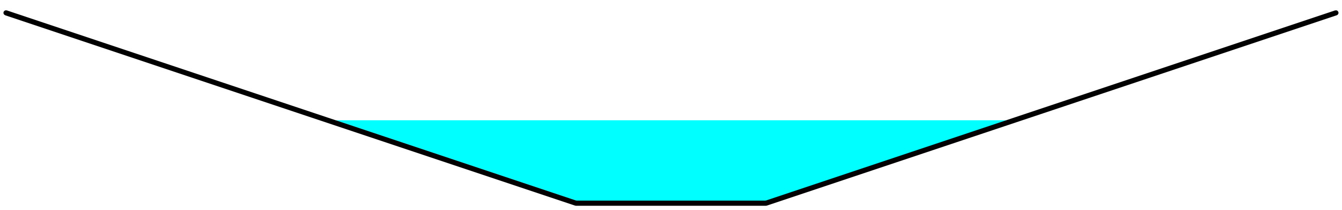
Summary for Reach Bench swale: Bench swale

Inflow Area = 1.046 ac, 0.00% Impervious, Inflow Depth > 2.25" for 10-YR 24HR event
Inflow = 3.15 cfs @ 12.06 hrs, Volume= 0.196 af
Outflow = 1.31 cfs @ 12.76 hrs, Volume= 0.188 af, Atten= 58%, Lag= 41.9 min

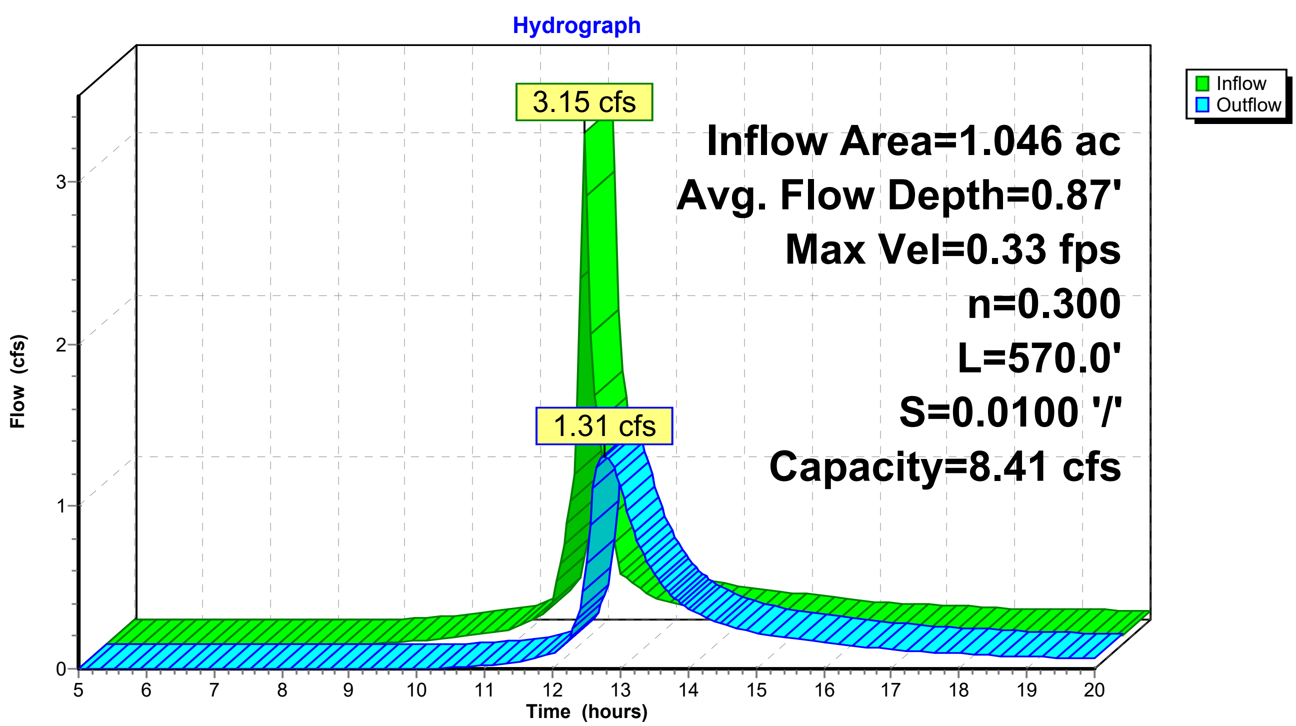
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.33 fps, Min. Travel Time= 29.1 min
Avg. Velocity = 0.16 fps, Avg. Travel Time= 57.7 min

Peak Storage= 2,293 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 8.41 cfs

2.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 570.0' Slope= 0.0100 '/'
Inlet Invert= 116.20', Outlet Invert= 110.50'



Reach Bench swale: Bench swale



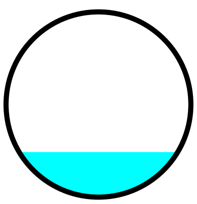
Summary for Reach Drop Pipe: Drop Pipe

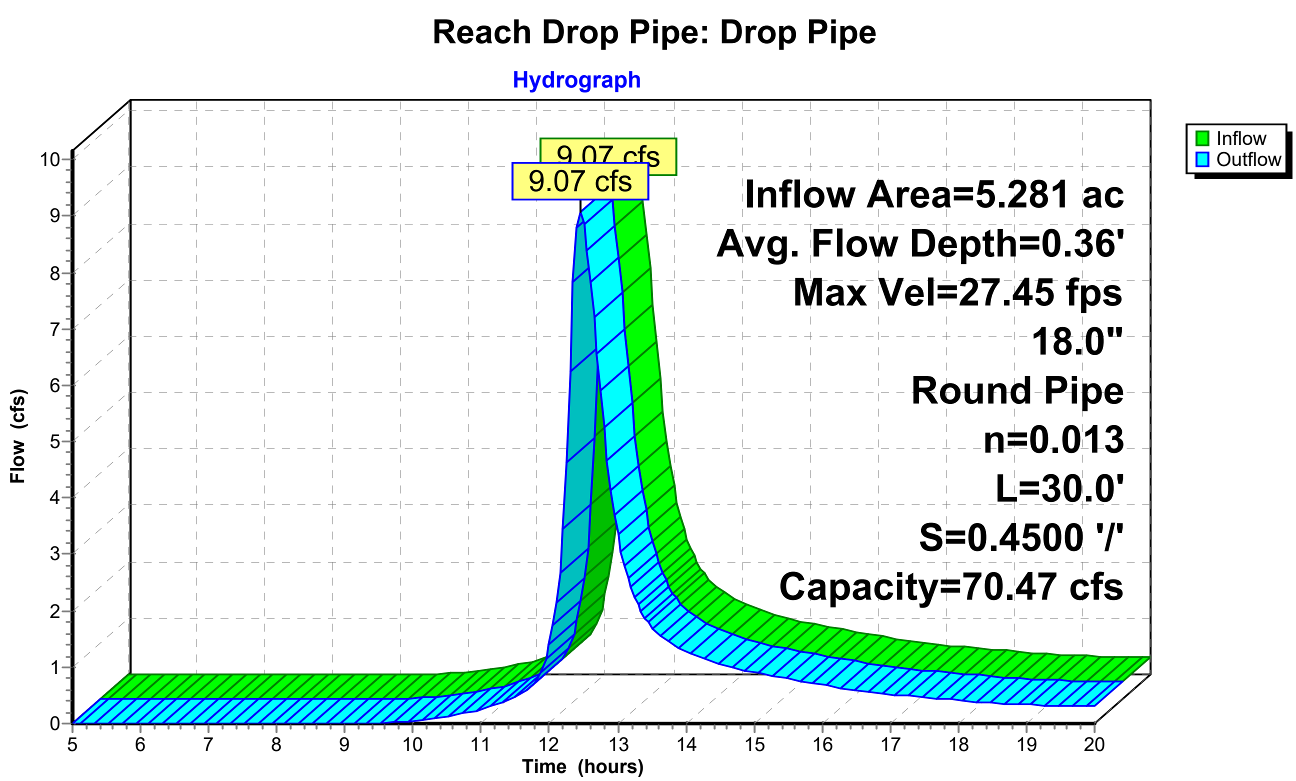
Inflow Area = 5.281 ac, 0.00% Impervious, Inflow Depth > 2.21" for 10-YR 24HR event
Inflow = 9.07 cfs @ 12.45 hrs, Volume= 0.973 af
Outflow = 9.07 cfs @ 12.45 hrs, Volume= 0.972 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 27.45 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 12.48 fps, Avg. Travel Time= 0.0 min

Peak Storage= 10 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 70.47 cfs

18.0" Round Pipe
n= 0.013
Length= 30.0' Slope= 0.4500 '/'
Inlet Invert= 122.00', Outlet Invert= 108.50'



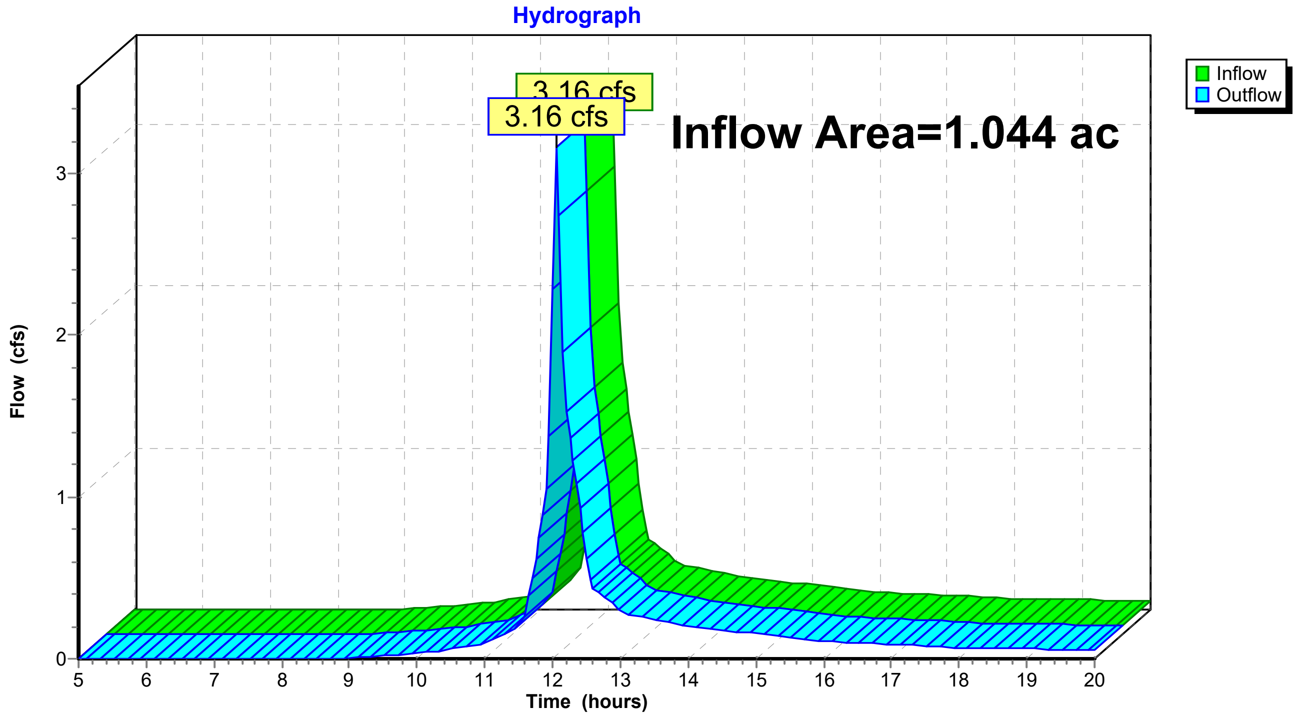


Summary for Reach REACH 1: Reach 1

Inflow Area = 1.044 ac, 0.00% Impervious, Inflow Depth > 2.25" for 10-YR 24HR event
Inflow = 3.16 cfs @ 12.06 hrs, Volume= 0.196 af
Outflow = 3.16 cfs @ 12.06 hrs, Volume= 0.196 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 1: Reach 1

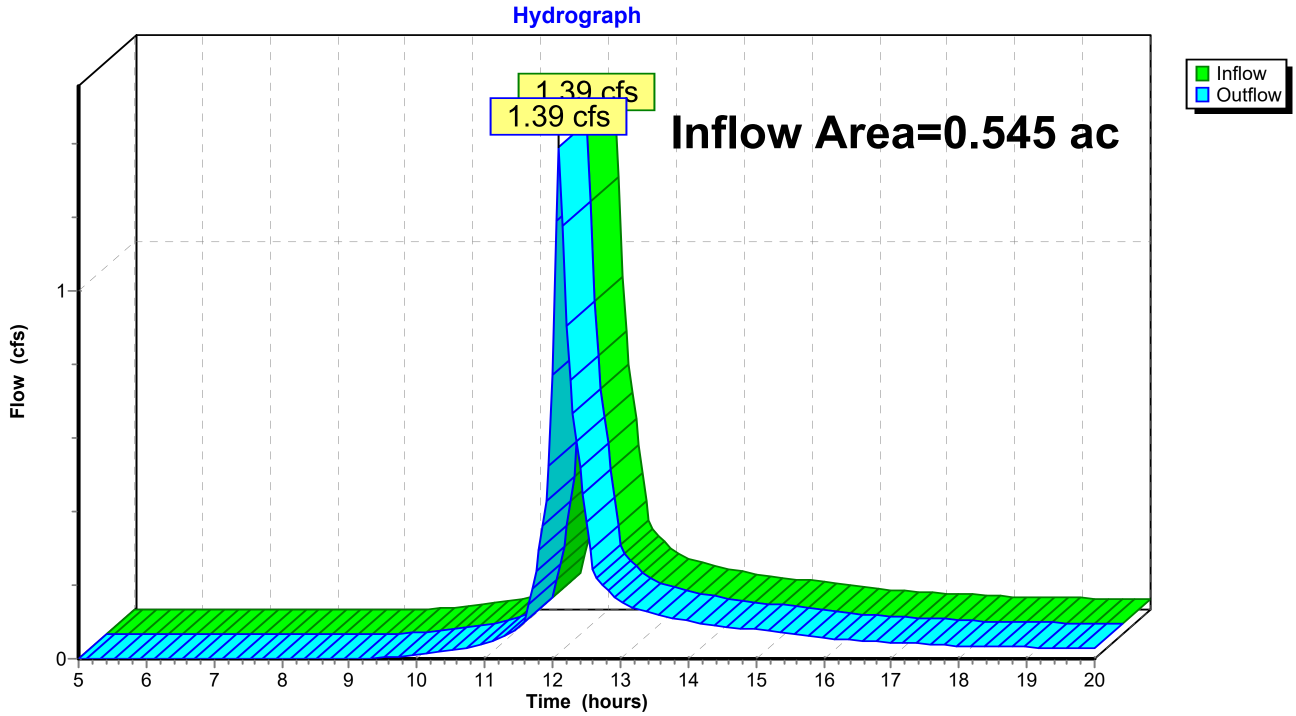


Summary for Reach REACH 3: Reach 3

Inflow Area = 0.545 ac, 0.00% Impervious, Inflow Depth > 2.09" for 10-YR 24HR event
Inflow = 1.39 cfs @ 12.10 hrs, Volume= 0.095 af
Outflow = 1.39 cfs @ 12.10 hrs, Volume= 0.095 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

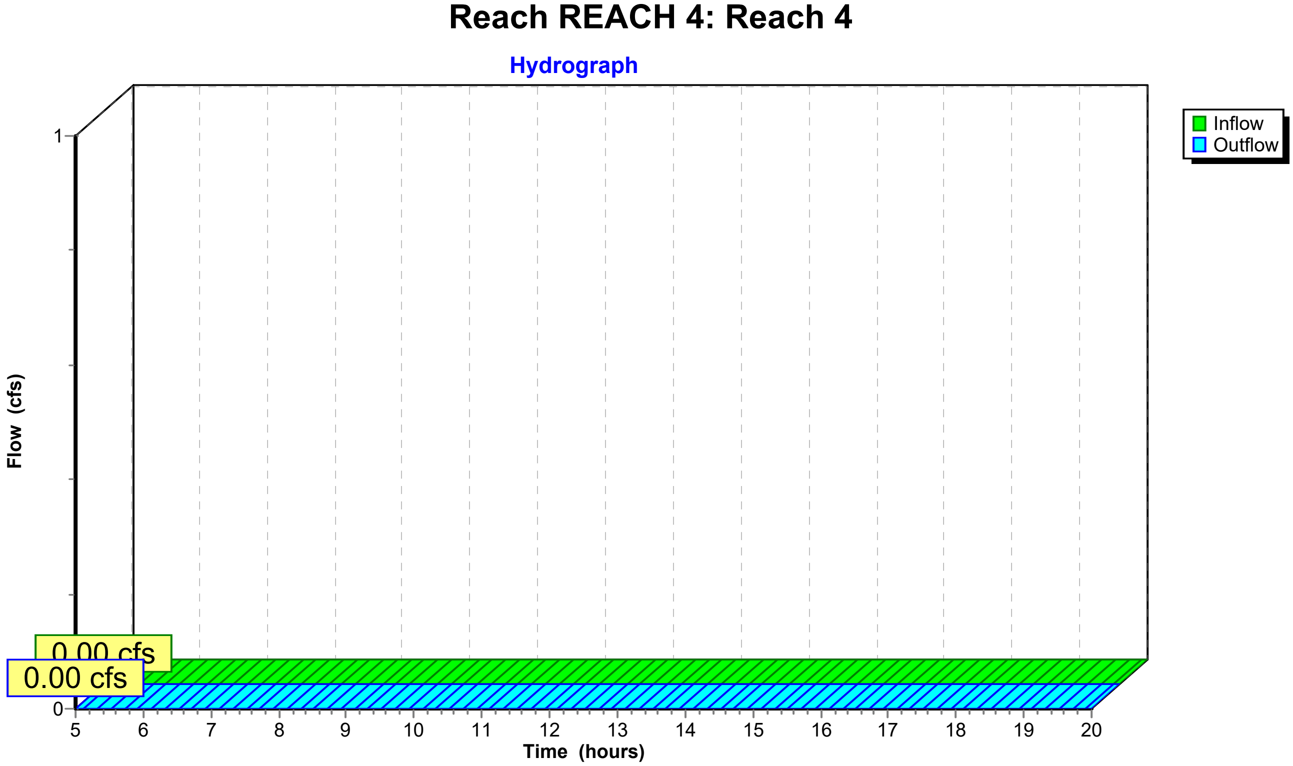
Reach REACH 3: Reach 3



Summary for Reach REACH 4: Reach 4

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

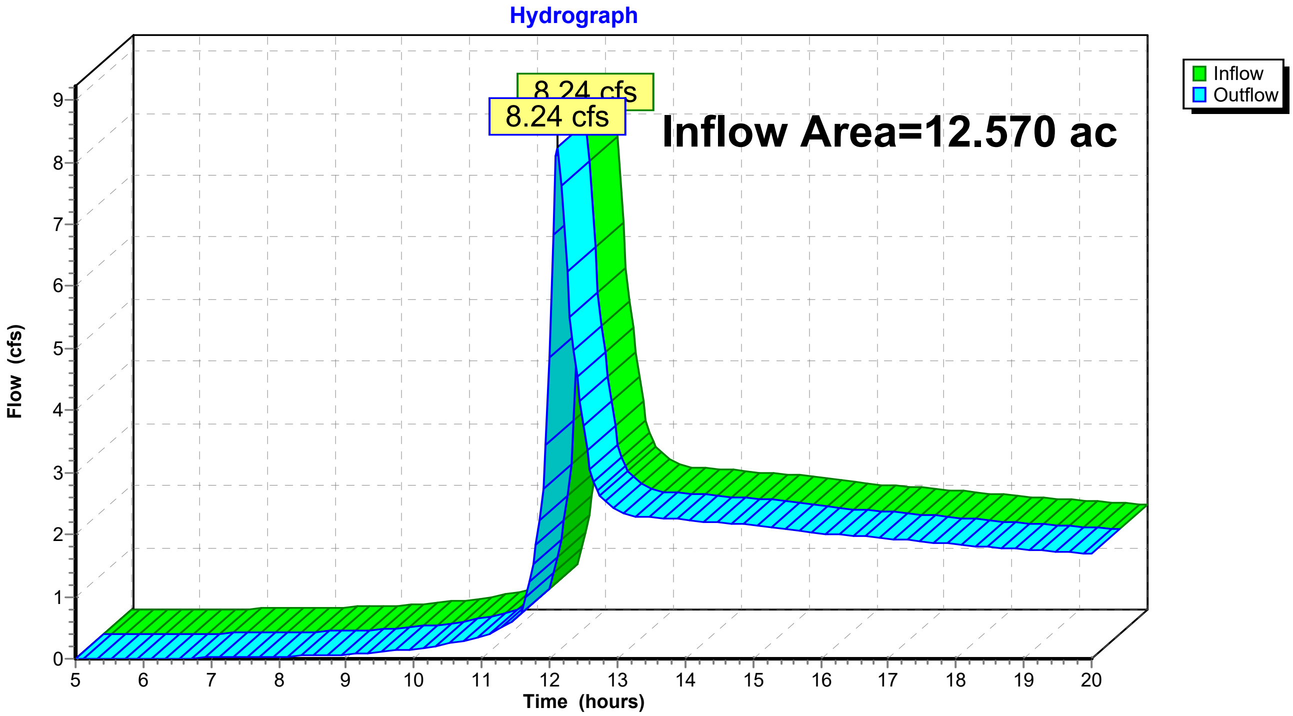


Summary for Reach REACH 5: Reach 5

Inflow Area =	12.570 ac,	10.08% Impervious,	Inflow Depth > 1.57"	for 10-YR 24HR event	
Inflow =	8.24 cfs @	12.12 hrs,	Volume=	1.649 af	
Outflow =	8.24 cfs @	12.12 hrs,	Volume=	1.649 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 5: Reach 5

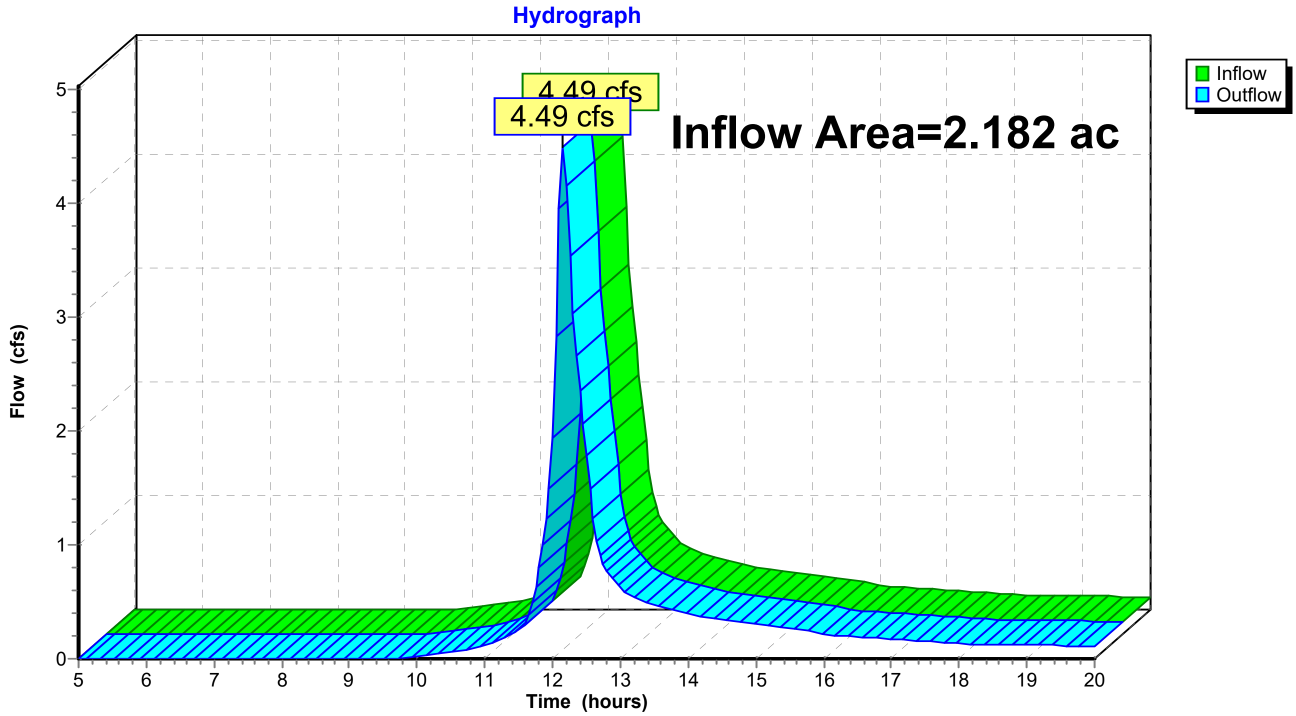


Summary for Reach REACH2: Reach2

Inflow Area = 2.182 ac, 0.00% Impervious, Inflow Depth > 1.93" for 10-YR 24HR event
Inflow = 4.49 cfs @ 12.16 hrs, Volume= 0.350 af
Outflow = 4.49 cfs @ 12.16 hrs, Volume= 0.350 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH2: Reach2



Summary for Reach Road Swale: Road Swale

Inflow Area = 2.037 ac, 0.00% Impervious, Inflow Depth > 2.58" for 10-YR 24HR event
Inflow = 2.89 cfs @ 12.61 hrs, Volume= 0.438 af
Outflow = 2.04 cfs @ 13.54 hrs, Volume= 0.415 af, Atten= 29%, Lag= 55.4 min

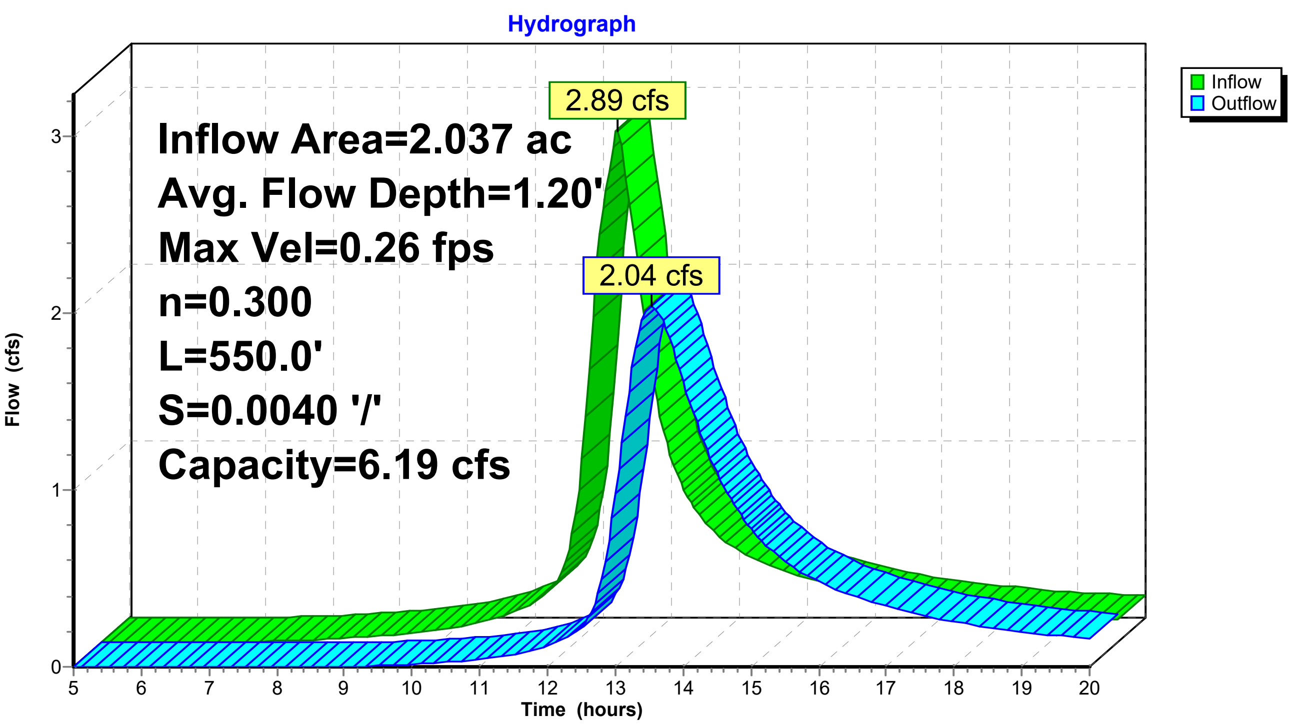
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.26 fps, Min. Travel Time= 35.5 min
Avg. Velocity = 0.13 fps, Avg. Travel Time= 71.2 min

Peak Storage= 4,344 cf @ 12.95 hrs
Average Depth at Peak Storage= 1.20'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 6.19 cfs

3.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 550.0' Slope= 0.0040 '/'
Inlet Invert= 110.50', Outlet Invert= 108.30'

‡

Reach Road Swale: Road Swale



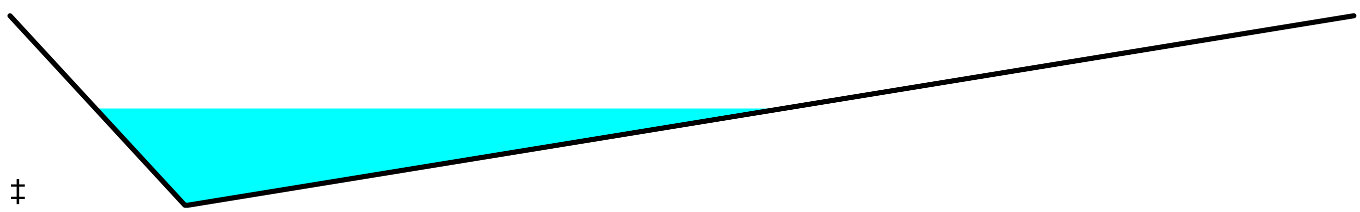
Summary for Reach So. Plateau Swale: So. Plateau Swale

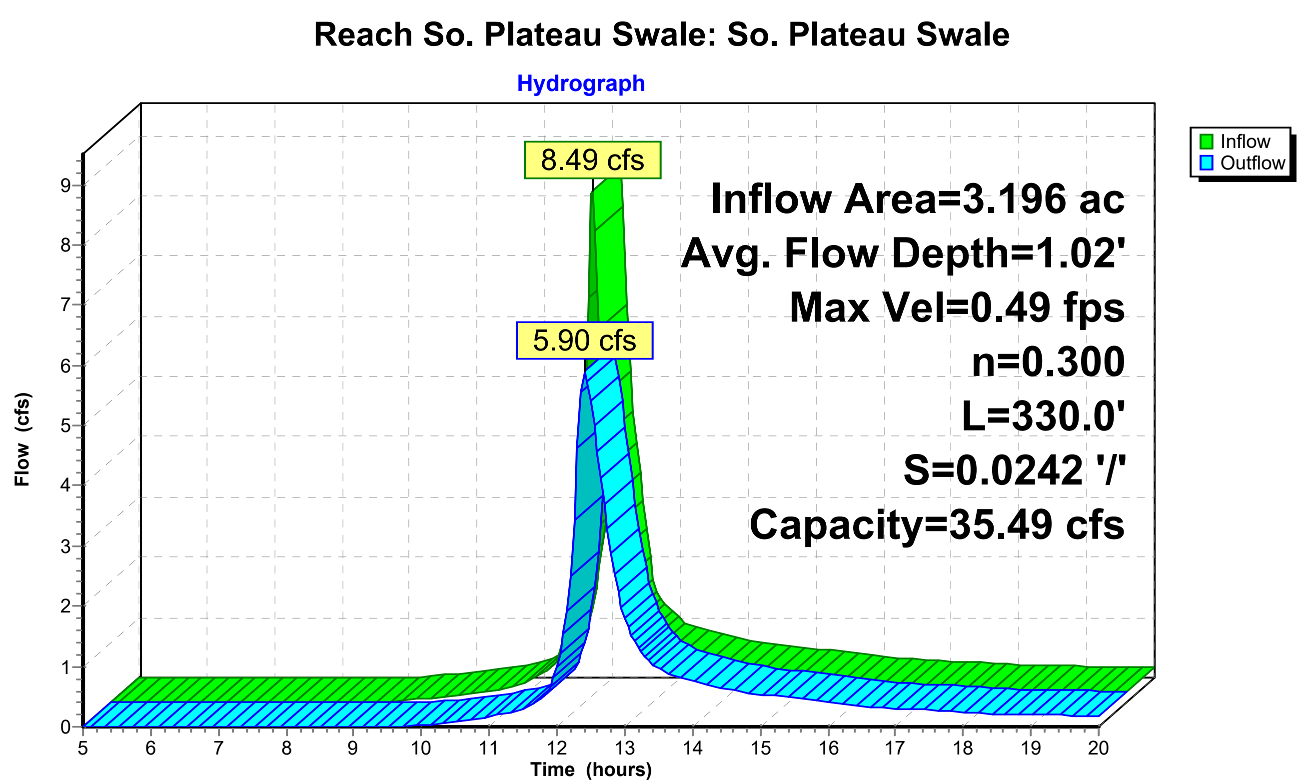
Inflow Area = 3.196 ac, 0.00% Impervious, Inflow Depth > 2.25" for 10-YR 24HR event
Inflow = 8.49 cfs @ 12.11 hrs, Volume= 0.599 af
Outflow = 5.90 cfs @ 12.41 hrs, Volume= 0.590 af, Atten= 31%, Lag= 17.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.49 fps, Min. Travel Time= 11.2 min
Avg. Velocity = 0.24 fps, Avg. Travel Time= 22.7 min

Peak Storage= 3,991 cf @ 12.22 hrs
Average Depth at Peak Storage= 1.02'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 35.49 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 20.0 '/' Top Width= 46.10'
Length= 330.0' Slope= 0.0242 '/'
Inlet Invert= 130.00', Outlet Invert= 122.00'





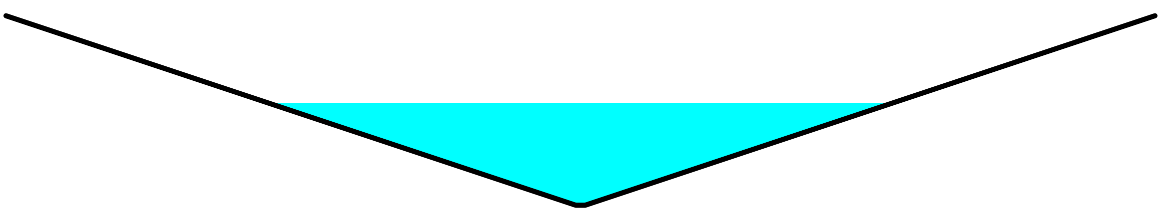
Summary for Reach Stone swale: stone swale

Inflow Area = 1.655 ac, 0.00% Impervious, Inflow Depth > 2.25" for 10-YR 24HR event
Inflow = 5.15 cfs @ 12.03 hrs, Volume= 0.311 af
Outflow = 4.07 cfs @ 12.17 hrs, Volume= 0.309 af, Atten= 21%, Lag= 8.2 min

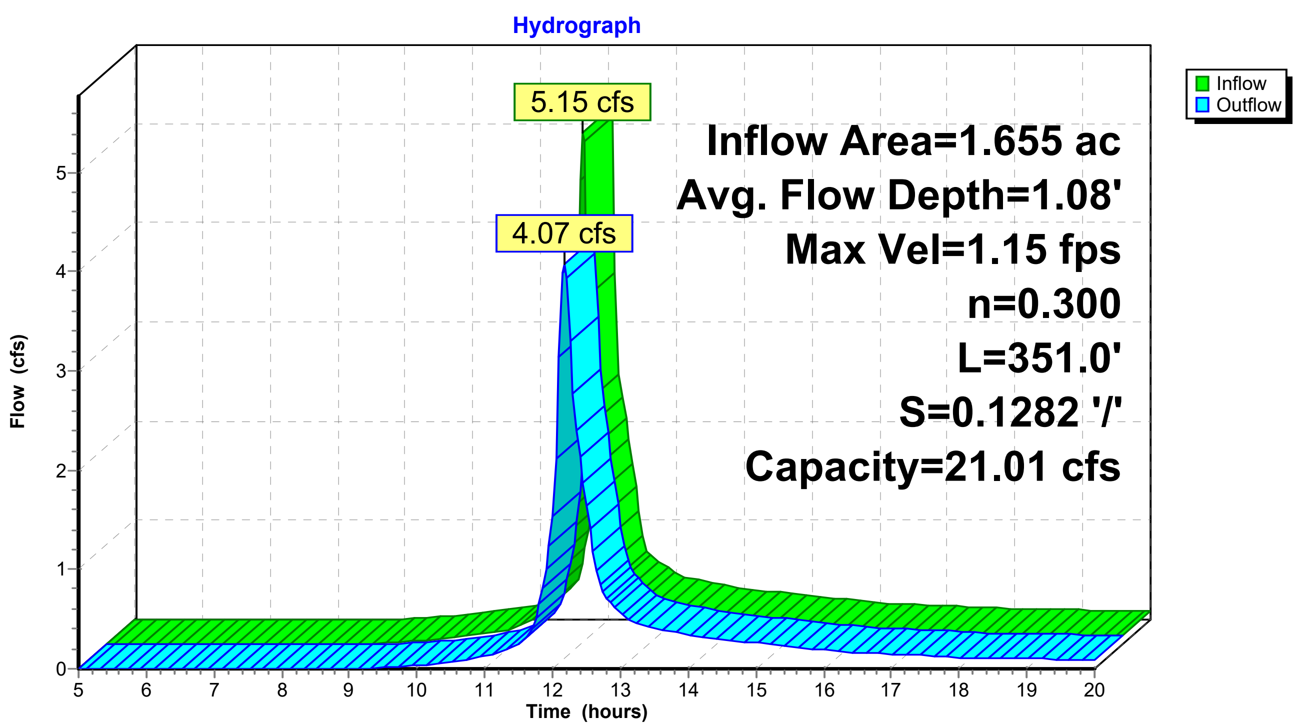
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.15 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 0.53 fps, Avg. Travel Time= 11.1 min

Peak Storage= 1,269 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.08'
Bank-Full Depth= 2.00' Flow Area= 12.2 sf, Capacity= 21.01 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 12.10'
Length= 351.0' Slope= 0.1282 '/'
Inlet Invert= 155.00', Outlet Invert= 110.00'



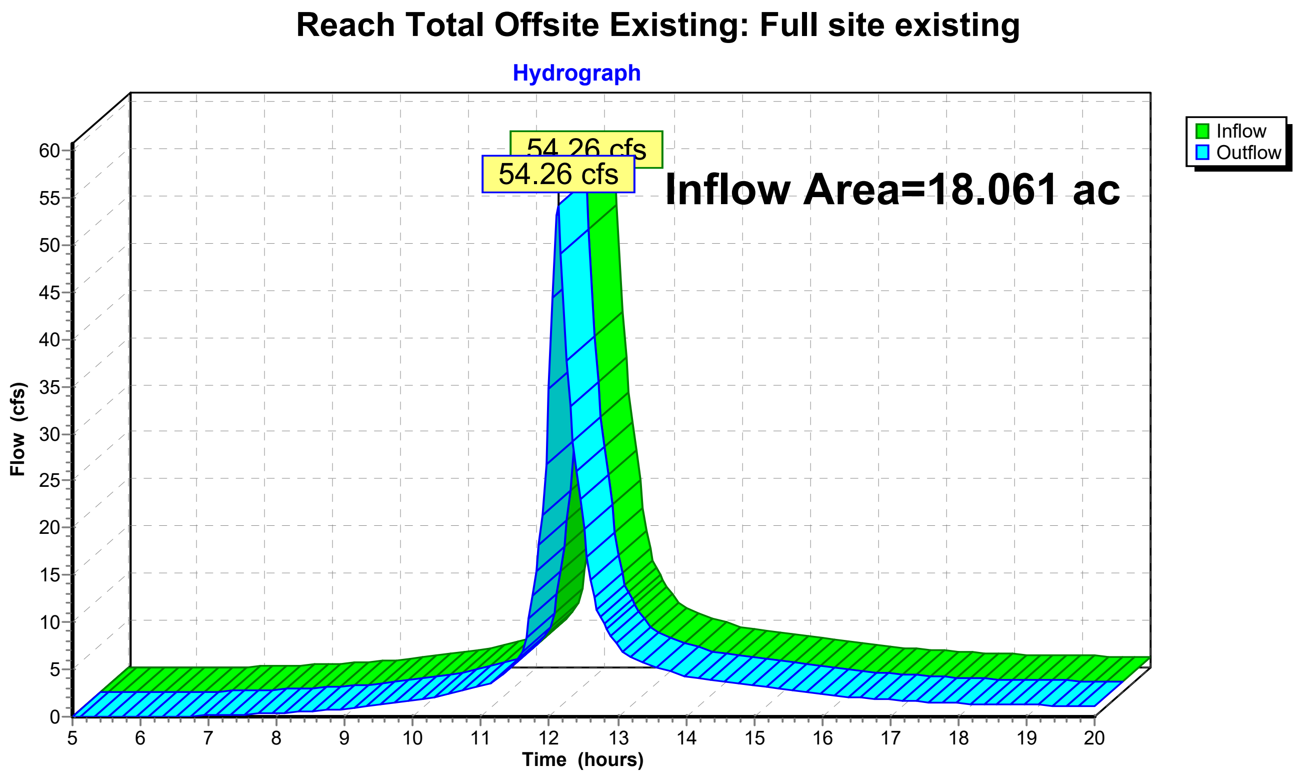
Reach Stone swale: stone swale



Summary for Reach Total Offsite Existing: Full site existing

Inflow Area =	18.061 ac,	0.00% Impervious, Inflow Depth > 3.10"	for 10-YR 24HR event	
Inflow =	54.26 cfs @	12.12 hrs, Volume=	4.671 af	
Outflow =	54.26 cfs @	12.12 hrs, Volume=	4.671 af,	Atten= 0%, Lag= 0.0 min

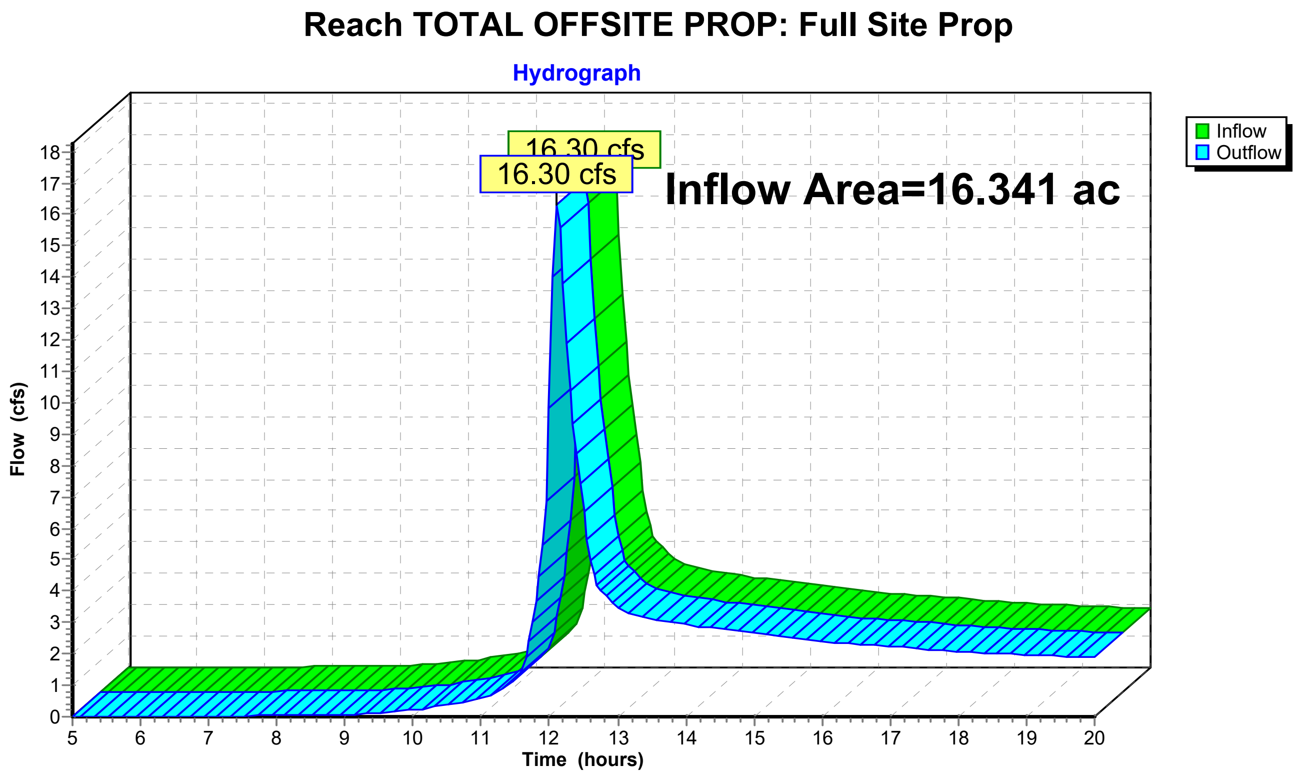
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



Summary for Reach TOTAL OFFSITE PROP: Full Site Prop

Inflow Area =	16.341 ac,	7.76% Impervious, Inflow Depth > 1.68"	for 10-YR 24HR event	
Inflow =	16.30 cfs @	12.11 hrs, Volume=	2.290 af	
Outflow =	16.30 cfs @	12.11 hrs, Volume=	2.290 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



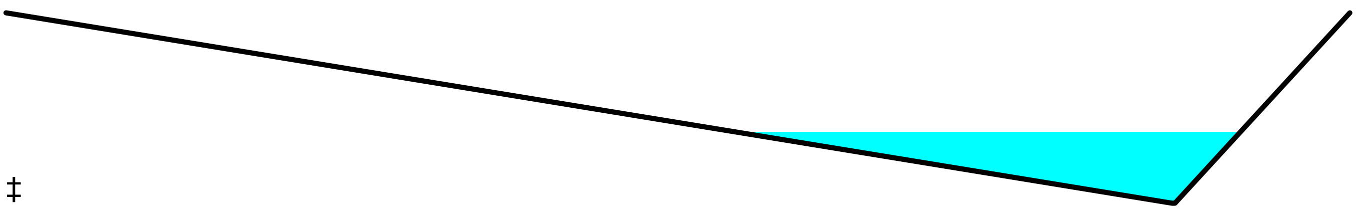
Summary for Reach West Plateau Swale: West Plateau Swale

Inflow Area = 2.085 ac, 0.00% Impervious, Inflow Depth > 2.25" for 10-YR 24HR event
Inflow = 5.44 cfs @ 12.12 hrs, Volume= 0.391 af
Outflow = 3.45 cfs @ 12.51 hrs, Volume= 0.383 af, Atten= 37%, Lag= 23.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.53 fps, Min. Travel Time= 15.1 min
Avg. Velocity = 0.27 fps, Avg. Travel Time= 29.8 min

Peak Storage= 3,123 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 46.67 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 20.0 3.0 '/' Top Width= 46.10'
Length= 477.0' Slope= 0.0419 '/'
Inlet Invert= 142.00', Outlet Invert= 122.00'



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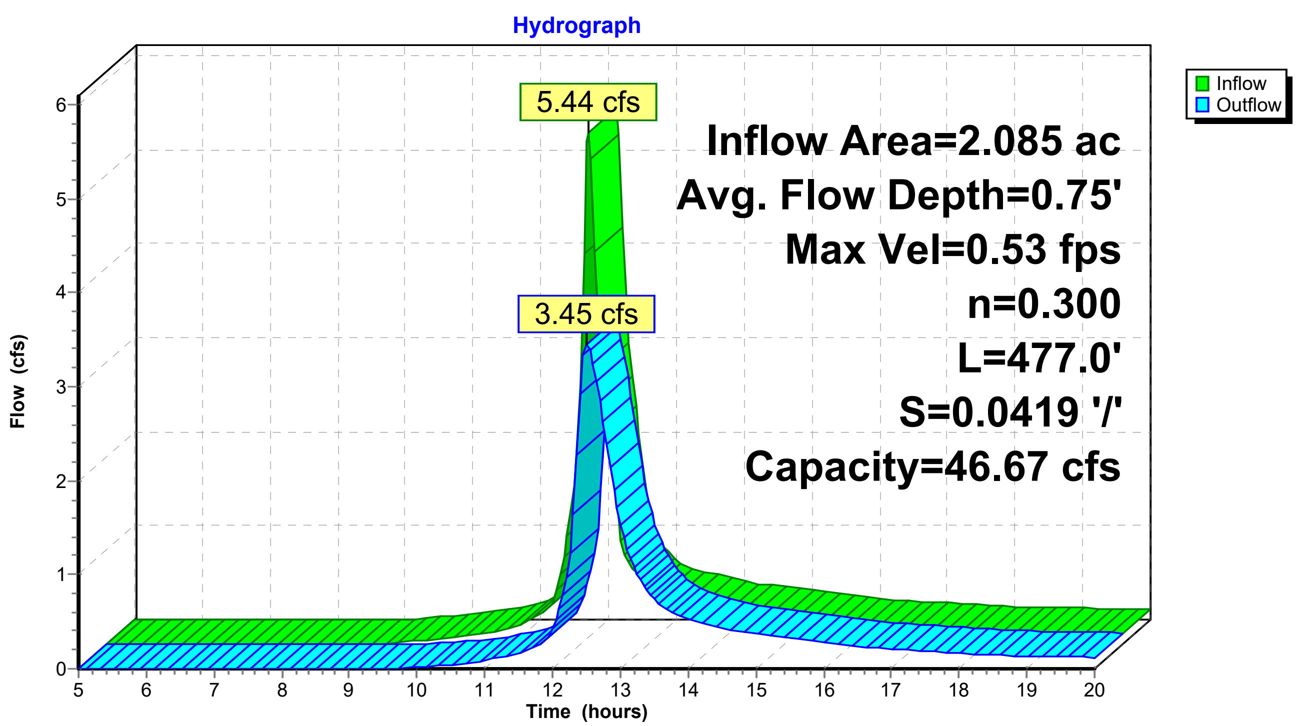
Reach West Plateau Swale: West Plateau Swale



Summary for Pond 3P: Detention Basin

Inflow Area = 9.853 ac, 12.86% Impervious, Inflow Depth > 2.60" for 10-YR 24HR event
Inflow = 13.60 cfs @ 12.02 hrs, Volume= 2.135 af
Outflow = 1.71 cfs @ 15.62 hrs, Volume= 1.045 af, Atten= 87%, Lag= 215.9 min
Primary = 1.71 cfs @ 15.62 hrs, Volume= 1.045 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 109.53' @ 15.62 hrs Surf.Area= 51,577 sf Storage= 57,859 cf

Plug-Flow detention time= 248.9 min calculated for 1.042 af (49% of inflow)
Center-of-Mass det. time= 153.3 min (968.3 - 815.0)

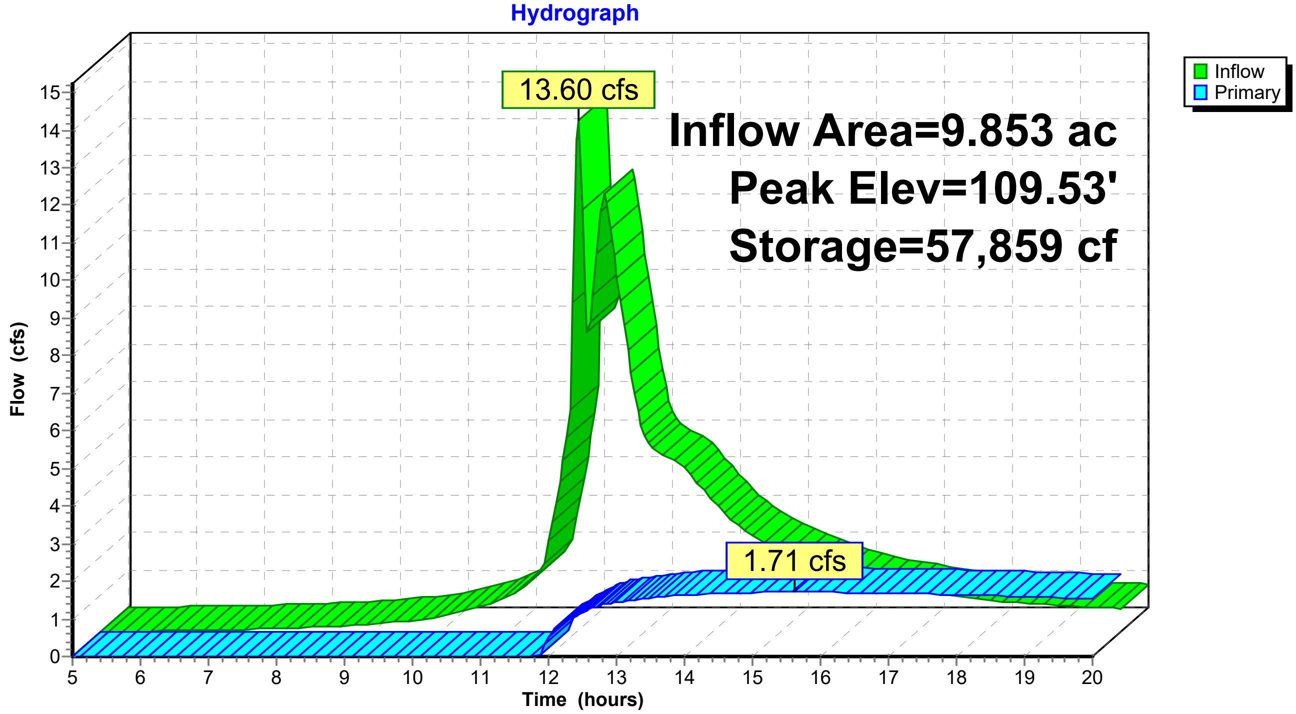
Volume	Invert	Avail.Storage	Storage Description
#1	108.20'	204,236 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
108.20	30,000	0	0
108.50	42,000	10,800	10,800
109.00	44,377	21,594	32,394
110.00	57,942	51,160	83,554
112.00	62,740	120,682	204,236

Device	Routing	Invert	Outlet Devices
#1	Primary	108.50'	**2.0" Horiz. Orifice/Grate X 4.00 columns** X 4 rows C= 0.600 Limited to weir flow at low heads
#2	Primary	110.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.71 cfs @ 15.62 hrs HW=109.53' (Free Discharge)
1=Orifice/Grate (Orifice Controls 1.71 cfs @ 4.89 fps)
2=Orifice/Grate (Controls 0.00 cfs)

Pond 3P: Detention Basin



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: E-1 Runoff Area=114,240 sf 0.00% Impervious Runoff Depth>4.36"
Flow Length=630' Tc=8.6 min CN=86 Runoff=12.50 cfs 0.952 af

Subcatchment E-2: E-2 Runoff Area=98,290 sf 0.00% Impervious Runoff Depth>3.60"
Flow Length=488' Slope=0.0100 '/' Tc=32.5 min CN=79 Runoff=5.57 cfs 0.677 af

Subcatchment E-3: E-3 Runoff Area=79,629 sf 0.00% Impervious Runoff Depth>3.95"
Tc=0.0 min CN=82 Runoff=10.20 cfs 0.601 af

Subcatchment E-4: E-4 Runoff Area=277,162 sf 0.00% Impervious Runoff Depth>4.36"
Flow Length=550' Slope=0.0100 '/' Tc=9.2 min CN=86 Runoff=29.58 cfs 2.309 af

Subcatchment E-5: E-5 Runoff Area=217,437 sf 0.00% Impervious Runoff Depth>3.94"
Flow Length=760' Tc=8.8 min CN=82 Runoff=21.76 cfs 1.637 af

Subcatchment P-1: P-1 Runoff Area=45,494 sf 0.00% Impervious Runoff Depth>3.14"
Flow Length=523' Tc=3.6 min CN=74 Runoff=4.41 cfs 0.274 af

Subcatchment P-10: P-10 Runoff Area=72,105 sf 0.00% Impervious Runoff Depth>3.14"
Flow Length=409' Slope=0.3300 '/' Tc=1.7 min CN=74 Runoff=7.16 cfs 0.434 af

Subcatchment P-11: P-11 Runoff Area=46,241 sf 0.00% Impervious Runoff Depth>4.36"
Flow Length=330' Slope=0.0100 '/' Tc=5.5 min CN=86 Runoff=5.53 cfs 0.386 af

Subcatchment P-2: P-2 Runoff Area=95,039 sf 0.00% Impervious Runoff Depth>2.76"
Flow Length=390' Tc=10.5 min CN=70 Runoff=6.47 cfs 0.502 af

Subcatchment P-3: P-3 Runoff Area=23,731 sf 0.00% Impervious Runoff Depth>2.95"
Flow Length=190' Slope=0.0100 '/' Tc=6.3 min CN=72 Runoff=1.97 cfs 0.134 af

Subcatchment P-4: P-4 Runoff Area=45,575 sf 0.00% Impervious Runoff Depth>3.14"
Flow Length=605' Tc=3.7 min CN=74 Runoff=4.40 cfs 0.274 af

Subcatchment P-5: P-5 Runoff Area=43,177 sf 0.00% Impervious Runoff Depth>4.01"
Flow Length=535' Tc=31.1 min CN=83 Runoff=2.75 cfs 0.331 af

Subcatchment P-6: P-6 Runoff Area=139,221 sf 0.00% Impervious Runoff Depth>3.14"
Flow Length=707' Slope=0.0500 '/' Tc=7.5 min CN=74 Runoff=11.85 cfs 0.836 af

Subcatchment P-7: P-7 Runoff Area=90,811 sf 0.00% Impervious Runoff Depth>3.14"
Flow Length=750' Slope=0.0500 '/' Tc=8.0 min CN=74 Runoff=7.59 cfs 0.545 af

Subcatchment P-8: P-8 Runoff Area=110,418 sf 50.00% Impervious Runoff Depth>4.58"
Flow Length=310' Slope=0.3300 '/' Tc=1.3 min CN=88 Runoff=15.23 cfs 0.967 af

Subcatchment P-9: P-9
Runoff=0.00 cfs 0.000 af

Reach Bench swale: Bench swale Avg. Flow Depth=1.05' Max Vel=0.36 fps Inflow=4.40 cfs 0.274 af
n=0.300 L=570.0' S=0.0100 '/' Capacity=8.41 cfs Outflow=1.95 cfs 0.264 af

Reach Drop Pipe: Drop Pipe Avg. Flow Depth=0.44' Max Vel=30.45 fps Inflow=13.10 cfs 1.360 af
18.0" Round Pipe n=0.013 L=30.0' S=0.4500 '/' Capacity=70.47 cfs Outflow=13.09 cfs 1.360 af

Reach REACH 1: Reach 1 Inflow=4.41 cfs 0.274 af
Outflow=4.41 cfs 0.274 af

Reach REACH 3: Reach 3 Inflow=1.97 cfs 0.134 af
Outflow=1.97 cfs 0.134 af

Reach REACH 4: Reach 4 Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach REACH 5: Reach 5 Inflow=11.41 cfs 2.101 af
Outflow=11.41 cfs 2.101 af

Reach REACH2: Reach2 Inflow=6.47 cfs 0.502 af
Outflow=6.47 cfs 0.502 af

Reach Road Swale: Road Swale Avg. Flow Depth=1.43' Max Vel=0.28 fps Inflow=4.22 cfs 0.596 af
n=0.300 L=550.0' S=0.0040 '/' Capacity=6.19 cfs Outflow=2.97 cfs 0.569 af

Reach So. Plateau Swale: So. Plateau Avg. Flow Depth=1.17' Max Vel=0.54 fps Inflow=11.85 cfs 0.836 af
n=0.300 L=330.0' S=0.0242 '/' Capacity=35.49 cfs Outflow=8.44 cfs 0.825 af

Reach Stone swale: stone swale Avg. Flow Depth=1.24' Max Vel=1.25 fps Inflow=7.16 cfs 0.434 af
n=0.300 L=351.0' S=0.1282 '/' Capacity=21.01 cfs Outflow=5.76 cfs 0.431 af

Reach Total Offsite Existing: Full site existing Inflow=70.77 cfs 6.176 af
Outflow=70.77 cfs 6.176 af

Reach TOTAL OFFSITE PROP: Full Site Prop Inflow=22.91 cfs 3.010 af
Outflow=22.91 cfs 3.010 af

Reach West Plateau Swale: West Avg. Flow Depth=0.86' Max Vel=0.58 fps Inflow=7.59 cfs 0.545 af
n=0.300 L=477.0' S=0.0419 '/' Capacity=46.67 cfs Outflow=4.99 cfs 0.535 af

Pond 3P: Detention Basin Peak Elev=109.97' Storage=82,085 cf Inflow=18.17 cfs 2.896 af
Outflow=2.04 cfs 1.284 af

Total Runoff Area = 34.402 ac Runoff Volume = 10.858 af Average Runoff Depth = 3.79"
96.32% Pervious = 33.135 ac 3.68% Impervious = 1.267 ac

Summary for Subcatchment E-1: E-1

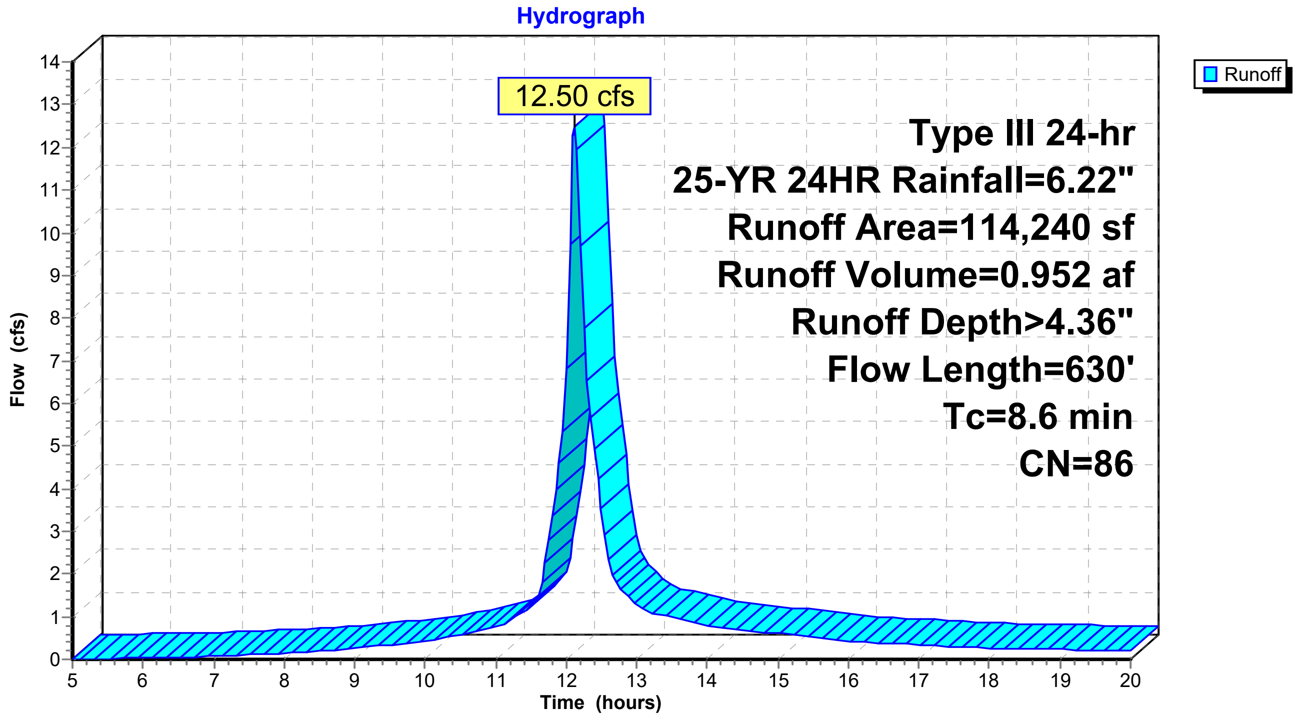
Runoff = 12.50 cfs @ 12.12 hrs, Volume= 0.952 af, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
114,240	86	<50% Grass cover, Poor, HSG C
114,240		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	320	0.3300	4.02		**Shallow Concentrated Flow, e1 1** Short Grass Pasture Kv= 7.0 fps
7.3	310	0.0050	0.71		**Shallow Concentrated Flow, e1 2** Nearly Bare & Untilled Kv= 10.0 fps
8.6	630	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

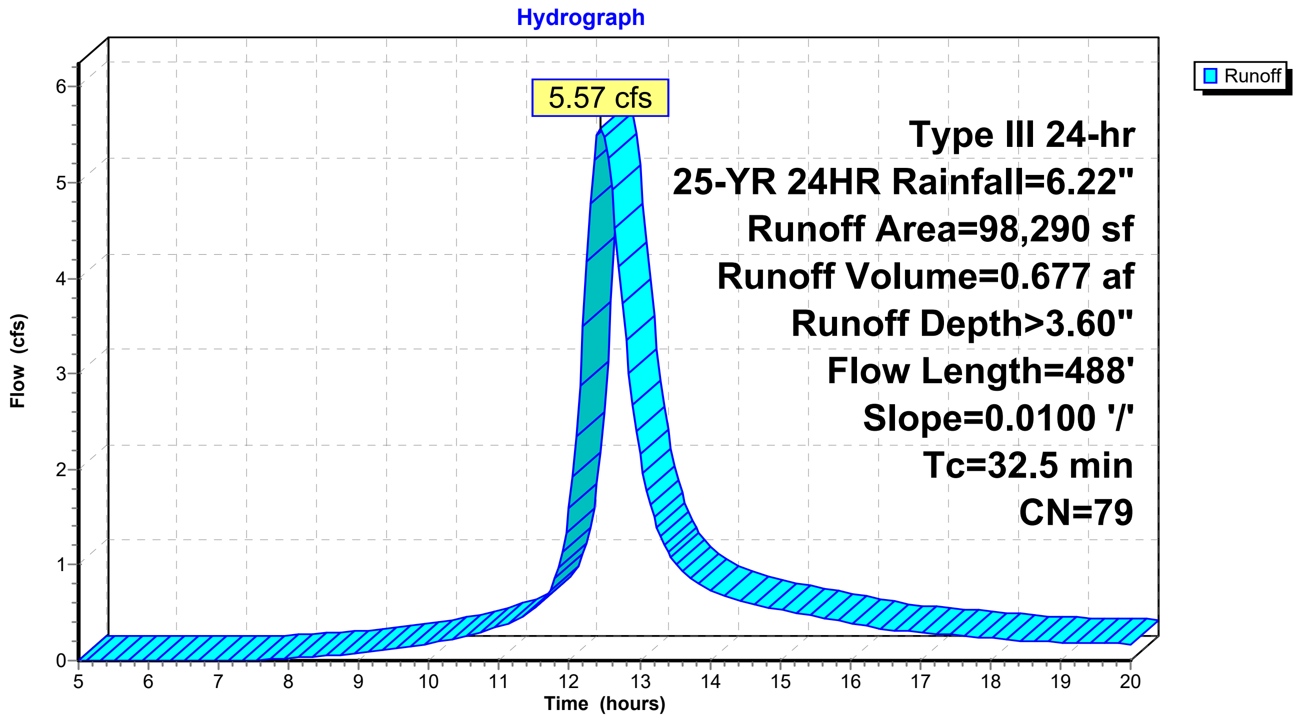
Runoff = 5.57 cfs @ 12.45 hrs, Volume= 0.677 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
54,000	86	<50% Grass cover, Poor, HSG C
44,290	70	Woods, Good, HSG C
98,290	79	Weighted Average
98,290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.5	488	0.0100	0.25		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps

Subcatchment E-2: E-2



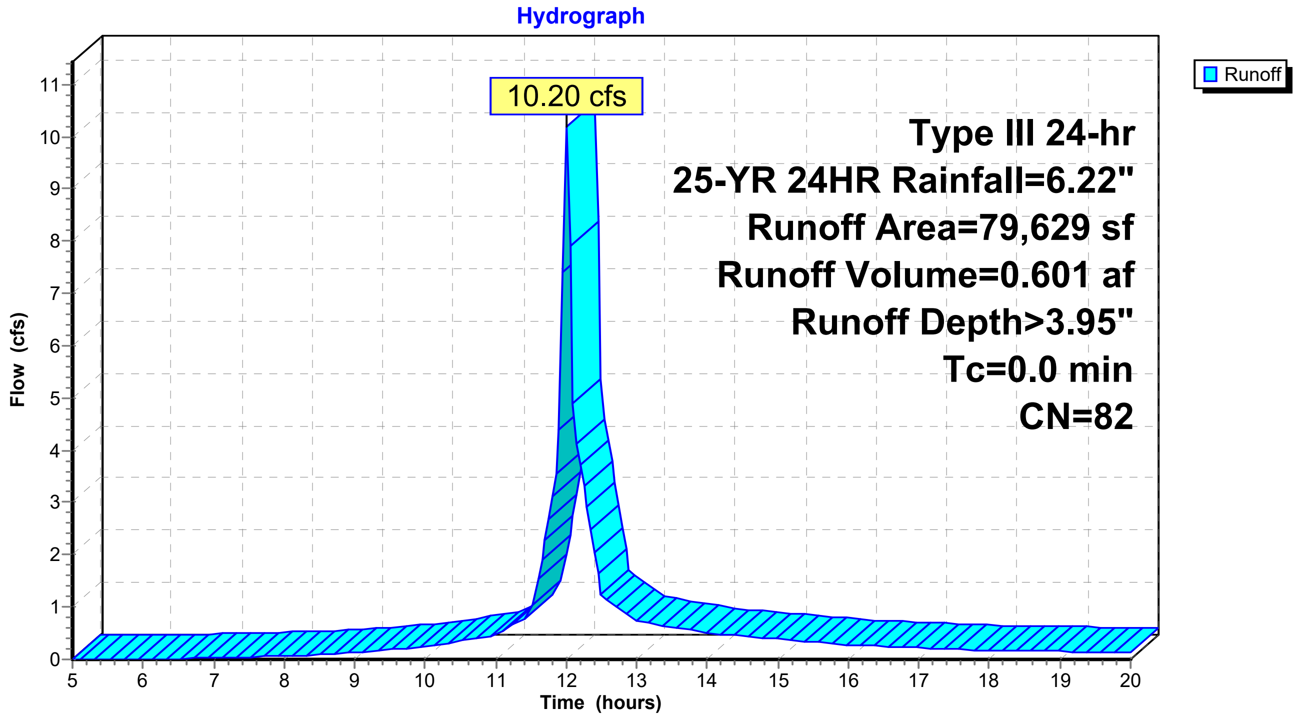
Summary for Subcatchment E-3: E-3

Runoff = 10.20 cfs @ 12.00 hrs, Volume= 0.601 af, Depth> 3.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
59,600	86	<50% Grass cover, Poor, HSG C
20,029	70	Woods, Good, HSG C
79,629	82	Weighted Average
79,629		100.00% Pervious Area

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

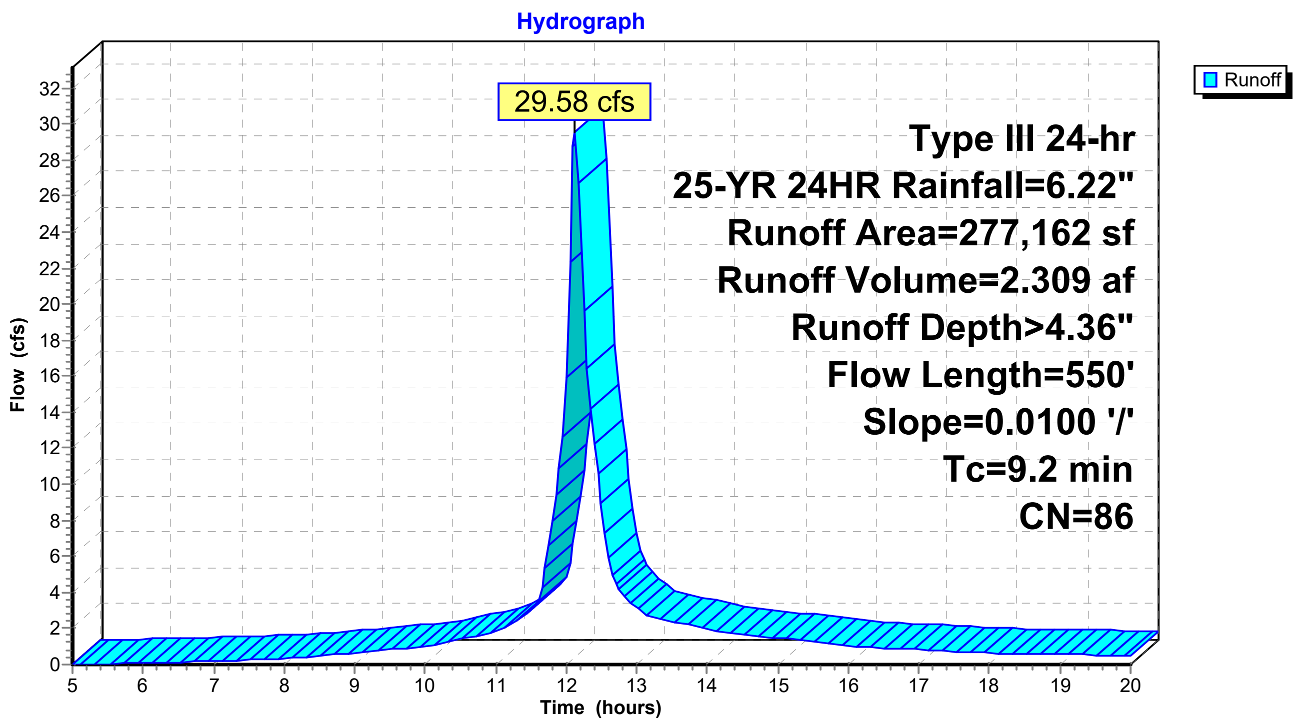
Runoff = 29.58 cfs @ 12.13 hrs, Volume= 2.309 af, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
277,162	86	<50% Grass cover, Poor, HSG C
277,162		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	550	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment E-4: E-4



Summary for Subcatchment E-5: E-5

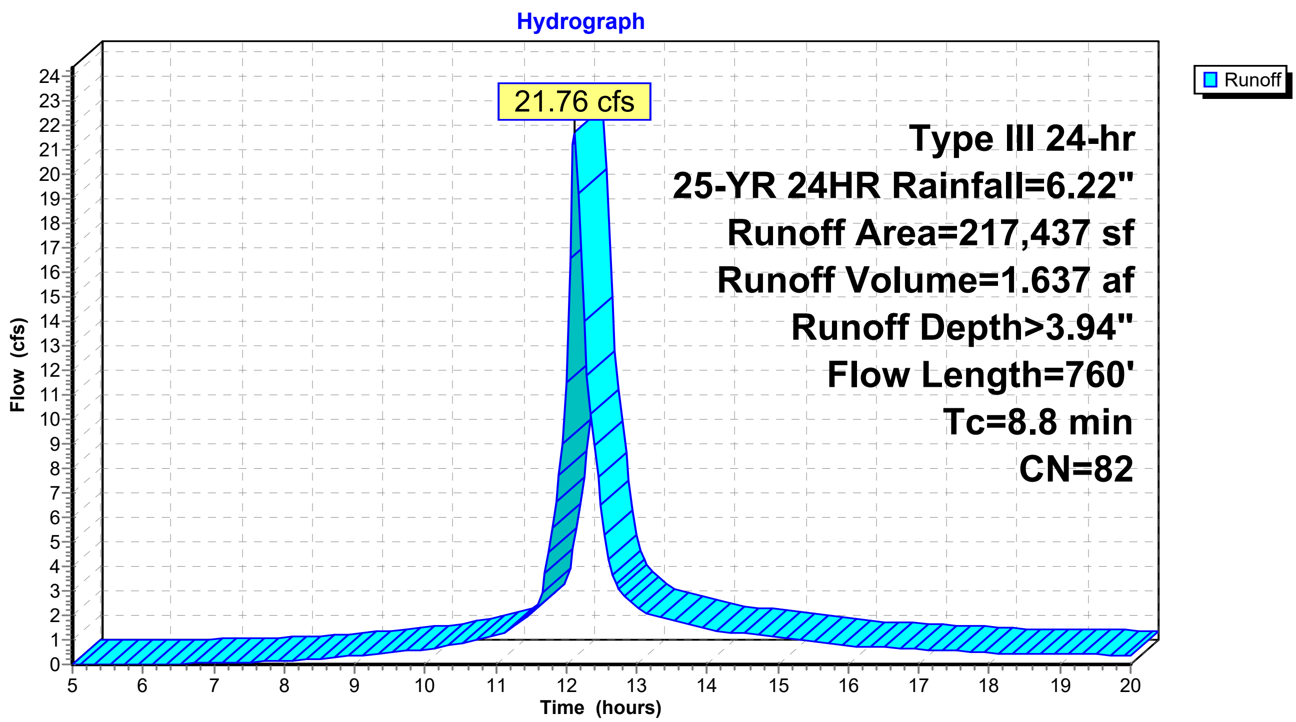
Runoff = 21.76 cfs @ 12.12 hrs, Volume= 1.637 af, Depth> 3.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
76,103	74	>75% Grass cover, Good, HSG C
141,334	86	<50% Grass cover, Poor, HSG C
217,437	82	Weighted Average
217,437		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	310	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.5	450	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
8.8	760	Total			

Subcatchment E-5: E-5



Summary for Subcatchment P-1: P-1

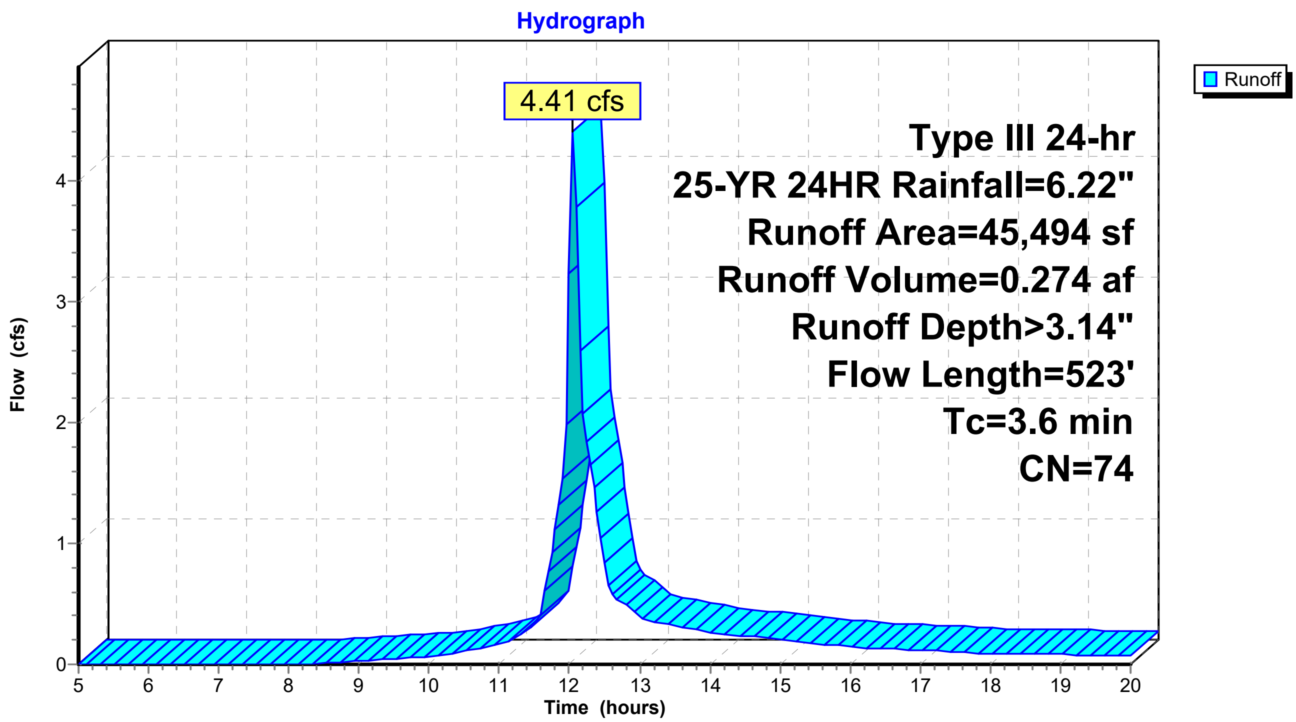
Runoff = 4.41 cfs @ 12.06 hrs, Volume= 0.274 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
45,494	74	>75% Grass cover, Good, HSG C
45,494		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	328	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.2	195	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.6	523	Total			

Subcatchment P-1: P-1



Summary for Subcatchment P-10: P-10

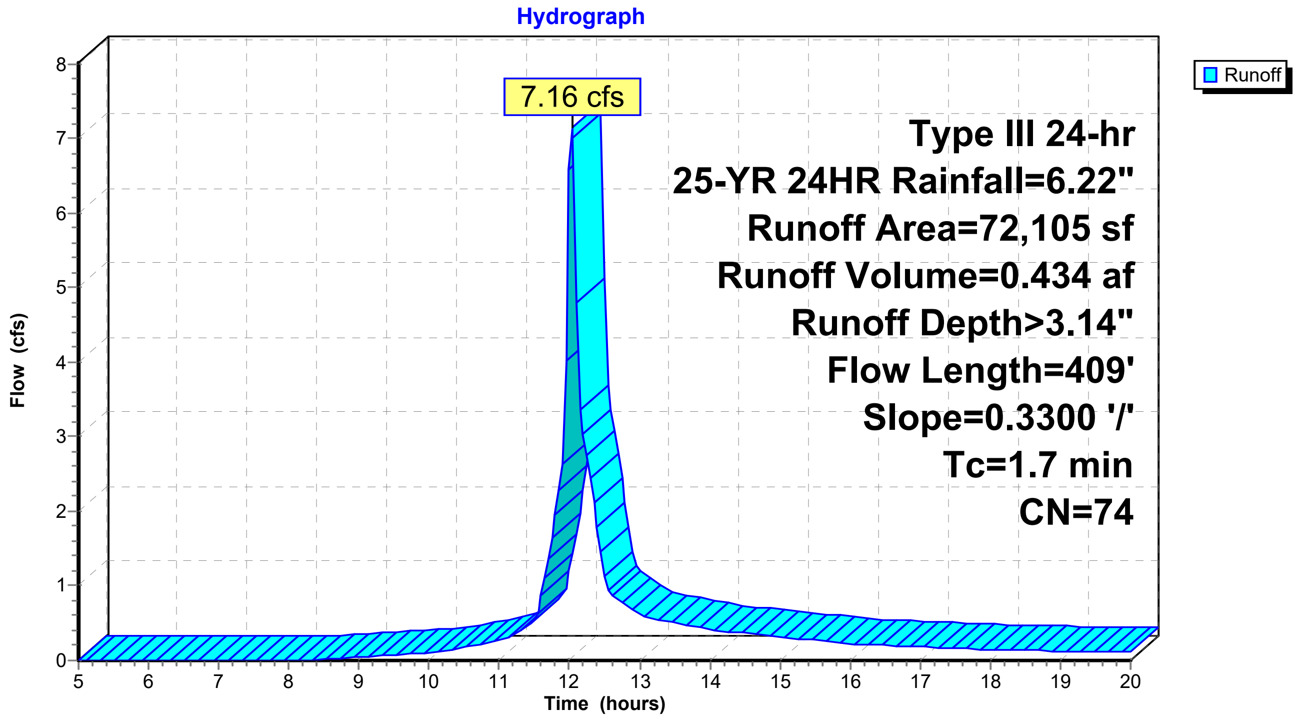
Runoff = 7.16 cfs @ 12.03 hrs, Volume= 0.434 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
72,105	74	>75% Grass cover, Good, HSG C
72,105		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	409	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-10: P-10



Summary for Subcatchment P-11: P-11

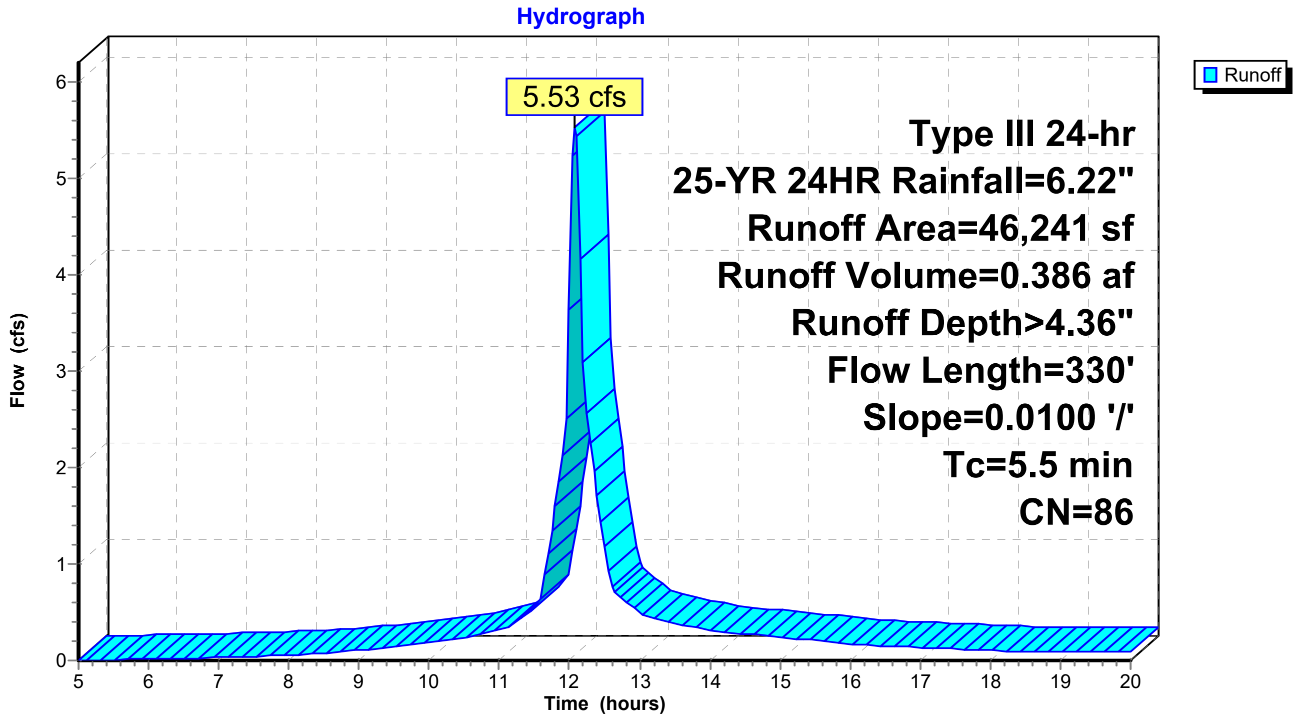
Runoff = 5.53 cfs @ 12.08 hrs, Volume= 0.386 af, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
46,241	86	<50% Grass cover, Poor, HSG C
46,241		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	330	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment P-11: P-11



Summary for Subcatchment P-2: P-2

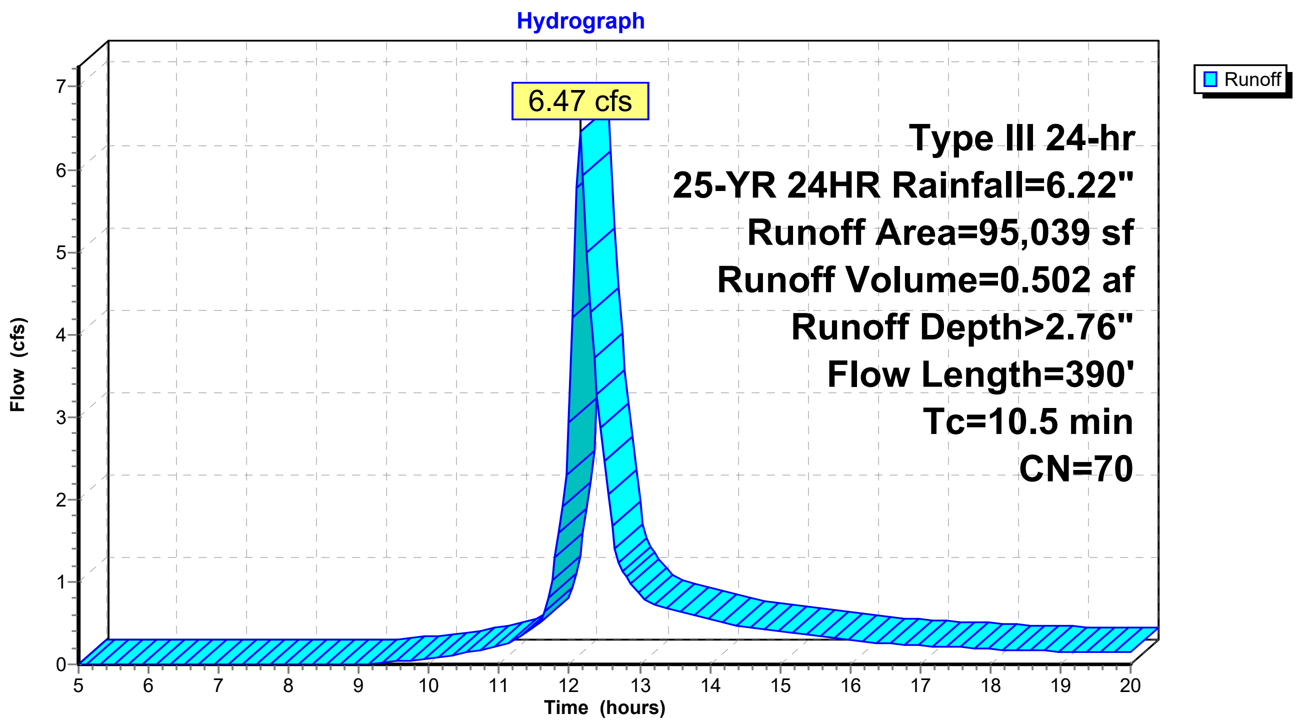
Runoff = 6.47 cfs @ 12.15 hrs, Volume= 0.502 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
95,039	70	Woods, Good, HSG C
95,039		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	110	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.3	280	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.5	390	Total			

Subcatchment P-2: P-2



Summary for Subcatchment P-3: P-3

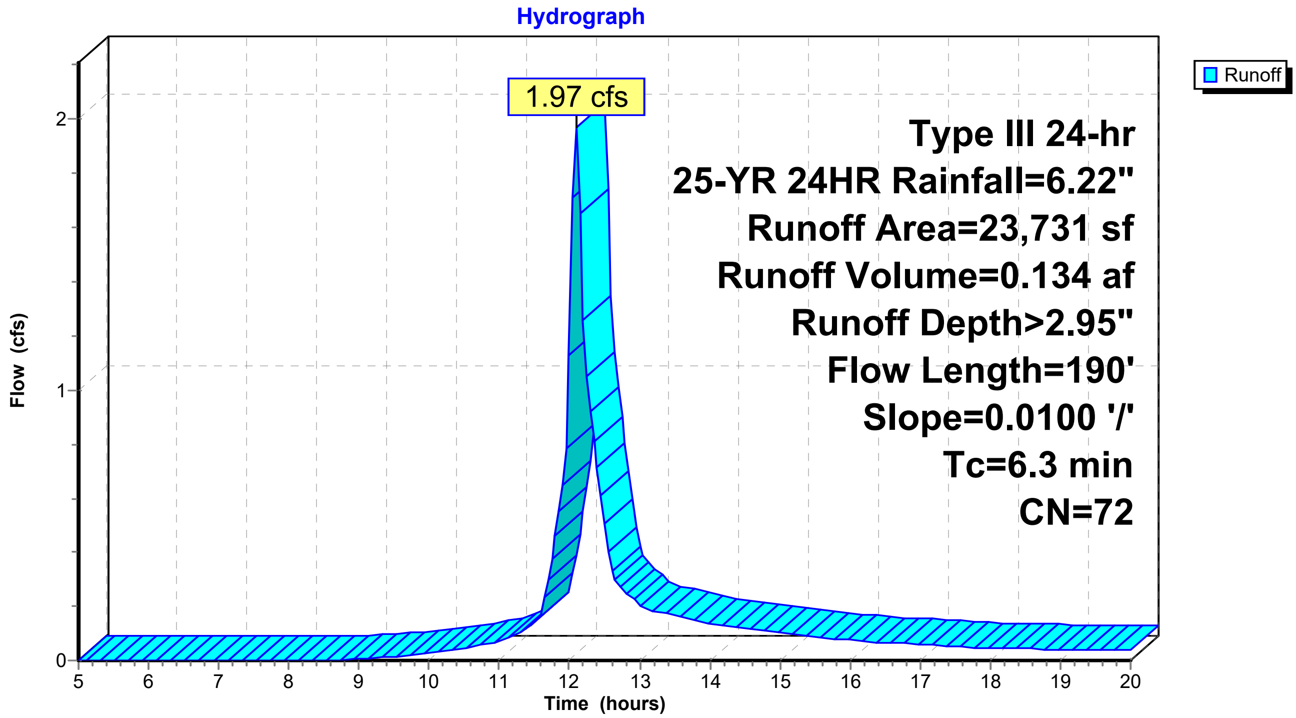
Runoff = 1.97 cfs @ 12.10 hrs, Volume= 0.134 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
23,731	72	Woods/grass comb., Good, HSG C
23,731		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	190	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment P-3: P-3



Summary for Subcatchment P-4: P-4

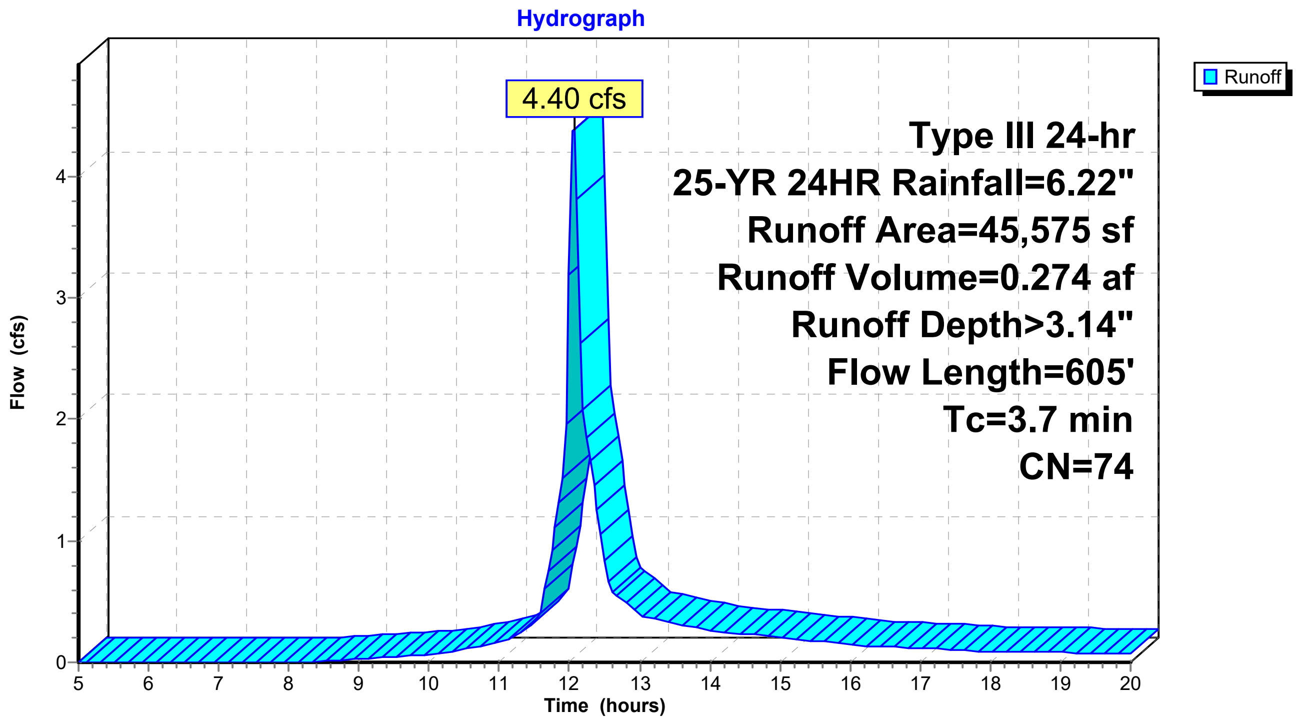
Runoff = 4.40 cfs @ 12.06 hrs, Volume= 0.274 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
45,575	74	>75% Grass cover, Good, HSG C
45,575		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	45	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.5	560	0.0100	2.70	10.78	**Trap/Vee/Rect Channel Flow, bench swale** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.040 Earth, cobble bottom, clean sides
3.7	605	Total			

Subcatchment P-4: P-4



Summary for Subcatchment P-5: P-5

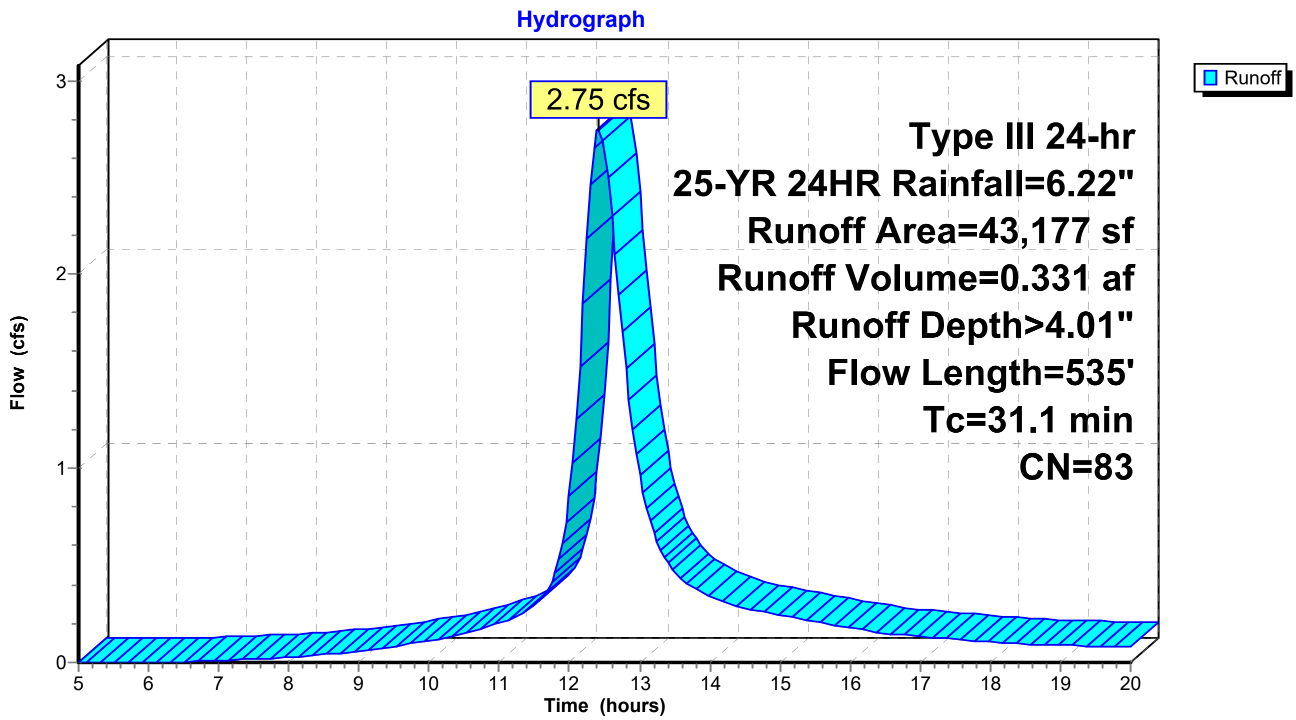
Runoff = 2.75 cfs @ 12.42 hrs, Volume= 0.331 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
22,177	79	50-75% Grass cover, Fair, HSG C
21,000	87	Dirt roads, HSG C
43,177	83	Weighted Average
43,177		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	35	0.3000	0.28		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
29.0	500	0.0030	0.29	4.60	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=2.00' Z= 3.0 '/' Top.W=14.00' n= 0.300
31.1	535	Total			

Subcatchment P-5: P-5



Summary for Subcatchment P-6: P-6

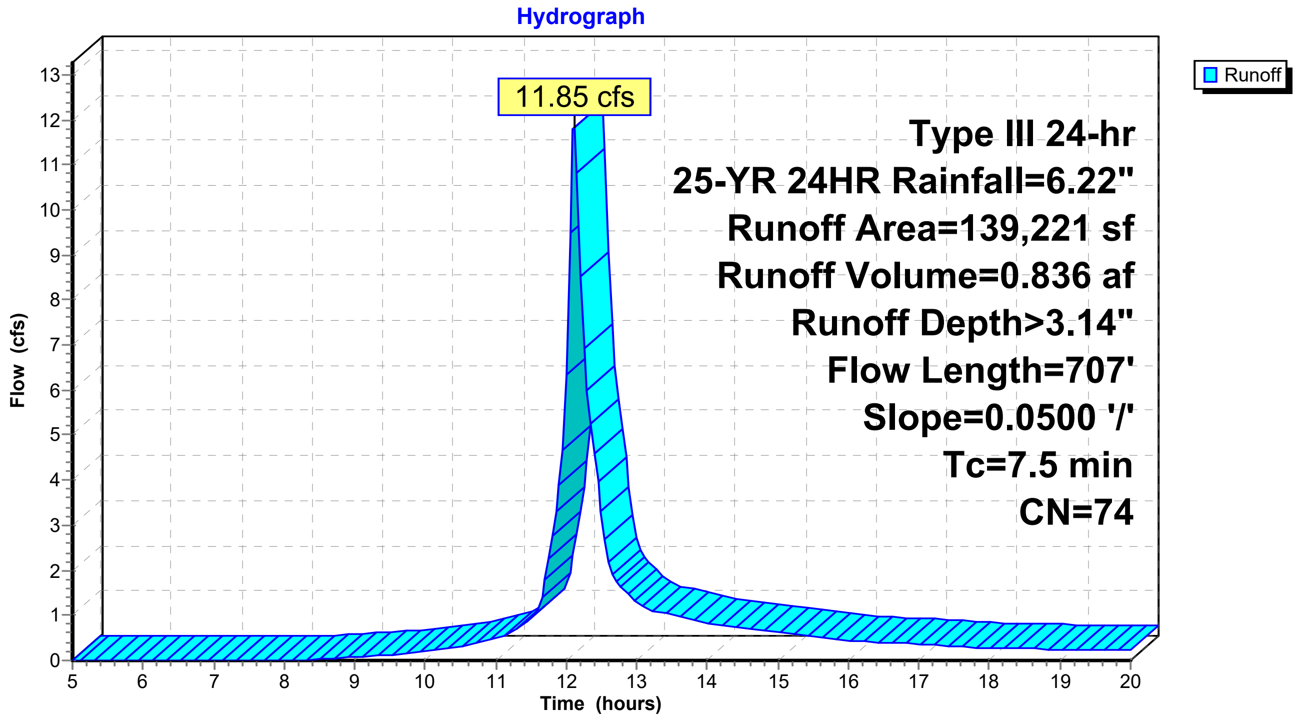
Runoff = 11.85 cfs @ 12.11 hrs, Volume= 0.836 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
139,221	74	>75% Grass cover, Good, HSG C
139,221		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	707	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-6: P-6



Summary for Subcatchment P-7: P-7

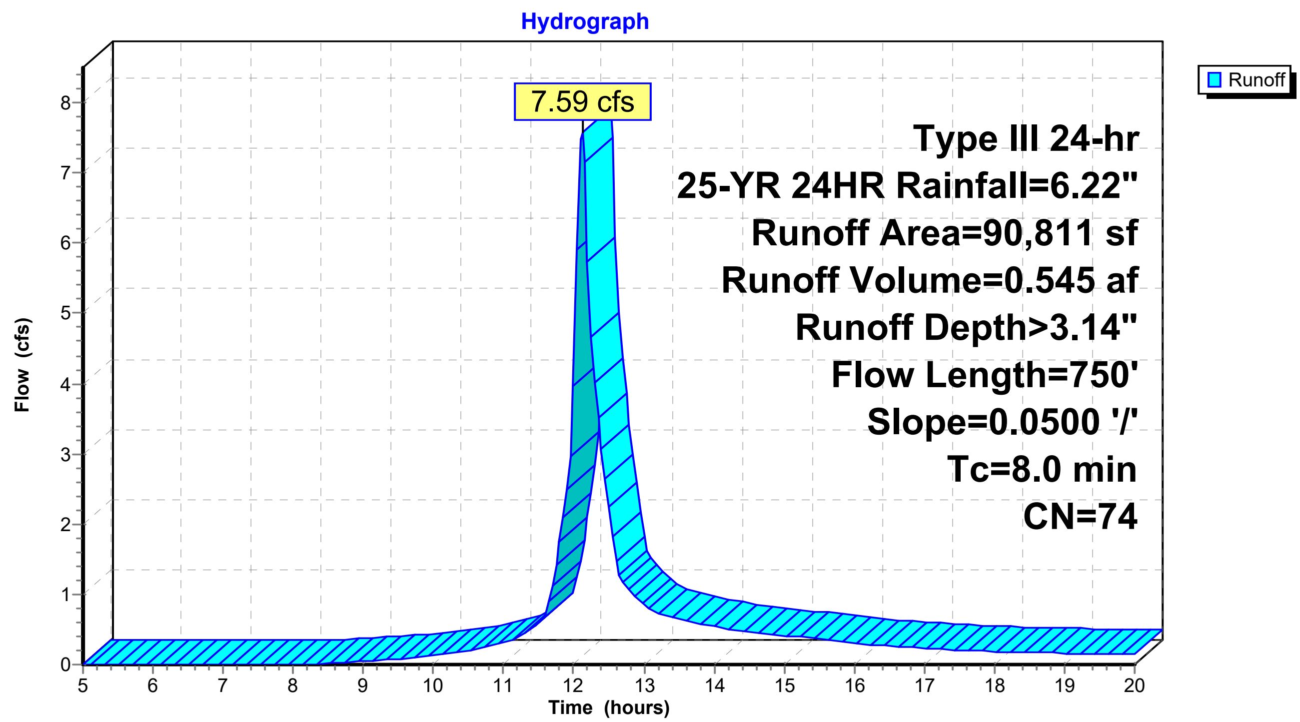
Runoff = 7.59 cfs @ 12.12 hrs, Volume= 0.545 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
90,811	74	>75% Grass cover, Good, HSG C
90,811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	750	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-7: P-7



Summary for Subcatchment P-8: P-8

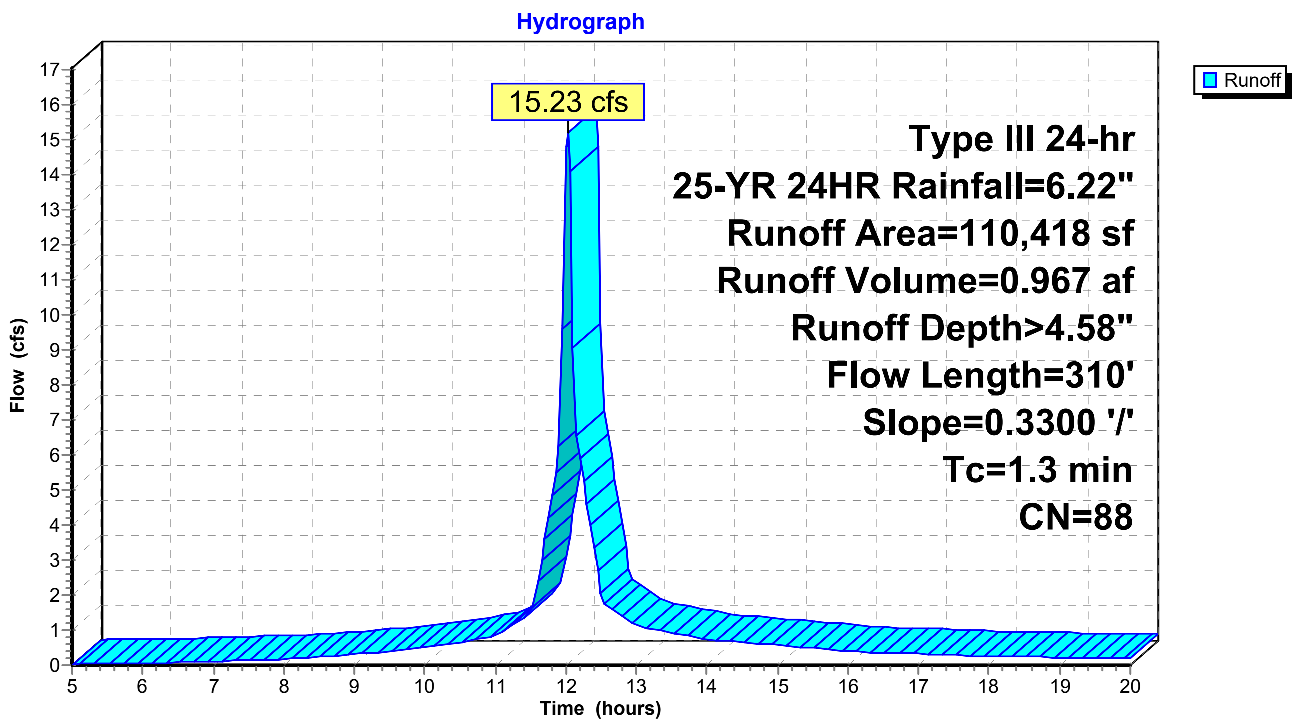
Runoff = 15.23 cfs @ 12.02 hrs, Volume= 0.967 af, Depth> 4.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
45,474	74	>75% Grass cover, Good, HSG C
9,735	96	Gravel surface, HSG C
55,209	98	Water Surface, HSG C
110,418	88	Weighted Average
55,209		50.00% Pervious Area
55,209		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	110	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	200		4.01		**Lake or Reservoir,** Mean Depth= 0.50'
1.3	310	Total			

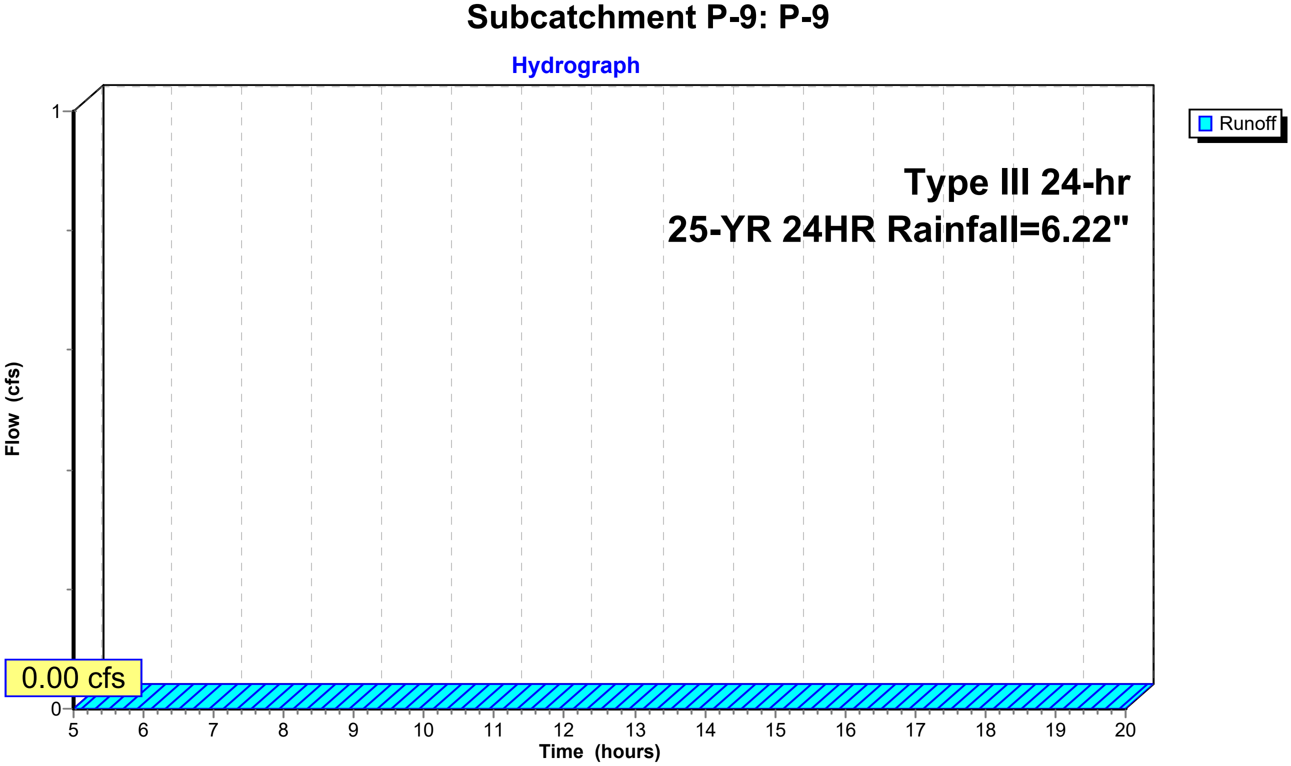
Subcatchment P-8: P-8



Summary for Subcatchment P-9: P-9

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"



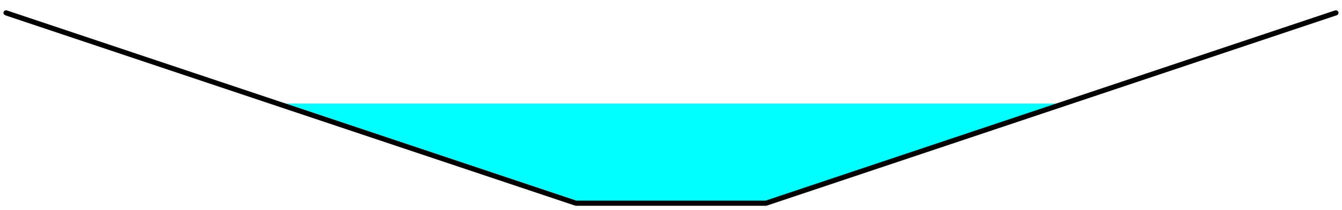
Summary for Reach Bench swale: Bench swale

Inflow Area = 1.046 ac, 0.00% Impervious, Inflow Depth > 3.14" for 25-YR 24HR event
Inflow = 4.40 cfs @ 12.06 hrs, Volume= 0.274 af
Outflow = 1.95 cfs @ 12.67 hrs, Volume= 0.264 af, Atten= 56%, Lag= 36.8 min

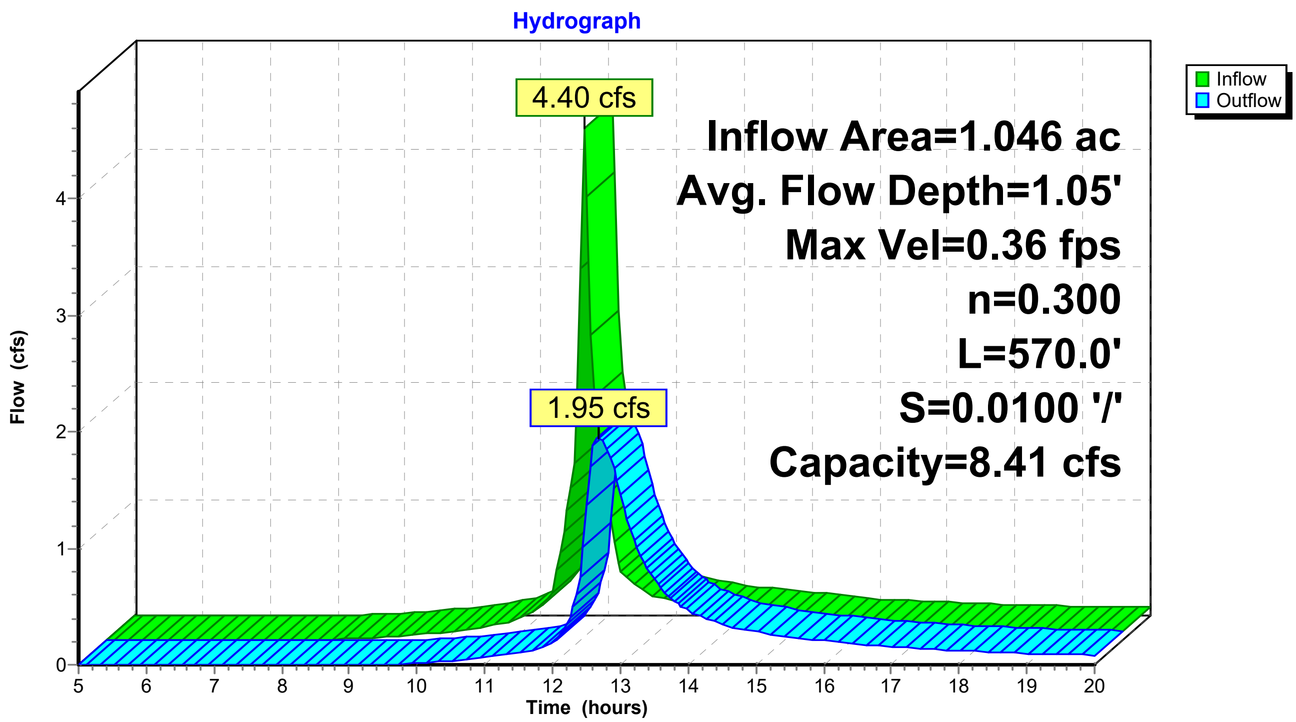
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.36 fps, Min. Travel Time= 26.3 min
Avg. Velocity = 0.18 fps, Avg. Travel Time= 54.2 min

Peak Storage= 3,068 cf @ 12.23 hrs
Average Depth at Peak Storage= 1.05'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 8.41 cfs

2.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 570.0' Slope= 0.0100 '/'
Inlet Invert= 116.20', Outlet Invert= 110.50'



Reach Bench swale: Bench swale



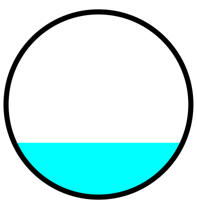
Summary for Reach Drop Pipe: Drop Pipe

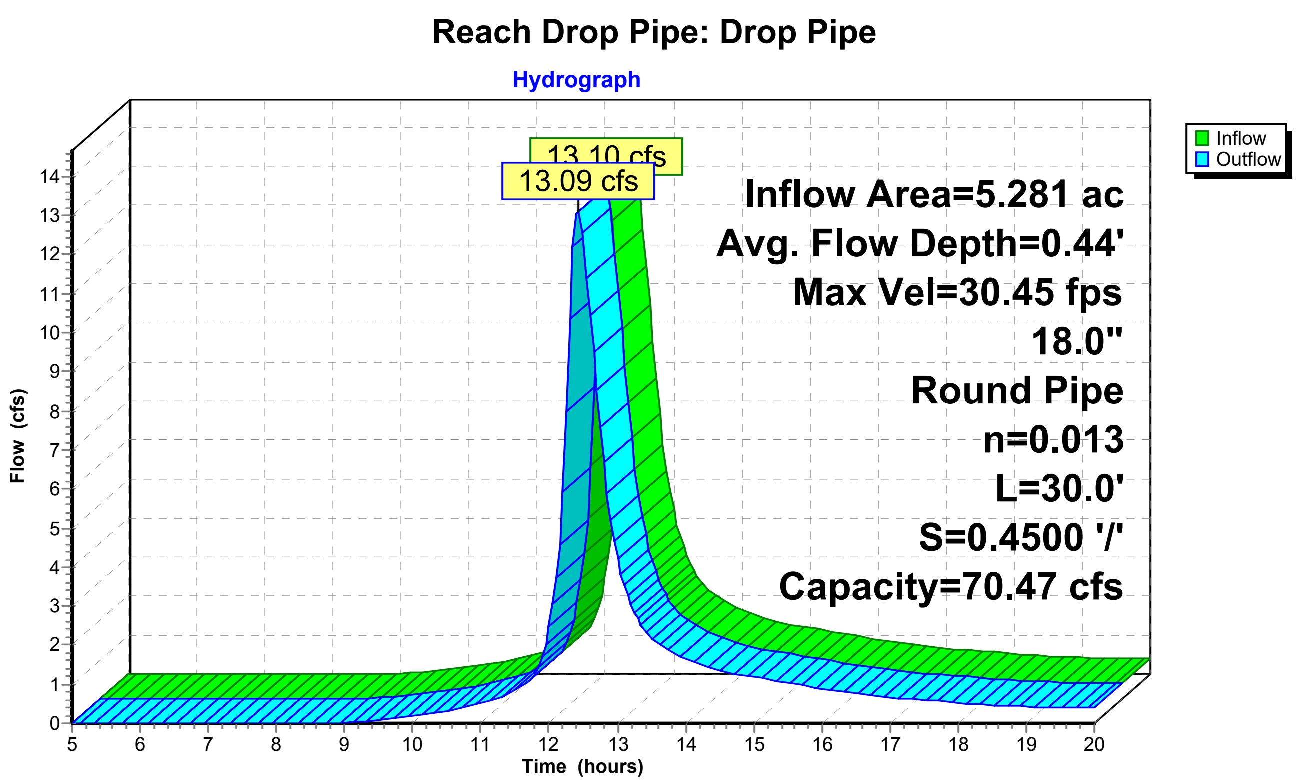
Inflow Area = 5.281 ac, 0.00% Impervious, Inflow Depth > 3.09" for 25-YR 24HR event
Inflow = 13.10 cfs @ 12.42 hrs, Volume= 1.360 af
Outflow = 13.09 cfs @ 12.42 hrs, Volume= 1.360 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 30.45 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 13.33 fps, Avg. Travel Time= 0.0 min

Peak Storage= 13 cf @ 12.42 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 70.47 cfs

18.0" Round Pipe
n= 0.013
Length= 30.0' Slope= 0.4500 '/'
Inlet Invert= 122.00', Outlet Invert= 108.50'



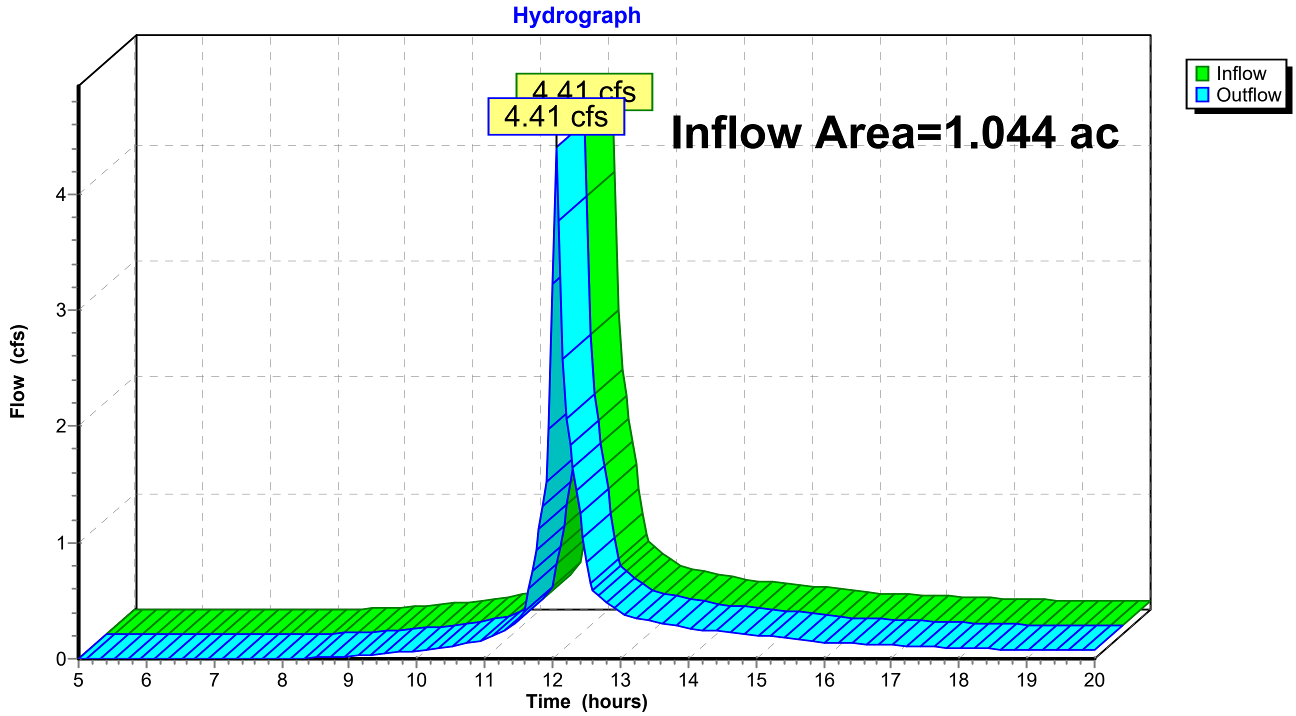


Summary for Reach REACH 1: Reach 1

Inflow Area = 1.044 ac, 0.00% Impervious, Inflow Depth > 3.14" for 25-YR 24HR event
Inflow = 4.41 cfs @ 12.06 hrs, Volume= 0.274 af
Outflow = 4.41 cfs @ 12.06 hrs, Volume= 0.274 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 1: Reach 1

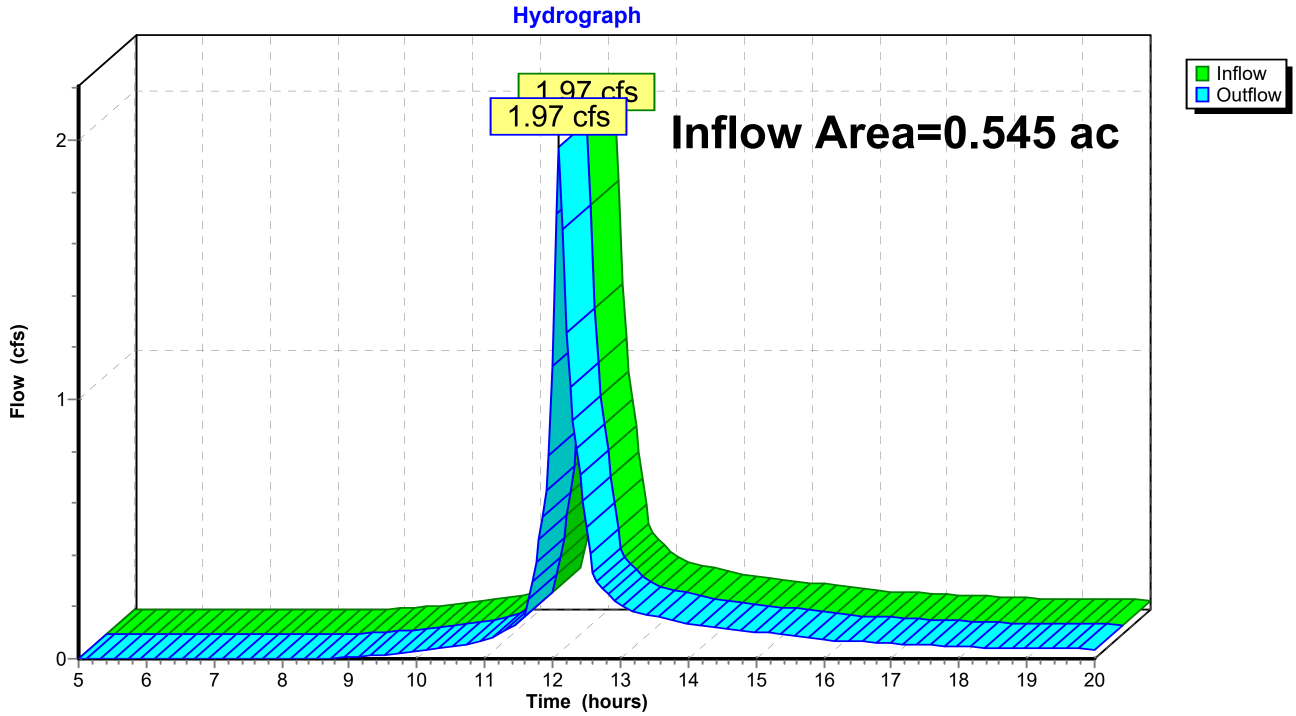


Summary for Reach REACH 3: Reach 3

Inflow Area =	0.545 ac,	0.00% Impervious, Inflow Depth >	2.95"	for 25-YR 24HR event
Inflow =	1.97 cfs @	12.10 hrs, Volume=	0.134 af	
Outflow =	1.97 cfs @	12.10 hrs, Volume=	0.134 af, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 3: Reach 3

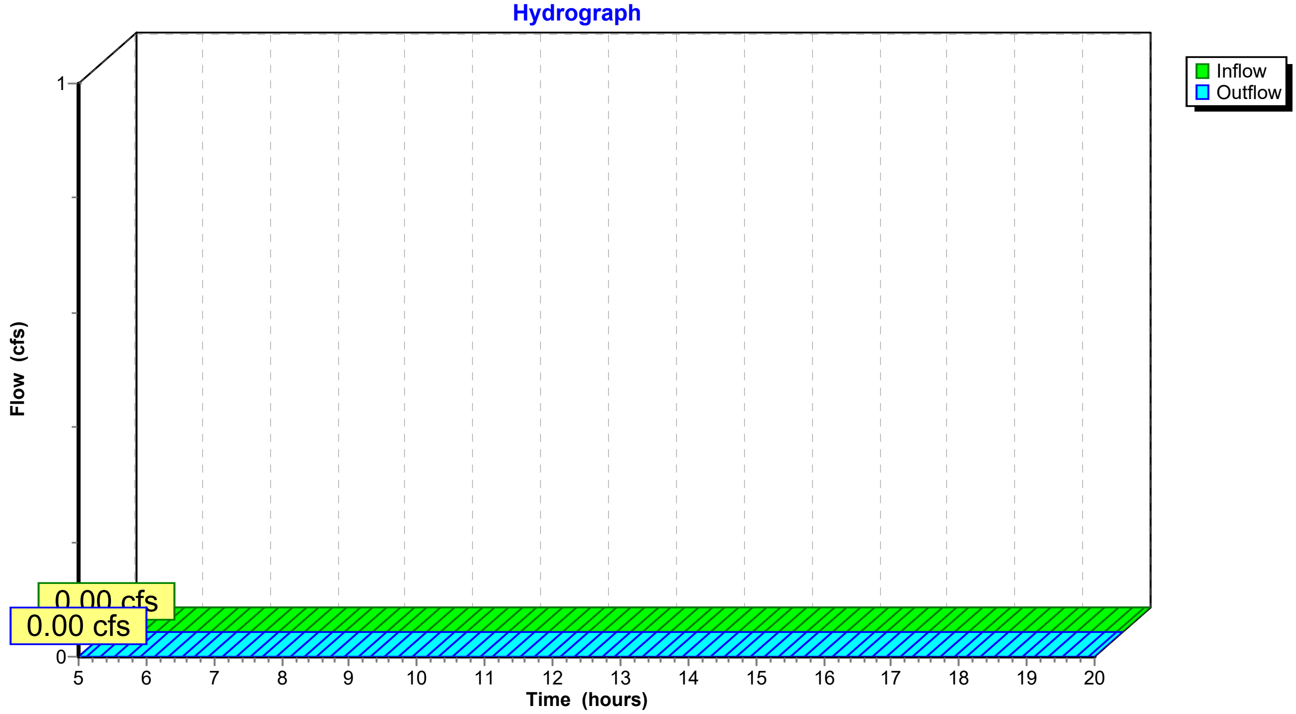


Summary for Reach REACH 4: Reach 4

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 4: Reach 4

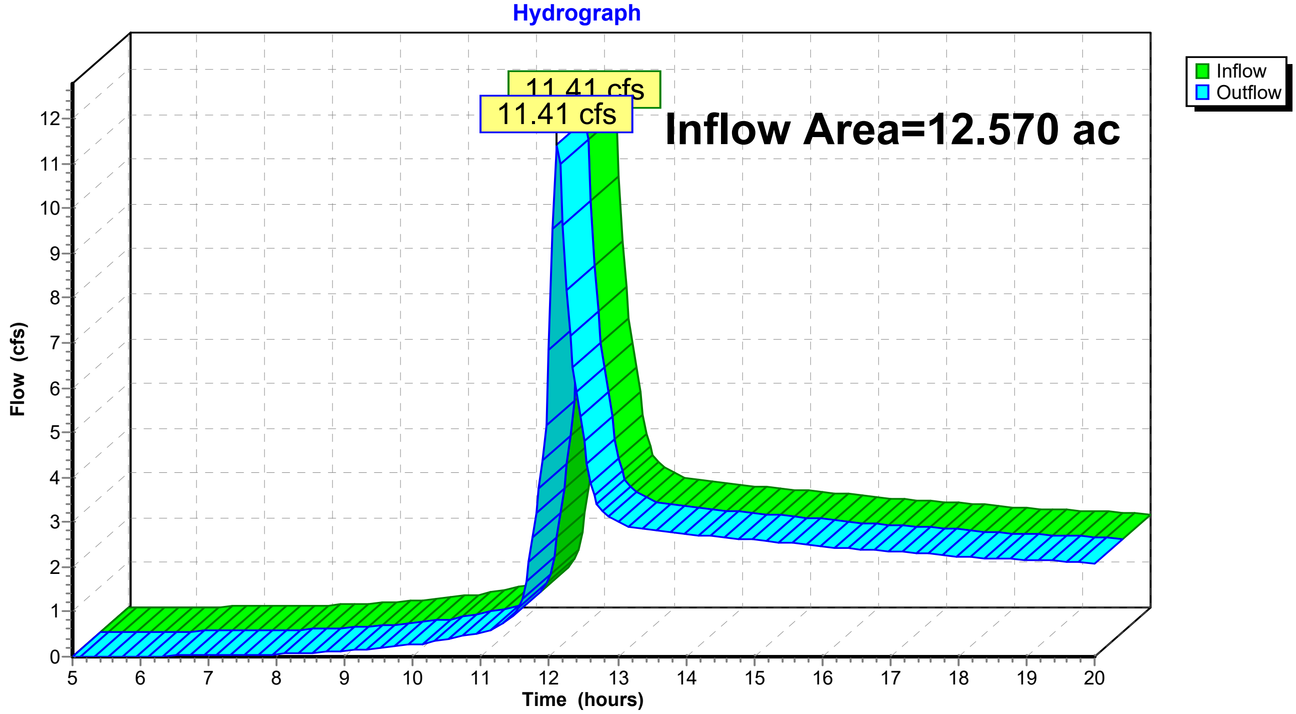


Summary for Reach REACH 5: Reach 5

Inflow Area = 12.570 ac, 10.08% Impervious, Inflow Depth > 2.01" for 25-YR 24HR event
Inflow = 11.41 cfs @ 12.12 hrs, Volume= 2.101 af
Outflow = 11.41 cfs @ 12.12 hrs, Volume= 2.101 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 5: Reach 5

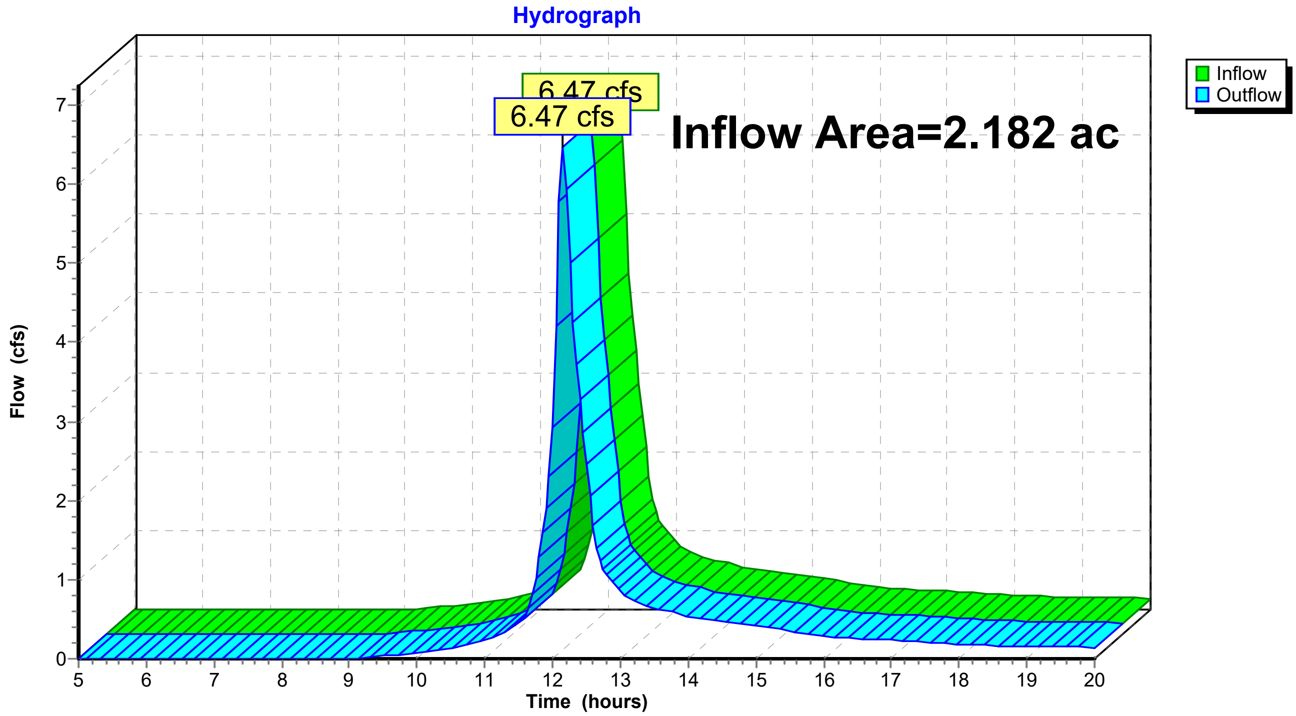


Summary for Reach REACH2: Reach2

Inflow Area =	2.182 ac,	0.00% Impervious, Inflow Depth > 2.76"	for 25-YR 24HR event	
Inflow =	6.47 cfs @	12.15 hrs, Volume=	0.502 af	
Outflow =	6.47 cfs @	12.15 hrs, Volume=	0.502 af, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH2: Reach2



Summary for Reach Road Swale: Road Swale

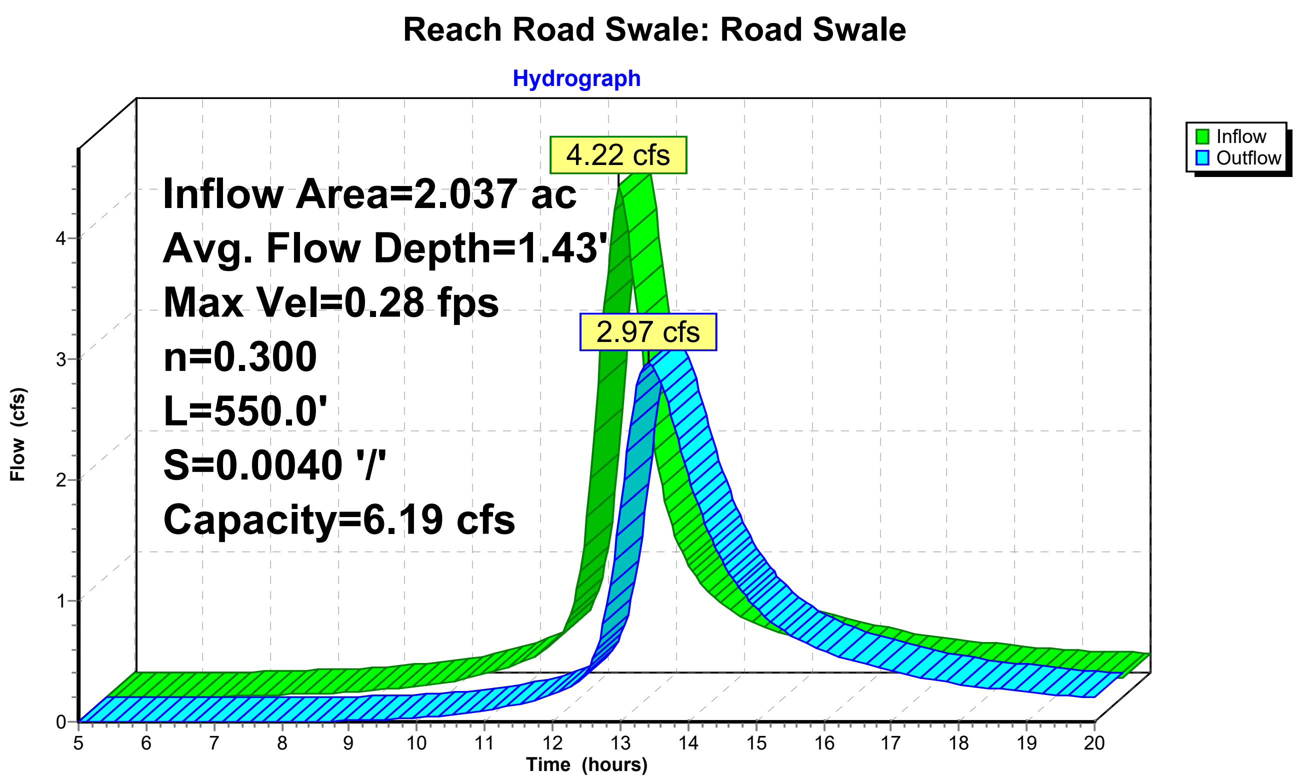
Inflow Area = 2.037 ac, 0.00% Impervious, Inflow Depth > 3.51" for 25-YR 24HR event
Inflow = 4.22 cfs @ 12.57 hrs, Volume= 0.596 af
Outflow = 2.97 cfs @ 13.42 hrs, Volume= 0.569 af, Atten= 30%, Lag= 50.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.28 fps, Min. Travel Time= 32.2 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 67.3 min

Peak Storage= 5,747 cf @ 12.88 hrs
Average Depth at Peak Storage= 1.43'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 6.19 cfs

3.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 550.0' Slope= 0.0040 '/'
Inlet Invert= 110.50', Outlet Invert= 108.30'

‡



Summary for Reach So. Plateau Swale: So. Plateau Swale

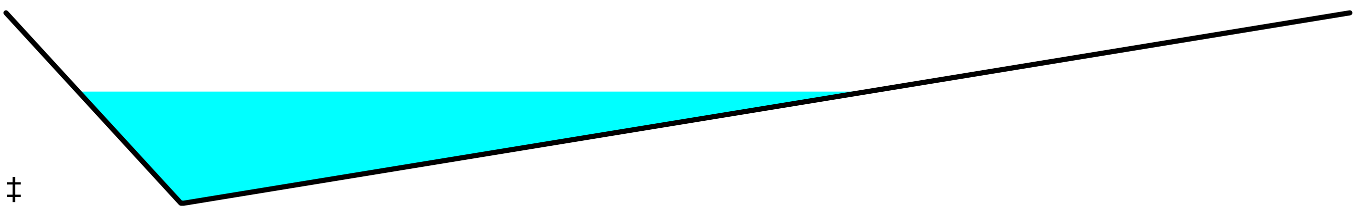
Inflow Area = 3.196 ac, 0.00% Impervious, Inflow Depth > 3.14" for 25-YR 24HR event
Inflow = 11.85 cfs @ 12.11 hrs, Volume= 0.836 af
Outflow = 8.44 cfs @ 12.38 hrs, Volume= 0.825 af, Atten= 29%, Lag= 16.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.54 fps, Min. Travel Time= 10.2 min
Avg. Velocity = 0.26 fps, Avg. Travel Time= 21.5 min

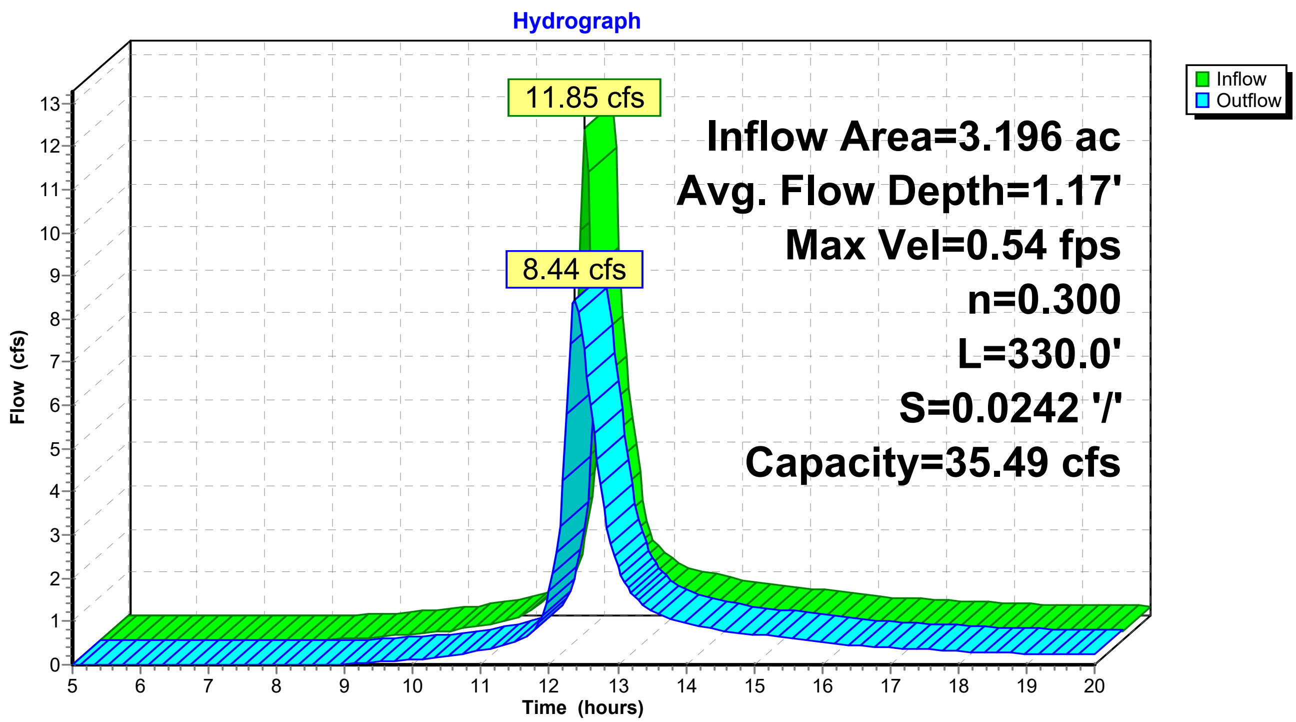
Peak Storage= 5,253 cf @ 12.21 hrs
Average Depth at Peak Storage= 1.17'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 35.49 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 20.0 '/' Top Width= 46.10'
Length= 330.0' Slope= 0.0242 '/'
Inlet Invert= 130.00', Outlet Invert= 122.00'

‡



Reach So. Plateau Swale: So. Plateau Swale



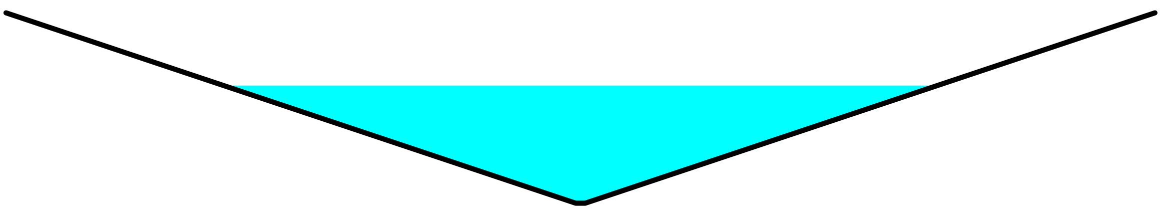
Summary for Reach Stone swale: stone swale

Inflow Area = 1.655 ac, 0.00% Impervious, Inflow Depth > 3.14" for 25-YR 24HR event
Inflow = 7.16 cfs @ 12.03 hrs, Volume= 0.434 af
Outflow = 5.76 cfs @ 12.16 hrs, Volume= 0.431 af, Atten= 20%, Lag= 7.7 min

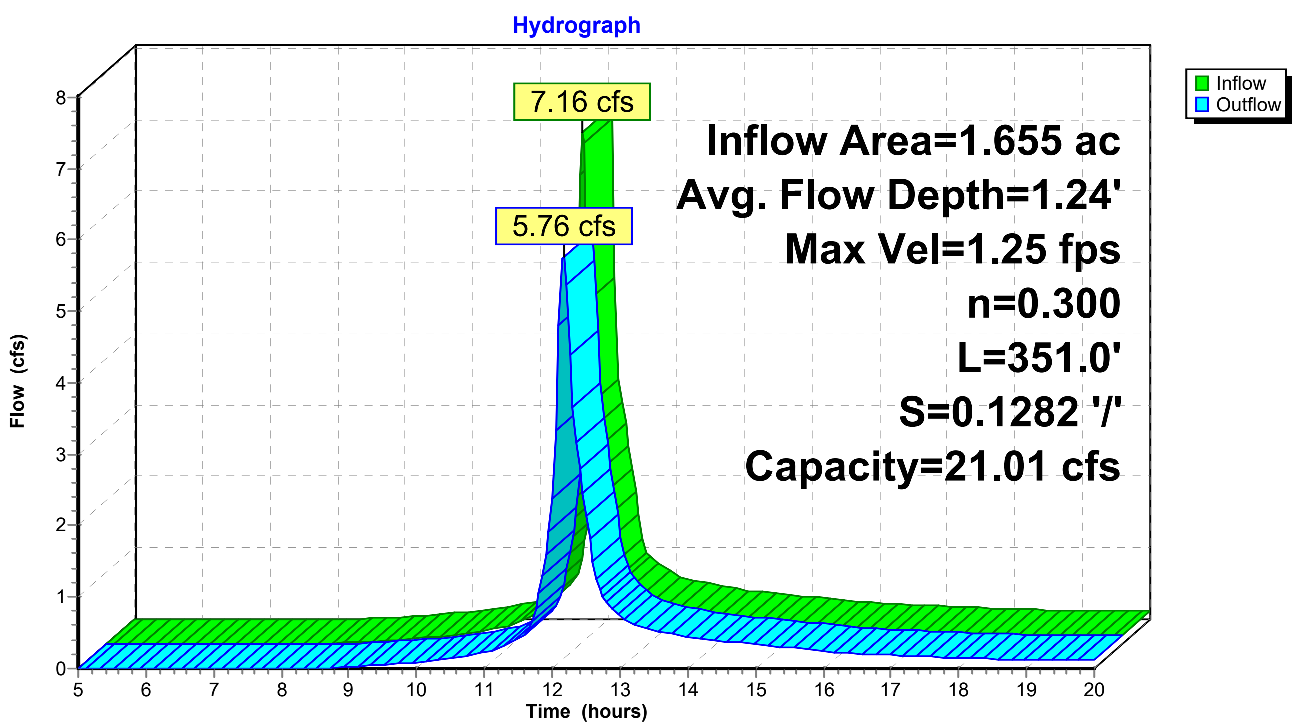
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.25 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 10.5 min

Peak Storage= 1,651 cf @ 12.08 hrs
Average Depth at Peak Storage= 1.24'
Bank-Full Depth= 2.00' Flow Area= 12.2 sf, Capacity= 21.01 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 12.10'
Length= 351.0' Slope= 0.1282 '/'
Inlet Invert= 155.00', Outlet Invert= 110.00'



Reach Stone swale: stone swale

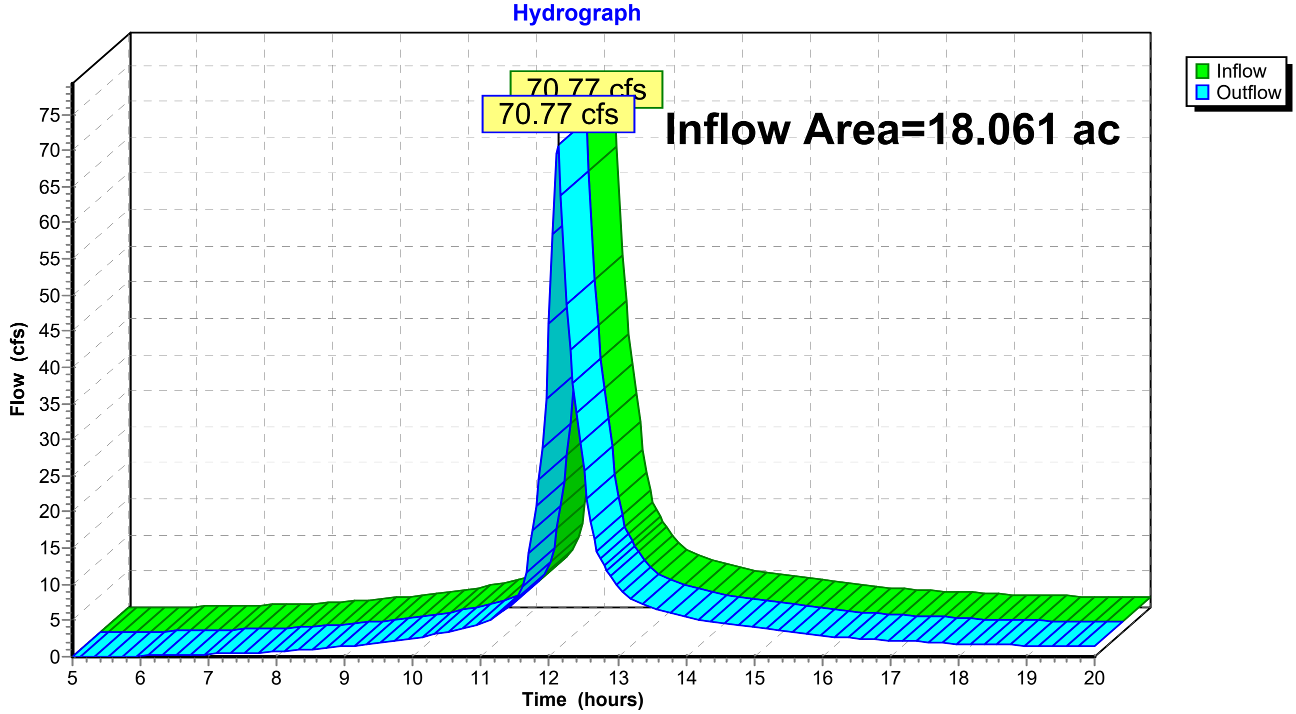


Summary for Reach Total Offsite Existing: Full site existing

Inflow Area = 18.061 ac, 0.00% Impervious, Inflow Depth > 4.10" for 25-YR 24HR event
Inflow = 70.77 cfs @ 12.12 hrs, Volume= 6.176 af
Outflow = 70.77 cfs @ 12.12 hrs, Volume= 6.176 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach Total Offsite Existing: Full site existing

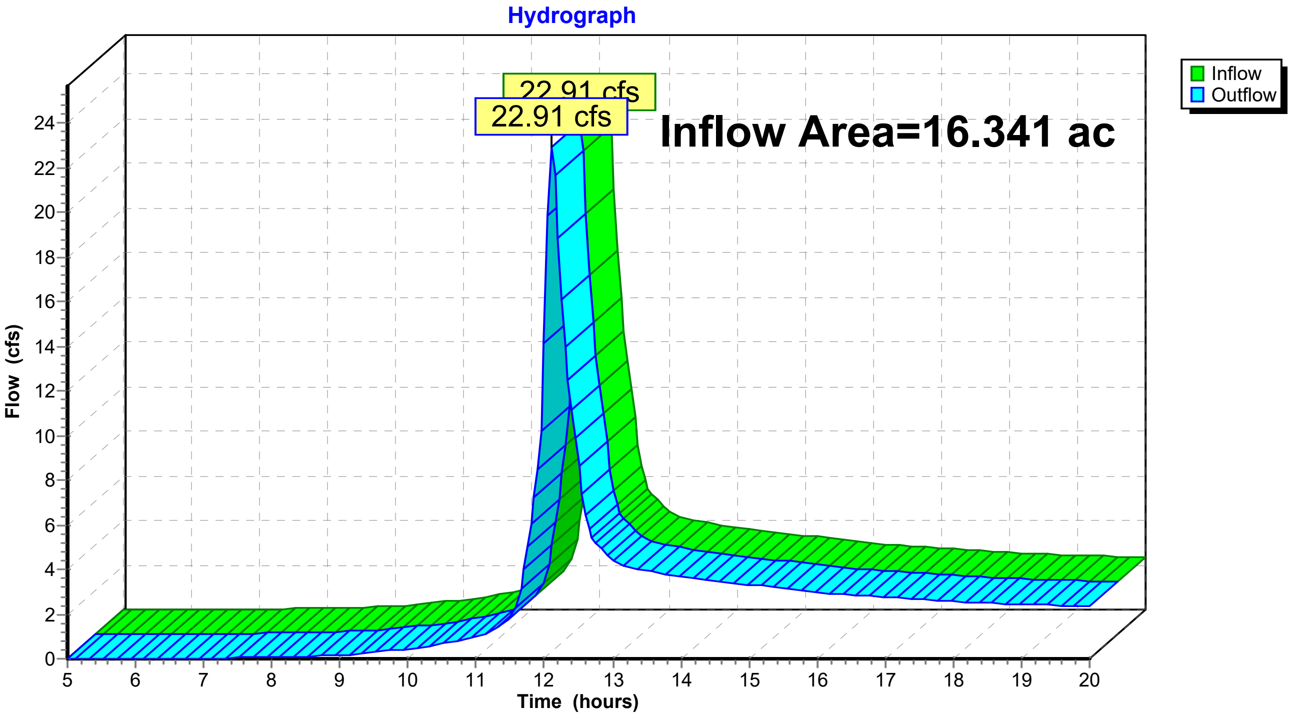


Summary for Reach TOTAL OFFSITE PROP: Full Site Prop

Inflow Area =	16.341 ac,	7.76% Impervious, Inflow Depth > 2.21"	for 25-YR 24HR event	
Inflow =	22.91 cfs @	12.11 hrs, Volume=	3.010 af	
Outflow =	22.91 cfs @	12.11 hrs, Volume=	3.010 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach TOTAL OFFSITE PROP: Full Site Prop



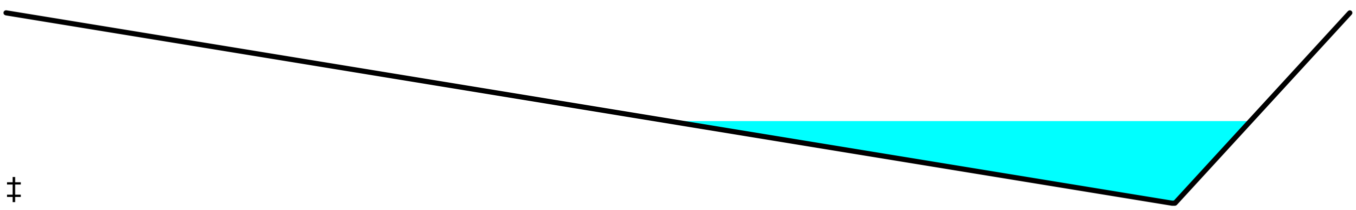
Summary for Reach West Plateau Swale: West Plateau Swale

Inflow Area = 2.085 ac, 0.00% Impervious, Inflow Depth > 3.14" for 25-YR 24HR event
Inflow = 7.59 cfs @ 12.12 hrs, Volume= 0.545 af
Outflow = 4.99 cfs @ 12.47 hrs, Volume= 0.535 af, Atten= 34%, Lag= 21.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.58 fps, Min. Travel Time= 13.8 min
Avg. Velocity = 0.28 fps, Avg. Travel Time= 28.1 min

Peak Storage= 4,130 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.86'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 46.67 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 20.0 3.0 '/' Top Width= 46.10'
Length= 477.0' Slope= 0.0419 '/'
Inlet Invert= 142.00', Outlet Invert= 122.00'



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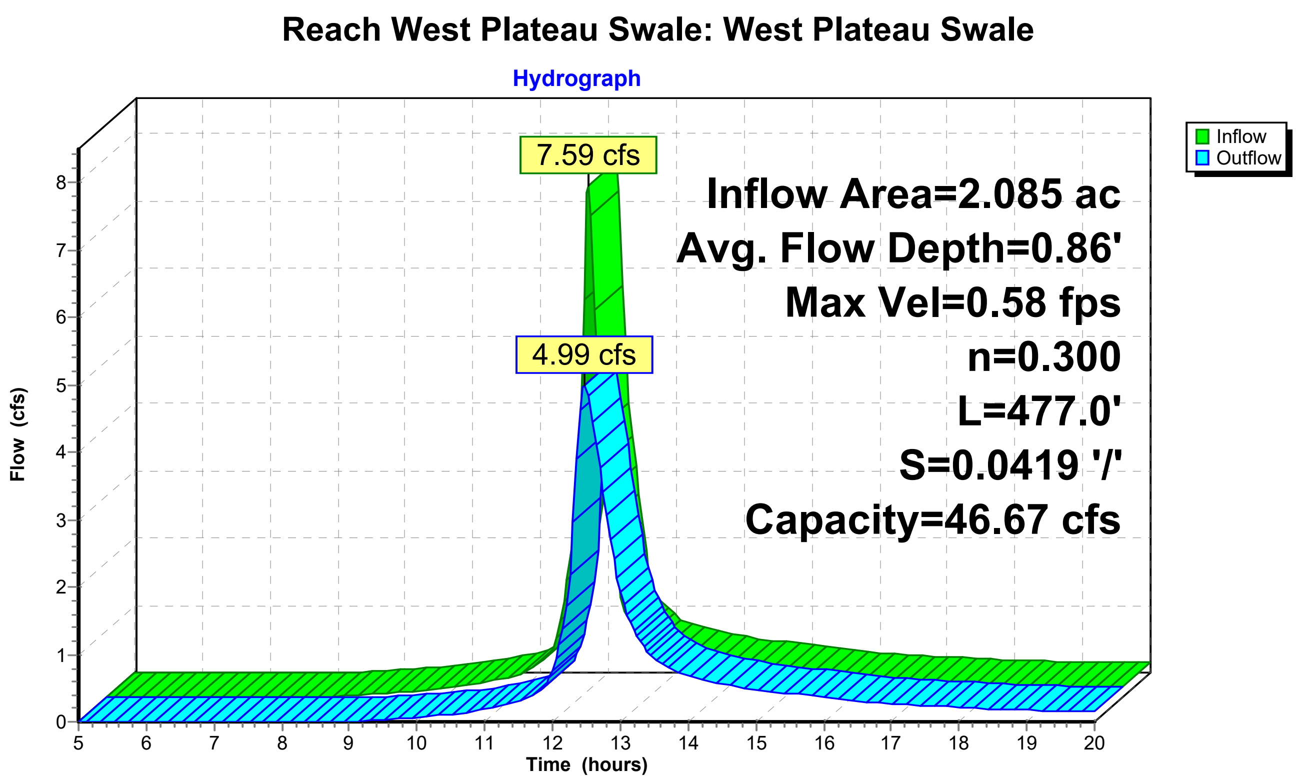


Summary for Pond 3P: Detention Basin

Inflow Area = 9.853 ac, 12.86% Impervious, Inflow Depth > 3.53" for 25-YR 24HR event
Inflow = 18.17 cfs @ 12.02 hrs, Volume= 2.896 af
Outflow = 2.04 cfs @ 15.76 hrs, Volume= 1.284 af, Atten= 89%, Lag= 224.4 min
Primary = 2.04 cfs @ 15.76 hrs, Volume= 1.284 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 109.97' @ 15.76 hrs Surf.Area= 57,597 sf Storage= 82,085 cf

Plug-Flow detention time= 256.9 min calculated for 1.280 af (44% of inflow)
Center-of-Mass det. time= 157.5 min (965.0 - 807.4)

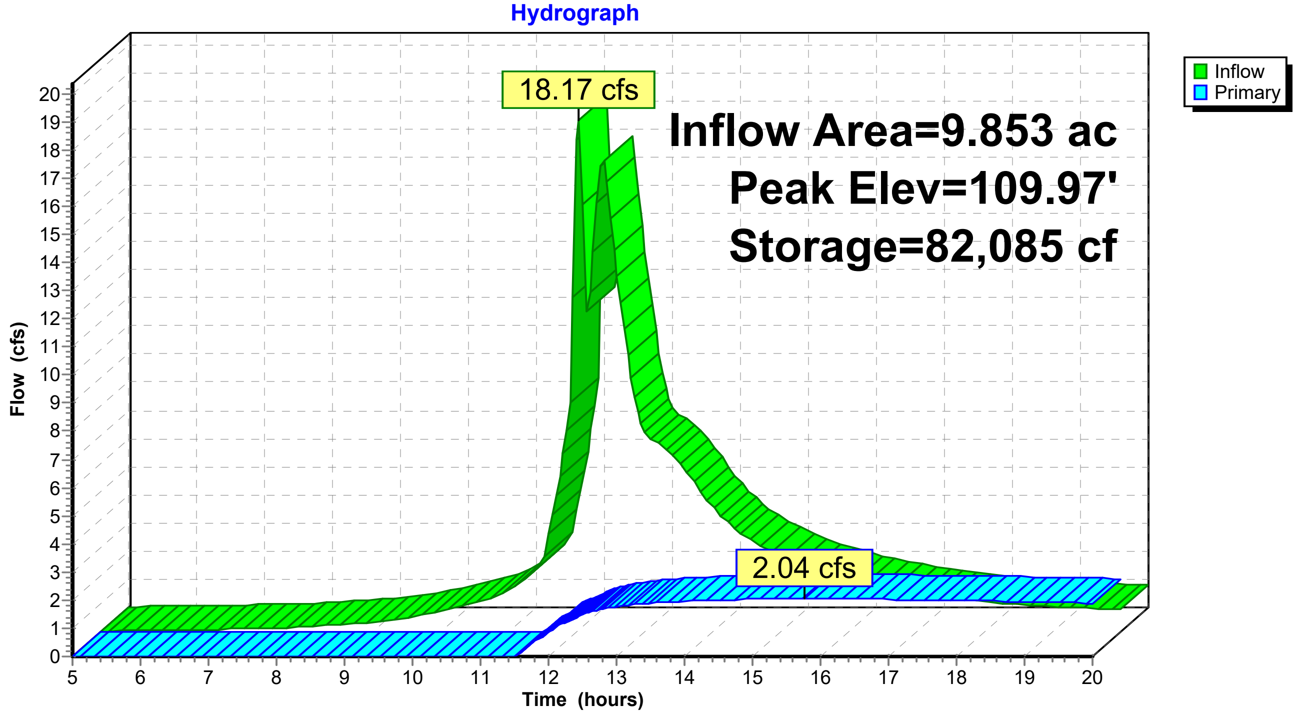
Volume	Invert	Avail.Storage	Storage Description
#1	108.20'	204,236 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
108.20	30,000	0	0
108.50	42,000	10,800	10,800
109.00	44,377	21,594	32,394
110.00	57,942	51,160	83,554
112.00	62,740	120,682	204,236

Device	Routing	Invert	Outlet Devices
#1	Primary	108.50'	**2.0" Horiz. Orifice/Grate X 4.00 columns** X 4 rows C= 0.600 Limited to weir flow at low heads
#2	Primary	110.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.04 cfs @ 15.76 hrs HW=109.97' (Free Discharge)
1=Orifice/Grate (Orifice Controls 2.04 cfs @ 5.85 fps)
2=Orifice/Grate (Controls 0.00 cfs)

Pond 3P: Detention Basin



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: E-1 Runoff Area=114,240 sf 0.00% Impervious Runoff Depth>6.94"
Flow Length=630' Tc=8.6 min CN=86 Runoff=19.42 cfs 1.516 af

Subcatchment E-2: E-2 Runoff Area=98,290 sf 0.00% Impervious Runoff Depth>6.06"
Flow Length=488' Slope=0.0100 '/' Tc=32.5 min CN=79 Runoff=9.21 cfs 1.140 af

Subcatchment E-3: E-3 Runoff Area=79,629 sf 0.00% Impervious Runoff Depth>6.48"
Tc=0.0 min CN=82 Runoff=16.33 cfs 0.987 af

Subcatchment E-4: E-4 Runoff Area=277,162 sf 0.00% Impervious Runoff Depth>6.94"
Flow Length=550' Slope=0.0100 '/' Tc=9.2 min CN=86 Runoff=45.93 cfs 3.677 af

Subcatchment E-5: E-5 Runoff Area=217,437 sf 0.00% Impervious Runoff Depth>6.47"
Flow Length=760' Tc=8.8 min CN=82 Runoff=34.91 cfs 2.690 af

Subcatchment P-1: P-1 Runoff Area=45,494 sf 0.00% Impervious Runoff Depth>5.51"
Flow Length=523' Tc=3.6 min CN=74 Runoff=7.61 cfs 0.479 af

Subcatchment P-10: P-10 Runoff Area=72,105 sf 0.00% Impervious Runoff Depth>5.51"
Flow Length=409' Slope=0.3300 '/' Tc=1.7 min CN=74 Runoff=12.33 cfs 0.760 af

Subcatchment P-11: P-11 Runoff Area=46,241 sf 0.00% Impervious Runoff Depth>6.94"
Flow Length=330' Slope=0.0100 '/' Tc=5.5 min CN=86 Runoff=8.58 cfs 0.614 af

Subcatchment P-2: P-2 Runoff Area=95,039 sf 0.00% Impervious Runoff Depth>5.01"
Flow Length=390' Tc=10.5 min CN=70 Runoff=11.70 cfs 0.912 af

Subcatchment P-3: P-3 Runoff Area=23,731 sf 0.00% Impervious Runoff Depth>5.26"
Flow Length=190' Slope=0.0100 '/' Tc=6.3 min CN=72 Runoff=3.48 cfs 0.239 af

Subcatchment P-4: P-4 Runoff Area=45,575 sf 0.00% Impervious Runoff Depth>5.51"
Flow Length=605' Tc=3.7 min CN=74 Runoff=7.60 cfs 0.480 af

Subcatchment P-5: P-5 Runoff Area=43,177 sf 0.00% Impervious Runoff Depth>6.55"
Flow Length=535' Tc=31.1 min CN=83 Runoff=4.38 cfs 0.541 af

Subcatchment P-6: P-6 Runoff Area=139,221 sf 0.00% Impervious Runoff Depth>5.50"
Flow Length=707' Slope=0.0500 '/' Tc=7.5 min CN=74 Runoff=20.49 cfs 1.465 af

Subcatchment P-7: P-7 Runoff Area=90,811 sf 0.00% Impervious Runoff Depth>5.50"
Flow Length=750' Slope=0.0500 '/' Tc=8.0 min CN=74 Runoff=13.14 cfs 0.956 af

Subcatchment P-8: P-8 Runoff Area=110,418 sf 50.00% Impervious Runoff Depth>7.17"
Flow Length=310' Slope=0.3300 '/' Tc=1.3 min CN=88 Runoff=23.30 cfs 1.515 af

Subcatchment P-9: P-9
Runoff=0.00 cfs 0.000 af

Reach Bench swale: Bench swale Avg. Flow Depth=1.40' Max Vel=0.43 fps Inflow=7.60 cfs 0.480 af
n=0.300 L=570.0' S=0.0100 '/' Capacity=8.41 cfs Outflow=3.70 cfs 0.467 af

Reach Drop Pipe: Drop Pipe Avg. Flow Depth=0.61' Max Vel=36.08 fps Inflow=24.16 cfs 2.392 af
18.0" Round Pipe n=0.013 L=30.0' S=0.4500 '/' Capacity=70.47 cfs Outflow=24.15 cfs 2.392 af

Reach REACH 1: Reach 1 Inflow=7.61 cfs 0.479 af
Outflow=7.61 cfs 0.479 af

Reach REACH 3: Reach 3 Inflow=3.48 cfs 0.239 af
Outflow=3.48 cfs 0.239 af

Reach REACH 4: Reach 4 Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach REACH 5: Reach 5 Inflow=19.46 cfs 3.770 af
Outflow=19.46 cfs 3.770 af

Reach REACH2: Reach2 Inflow=11.70 cfs 0.912 af
Outflow=11.70 cfs 0.912 af

Reach Road Swale: Road Swale Avg. Flow Depth=1.90' Max Vel=0.33 fps Inflow=7.73 cfs 1.008 af
n=0.300 L=550.0' S=0.0040 '/' Capacity=6.19 cfs Outflow=5.52 cfs 0.974 af

Reach So. Plateau Swale: So. Plateau Avg. Flow Depth=1.47' Max Vel=0.62 fps Inflow=20.49 cfs 1.465 af
n=0.300 L=330.0' S=0.0242 '/' Capacity=35.49 cfs Outflow=15.50 cfs 1.450 af

Reach Stone swale: stone swale Avg. Flow Depth=1.54' Max Vel=1.44 fps Inflow=12.33 cfs 0.760 af
n=0.300 L=351.0' S=0.1282 '/' Capacity=21.01 cfs Outflow=10.22 cfs 0.757 af

Reach Total Offsite Existing: Full site existing Inflow=111.61 cfs 10.010 af
Outflow=111.61 cfs 10.010 af

Reach TOTAL OFFSITE PROP: Full Site Prop Inflow=39.97 cfs 5.400 af
Outflow=39.97 cfs 5.400 af

Reach West Plateau Swale: West Avg. Flow Depth=1.09' Max Vel=0.67 fps Inflow=13.14 cfs 0.956 af
n=0.300 L=477.0' S=0.0419 '/' Capacity=46.67 cfs Outflow=9.23 cfs 0.942 af

Pond 3P: Detention Basin Peak Elev=110.79' Storage=130,370 cf Inflow=30.78 cfs 4.881 af
Outflow=5.84 cfs 2.399 af

Total Runoff Area = 34.402 ac Runoff Volume = 17.972 af Average Runoff Depth = 6.27"
96.32% Pervious = 33.135 ac 3.68% Impervious = 1.267 ac

Summary for Subcatchment E-1: E-1

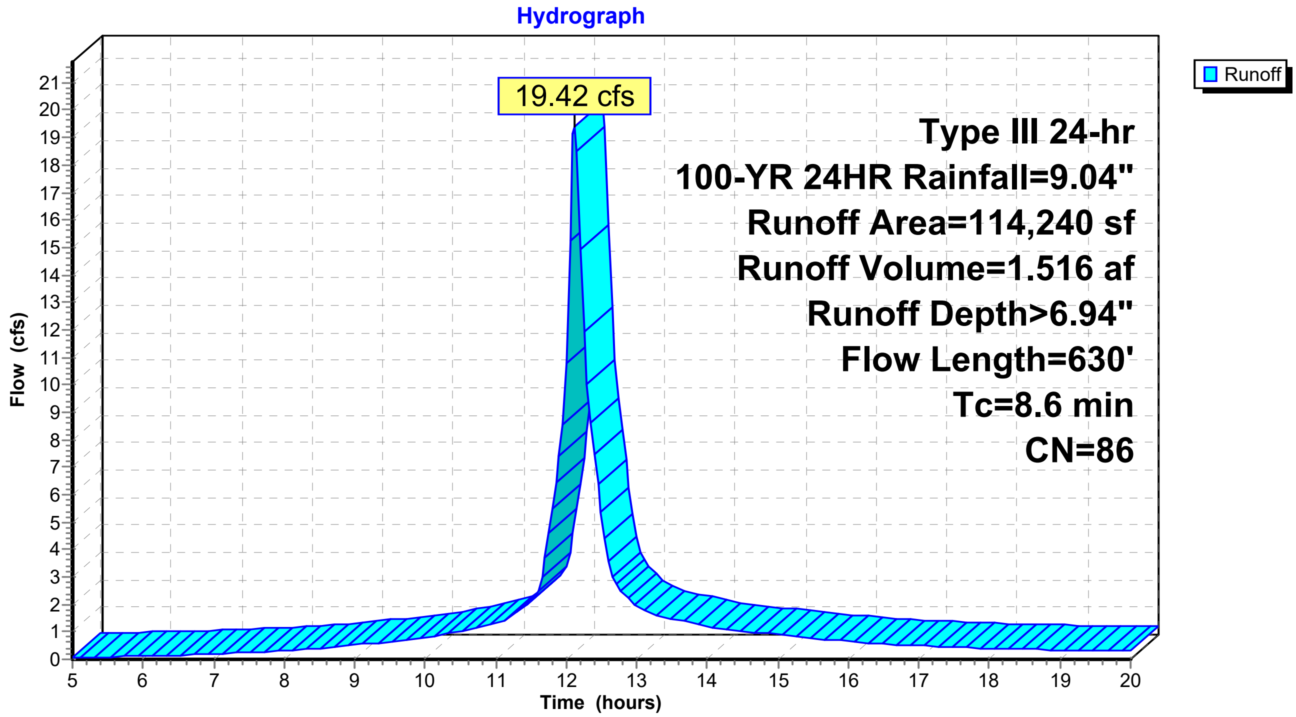
Runoff = 19.42 cfs @ 12.12 hrs, Volume= 1.516 af, Depth> 6.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
114,240	86	<50% Grass cover, Poor, HSG C
114,240		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	320	0.3300	4.02		**Shallow Concentrated Flow, e1 1** Short Grass Pasture Kv= 7.0 fps
7.3	310	0.0050	0.71		**Shallow Concentrated Flow, e1 2** Nearly Bare & Untilled Kv= 10.0 fps
8.6	630	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

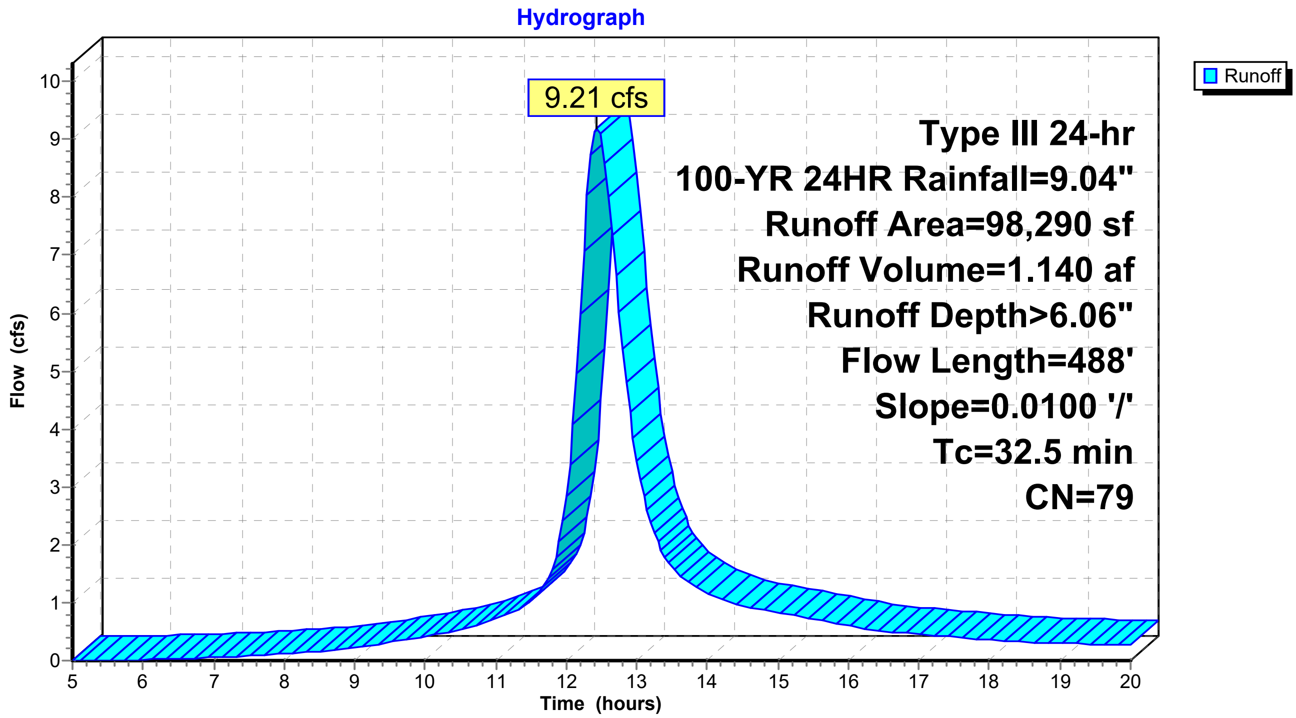
Runoff = 9.21 cfs @ 12.44 hrs, Volume= 1.140 af, Depth> 6.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
54,000	86	<50% Grass cover, Poor, HSG C
44,290	70	Woods, Good, HSG C
98,290	79	Weighted Average
98,290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.5	488	0.0100	0.25		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps

Subcatchment E-2: E-2



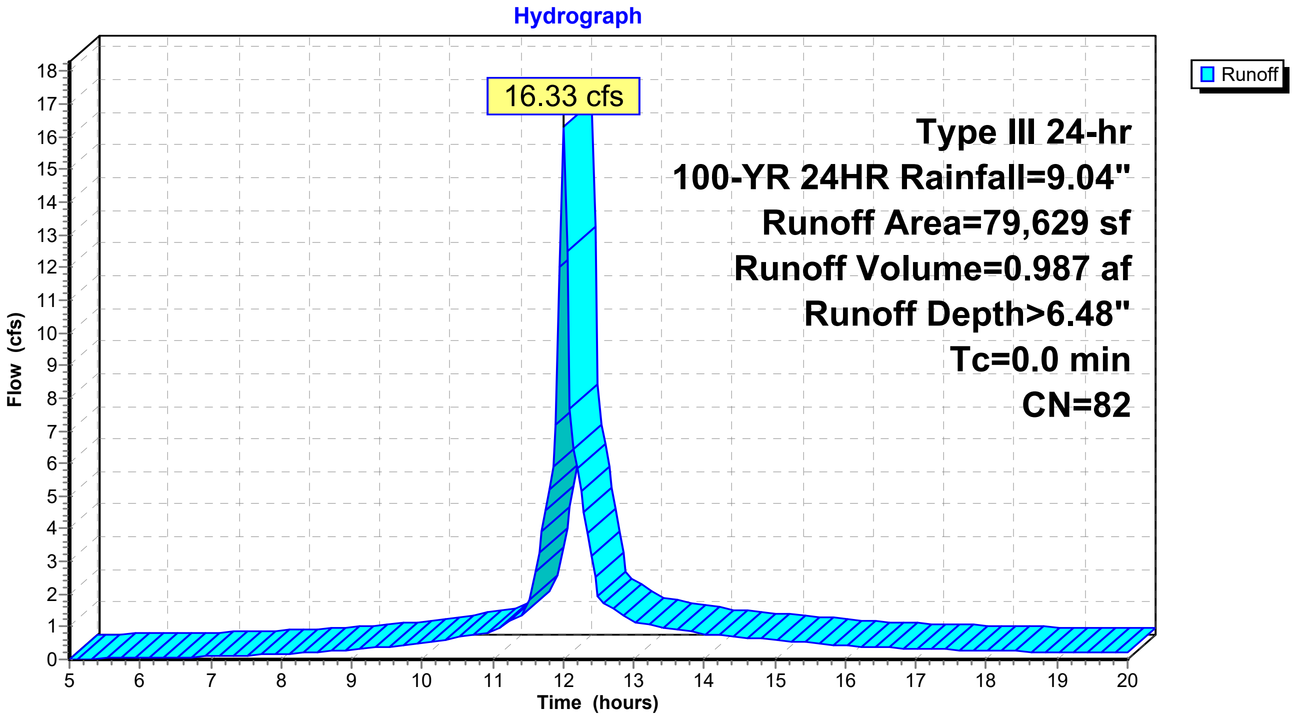
Summary for Subcatchment E-3: E-3

Runoff = 16.33 cfs @ 12.00 hrs, Volume= 0.987 af, Depth> 6.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
59,600	86	<50% Grass cover, Poor, HSG C
20,029	70	Woods, Good, HSG C
79,629	82	Weighted Average
79,629		100.00% Pervious Area

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

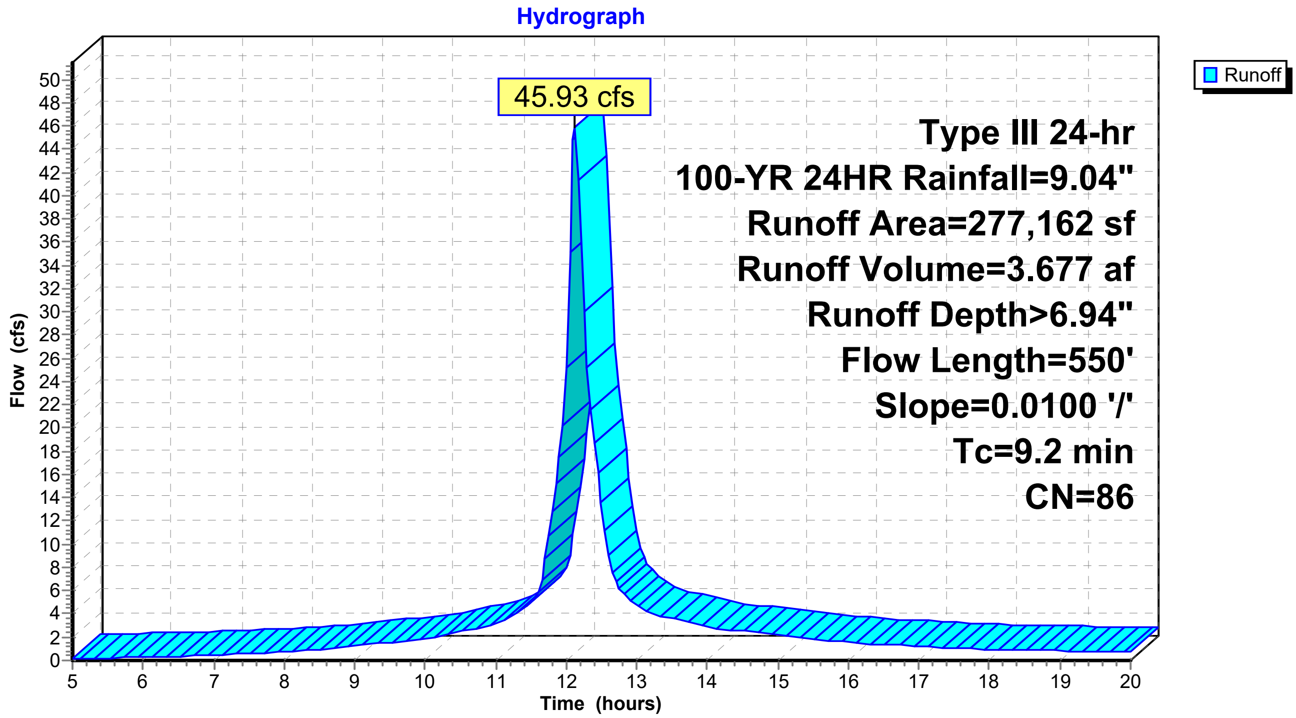
Runoff = 45.93 cfs @ 12.13 hrs, Volume= 3.677 af, Depth> 6.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
277,162	86	<50% Grass cover, Poor, HSG C
277,162		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	550	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment E-4: E-4



Summary for Subcatchment E-5: E-5

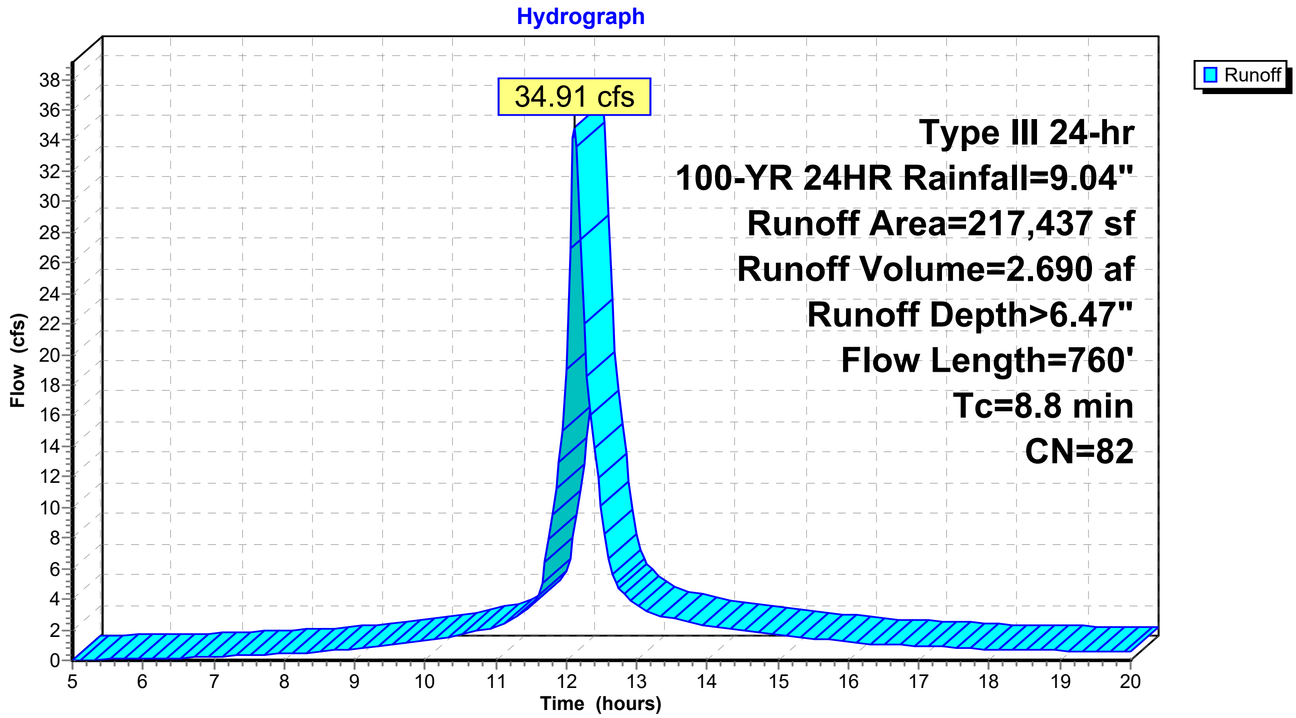
Runoff = 34.91 cfs @ 12.12 hrs, Volume= 2.690 af, Depth> 6.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
76,103	74	>75% Grass cover, Good, HSG C
141,334	86	<50% Grass cover, Poor, HSG C
217,437	82	Weighted Average
217,437		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	310	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.5	450	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
8.8	760	Total			

Subcatchment E-5: E-5



Summary for Subcatchment P-1: P-1

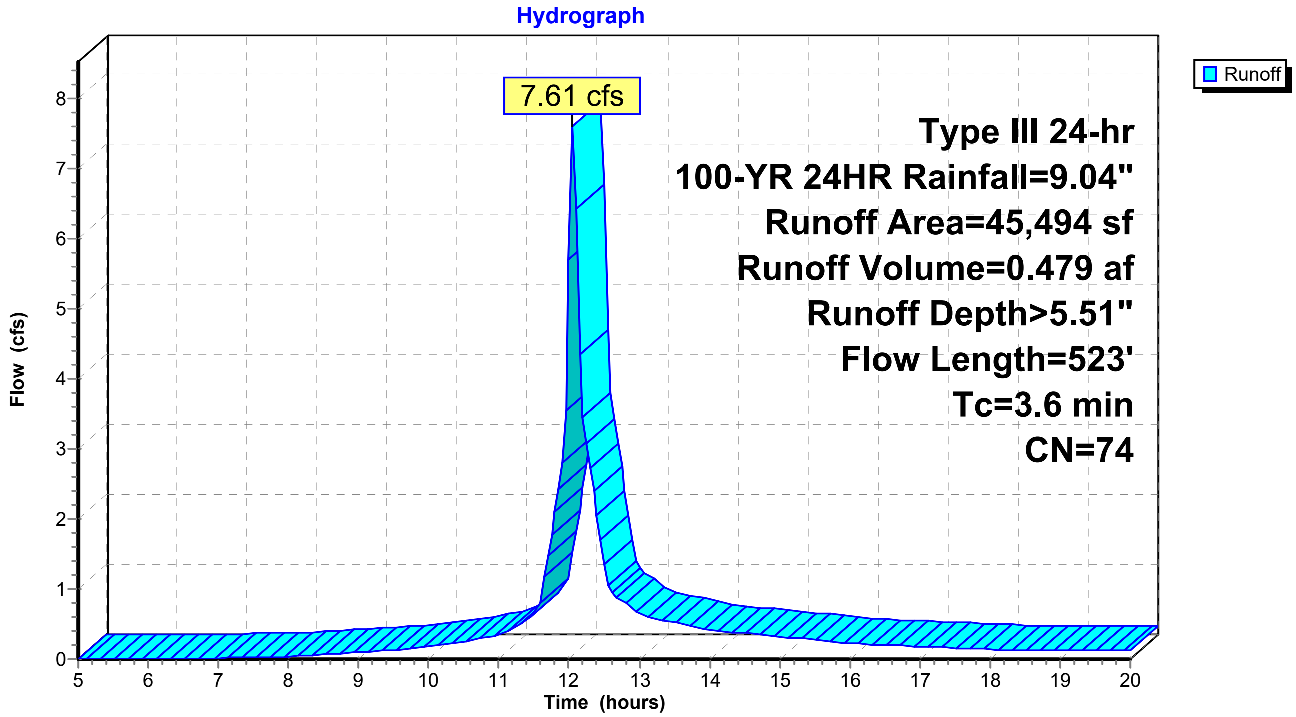
Runoff = 7.61 cfs @ 12.06 hrs, Volume= 0.479 af, Depth> 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
45,494	74	>75% Grass cover, Good, HSG C
45,494		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	328	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.2	195	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.6	523	Total			

Subcatchment P-1: P-1



Summary for Subcatchment P-10: P-10

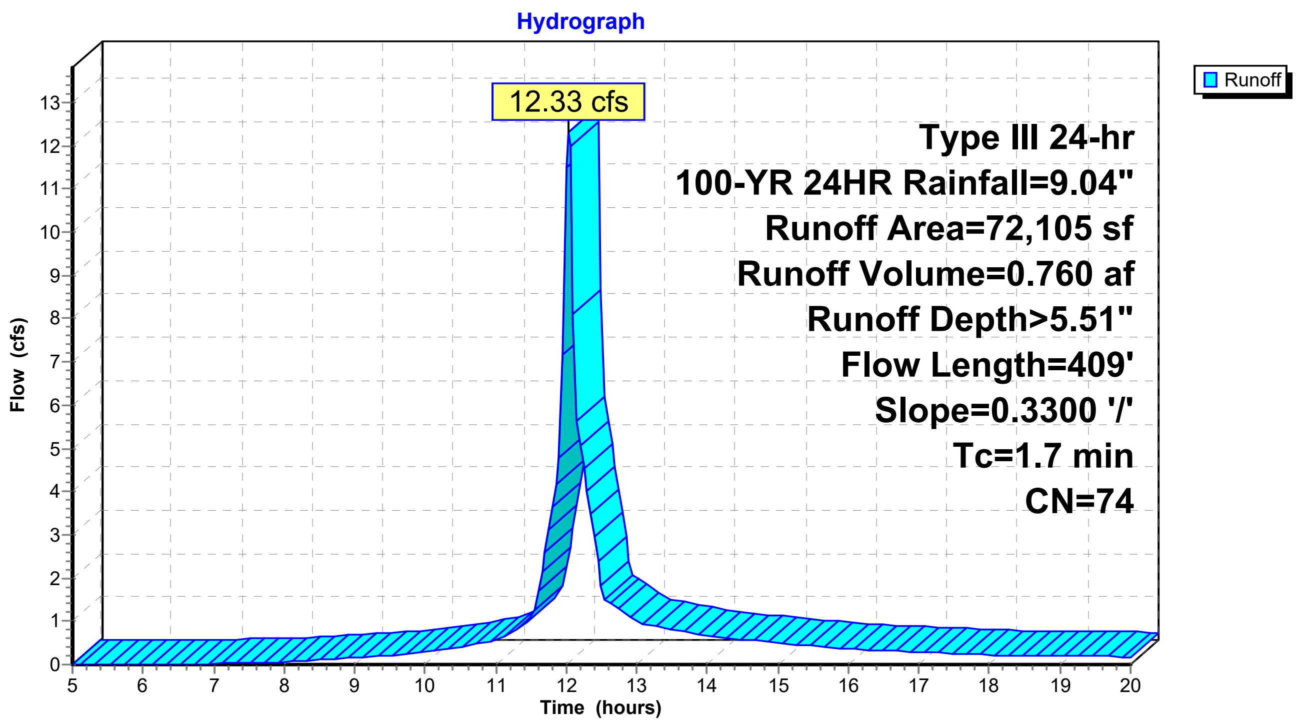
Runoff = 12.33 cfs @ 12.03 hrs, Volume= 0.760 af, Depth> 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
72,105	74	>75% Grass cover, Good, HSG C
72,105		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	409	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-10: P-10



Summary for Subcatchment P-11: P-11

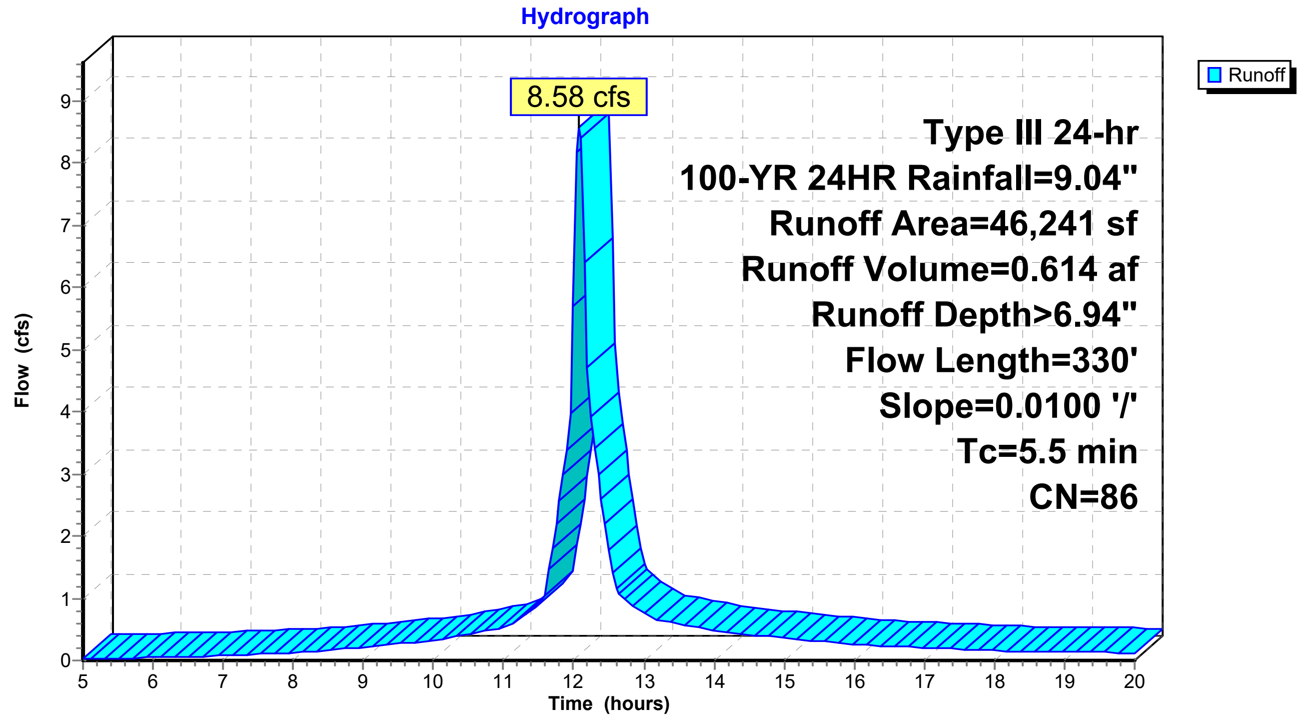
Runoff = 8.58 cfs @ 12.08 hrs, Volume= 0.614 af, Depth> 6.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
46,241	86	<50% Grass cover, Poor, HSG C
46,241		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	330	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment P-11: P-11



Summary for Subcatchment P-2: P-2

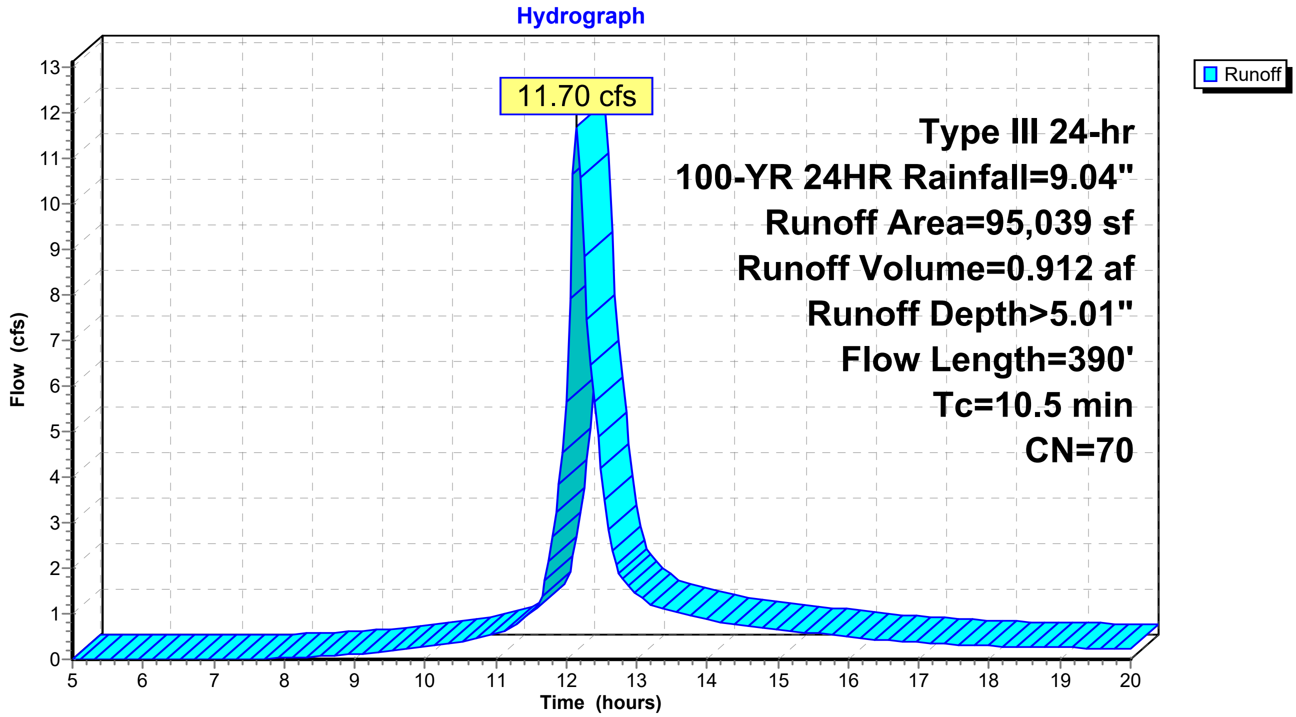
Runoff = 11.70 cfs @ 12.15 hrs, Volume= 0.912 af, Depth> 5.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
95,039	70	Woods, Good, HSG C
95,039		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	110	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.3	280	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.5	390	Total			

Subcatchment P-2: P-2



Summary for Subcatchment P-3: P-3

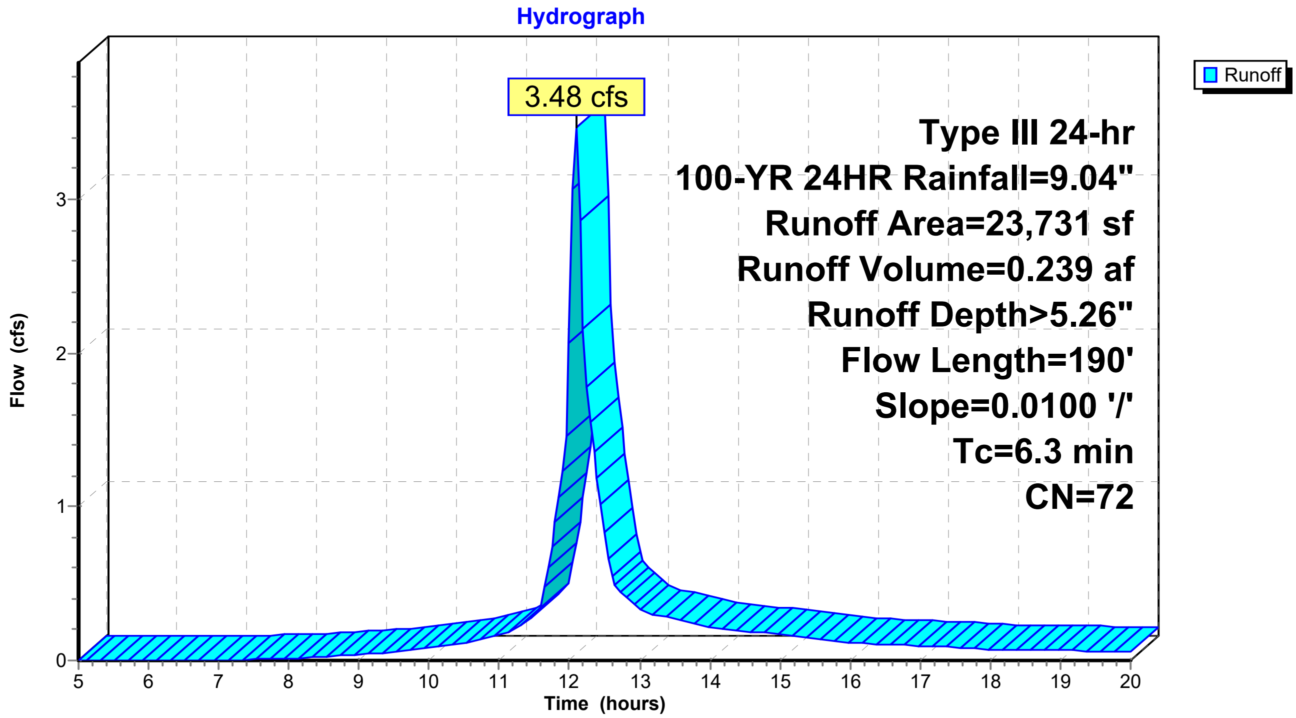
Runoff = 3.48 cfs @ 12.09 hrs, Volume= 0.239 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
23,731	72	Woods/grass comb., Good, HSG C
23,731		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	190	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment P-3: P-3



Summary for Subcatchment P-4: P-4

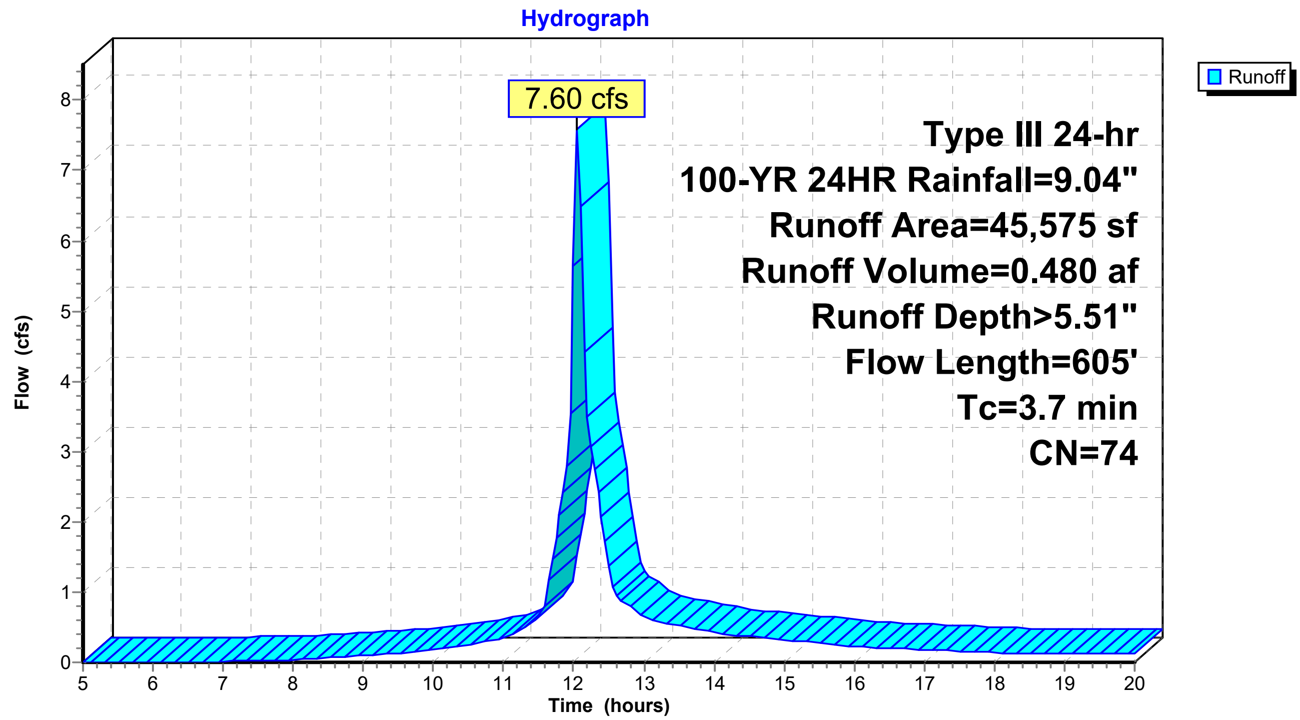
Runoff = 7.60 cfs @ 12.06 hrs, Volume= 0.480 af, Depth> 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
45,575	74	>75% Grass cover, Good, HSG C
45,575		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	45	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.5	560	0.0100	2.70	10.78	**Trap/Vee/Rect Channel Flow, bench swale** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.040 Earth, cobble bottom, clean sides
3.7	605	Total			

Subcatchment P-4: P-4



Summary for Subcatchment P-5: P-5

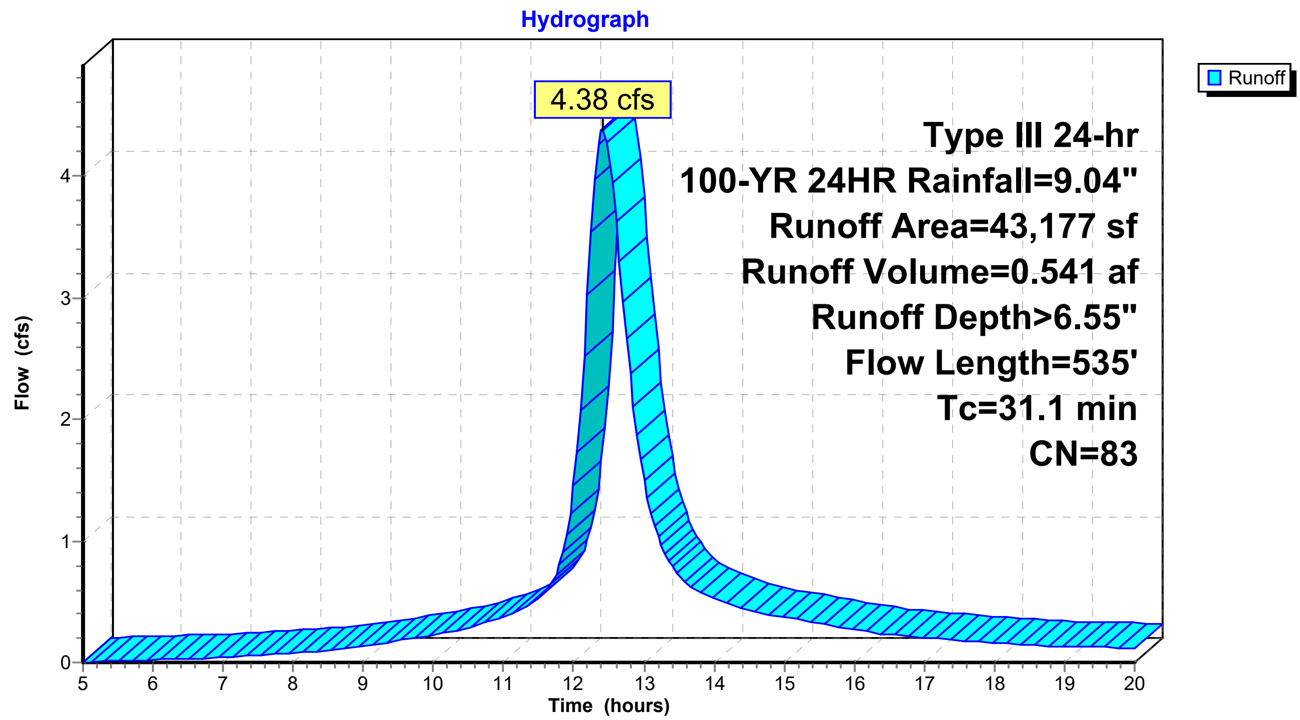
Runoff = 4.38 cfs @ 12.41 hrs, Volume= 0.541 af, Depth> 6.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
22,177	79	50-75% Grass cover, Fair, HSG C
21,000	87	Dirt roads, HSG C
43,177	83	Weighted Average
43,177		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	35	0.3000	0.28		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
29.0	500	0.0030	0.29	4.60	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=2.00' Z= 3.0 '/' Top.W=14.00' n= 0.300
31.1	535	Total			

Subcatchment P-5: P-5



Summary for Subcatchment P-6: P-6

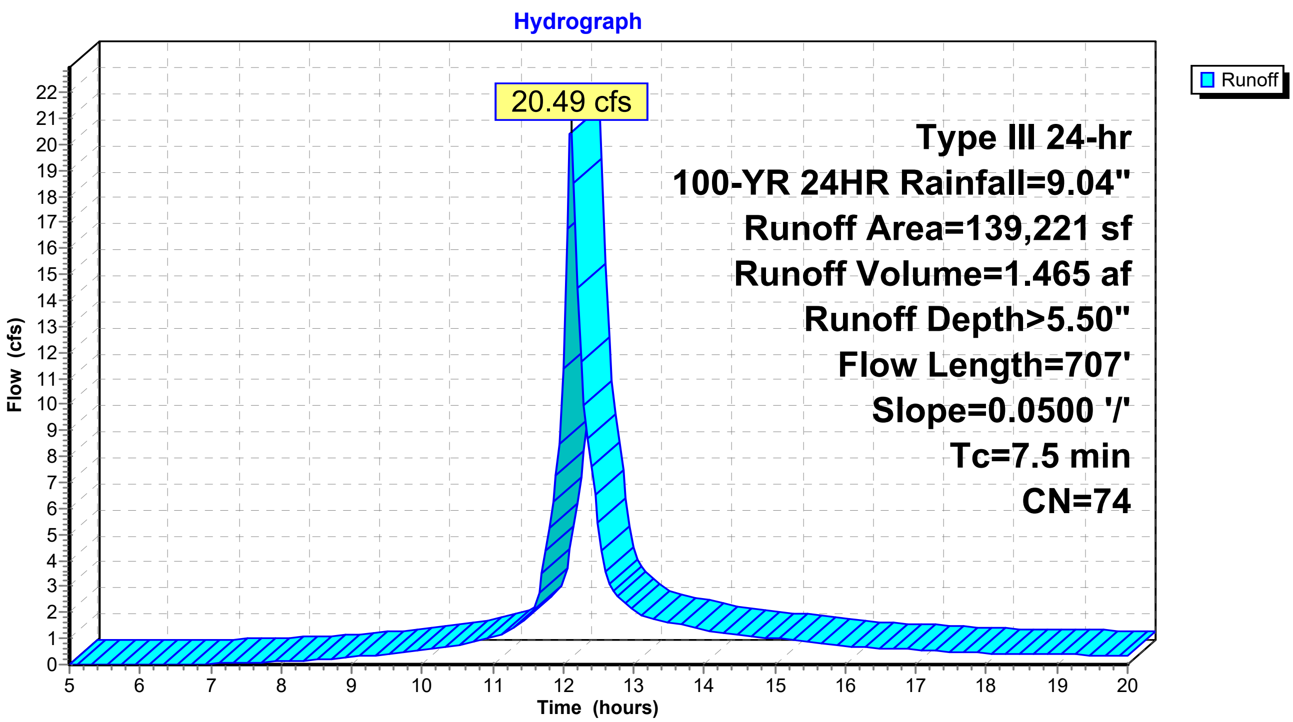
Runoff = 20.49 cfs @ 12.11 hrs, Volume= 1.465 af, Depth> 5.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
139,221	74	>75% Grass cover, Good, HSG C
139,221		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	707	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-6: P-6



Summary for Subcatchment P-7: P-7

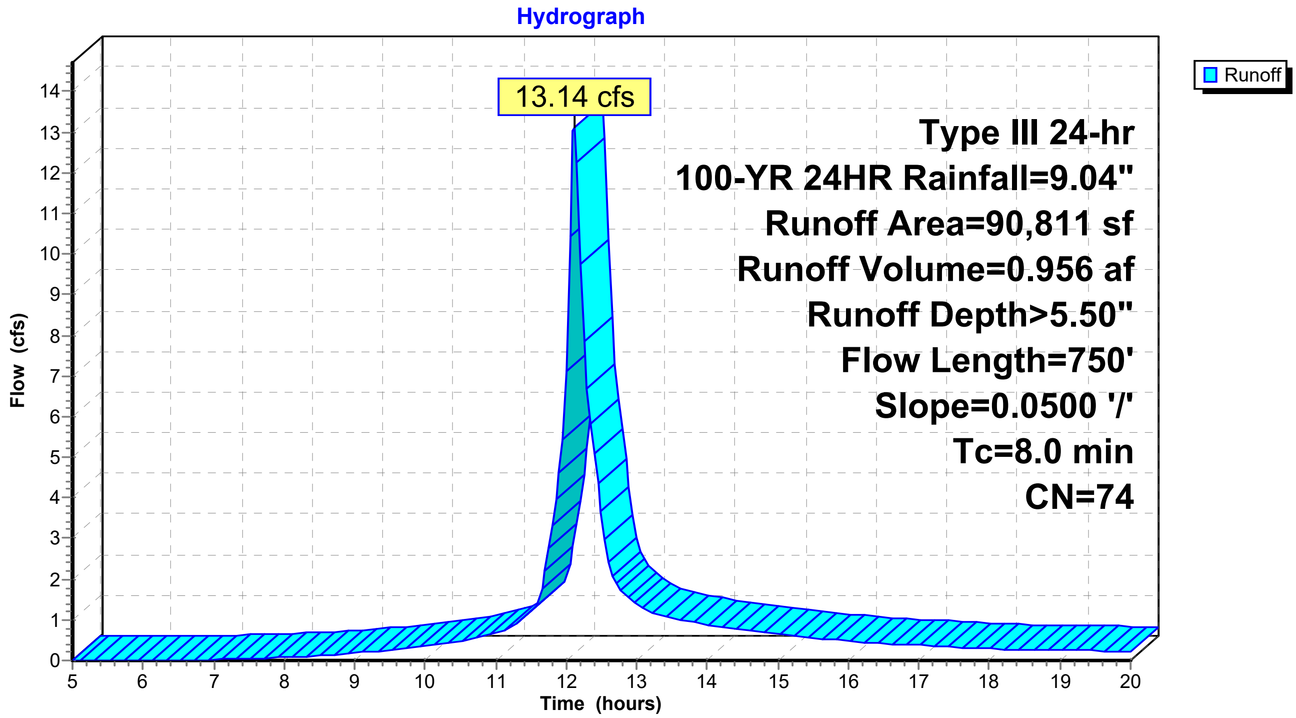
Runoff = 13.14 cfs @ 12.11 hrs, Volume= 0.956 af, Depth> 5.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
90,811	74	>75% Grass cover, Good, HSG C
90,811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	750	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-7: P-7



Summary for Subcatchment P-8: P-8

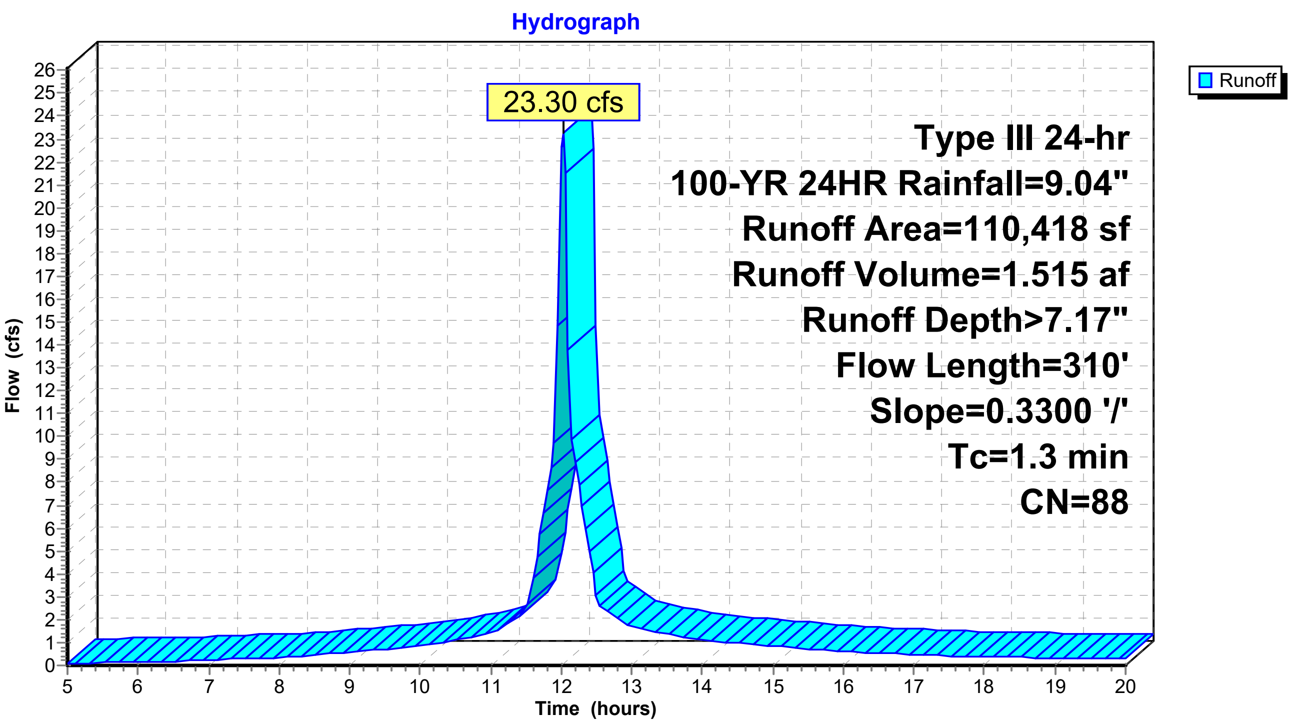
Runoff = 23.30 cfs @ 12.02 hrs, Volume= 1.515 af, Depth> 7.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
45,474	74	>75% Grass cover, Good, HSG C
9,735	96	Gravel surface, HSG C
55,209	98	Water Surface, HSG C
110,418	88	Weighted Average
55,209		50.00% Pervious Area
55,209		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	110	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	200		4.01		**Lake or Reservoir,** Mean Depth= 0.50'
1.3	310	Total			

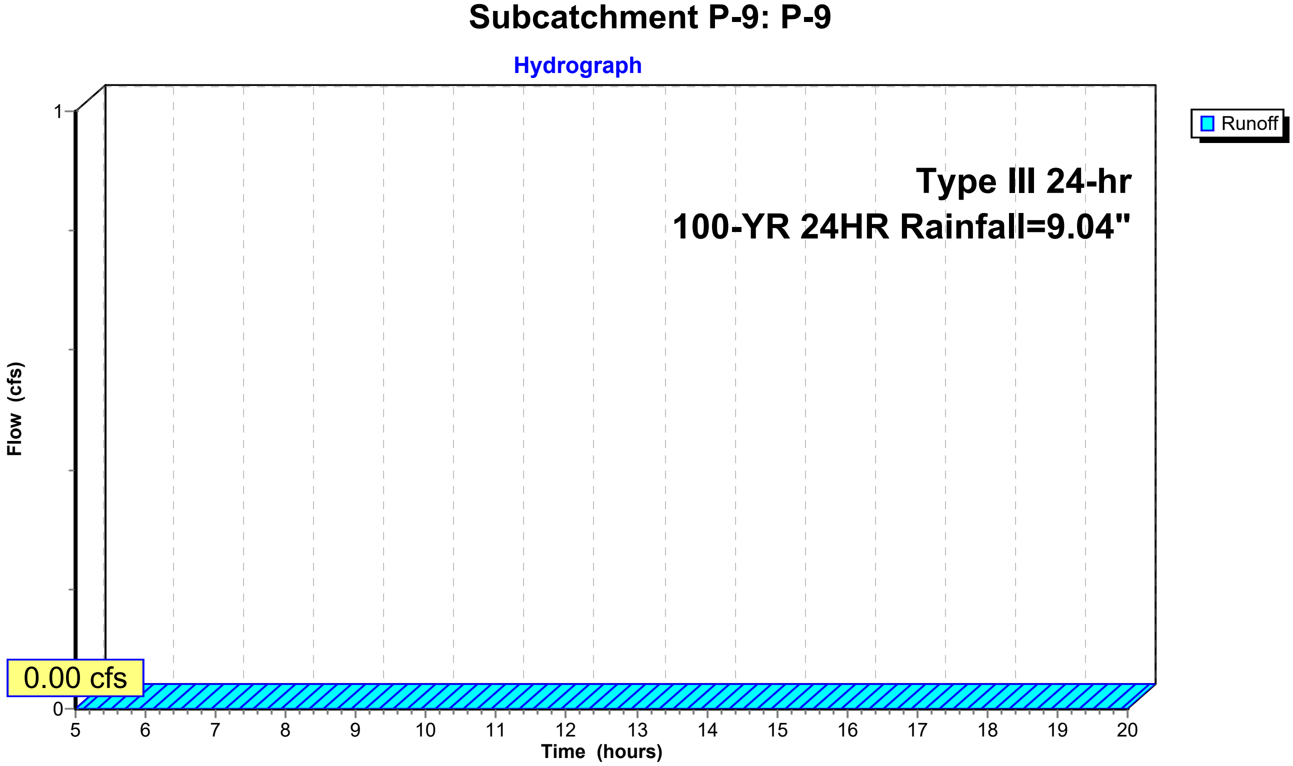
Subcatchment P-8: P-8



Summary for Subcatchment P-9: P-9

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"



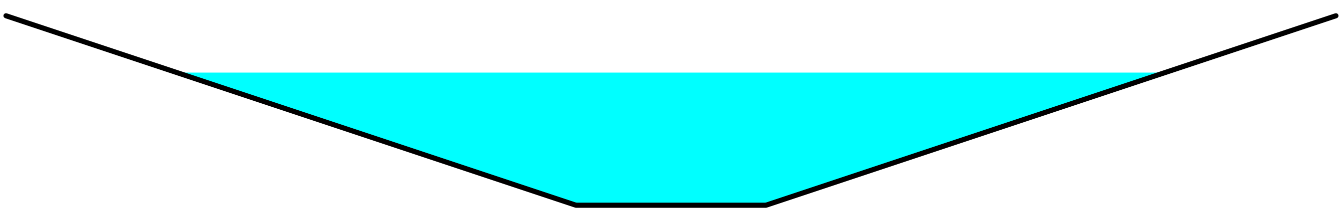
Summary for Reach Bench swale: Bench swale

Inflow Area = 1.046 ac, 0.00% Impervious, Inflow Depth > 5.51" for 100-YR 24HR event
Inflow = 7.60 cfs @ 12.06 hrs, Volume= 0.480 af
Outflow = 3.70 cfs @ 12.57 hrs, Volume= 0.467 af, Atten= 51%, Lag= 30.8 min

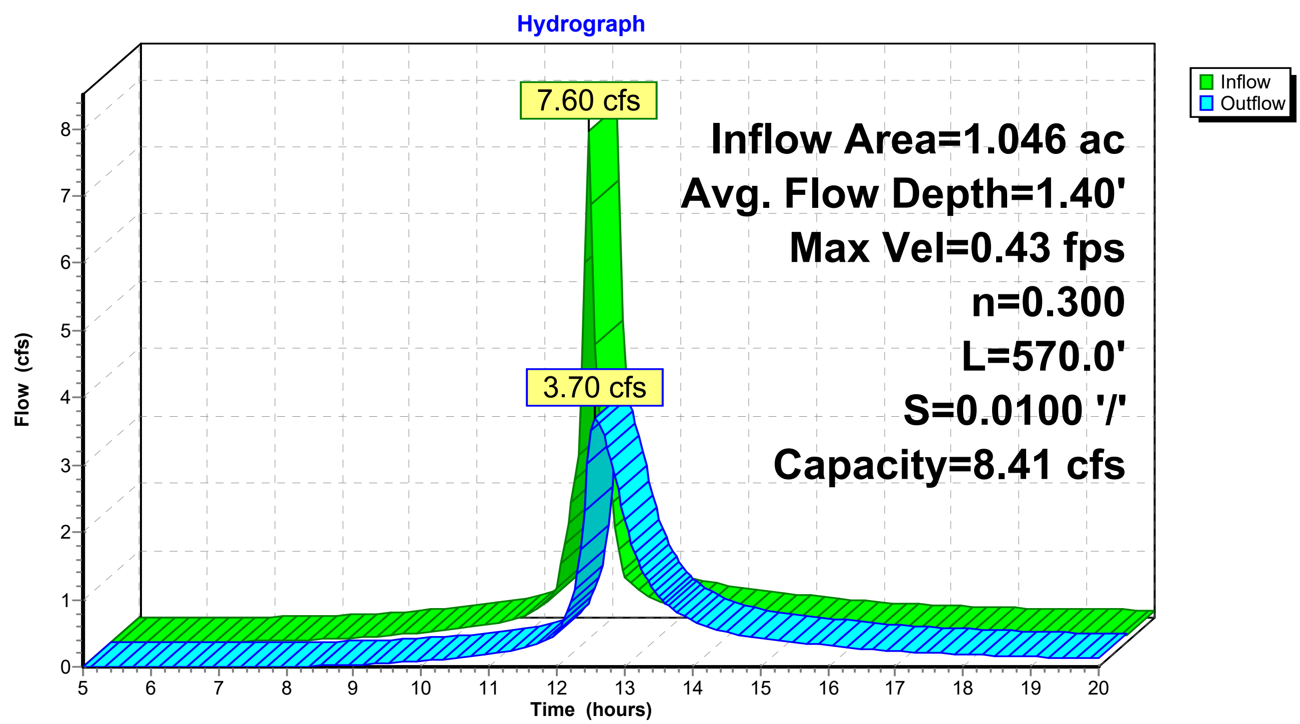
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.43 fps, Min. Travel Time= 22.3 min
Avg. Velocity = 0.19 fps, Avg. Travel Time= 48.7 min

Peak Storage= 4,951 cf @ 12.20 hrs
Average Depth at Peak Storage= 1.40'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 8.41 cfs

2.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 570.0' Slope= 0.0100 '/'
Inlet Invert= 116.20', Outlet Invert= 110.50'



Reach Bench swale: Bench swale



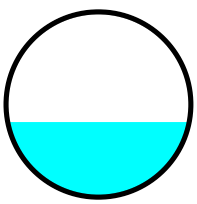
Summary for Reach Drop Pipe: Drop Pipe

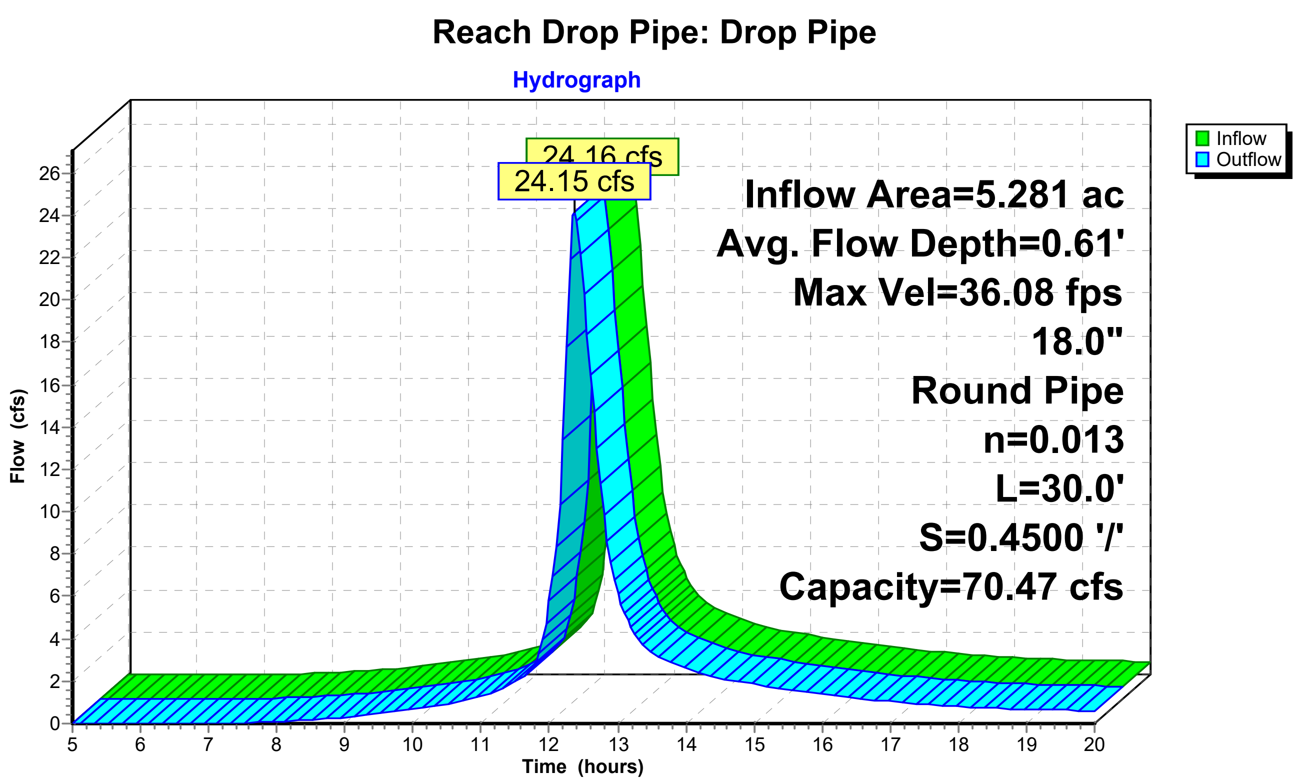
Inflow Area = 5.281 ac, 0.00% Impervious, Inflow Depth > 5.44" for 100-YR 24HR event
Inflow = 24.16 cfs @ 12.37 hrs, Volume= 2.392 af
Outflow = 24.15 cfs @ 12.37 hrs, Volume= 2.392 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 36.08 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 14.93 fps, Avg. Travel Time= 0.0 min

Peak Storage= 20 cf @ 12.37 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 70.47 cfs

18.0" Round Pipe
n= 0.013
Length= 30.0' Slope= 0.4500 '/'
Inlet Invert= 122.00', Outlet Invert= 108.50'



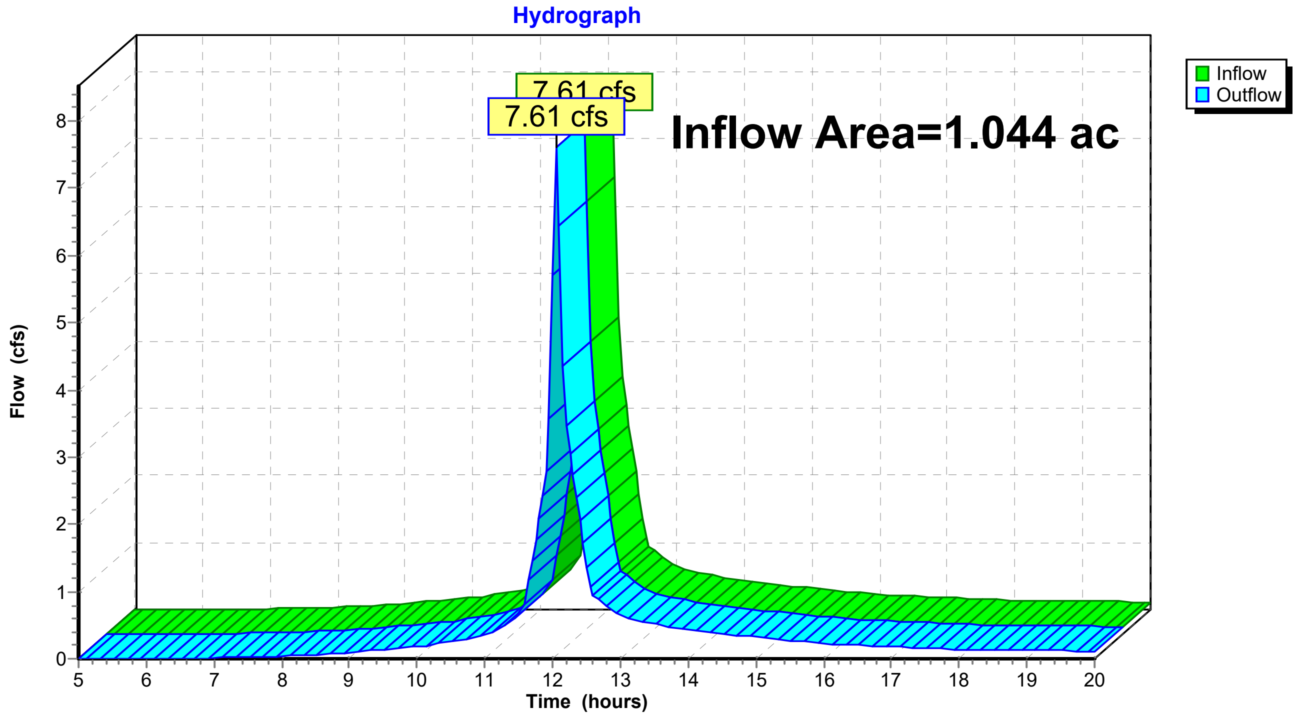


Summary for Reach REACH 1: Reach 1

Inflow Area = 1.044 ac, 0.00% Impervious, Inflow Depth > 5.51" for 100-YR 24HR event
Inflow = 7.61 cfs @ 12.06 hrs, Volume= 0.479 af
Outflow = 7.61 cfs @ 12.06 hrs, Volume= 0.479 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 1: Reach 1

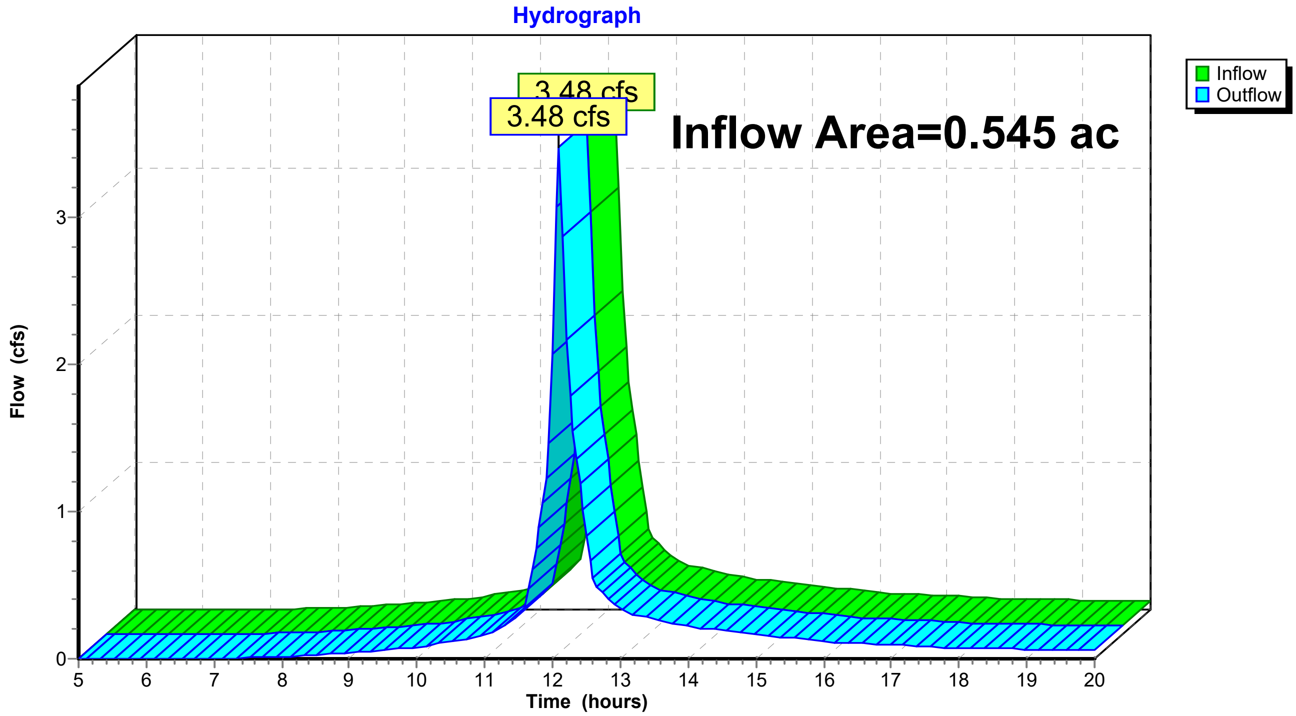


Summary for Reach REACH 3: Reach 3

Inflow Area =	0.545 ac,	0.00% Impervious, Inflow Depth > 5.26"	for 100-YR 24HR event
Inflow =	3.48 cfs @	12.09 hrs, Volume=	0.239 af
Outflow =	3.48 cfs @	12.09 hrs, Volume=	0.239 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 3: Reach 3

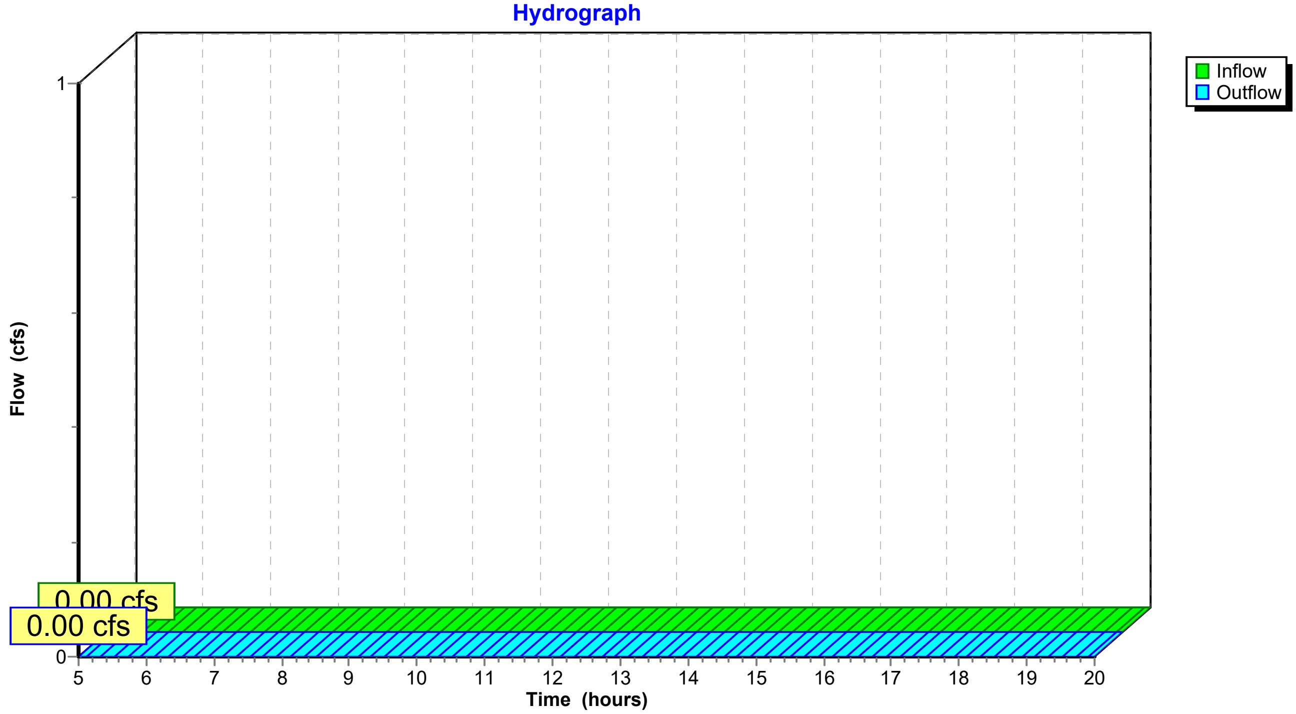


Summary for Reach REACH 4: Reach 4

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 4: Reach 4

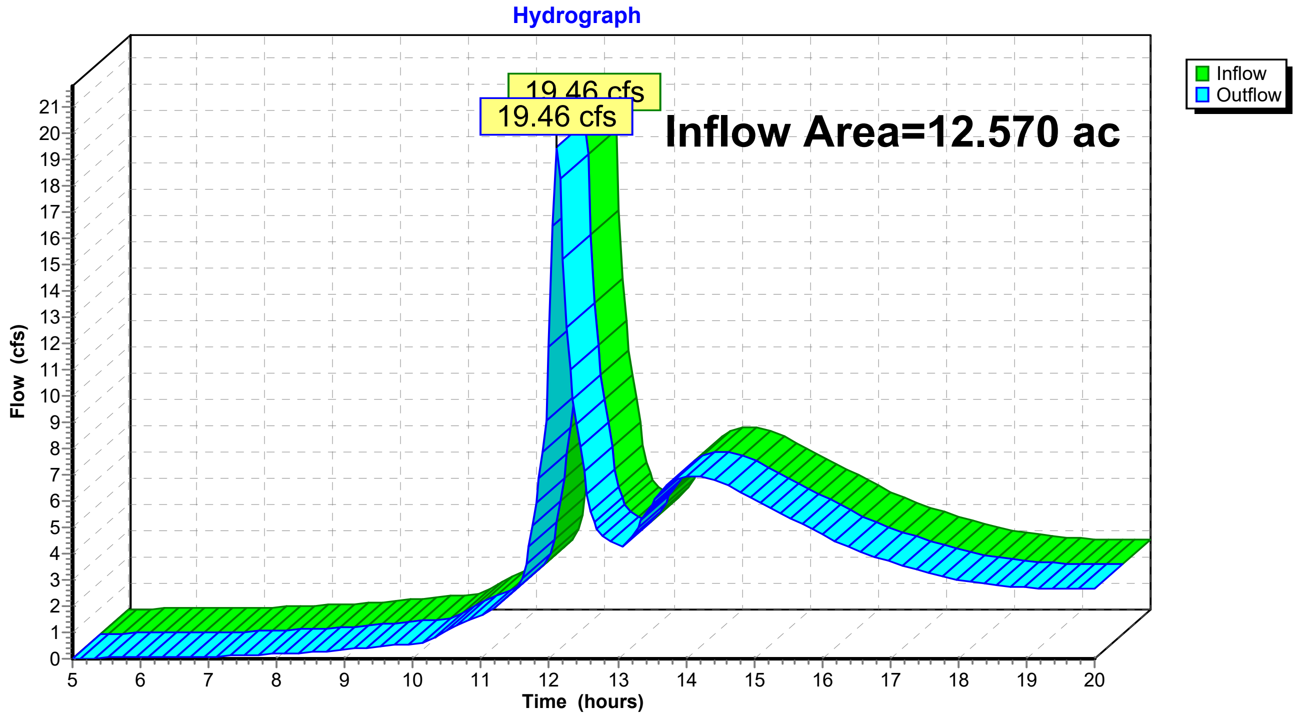


Summary for Reach REACH 5: Reach 5

Inflow Area = 12.570 ac, 10.08% Impervious, Inflow Depth > 3.60" for 100-YR 24HR event
Inflow = 19.46 cfs @ 12.11 hrs, Volume= 3.770 af
Outflow = 19.46 cfs @ 12.11 hrs, Volume= 3.770 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

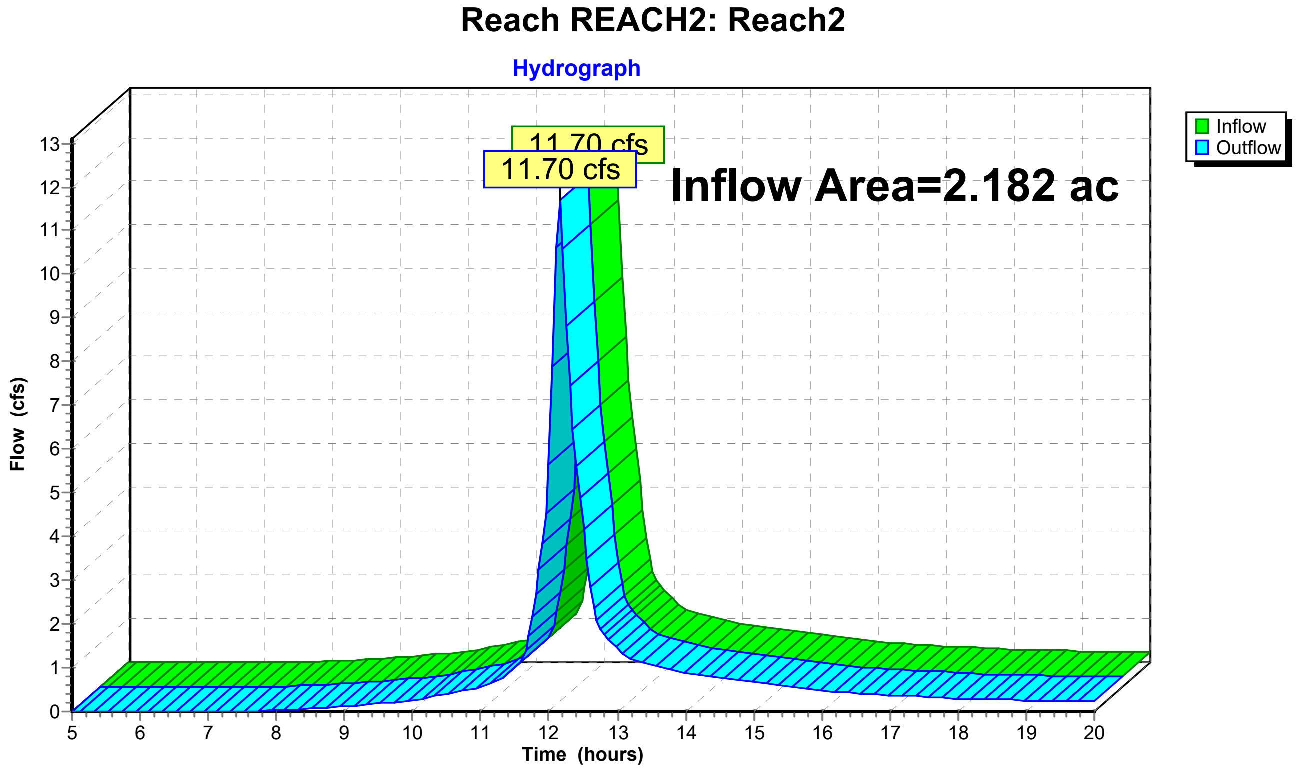
Reach REACH 5: Reach 5



Summary for Reach REACH2: Reach2

Inflow Area = 2.182 ac, 0.00% Impervious, Inflow Depth > 5.01" for 100-YR 24HR event
Inflow = 11.70 cfs @ 12.15 hrs, Volume= 0.912 af
Outflow = 11.70 cfs @ 12.15 hrs, Volume= 0.912 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



Summary for Reach Road Swale: Road Swale

Inflow Area = 2.037 ac, 0.00% Impervious, Inflow Depth > 5.94" for 100-YR 24HR event
Inflow = 7.73 cfs @ 12.52 hrs, Volume= 1.008 af
Outflow = 5.52 cfs @ 13.25 hrs, Volume= 0.974 af, Atten= 29%, Lag= 44.1 min

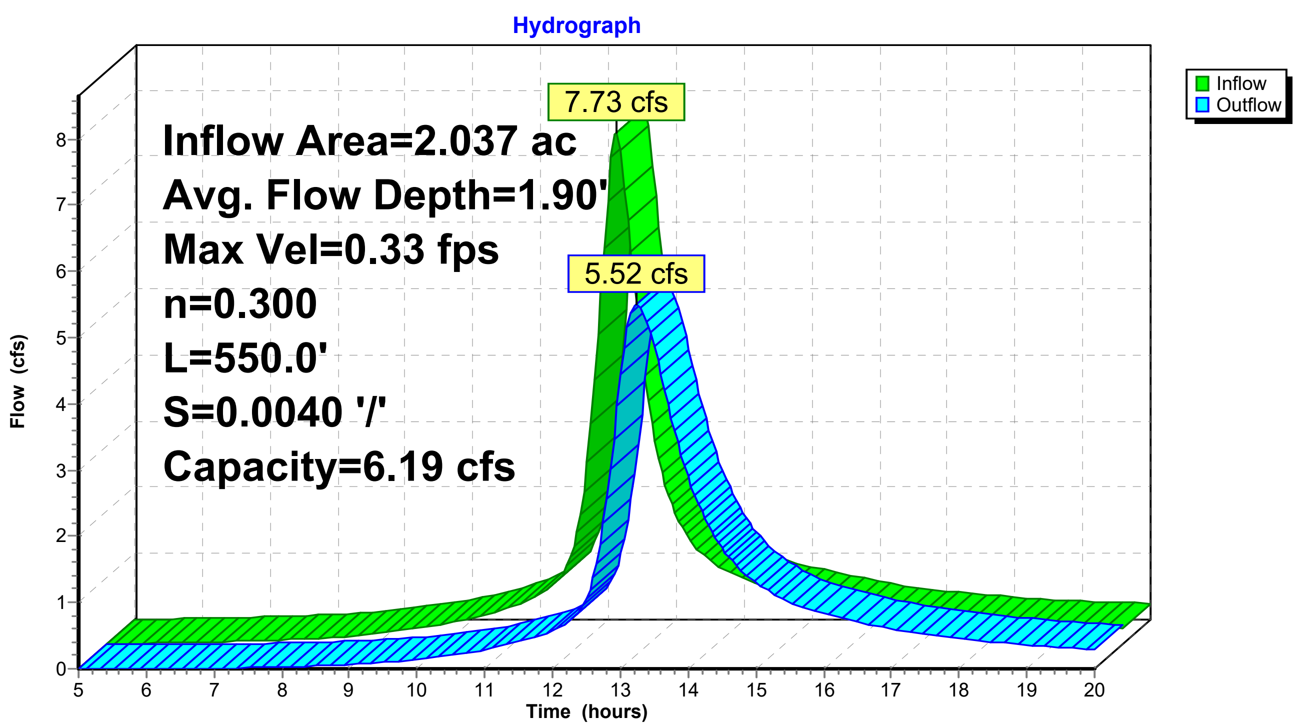
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.33 fps, Min. Travel Time= 27.4 min
Avg. Velocity = 0.16 fps, Avg. Travel Time= 58.3 min

Peak Storage= 9,092 cf @ 12.79 hrs
Average Depth at Peak Storage= 1.90'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 6.19 cfs

3.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 550.0' Slope= 0.0040 '/'
Inlet Invert= 110.50', Outlet Invert= 108.30'

‡

Reach Road Swale: Road Swale



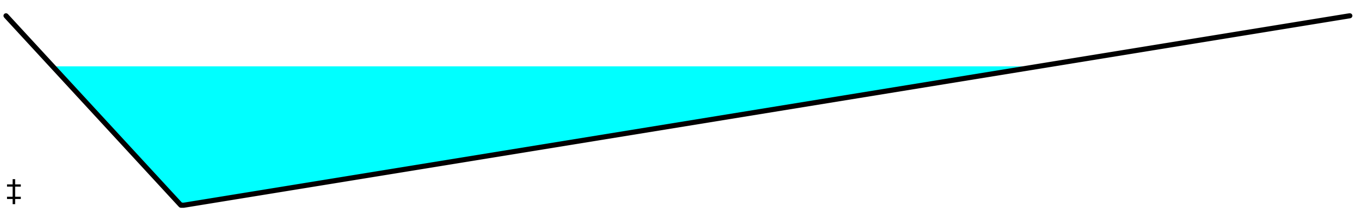
Summary for Reach So. Plateau Swale: So. Plateau Swale

Inflow Area = 3.196 ac, 0.00% Impervious, Inflow Depth > 5.50" for 100-YR 24HR event
Inflow = 20.49 cfs @ 12.11 hrs, Volume= 1.465 af
Outflow = 15.50 cfs @ 12.34 hrs, Volume= 1.450 af, Atten= 24%, Lag= 14.0 min

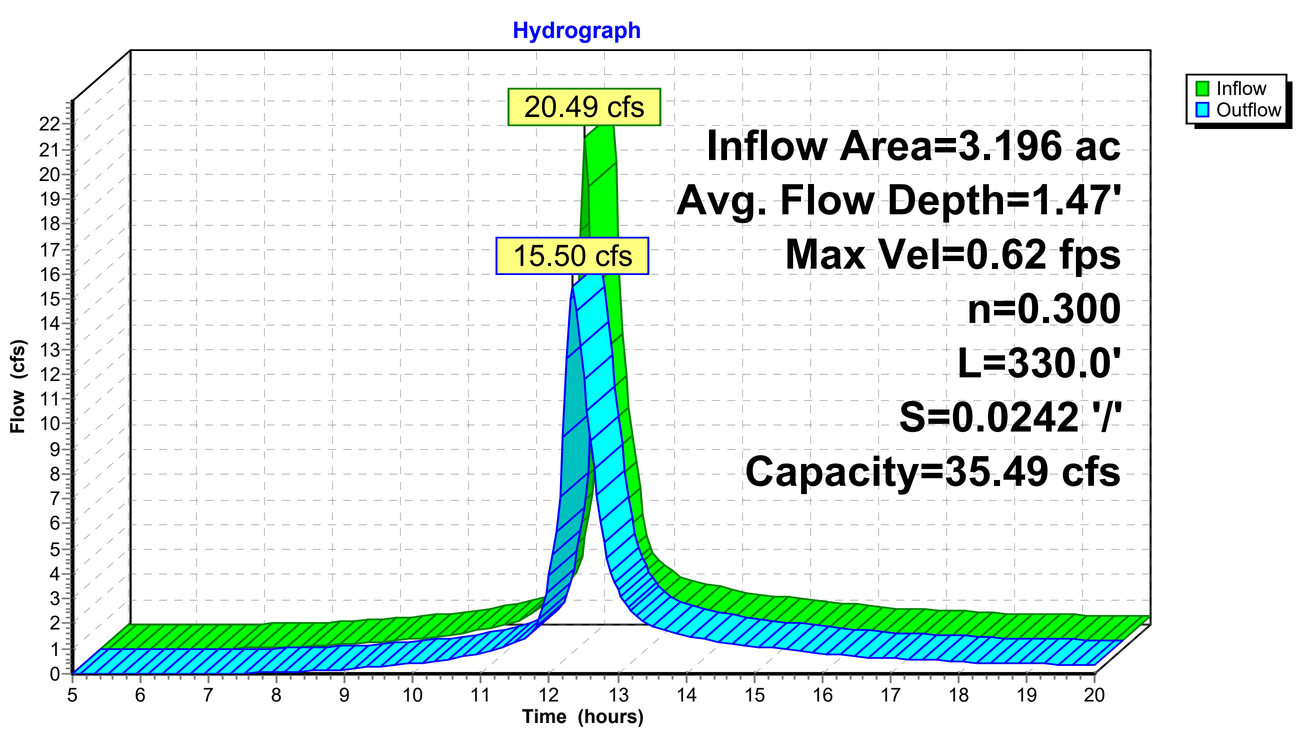
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.62 fps, Min. Travel Time= 8.8 min
Avg. Velocity = 0.28 fps, Avg. Travel Time= 19.5 min

Peak Storage= 8,212 cf @ 12.19 hrs
Average Depth at Peak Storage= 1.47'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 35.49 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 20.0 '/' Top Width= 46.10'
Length= 330.0' Slope= 0.0242 '/'
Inlet Invert= 130.00', Outlet Invert= 122.00'



Reach So. Plateau Swale: So. Plateau Swale



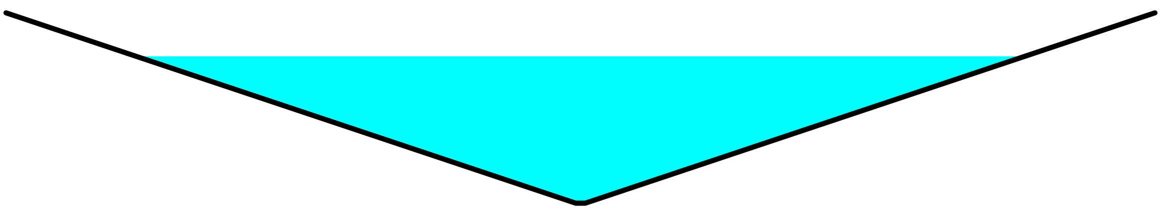
Summary for Reach Stone swale: stone swale

Inflow Area = 1.655 ac, 0.00% Impervious, Inflow Depth > 5.51" for 100-YR 24HR event
Inflow = 12.33 cfs @ 12.03 hrs, Volume= 0.760 af
Outflow = 10.22 cfs @ 12.14 hrs, Volume= 0.757 af, Atten= 17%, Lag= 6.7 min

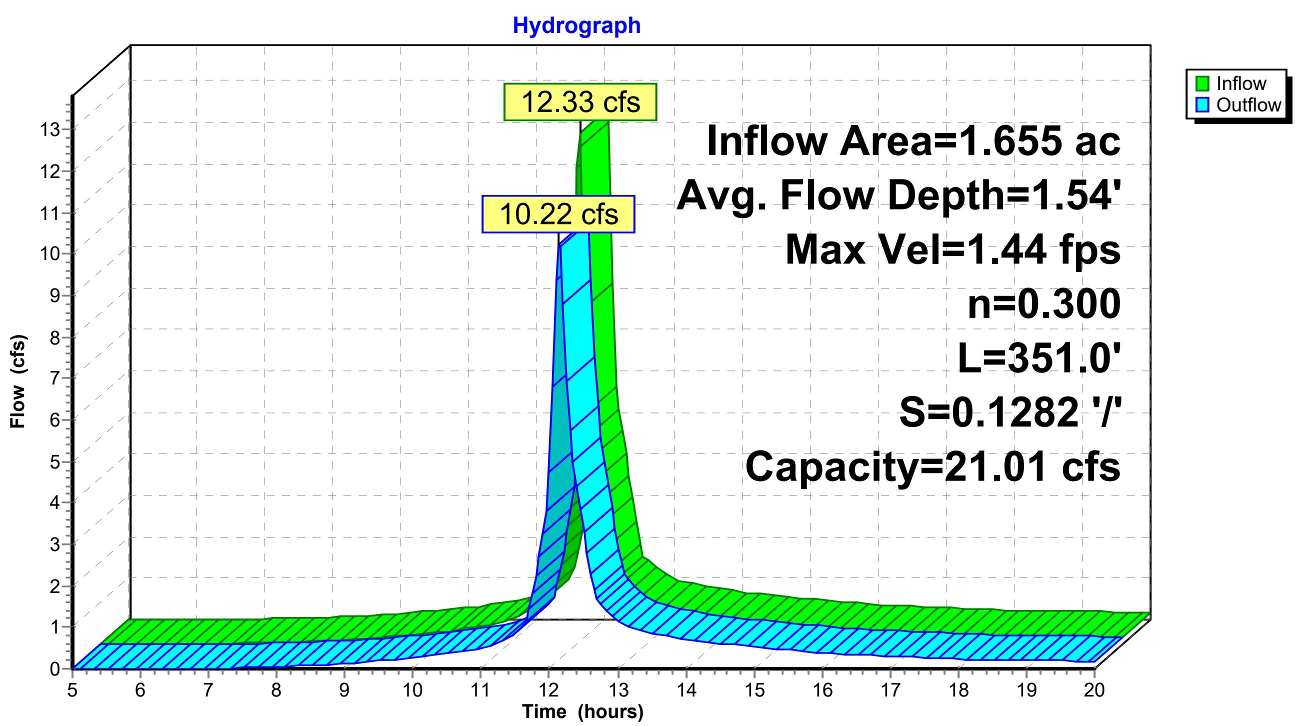
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.44 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 9.5 min

Peak Storage= 2,561 cf @ 12.07 hrs
Average Depth at Peak Storage= 1.54'
Bank-Full Depth= 2.00' Flow Area= 12.2 sf, Capacity= 21.01 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 12.10'
Length= 351.0' Slope= 0.1282 '/'
Inlet Invert= 155.00', Outlet Invert= 110.00'



Reach Stone swale: stone swale

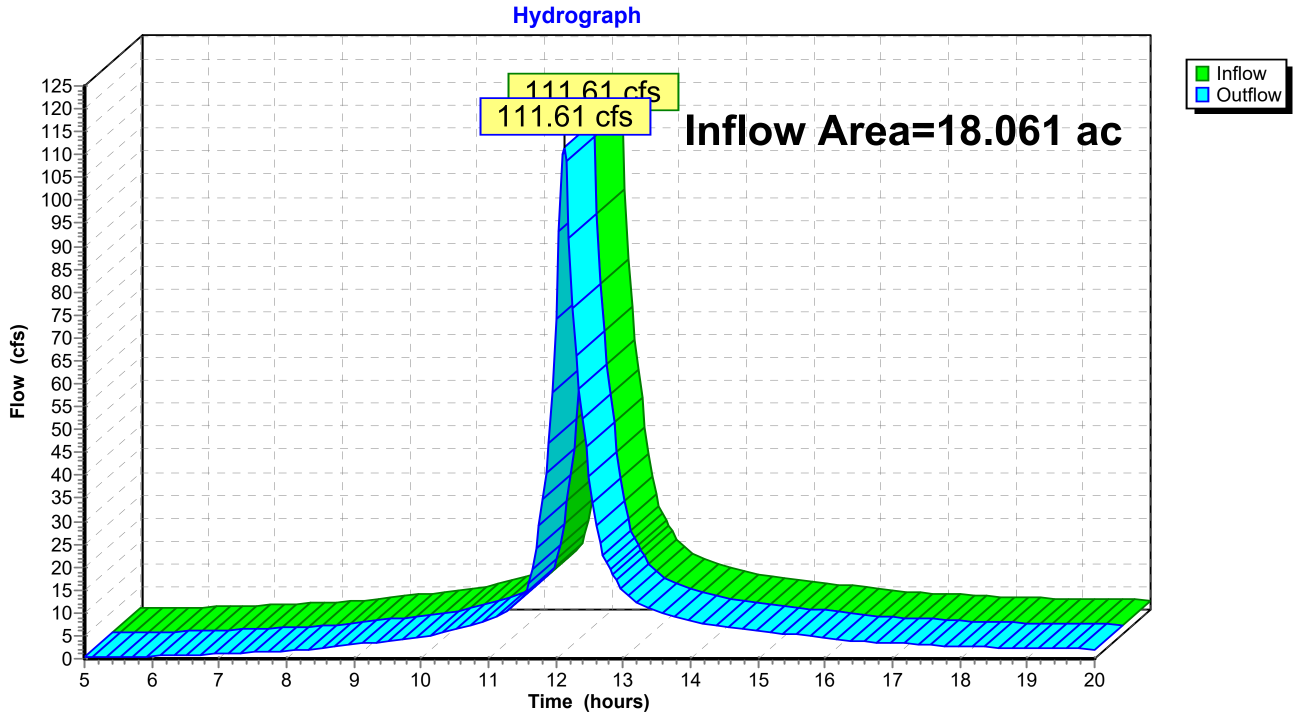


Summary for Reach Total Offsite Existing: Full site existing

Inflow Area =	18.061 ac,	0.00% Impervious, Inflow Depth > 6.65"	for 100-YR 24HR event
Inflow =	111.61 cfs @	12.12 hrs, Volume=	10.010 af
Outflow =	111.61 cfs @	12.12 hrs, Volume=	10.010 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

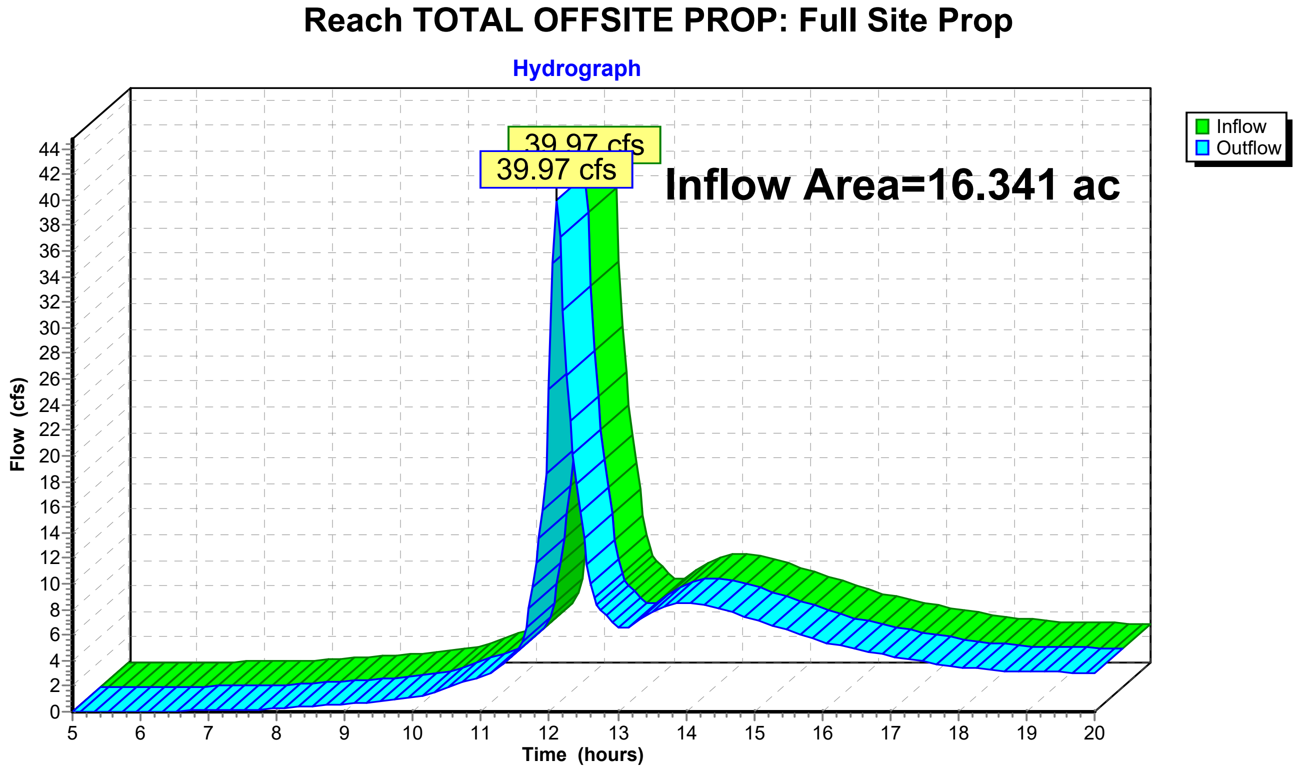
Reach Total Offsite Existing: Full site existing



Summary for Reach TOTAL OFFSITE PROP: Full Site Prop

Inflow Area = 16.341 ac, 7.76% Impervious, Inflow Depth > 3.97" for 100-YR 24HR event
Inflow = 39.97 cfs @ 12.11 hrs, Volume= 5.400 af
Outflow = 39.97 cfs @ 12.11 hrs, Volume= 5.400 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



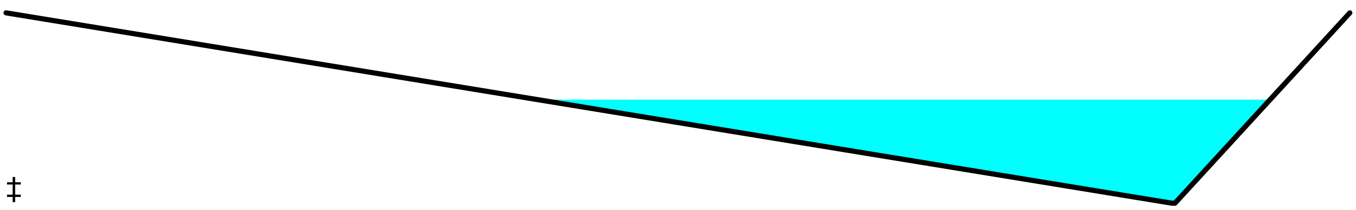
Summary for Reach West Plateau Swale: West Plateau Swale

Inflow Area = 2.085 ac, 0.00% Impervious, Inflow Depth > 5.50" for 100-YR 24HR event
Inflow = 13.14 cfs @ 12.11 hrs, Volume= 0.956 af
Outflow = 9.23 cfs @ 12.42 hrs, Volume= 0.942 af, Atten= 30%, Lag= 18.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.67 fps, Min. Travel Time= 11.8 min
Avg. Velocity = 0.31 fps, Avg. Travel Time= 25.7 min

Peak Storage= 6,545 cf @ 12.22 hrs
Average Depth at Peak Storage= 1.09'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 46.67 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 20.0 3.0 '/' Top Width= 46.10'
Length= 477.0' Slope= 0.0419 '/'
Inlet Invert= 142.00', Outlet Invert= 122.00'



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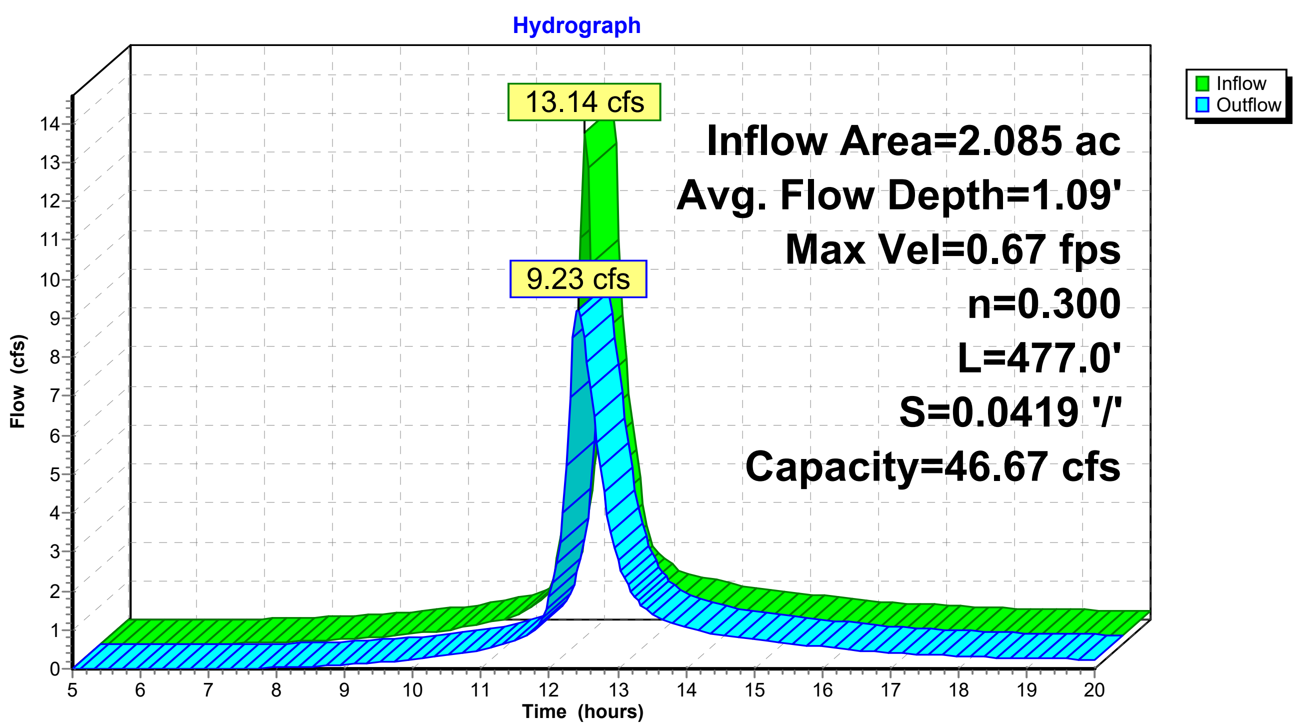
Reach West Plateau Swale: West Plateau Swale



Summary for Pond 3P: Detention Basin

Inflow Area = 9.853 ac, 12.86% Impervious, Inflow Depth > 5.94" for 100-YR 24HR event
Inflow = 30.78 cfs @ 12.35 hrs, Volume= 4.881 af
Outflow = 5.84 cfs @ 14.19 hrs, Volume= 2.399 af, Atten= 81%, Lag= 110.7 min
Primary = 5.84 cfs @ 14.19 hrs, Volume= 2.399 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 110.79' @ 14.19 hrs Surf.Area= 59,849 sf Storage= 130,370 cf

Plug-Flow detention time= 231.5 min calculated for 2.391 af (49% of inflow)
Center-of-Mass det. time= 138.8 min (933.2 - 794.4)

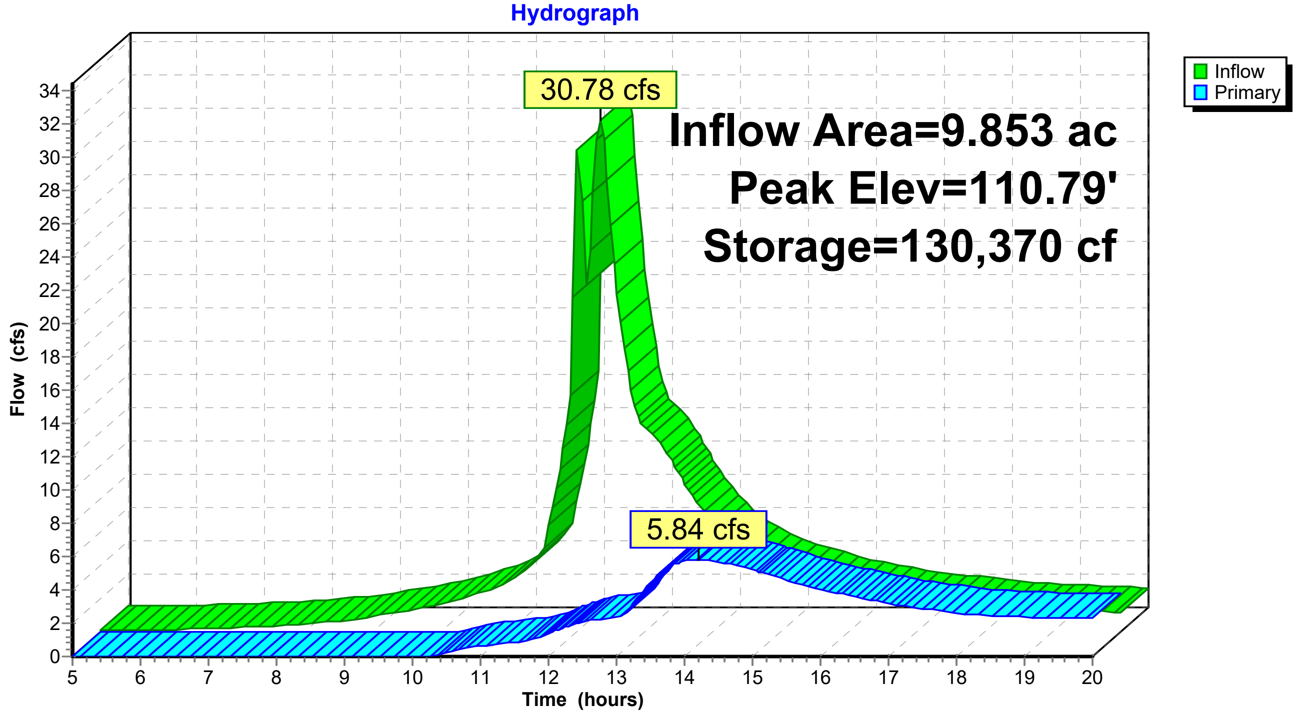
Volume	Invert	Avail.Storage	Storage Description
#1	108.20'	204,236 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

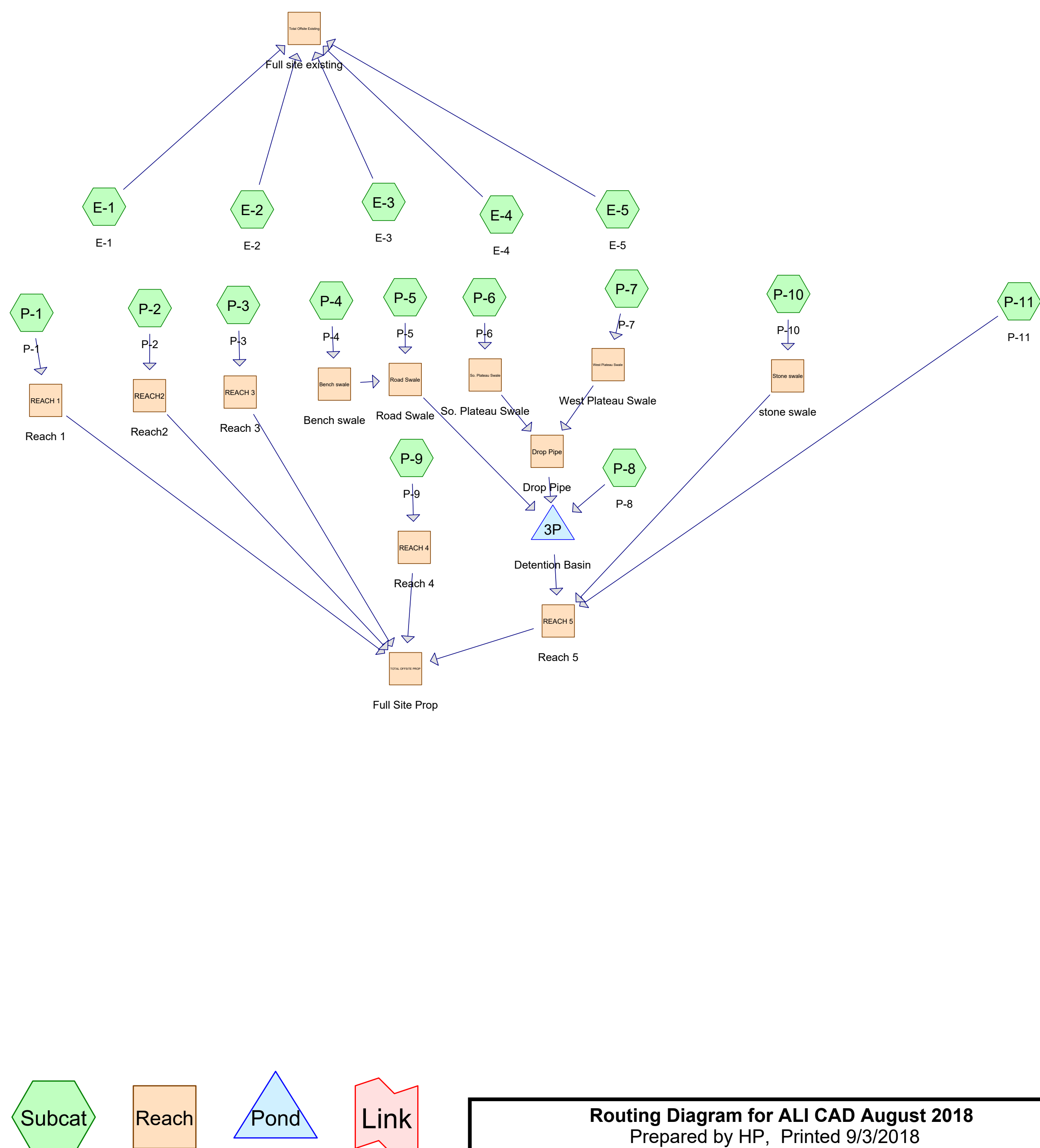
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
108.20	30,000	0	0
108.50	42,000	10,800	10,800
109.00	44,377	21,594	32,394
110.00	57,942	51,160	83,554
112.00	62,740	120,682	204,236

Device	Routing	Invert	Outlet Devices
#1	Primary	108.50'	**2.0" Horiz. Orifice/Grate X 4.00 columns** X 4 rows C= 0.600 Limited to weir flow at low heads
#2	Primary	110.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=5.84 cfs @ 14.19 hrs HW=110.79' (Free Discharge)
1=Orifice/Grate (Orifice Controls 2.55 cfs @ 7.29 fps)
2=Orifice/Grate (Weir Controls 3.29 cfs @ 1.78 fps)

Pond 3P: Detention Basin





Routing Diagram for ALI CAD August 2018
Prepared by HP, Printed 9/3/2018
HydroCAD® 10.00-15 s/n 02179 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.509	79	50-75% Grass cover, Fair, HSG C (P-5)
15.899	86	<50% Grass cover, Poor, HSG C (E-1, E-2, E-3, E-4, E-5, P-11)
11.818	74	>75% Grass cover, Good, HSG C (E-5, P-1, P-10, P-4, P-6, P-7, P-8)
0.482	87	Dirt roads, HSG C (P-5)
0.223	96	Gravel surface, HSG C (P-8)
1.267	98	Water Surface, HSG C (P-8)
3.658	70	Woods, Good, HSG C (E-2, E-3, P-2)
0.545	72	Woods/grass comb., Good, HSG C (P-3)
34.402	**80**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
34.402	HSG C	E-1, E-2, E-3, E-4, E-5, P-1, P-10, P-11, P-2, P-3, P-4, P-5, P-6, P-7, P-8
0.000	HSG D	
0.000	Other	
34.402		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.509	0.000	0.000	0.509	50-75% Grass cover, Fair	P-5
0.000	0.000	15.899	0.000	0.000	15.899	<50% Grass cover, Poor	E-1, E-2, E-3, E-4, E-5, P-11
0.000	0.000	11.818	0.000	0.000	11.818	>75% Grass cover, Good	E-5, P-1, P-10, P-4, P-6, P-7, P-8
0.000	0.000	0.482	0.000	0.000	0.482	Dirt roads	P-5
0.000	0.000	0.223	0.000	0.000	0.223	Gravel surface	P-8
0.000	0.000	1.267	0.000	0.000	1.267	Water Surface	P-8
0.000	0.000	3.658	0.000	0.000	3.658	Woods, Good	E-2, E-3, P-2
0.000	0.000	0.545	0.000	0.000	0.545	Woods/grass comb., Good	P-3
0.000	**0.000**	**34.402**	**0.000**	**0.000**	**34.402**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	Drop Pipe	122.00	108.50	30.0	0.4500	0.013	18.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: E-1 Runoff Area=114,240 sf 0.00% Impervious Runoff Depth>3.33"
Flow Length=630' Tc=8.6 min CN=86 Runoff=9.69 cfs 0.728 af

Subcatchment E-2: E-2 Runoff Area=98,290 sf 0.00% Impervious Runoff Depth>2.65"
Flow Length=488' Slope=0.0100 '/' Tc=32.5 min CN=79 Runoff=4.14 cfs 0.499 af

Subcatchment E-3: E-3 Runoff Area=79,629 sf 0.00% Impervious Runoff Depth>2.96"
Tc=0.0 min CN=82 Runoff=7.73 cfs 0.450 af

Subcatchment E-4: E-4 Runoff Area=277,162 sf 0.00% Impervious Runoff Depth>3.33"
Flow Length=550' Slope=0.0100 '/' Tc=9.2 min CN=86 Runoff=22.93 cfs 1.766 af

Subcatchment E-5: E-5 Runoff Area=217,437 sf 0.00% Impervious Runoff Depth>2.95"
Flow Length=760' Tc=8.8 min CN=82 Runoff=16.47 cfs 1.227 af

Subcatchment P-1: P-1 Runoff Area=45,494 sf 0.00% Impervious Runoff Depth>2.25"
Flow Length=523' Tc=3.6 min CN=74 Runoff=3.16 cfs 0.196 af

Subcatchment P-10: P-10 Runoff Area=72,105 sf 0.00% Impervious Runoff Depth>2.25"
Flow Length=409' Slope=0.3300 '/' Tc=1.7 min CN=74 Runoff=5.15 cfs 0.311 af

Subcatchment P-11: P-11 Runoff Area=46,241 sf 0.00% Impervious Runoff Depth>3.33"
Flow Length=330' Slope=0.0100 '/' Tc=5.5 min CN=86 Runoff=4.29 cfs 0.295 af

Subcatchment P-2: P-2 Runoff Area=95,039 sf 0.00% Impervious Runoff Depth>1.93"
Flow Length=390' Tc=10.5 min CN=70 Runoff=4.49 cfs 0.350 af

Subcatchment P-3: P-3 Runoff Area=23,731 sf 0.00% Impervious Runoff Depth>2.09"
Flow Length=190' Slope=0.0100 '/' Tc=6.3 min CN=72 Runoff=1.39 cfs 0.095 af

Subcatchment P-4: P-4 Runoff Area=45,575 sf 0.00% Impervious Runoff Depth>2.25"
Flow Length=605' Tc=3.7 min CN=74 Runoff=3.15 cfs 0.196 af

Subcatchment P-5: P-5 Runoff Area=43,177 sf 0.00% Impervious Runoff Depth>3.02"
Flow Length=535' Tc=31.1 min CN=83 Runoff=2.09 cfs 0.250 af

Subcatchment P-6: P-6 Runoff Area=139,221 sf 0.00% Impervious Runoff Depth>2.25"
Flow Length=707' Slope=0.0500 '/' Tc=7.5 min CN=74 Runoff=8.49 cfs 0.599 af

Subcatchment P-7: P-7 Runoff Area=90,811 sf 0.00% Impervious Runoff Depth>2.25"
Flow Length=750' Slope=0.0500 '/' Tc=8.0 min CN=74 Runoff=5.44 cfs 0.391 af

Subcatchment P-8: P-8 Runoff Area=110,418 sf 50.00% Impervious Runoff Depth>3.54"
Flow Length=310' Slope=0.3300 '/' Tc=1.3 min CN=88 Runoff=11.94 cfs 0.747 af

Subcatchment P-9: P-9
Runoff=0.00 cfs 0.000 af

Reach Bench swale: Bench swale Avg. Flow Depth=0.87' Max Vel=0.33 fps Inflow=3.15 cfs 0.196 af
n=0.300 L=570.0' S=0.0100 '/' Capacity=8.41 cfs Outflow=1.31 cfs 0.188 af

Reach Drop Pipe: Drop Pipe Avg. Flow Depth=0.36' Max Vel=27.45 fps Inflow=9.07 cfs 0.973 af
18.0" Round Pipe n=0.013 L=30.0' S=0.4500 '/' Capacity=70.47 cfs Outflow=9.07 cfs 0.972 af

Reach REACH 1: Reach 1 Inflow=3.16 cfs 0.196 af
Outflow=3.16 cfs 0.196 af

Reach REACH 3: Reach 3 Inflow=1.39 cfs 0.095 af
Outflow=1.39 cfs 0.095 af

Reach REACH 4: Reach 4 Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach REACH 5: Reach 5 Inflow=8.24 cfs 1.649 af
Outflow=8.24 cfs 1.649 af

Reach REACH2: Reach2 Inflow=4.49 cfs 0.350 af
Outflow=4.49 cfs 0.350 af

Reach Road Swale: Road Swale Avg. Flow Depth=1.20' Max Vel=0.26 fps Inflow=2.89 cfs 0.438 af
n=0.300 L=550.0' S=0.0040 '/' Capacity=6.19 cfs Outflow=2.04 cfs 0.415 af

Reach So. Plateau Swale: So. Plateau Avg. Flow Depth=1.02' Max Vel=0.49 fps Inflow=8.49 cfs 0.599 af
n=0.300 L=330.0' S=0.0242 '/' Capacity=35.49 cfs Outflow=5.90 cfs 0.590 af

Reach Stone swale: stone swale Avg. Flow Depth=1.08' Max Vel=1.15 fps Inflow=5.15 cfs 0.311 af
n=0.300 L=351.0' S=0.1282 '/' Capacity=21.01 cfs Outflow=4.07 cfs 0.309 af

Reach Total Offsite Existing: Full site existing Inflow=54.26 cfs 4.671 af
Outflow=54.26 cfs 4.671 af

Reach TOTAL OFFSITE PROP: Full Site Prop Inflow=16.30 cfs 2.290 af
Outflow=16.30 cfs 2.290 af

Reach West Plateau Swale: West Avg. Flow Depth=0.75' Max Vel=0.53 fps Inflow=5.44 cfs 0.391 af
n=0.300 L=477.0' S=0.0419 '/' Capacity=46.67 cfs Outflow=3.45 cfs 0.383 af

Pond 3P: Detention Basin Peak Elev=109.53' Storage=57,859 cf Inflow=13.60 cfs 2.135 af
Outflow=1.71 cfs 1.045 af

Total Runoff Area = 34.402 ac Runoff Volume = 8.101 af Average Runoff Depth = 2.83"
96.32% Pervious = 33.135 ac 3.68% Impervious = 1.267 ac

Summary for Subcatchment E-1: E-1

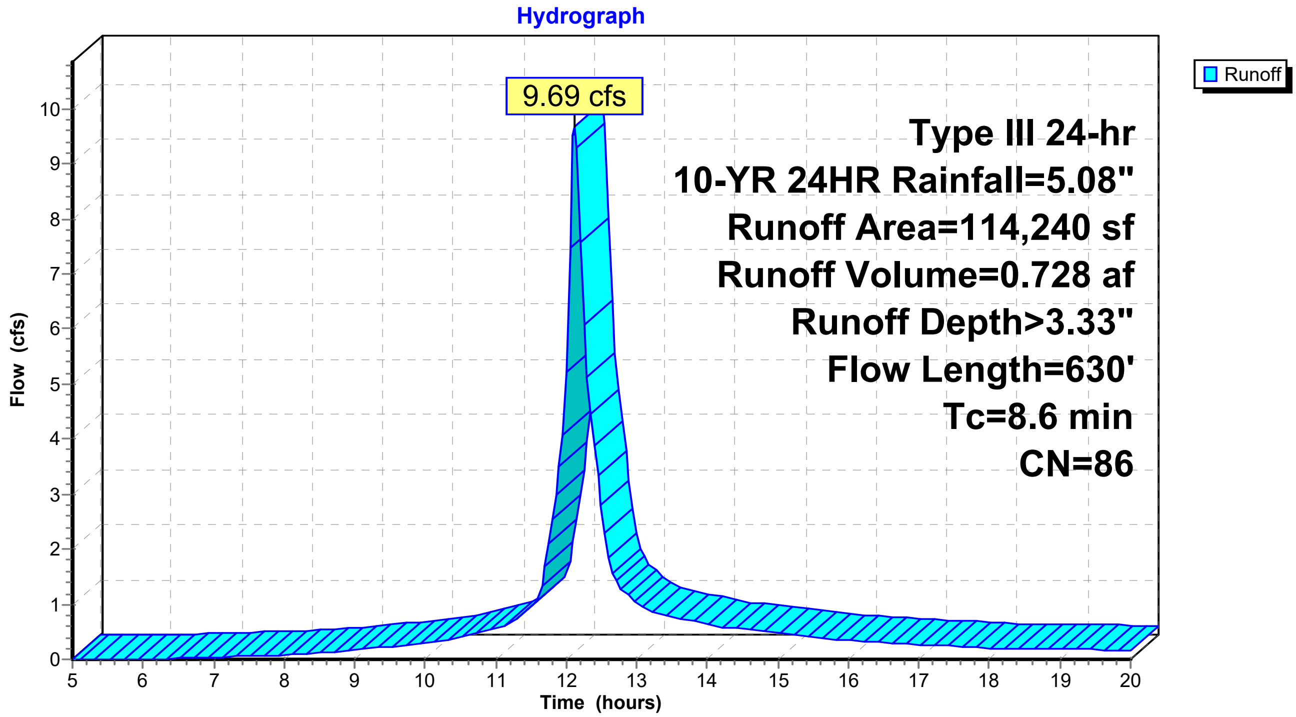
Runoff = 9.69 cfs @ 12.12 hrs, Volume= 0.728 af, Depth> 3.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
114,240	86	<50% Grass cover, Poor, HSG C
114,240		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	320	0.3300	4.02		**Shallow Concentrated Flow, e1 1** Short Grass Pasture Kv= 7.0 fps
7.3	310	0.0050	0.71		**Shallow Concentrated Flow, e1 2** Nearly Bare & Untilled Kv= 10.0 fps
8.6	630	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

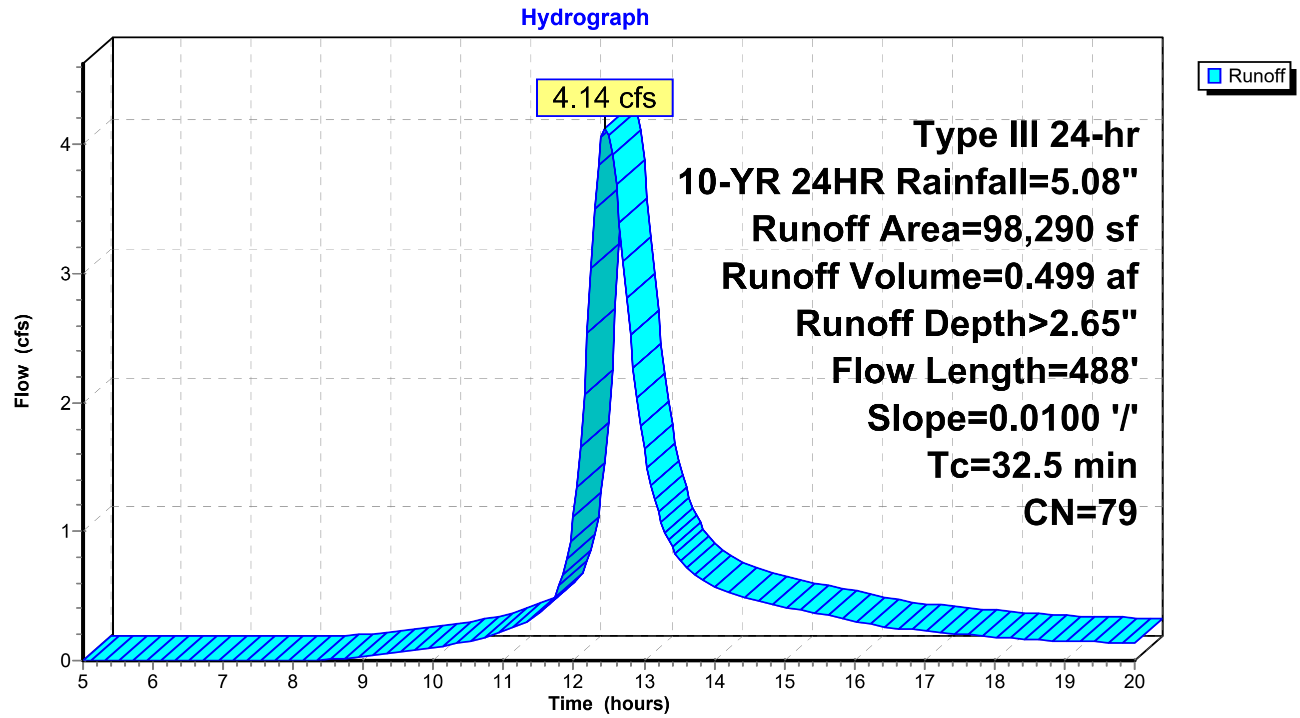
Runoff = 4.14 cfs @ 12.45 hrs, Volume= 0.499 af, Depth> 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
54,000	86	<50% Grass cover, Poor, HSG C
44,290	70	Woods, Good, HSG C
98,290	79	Weighted Average
98,290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.5	488	0.0100	0.25		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps

Subcatchment E-2: E-2



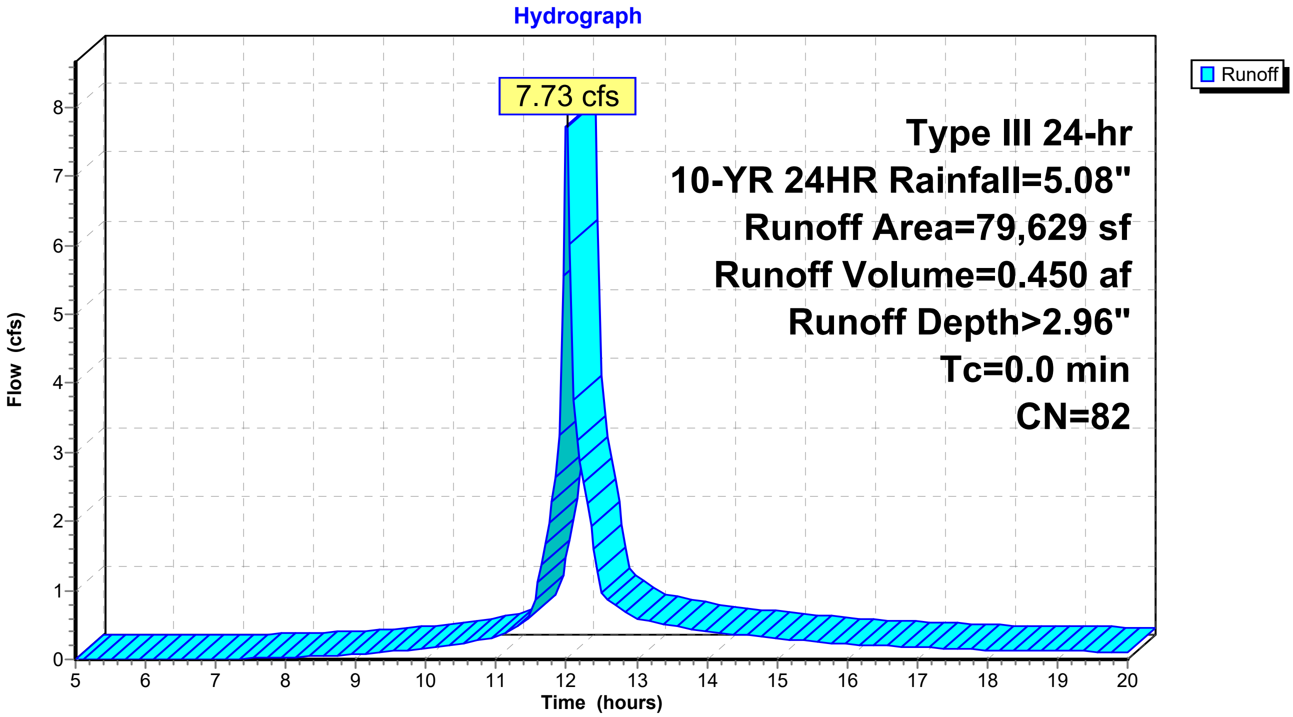
Summary for Subcatchment E-3: E-3

Runoff = 7.73 cfs @ 12.00 hrs, Volume= 0.450 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
59,600	86	<50% Grass cover, Poor, HSG C
20,029	70	Woods, Good, HSG C
79,629	82	Weighted Average
79,629		100.00% Pervious Area

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

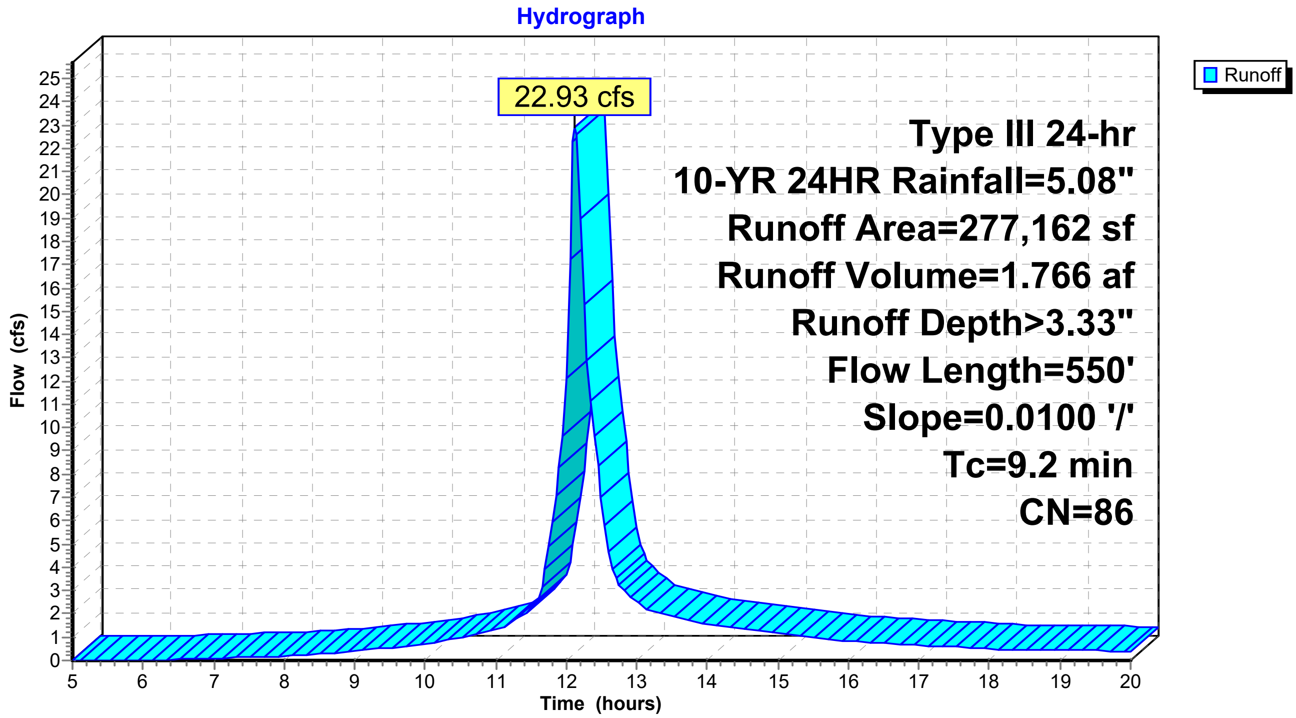
Runoff = 22.93 cfs @ 12.13 hrs, Volume= 1.766 af, Depth> 3.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
277,162	86	<50% Grass cover, Poor, HSG C
277,162		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	550	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment E-4: E-4



Summary for Subcatchment E-5: E-5

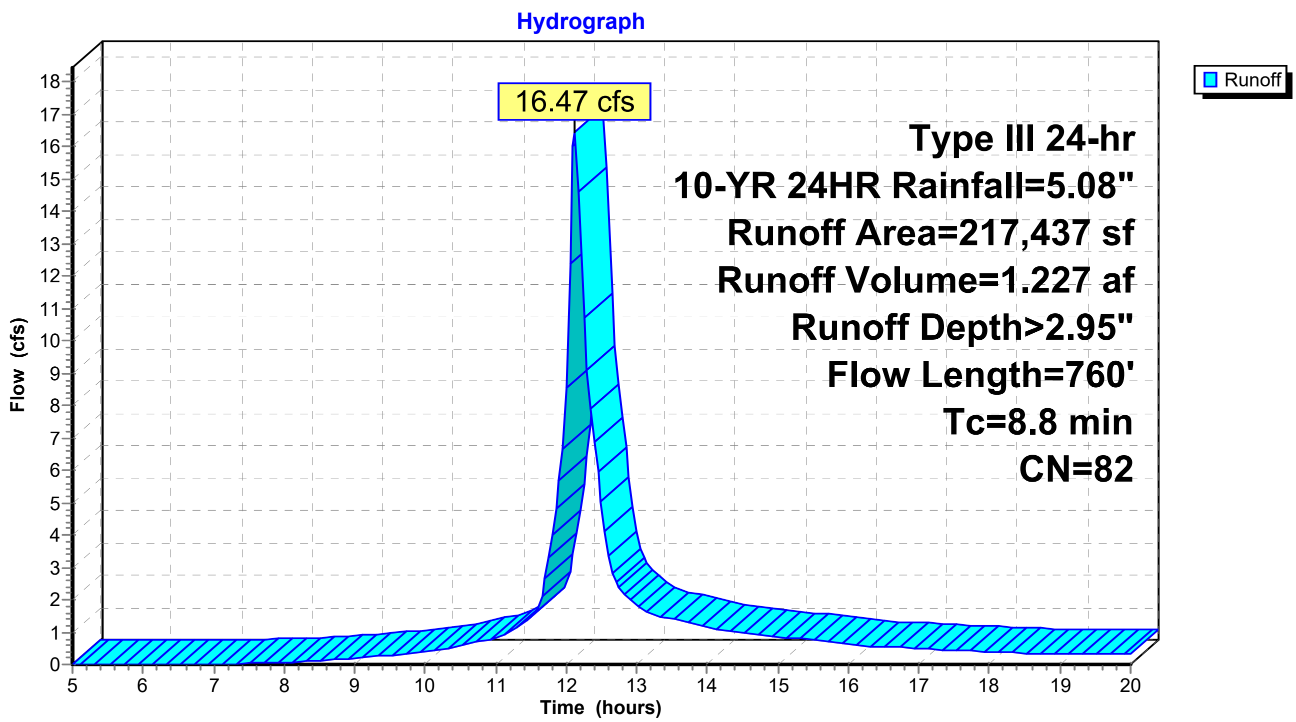
Runoff = 16.47 cfs @ 12.12 hrs, Volume= 1.227 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
76,103	74	>75% Grass cover, Good, HSG C
141,334	86	<50% Grass cover, Poor, HSG C
217,437	82	Weighted Average
217,437		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	310	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.5	450	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
8.8	760	Total			

Subcatchment E-5: E-5



Summary for Subcatchment P-1: P-1

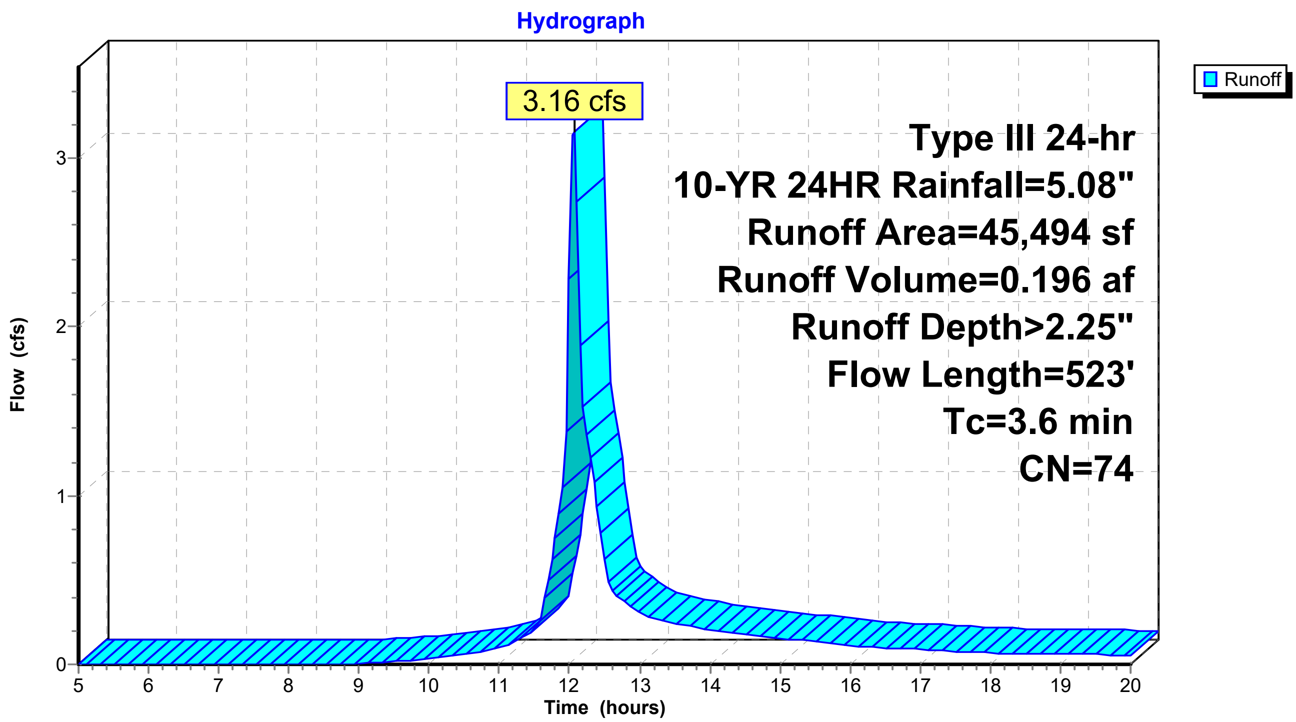
Runoff = 3.16 cfs @ 12.06 hrs, Volume= 0.196 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
45,494	74	>75% Grass cover, Good, HSG C
45,494		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	328	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.2	195	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.6	523	Total			

Subcatchment P-1: P-1



Summary for Subcatchment P-10: P-10

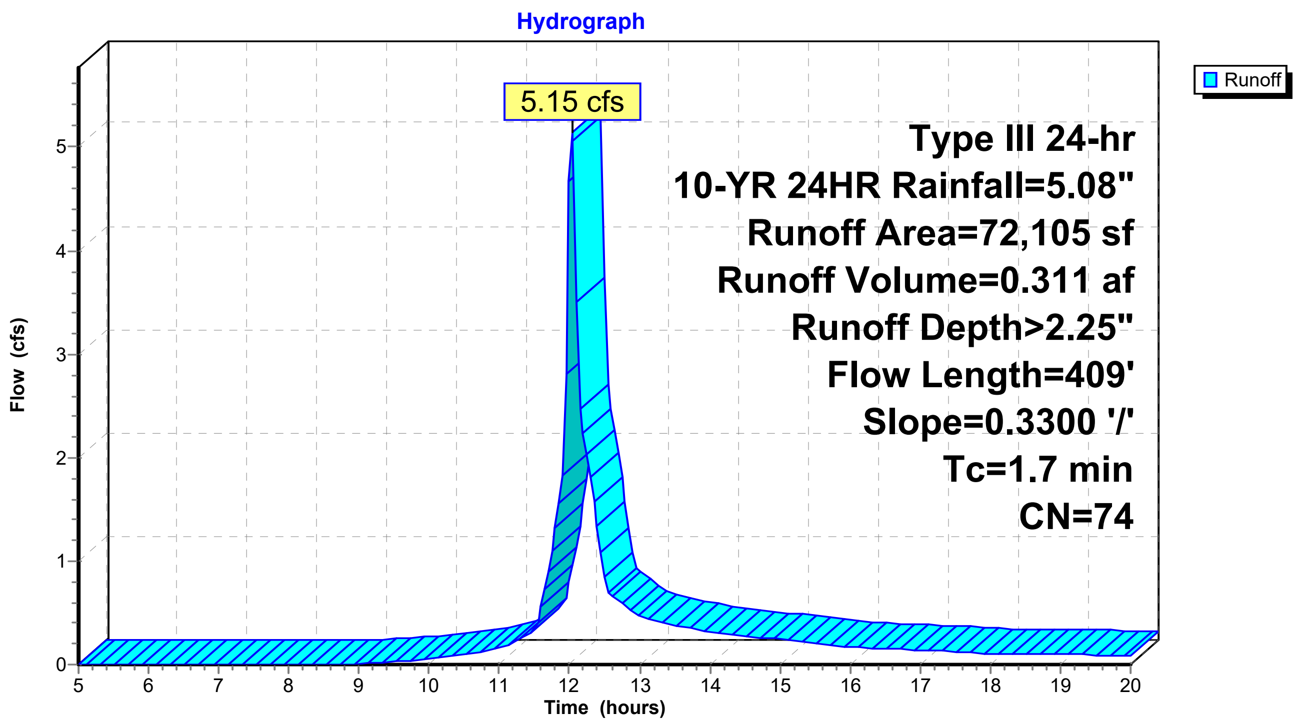
Runoff = 5.15 cfs @ 12.03 hrs, Volume= 0.311 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
72,105	74	>75% Grass cover, Good, HSG C
72,105		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	409	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-10: P-10



Summary for Subcatchment P-11: P-11

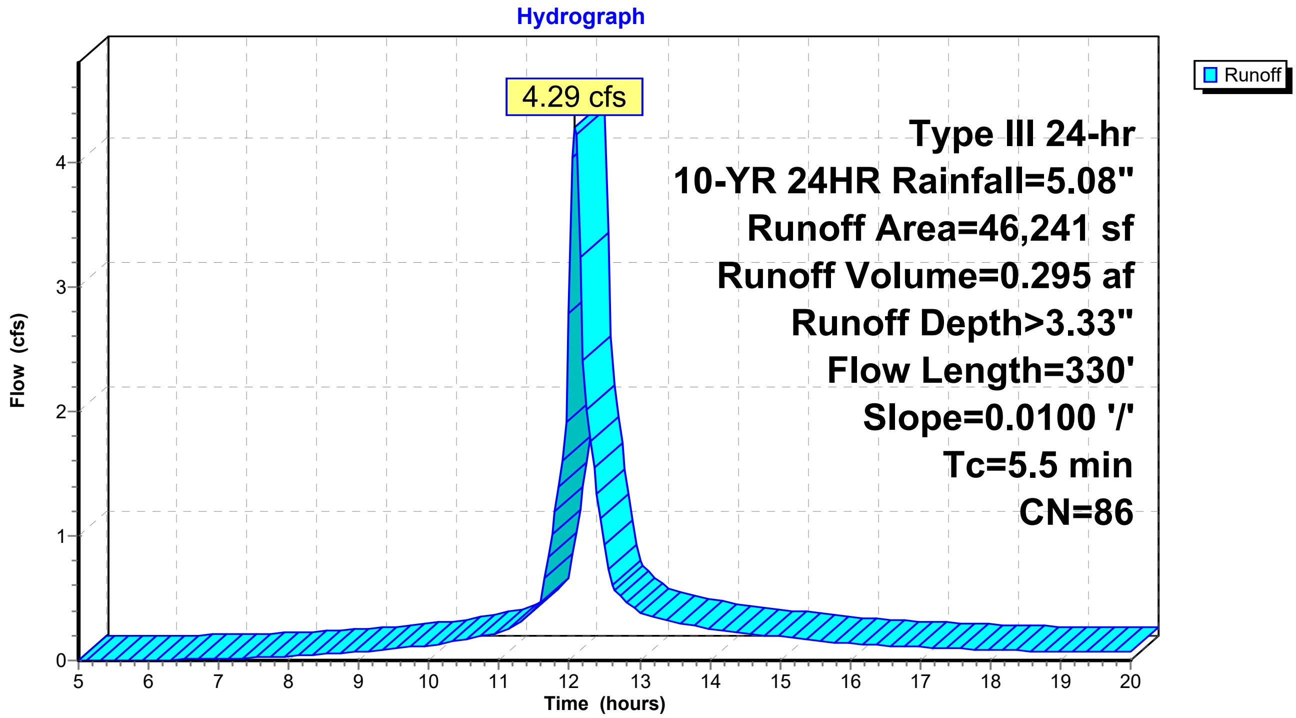
Runoff = 4.29 cfs @ 12.08 hrs, Volume= 0.295 af, Depth> 3.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
46,241	86	<50% Grass cover, Poor, HSG C
46,241		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	330	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment P-11: P-11



Summary for Subcatchment P-2: P-2

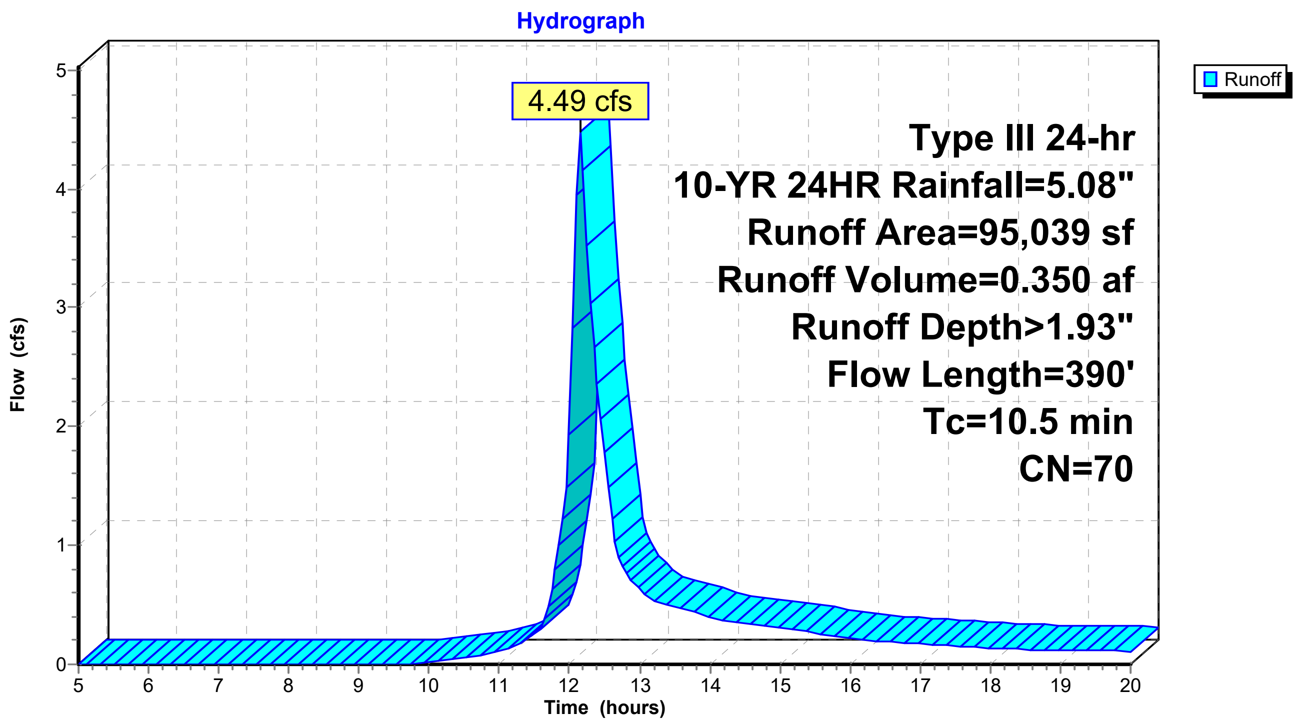
Runoff = 4.49 cfs @ 12.16 hrs, Volume= 0.350 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
95,039	70	Woods, Good, HSG C
95,039		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	110	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.3	280	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.5	390	Total			

Subcatchment P-2: P-2



Summary for Subcatchment P-3: P-3

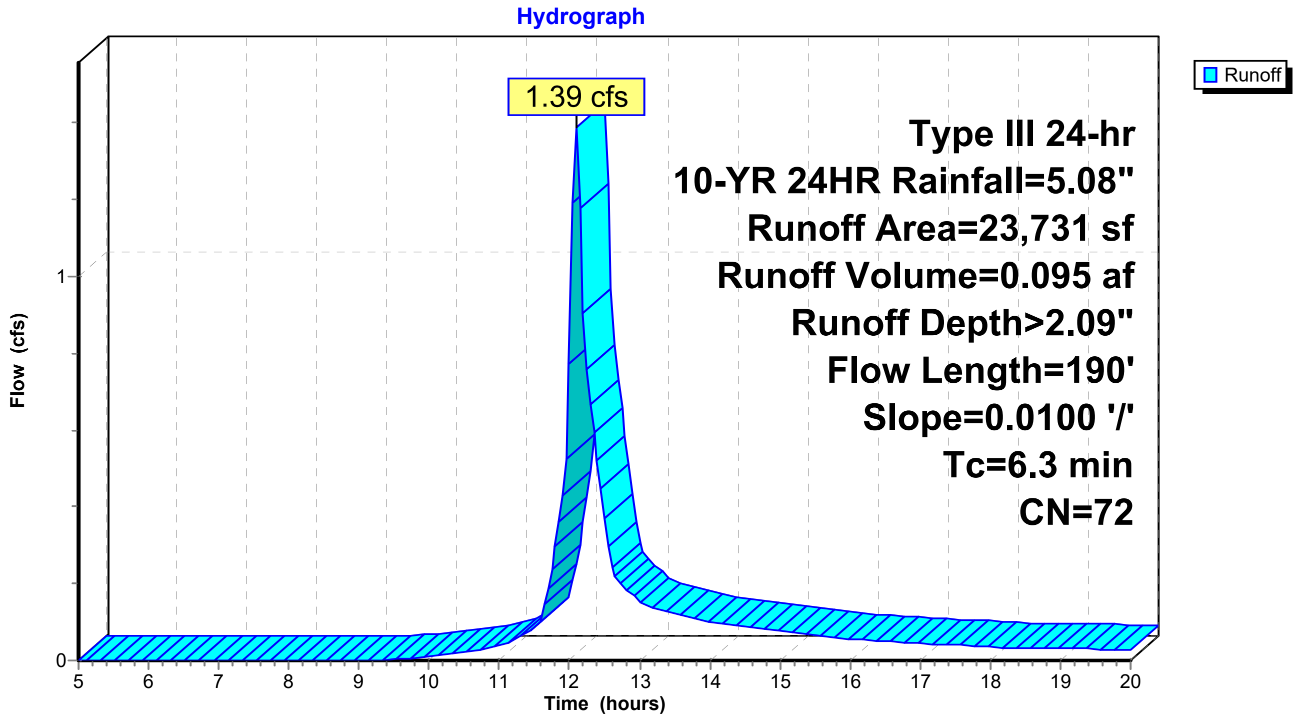
Runoff = 1.39 cfs @ 12.10 hrs, Volume= 0.095 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
23,731	72	Woods/grass comb., Good, HSG C
23,731		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	190	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment P-3: P-3



Summary for Subcatchment P-4: P-4

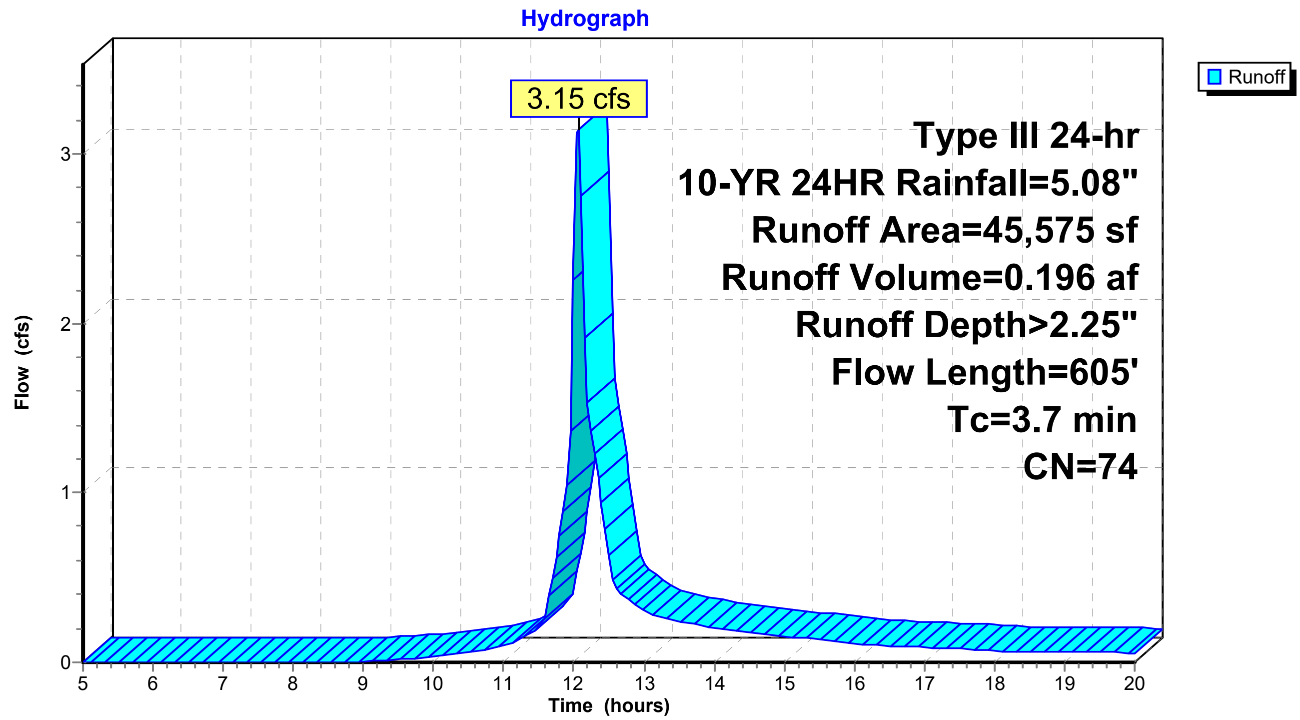
Runoff = 3.15 cfs @ 12.06 hrs, Volume= 0.196 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
45,575	74	>75% Grass cover, Good, HSG C
45,575		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	45	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.5	560	0.0100	2.70	10.78	**Trap/Vee/Rect Channel Flow, bench swale** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.040 Earth, cobble bottom, clean sides
3.7	605	Total			

Subcatchment P-4: P-4



Summary for Subcatchment P-5: P-5

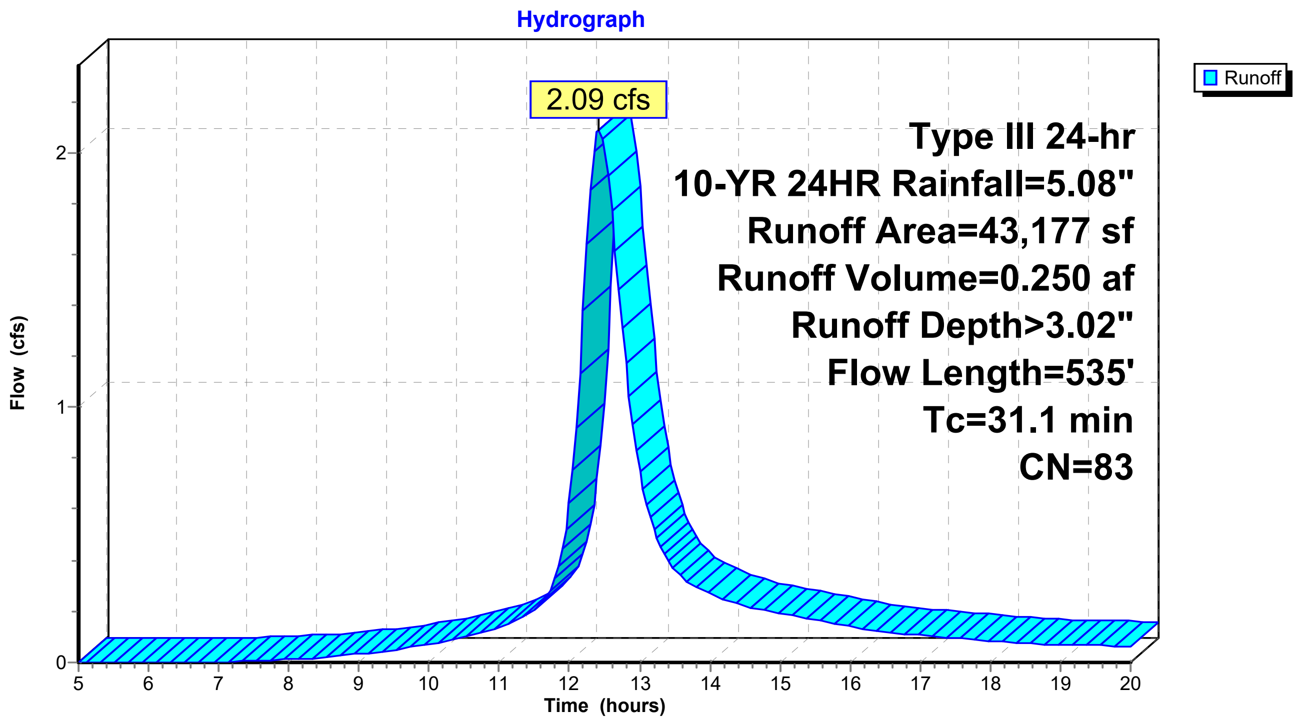
Runoff = 2.09 cfs @ 12.42 hrs, Volume= 0.250 af, Depth> 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
22,177	79	50-75% Grass cover, Fair, HSG C
21,000	87	Dirt roads, HSG C
43,177	83	Weighted Average
43,177		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	35	0.3000	0.28		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
29.0	500	0.0030	0.29	4.60	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=2.00' Z= 3.0 '/' Top.W=14.00' n= 0.300
31.1	535	Total			

Subcatchment P-5: P-5



Summary for Subcatchment P-6: P-6

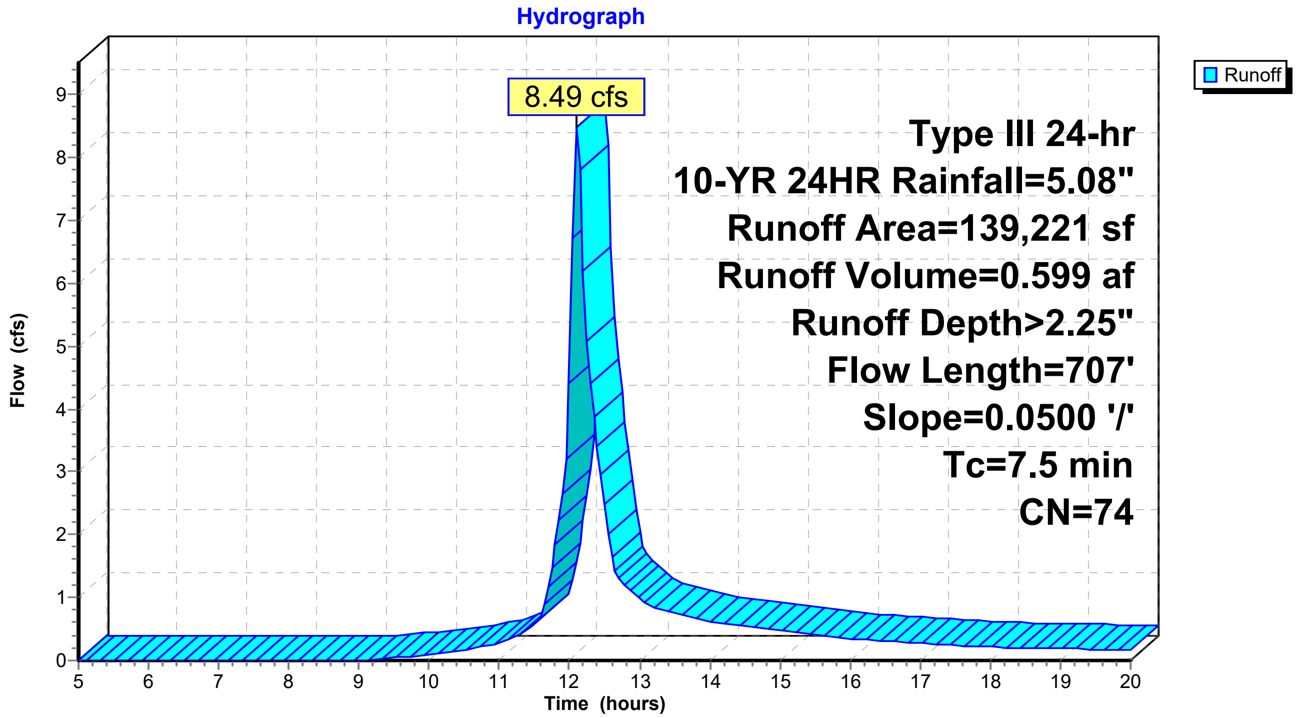
Runoff = 8.49 cfs @ 12.11 hrs, Volume= 0.599 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
139,221	74	>75% Grass cover, Good, HSG C
139,221		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	707	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-6: P-6



Summary for Subcatchment P-7: P-7

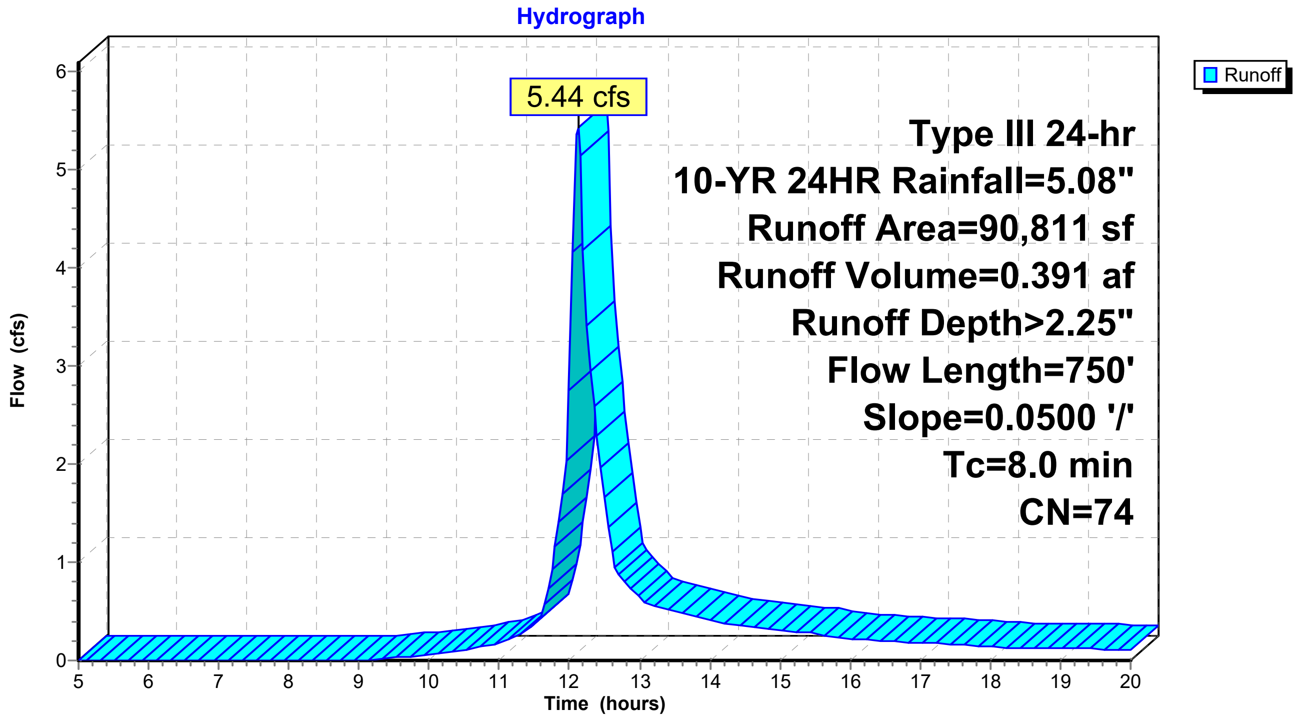
Runoff = 5.44 cfs @ 12.12 hrs, Volume= 0.391 af, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
90,811	74	>75% Grass cover, Good, HSG C
90,811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	750	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-7: P-7



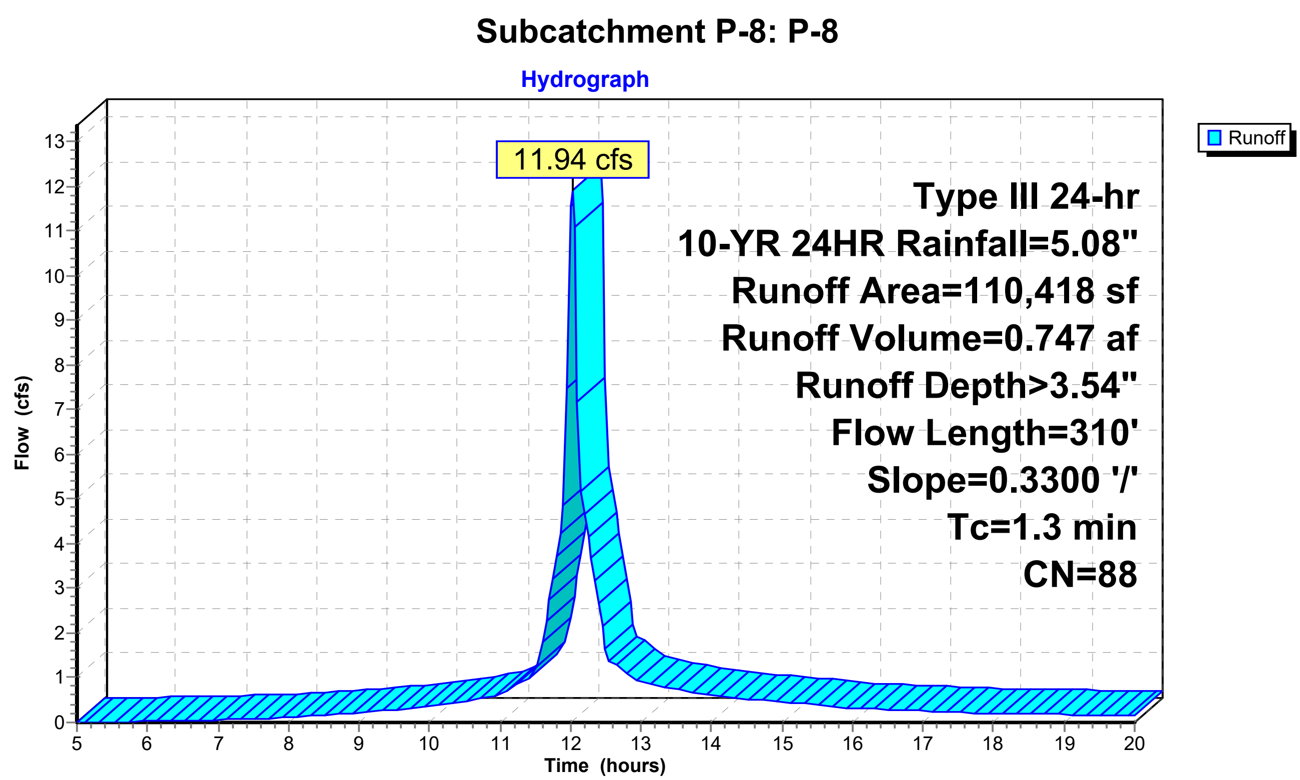
Summary for Subcatchment P-8: P-8

Runoff = 11.94 cfs @ 12.02 hrs, Volume= 0.747 af, Depth> 3.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"

Area (sf)	CN	Description
45,474	74	>75% Grass cover, Good, HSG C
9,735	96	Gravel surface, HSG C
55,209	98	Water Surface, HSG C
110,418	88	Weighted Average
55,209		50.00% Pervious Area
55,209		50.00% Impervious Area

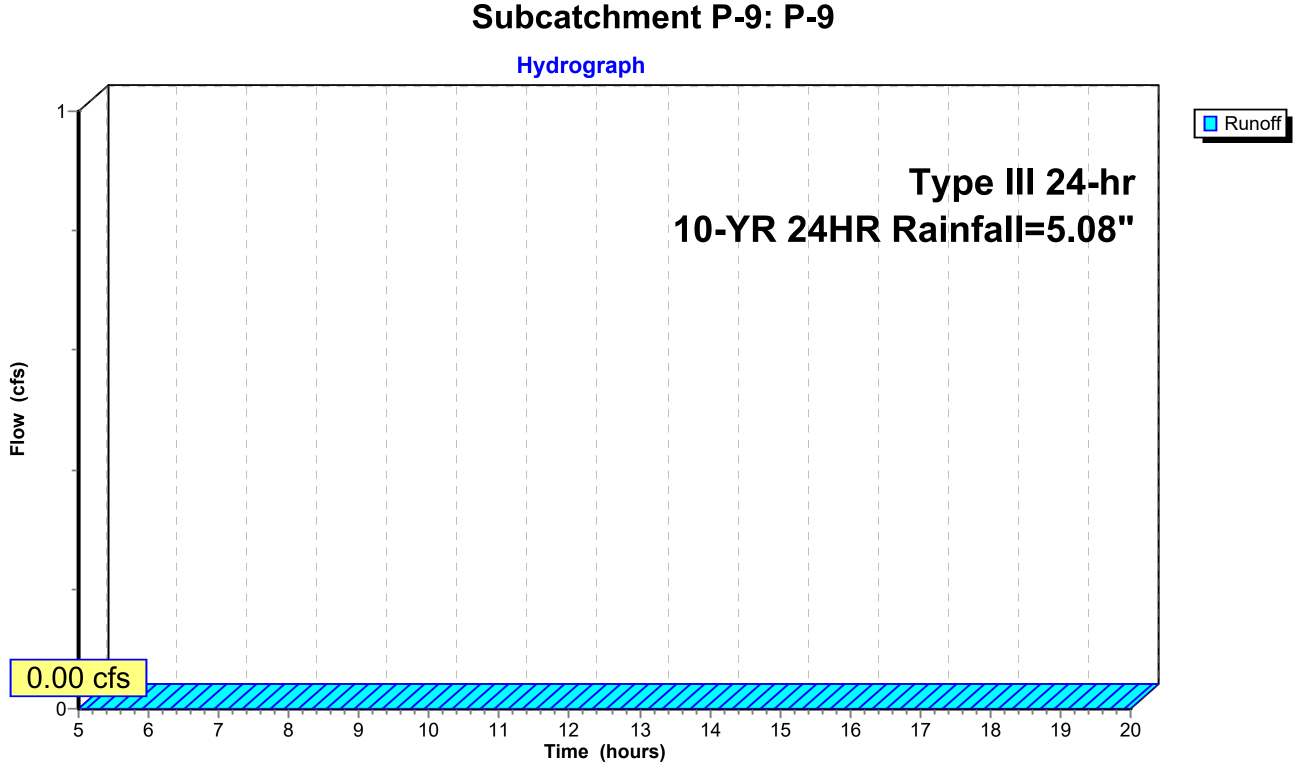
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	110	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	200		4.01		**Lake or Reservoir,** Mean Depth= 0.50'
1.3	310	Total			



Summary for Subcatchment P-9: P-9

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR 24HR Rainfall=5.08"



Summary for Reach Bench swale: Bench swale

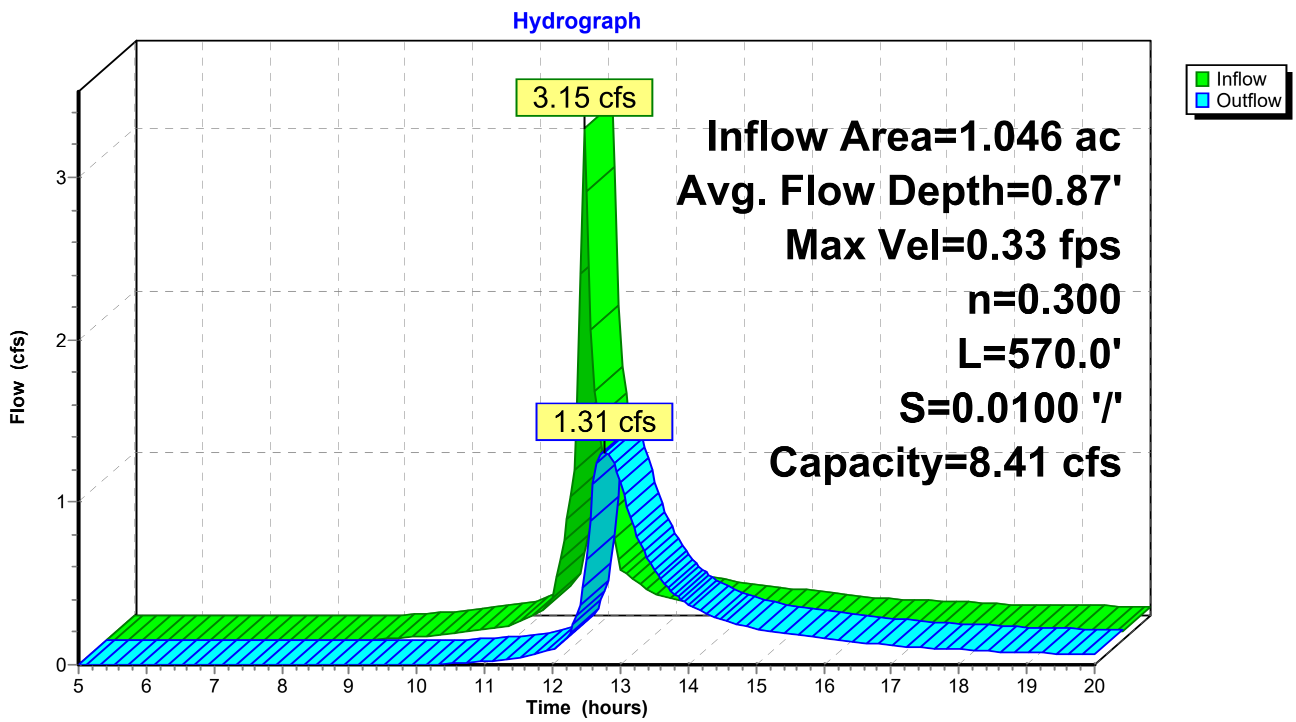
Inflow Area = 1.046 ac, 0.00% Impervious, Inflow Depth > 2.25" for 10-YR 24HR event
Inflow = 3.15 cfs @ 12.06 hrs, Volume= 0.196 af
Outflow = 1.31 cfs @ 12.76 hrs, Volume= 0.188 af, Atten= 58%, Lag= 41.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.33 fps, Min. Travel Time= 29.1 min
Avg. Velocity = 0.16 fps, Avg. Travel Time= 57.7 min

Peak Storage= 2,293 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 8.41 cfs

2.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 570.0' Slope= 0.0100 '/'
Inlet Invert= 116.20', Outlet Invert= 110.50'

Reach Bench swale: Bench swale



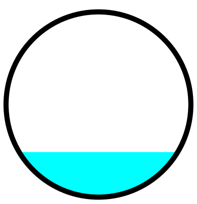
Summary for Reach Drop Pipe: Drop Pipe

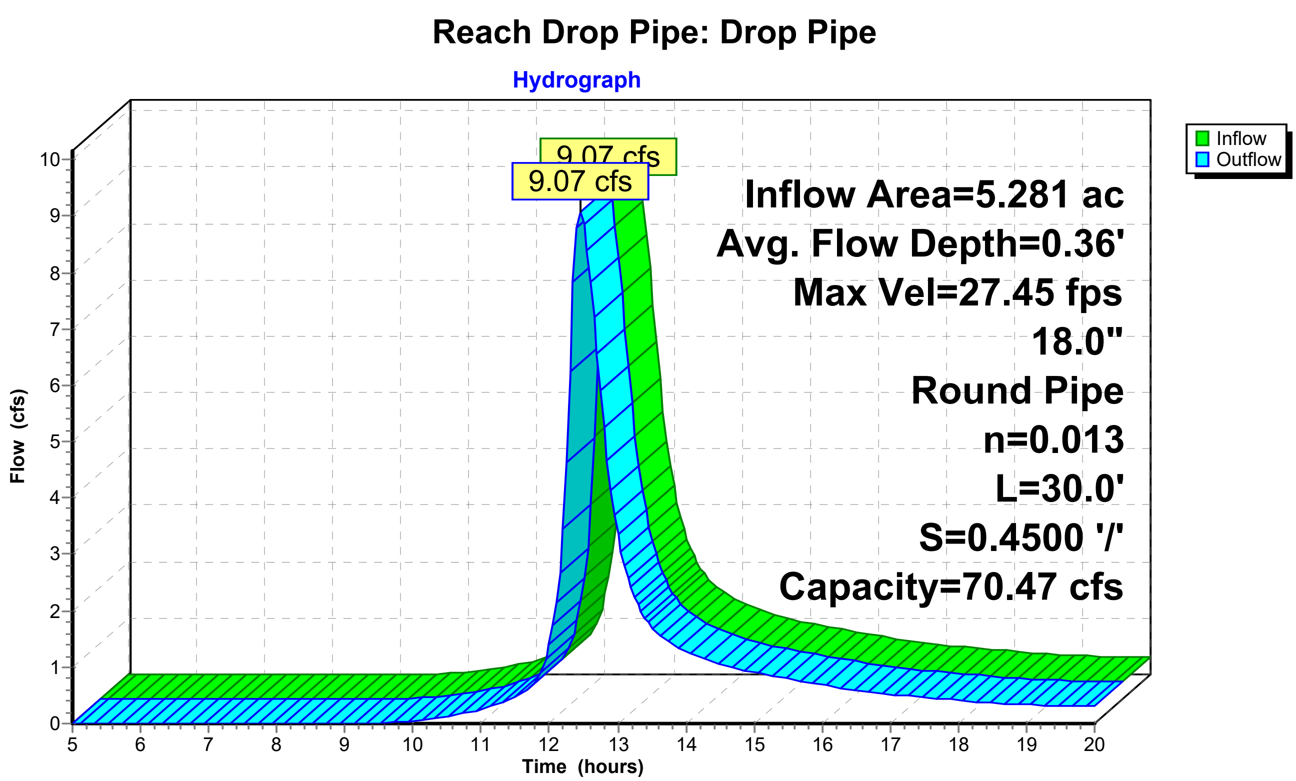
Inflow Area = 5.281 ac, 0.00% Impervious, Inflow Depth > 2.21" for 10-YR 24HR event
Inflow = 9.07 cfs @ 12.45 hrs, Volume= 0.973 af
Outflow = 9.07 cfs @ 12.45 hrs, Volume= 0.972 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 27.45 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 12.48 fps, Avg. Travel Time= 0.0 min

Peak Storage= 10 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 70.47 cfs

18.0" Round Pipe
n= 0.013
Length= 30.0' Slope= 0.4500 '/'
Inlet Invert= 122.00', Outlet Invert= 108.50'



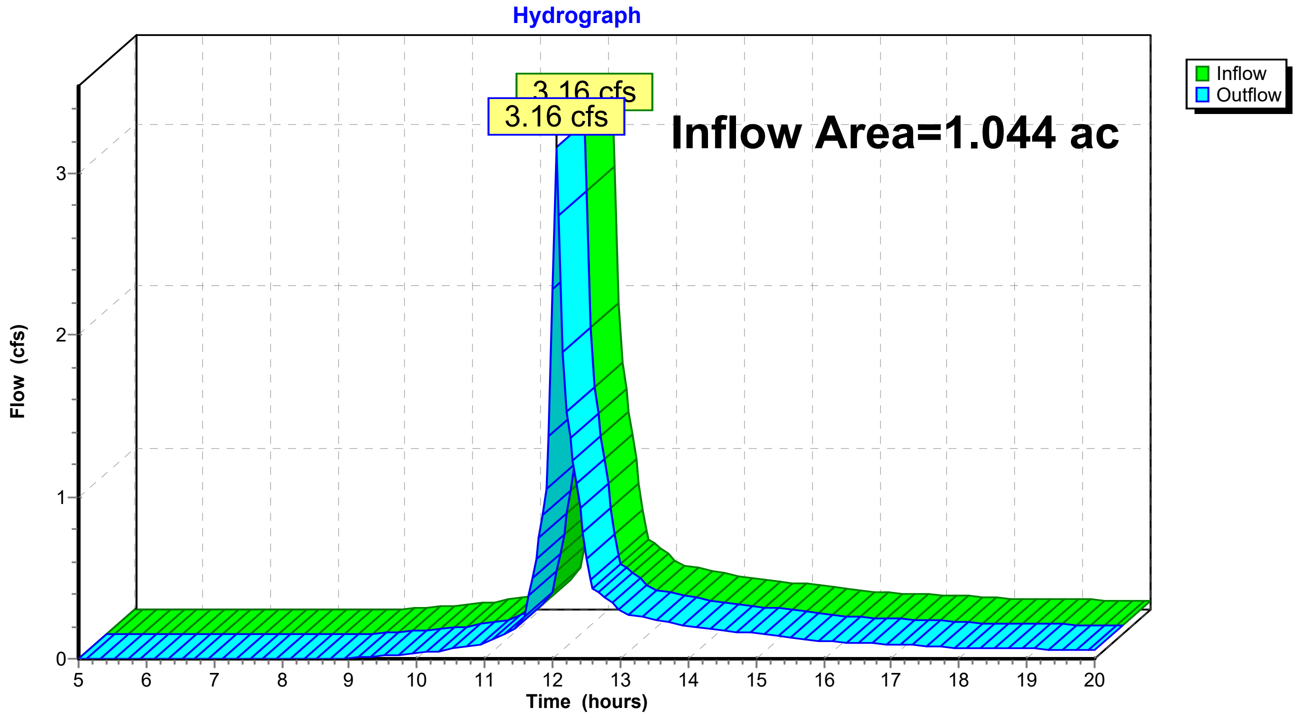


Summary for Reach REACH 1: Reach 1

Inflow Area = 1.044 ac, 0.00% Impervious, Inflow Depth > 2.25" for 10-YR 24HR event
Inflow = 3.16 cfs @ 12.06 hrs, Volume= 0.196 af
Outflow = 3.16 cfs @ 12.06 hrs, Volume= 0.196 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

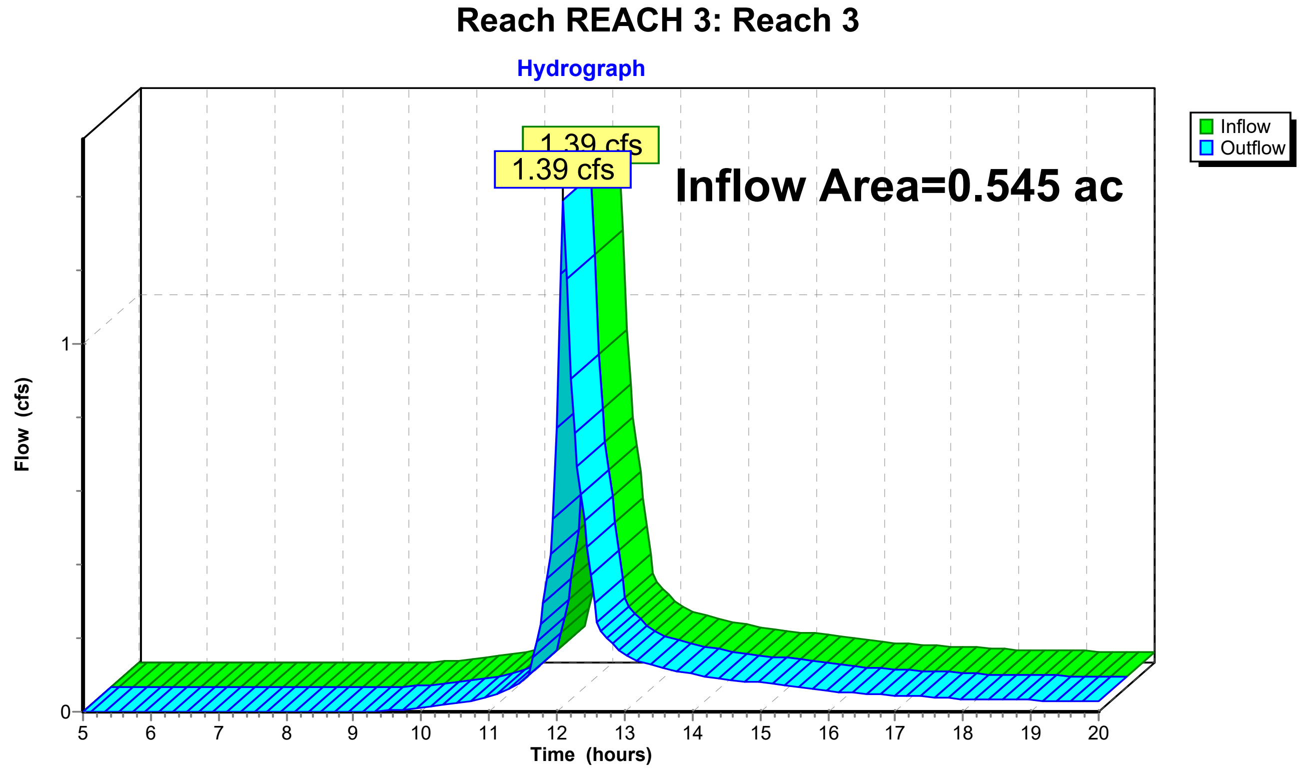
Reach REACH 1: Reach 1



Summary for Reach REACH 3: Reach 3

Inflow Area = 0.545 ac, 0.00% Impervious, Inflow Depth > 2.09" for 10-YR 24HR event
Inflow = 1.39 cfs @ 12.10 hrs, Volume= 0.095 af
Outflow = 1.39 cfs @ 12.10 hrs, Volume= 0.095 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

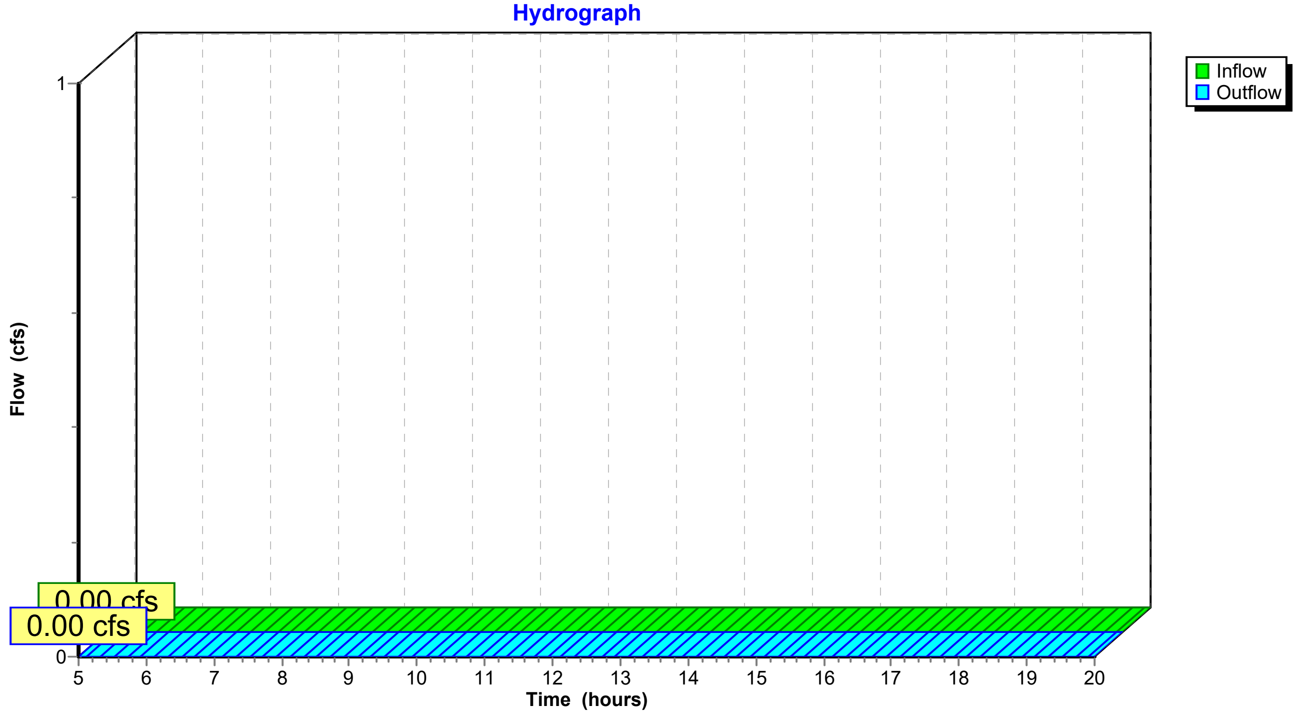


Summary for Reach REACH 4: Reach 4

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 4: Reach 4

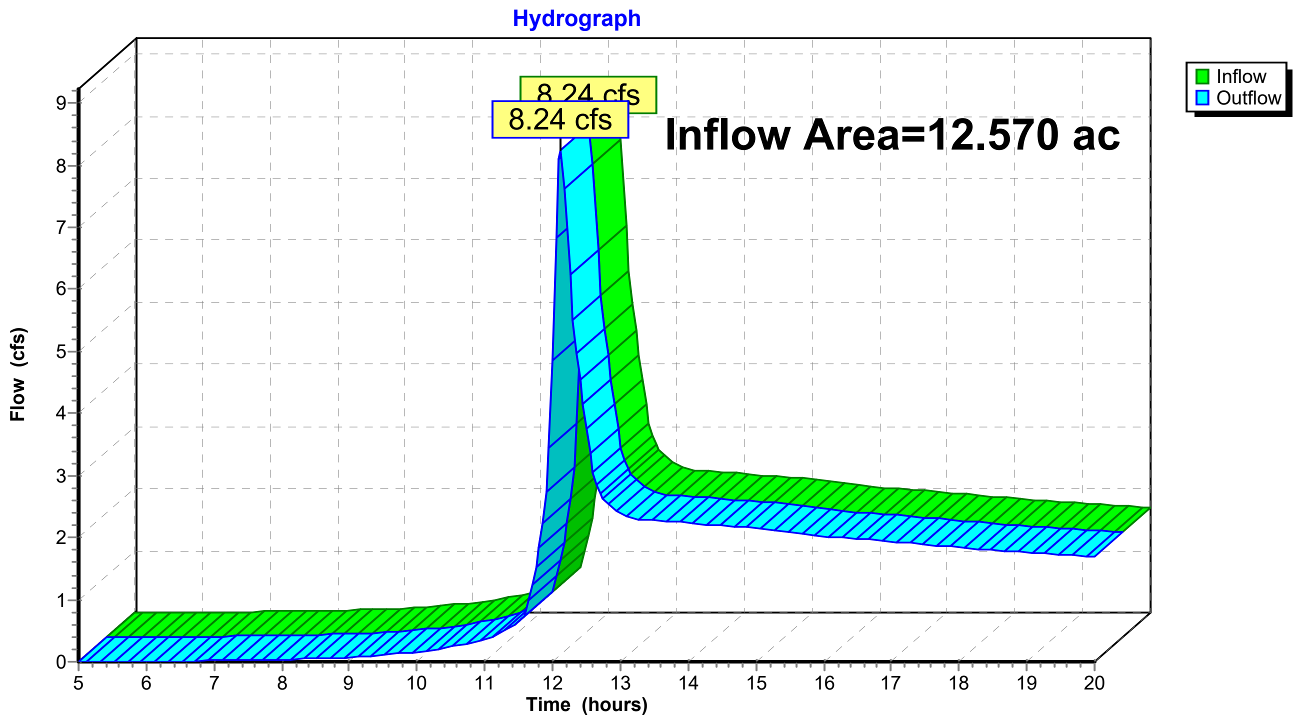


Summary for Reach REACH 5: Reach 5

Inflow Area = 12.570 ac, 10.08% Impervious, Inflow Depth > 1.57" for 10-YR 24HR event
Inflow = 8.24 cfs @ 12.12 hrs, Volume= 1.649 af
Outflow = 8.24 cfs @ 12.12 hrs, Volume= 1.649 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 5: Reach 5

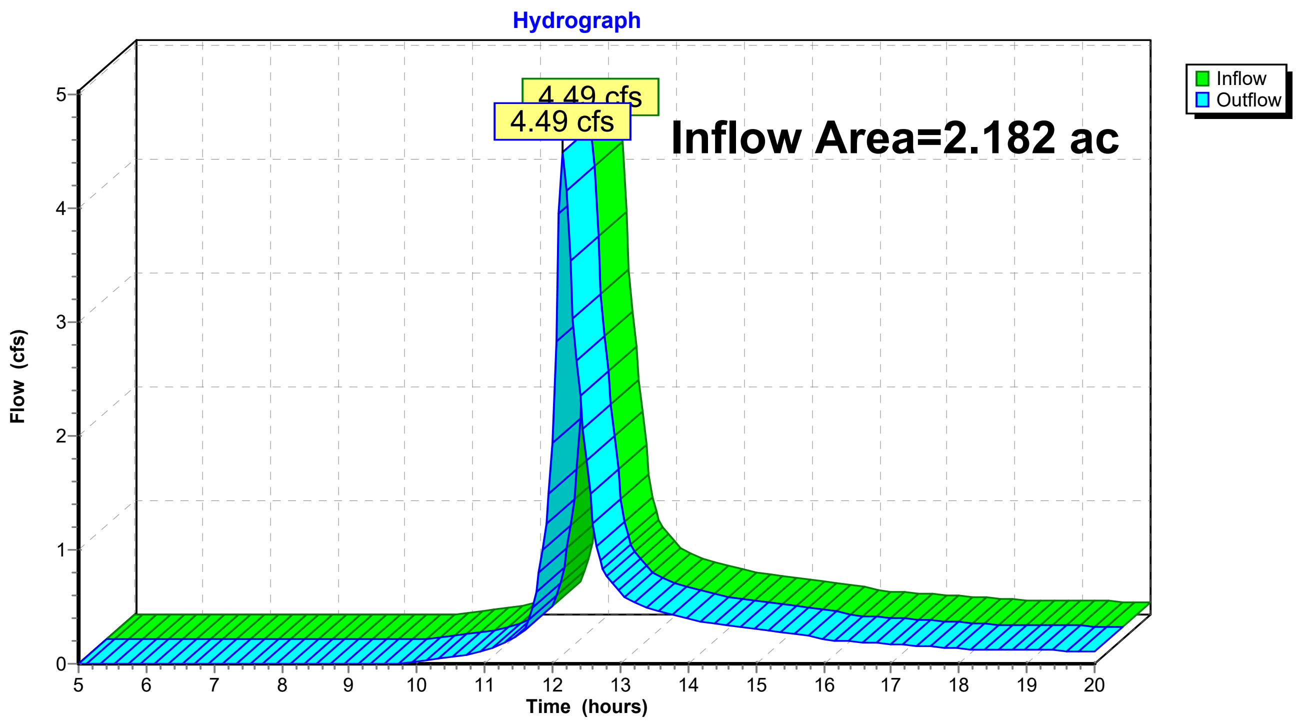


Summary for Reach REACH2: Reach2

Inflow Area =	2.182 ac,	0.00% Impervious, Inflow Depth > 1.93"	for 10-YR 24HR event	
Inflow =	4.49 cfs @	12.16 hrs, Volume=	0.350 af	
Outflow =	4.49 cfs @	12.16 hrs, Volume=	0.350 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH2: Reach2



Summary for Reach Road Swale: Road Swale

Inflow Area = 2.037 ac, 0.00% Impervious, Inflow Depth > 2.58" for 10-YR 24HR event
Inflow = 2.89 cfs @ 12.61 hrs, Volume= 0.438 af
Outflow = 2.04 cfs @ 13.54 hrs, Volume= 0.415 af, Atten= 29%, Lag= 55.4 min

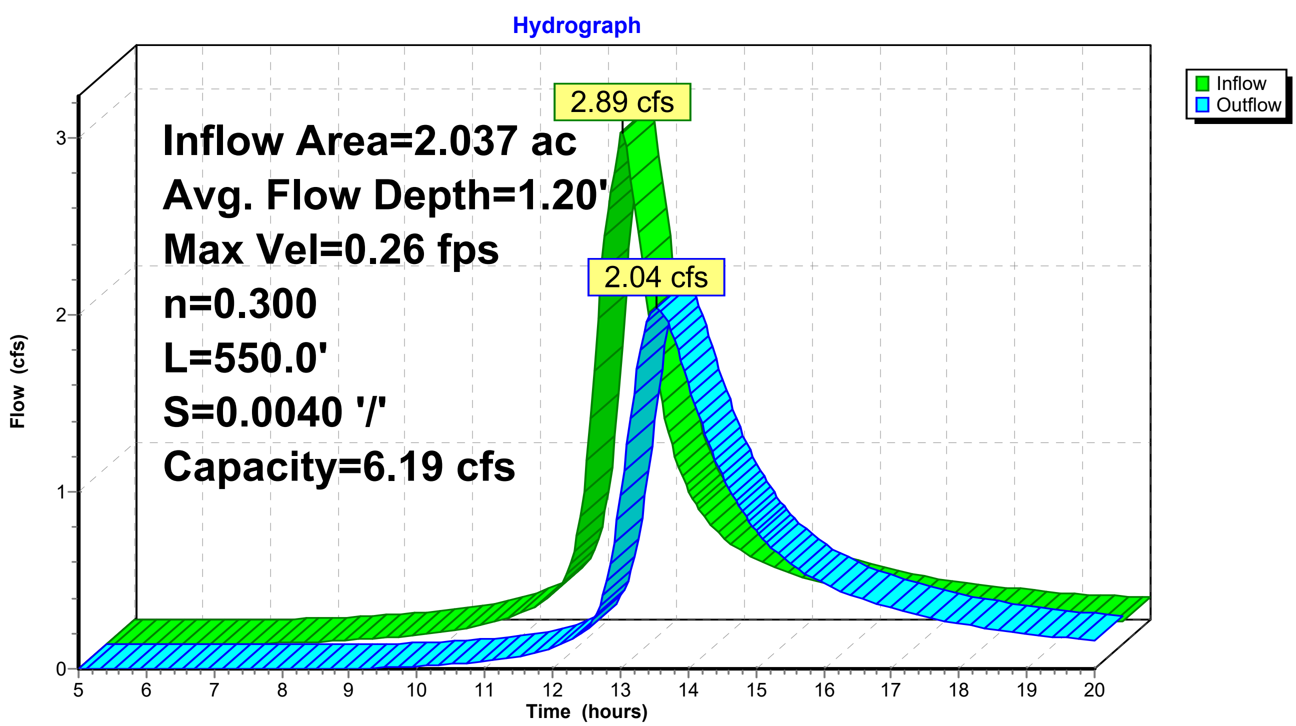
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.26 fps, Min. Travel Time= 35.5 min
Avg. Velocity = 0.13 fps, Avg. Travel Time= 71.2 min

Peak Storage= 4,344 cf @ 12.95 hrs
Average Depth at Peak Storage= 1.20'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 6.19 cfs

3.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 550.0' Slope= 0.0040 '/'
Inlet Invert= 110.50', Outlet Invert= 108.30'

‡

Reach Road Swale: Road Swale



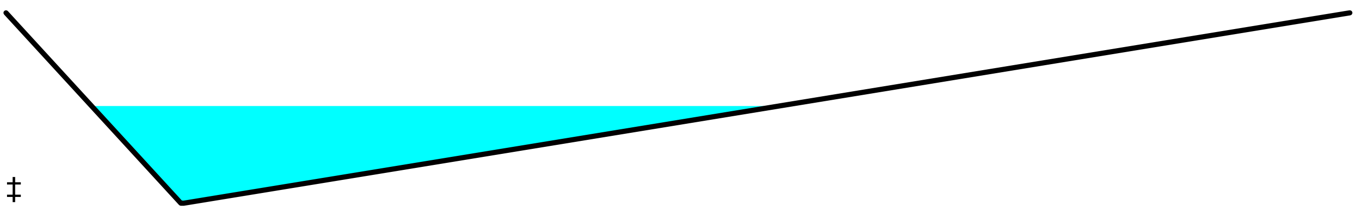
Summary for Reach So. Plateau Swale: So. Plateau Swale

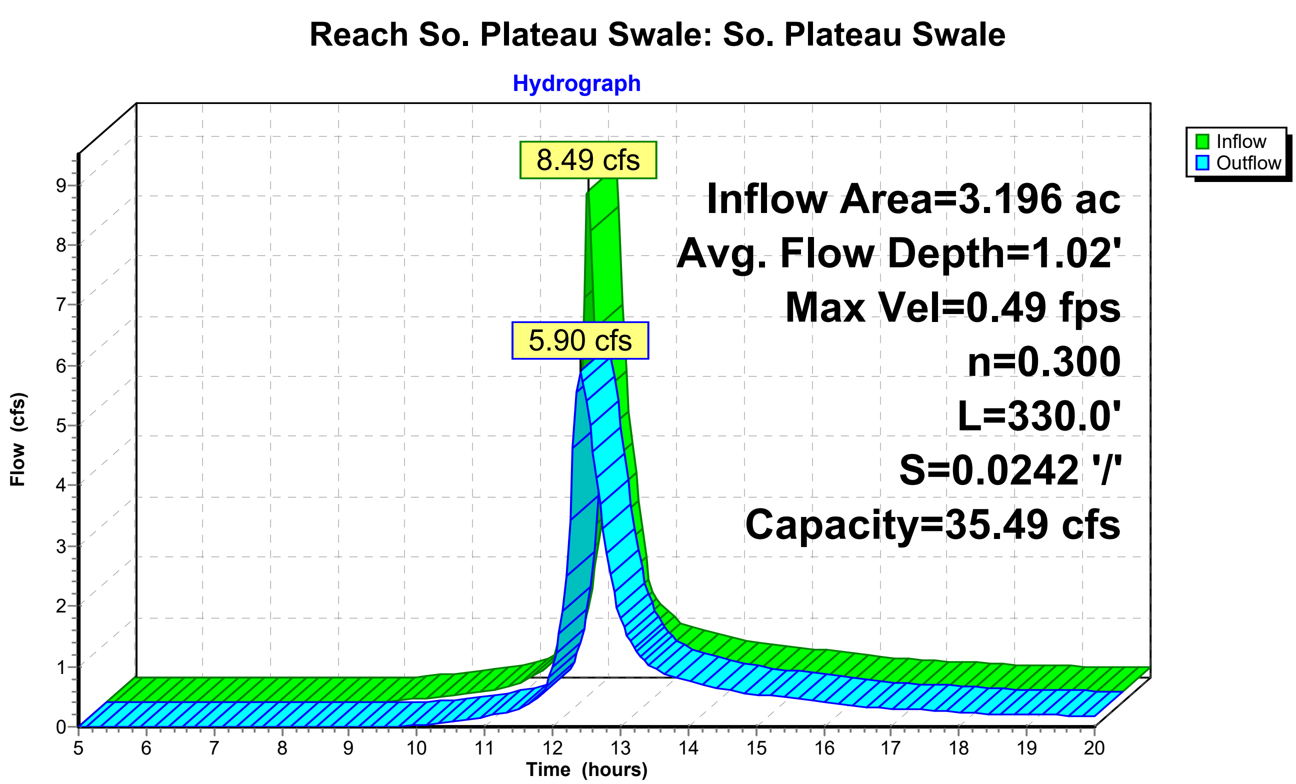
Inflow Area = 3.196 ac, 0.00% Impervious, Inflow Depth > 2.25" for 10-YR 24HR event
Inflow = 8.49 cfs @ 12.11 hrs, Volume= 0.599 af
Outflow = 5.90 cfs @ 12.41 hrs, Volume= 0.590 af, Atten= 31%, Lag= 17.9 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.49 fps, Min. Travel Time= 11.2 min
Avg. Velocity = 0.24 fps, Avg. Travel Time= 22.7 min

Peak Storage= 3,991 cf @ 12.22 hrs
Average Depth at Peak Storage= 1.02'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 35.49 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 20.0 '/' Top Width= 46.10'
Length= 330.0' Slope= 0.0242 '/'
Inlet Invert= 130.00', Outlet Invert= 122.00'





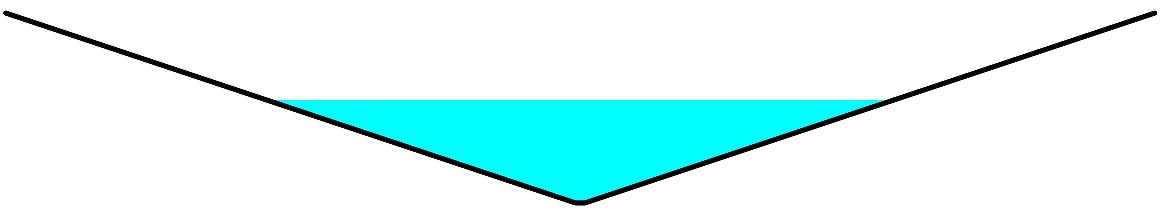
Summary for Reach Stone swale: stone swale

Inflow Area = 1.655 ac, 0.00% Impervious, Inflow Depth > 2.25" for 10-YR 24HR event
Inflow = 5.15 cfs @ 12.03 hrs, Volume= 0.311 af
Outflow = 4.07 cfs @ 12.17 hrs, Volume= 0.309 af, Atten= 21%, Lag= 8.2 min

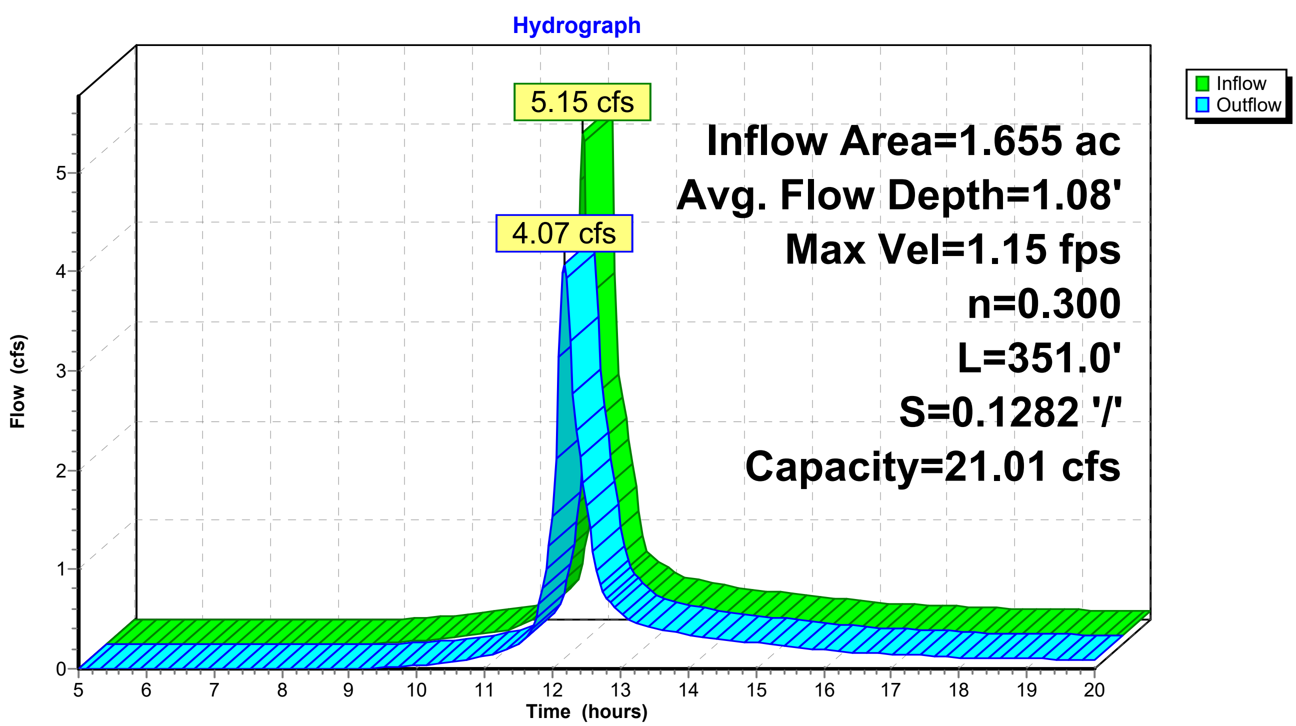
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.15 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 0.53 fps, Avg. Travel Time= 11.1 min

Peak Storage= 1,269 cf @ 12.09 hrs
Average Depth at Peak Storage= 1.08'
Bank-Full Depth= 2.00' Flow Area= 12.2 sf, Capacity= 21.01 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 12.10'
Length= 351.0' Slope= 0.1282 '/'
Inlet Invert= 155.00', Outlet Invert= 110.00'



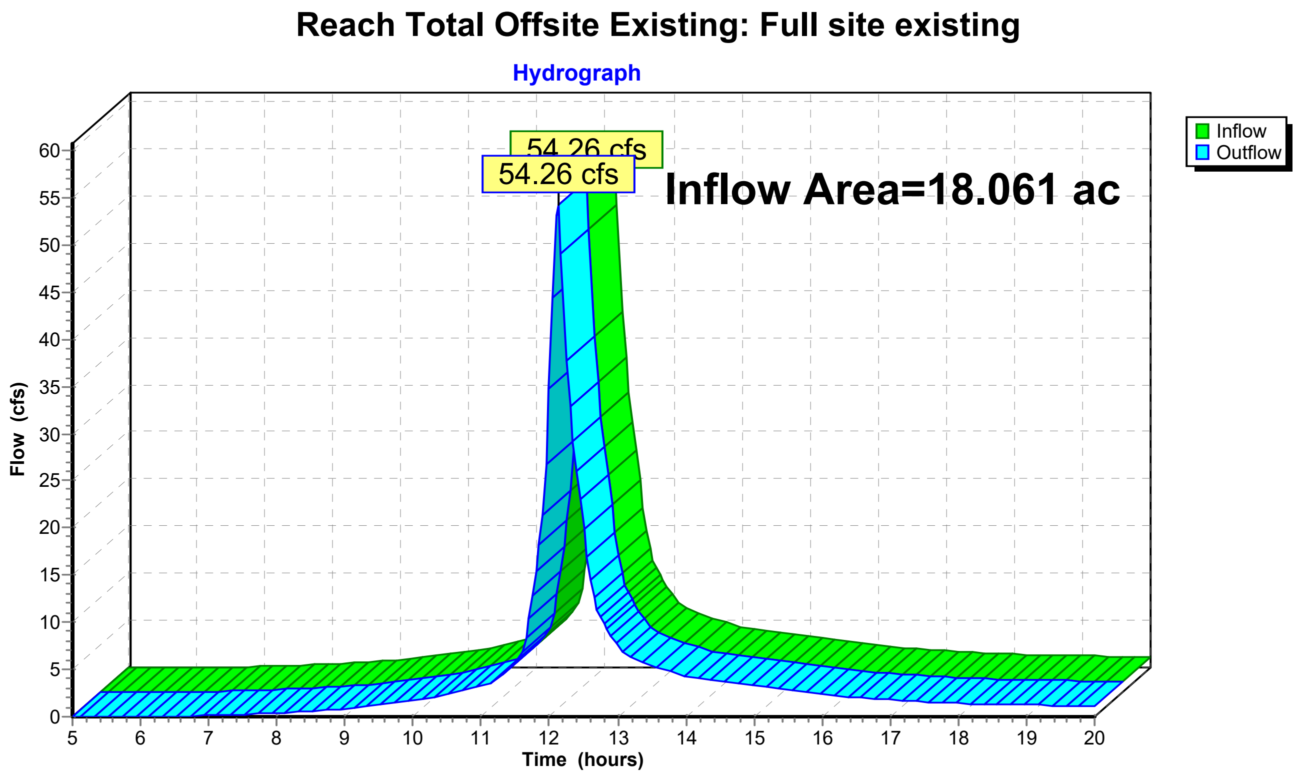
Reach Stone swale: stone swale



Summary for Reach Total Offsite Existing: Full site existing

Inflow Area = 18.061 ac, 0.00% Impervious, Inflow Depth > 3.10" for 10-YR 24HR event
Inflow = 54.26 cfs @ 12.12 hrs, Volume= 4.671 af
Outflow = 54.26 cfs @ 12.12 hrs, Volume= 4.671 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

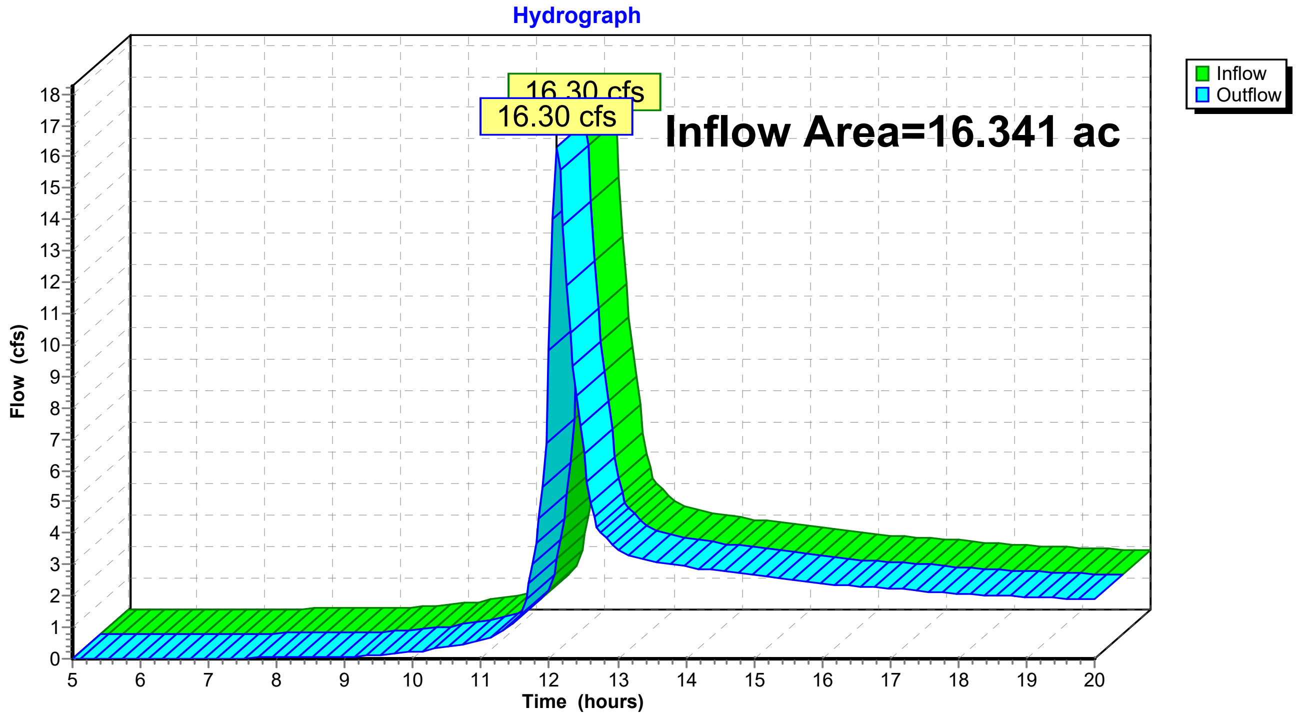


Summary for Reach TOTAL OFFSITE PROP: Full Site Prop

Inflow Area = 16.341 ac, 7.76% Impervious, Inflow Depth > 1.68" for 10-YR 24HR event
Inflow = 16.30 cfs @ 12.11 hrs, Volume= 2.290 af
Outflow = 16.30 cfs @ 12.11 hrs, Volume= 2.290 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach TOTAL OFFSITE PROP: Full Site Prop



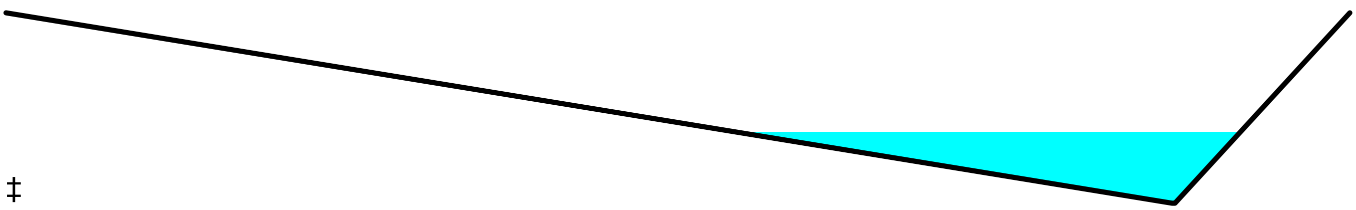
Summary for Reach West Plateau Swale: West Plateau Swale

Inflow Area = 2.085 ac, 0.00% Impervious, Inflow Depth > 2.25" for 10-YR 24HR event
Inflow = 5.44 cfs @ 12.12 hrs, Volume= 0.391 af
Outflow = 3.45 cfs @ 12.51 hrs, Volume= 0.383 af, Atten= 37%, Lag= 23.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.53 fps, Min. Travel Time= 15.1 min
Avg. Velocity = 0.27 fps, Avg. Travel Time= 29.8 min

Peak Storage= 3,123 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 46.67 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 20.0 3.0 '/' Top Width= 46.10'
Length= 477.0' Slope= 0.0419 '/'
Inlet Invert= 142.00', Outlet Invert= 122.00'



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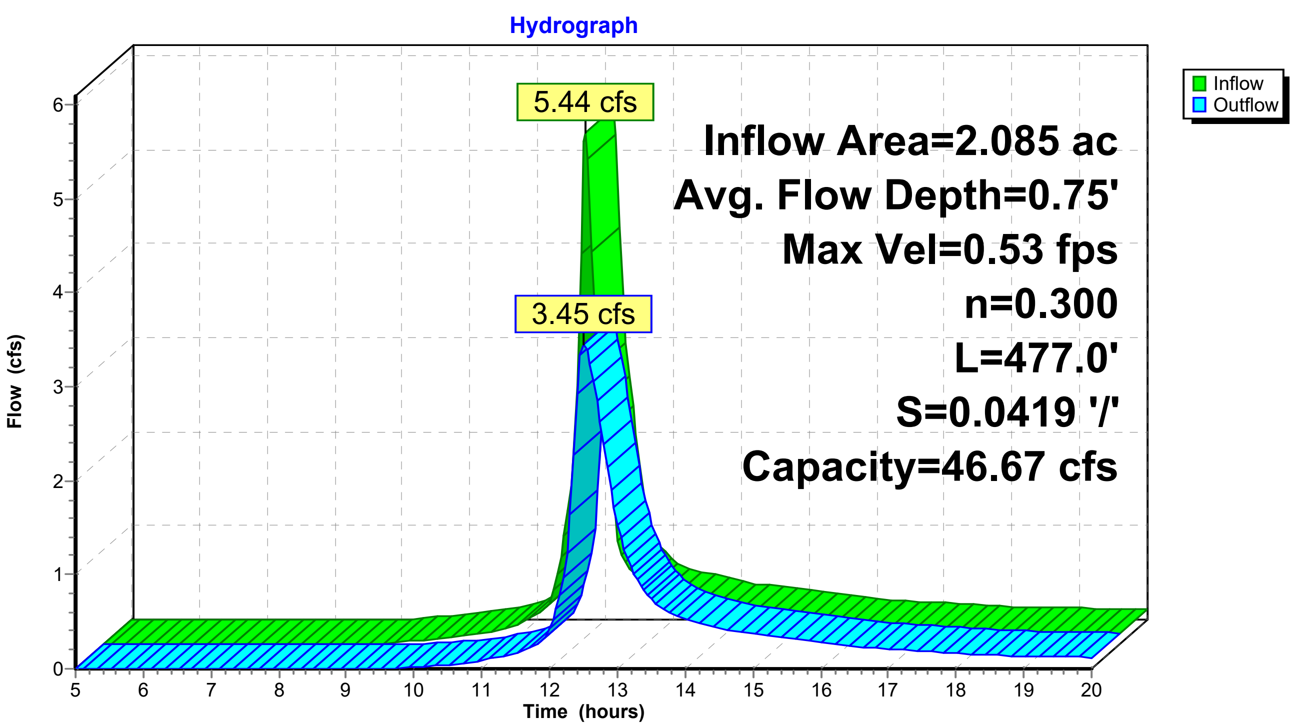
Reach West Plateau Swale: West Plateau Swale



Summary for Pond 3P: Detention Basin

Inflow Area = 9.853 ac, 12.86% Impervious, Inflow Depth > 2.60" for 10-YR 24HR event
Inflow = 13.60 cfs @ 12.02 hrs, Volume= 2.135 af
Outflow = 1.71 cfs @ 15.62 hrs, Volume= 1.045 af, Atten= 87%, Lag= 215.9 min
Primary = 1.71 cfs @ 15.62 hrs, Volume= 1.045 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 109.53' @ 15.62 hrs Surf.Area= 51,577 sf Storage= 57,859 cf

Plug-Flow detention time= 248.9 min calculated for 1.042 af (49% of inflow)
Center-of-Mass det. time= 153.3 min (968.3 - 815.0)

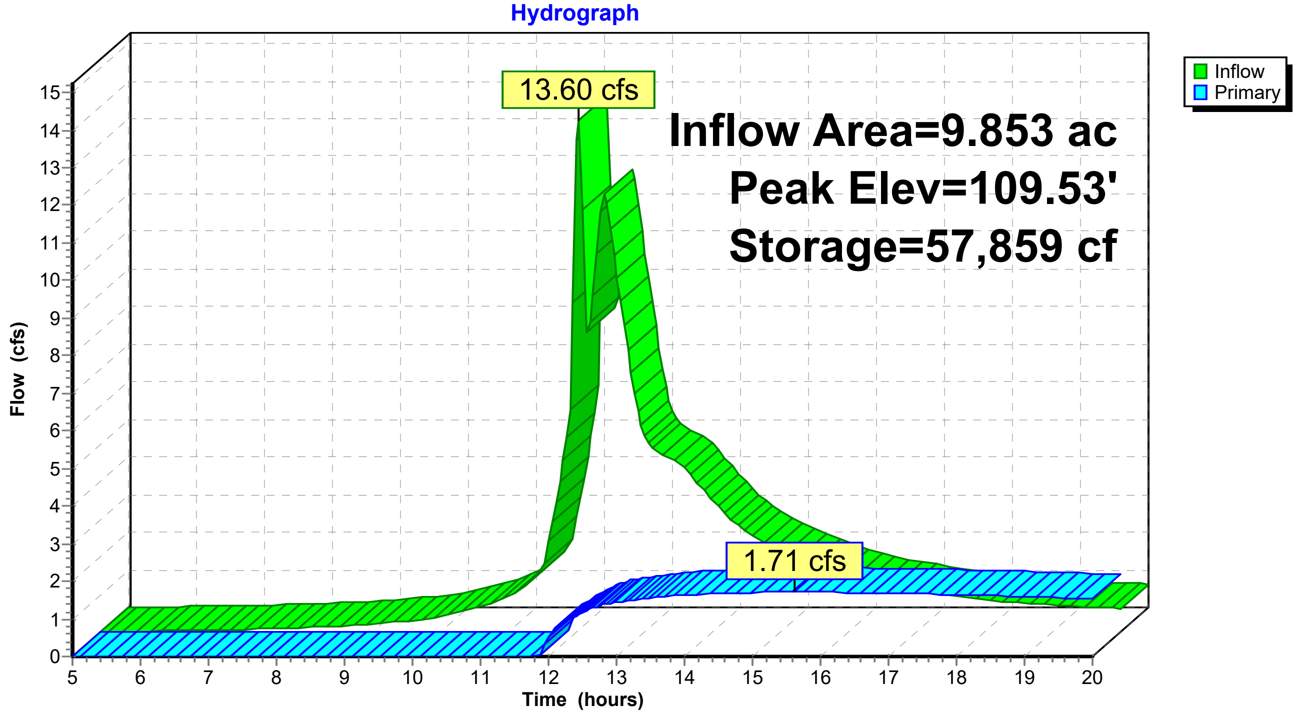
Volume	Invert	Avail.Storage	Storage Description
#1	108.20'	204,236 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
108.20	30,000	0	0
108.50	42,000	10,800	10,800
109.00	44,377	21,594	32,394
110.00	57,942	51,160	83,554
112.00	62,740	120,682	204,236

Device	Routing	Invert	Outlet Devices
#1	Primary	108.50'	**2.0" Horiz. Orifice/Grate X 4.00 columns** X 4 rows C= 0.600 Limited to weir flow at low heads
#2	Primary	110.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.71 cfs @ 15.62 hrs HW=109.53' (Free Discharge)
├─**1=Orifice/Grate** (Orifice Controls 1.71 cfs @ 4.89 fps)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: Detention Basin



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: E-1 Runoff Area=114,240 sf 0.00% Impervious Runoff Depth>4.36"
Flow Length=630' Tc=8.6 min CN=86 Runoff=12.50 cfs 0.952 af

Subcatchment E-2: E-2 Runoff Area=98,290 sf 0.00% Impervious Runoff Depth>3.60"
Flow Length=488' Slope=0.0100 '/' Tc=32.5 min CN=79 Runoff=5.57 cfs 0.677 af

Subcatchment E-3: E-3 Runoff Area=79,629 sf 0.00% Impervious Runoff Depth>3.95"
Tc=0.0 min CN=82 Runoff=10.20 cfs 0.601 af

Subcatchment E-4: E-4 Runoff Area=277,162 sf 0.00% Impervious Runoff Depth>4.36"
Flow Length=550' Slope=0.0100 '/' Tc=9.2 min CN=86 Runoff=29.58 cfs 2.309 af

Subcatchment E-5: E-5 Runoff Area=217,437 sf 0.00% Impervious Runoff Depth>3.94"
Flow Length=760' Tc=8.8 min CN=82 Runoff=21.76 cfs 1.637 af

Subcatchment P-1: P-1 Runoff Area=45,494 sf 0.00% Impervious Runoff Depth>3.14"
Flow Length=523' Tc=3.6 min CN=74 Runoff=4.41 cfs 0.274 af

Subcatchment P-10: P-10 Runoff Area=72,105 sf 0.00% Impervious Runoff Depth>3.14"
Flow Length=409' Slope=0.3300 '/' Tc=1.7 min CN=74 Runoff=7.16 cfs 0.434 af

Subcatchment P-11: P-11 Runoff Area=46,241 sf 0.00% Impervious Runoff Depth>4.36"
Flow Length=330' Slope=0.0100 '/' Tc=5.5 min CN=86 Runoff=5.53 cfs 0.386 af

Subcatchment P-2: P-2 Runoff Area=95,039 sf 0.00% Impervious Runoff Depth>2.76"
Flow Length=390' Tc=10.5 min CN=70 Runoff=6.47 cfs 0.502 af

Subcatchment P-3: P-3 Runoff Area=23,731 sf 0.00% Impervious Runoff Depth>2.95"
Flow Length=190' Slope=0.0100 '/' Tc=6.3 min CN=72 Runoff=1.97 cfs 0.134 af

Subcatchment P-4: P-4 Runoff Area=45,575 sf 0.00% Impervious Runoff Depth>3.14"
Flow Length=605' Tc=3.7 min CN=74 Runoff=4.40 cfs 0.274 af

Subcatchment P-5: P-5 Runoff Area=43,177 sf 0.00% Impervious Runoff Depth>4.01"
Flow Length=535' Tc=31.1 min CN=83 Runoff=2.75 cfs 0.331 af

Subcatchment P-6: P-6 Runoff Area=139,221 sf 0.00% Impervious Runoff Depth>3.14"
Flow Length=707' Slope=0.0500 '/' Tc=7.5 min CN=74 Runoff=11.85 cfs 0.836 af

Subcatchment P-7: P-7 Runoff Area=90,811 sf 0.00% Impervious Runoff Depth>3.14"
Flow Length=750' Slope=0.0500 '/' Tc=8.0 min CN=74 Runoff=7.59 cfs 0.545 af

Subcatchment P-8: P-8 Runoff Area=110,418 sf 50.00% Impervious Runoff Depth>4.58"
Flow Length=310' Slope=0.3300 '/' Tc=1.3 min CN=88 Runoff=15.23 cfs 0.967 af

Subcatchment P-9: P-9
Runoff=0.00 cfs 0.000 af

Reach Bench swale: Bench swale Avg. Flow Depth=1.05' Max Vel=0.36 fps Inflow=4.40 cfs 0.274 af
n=0.300 L=570.0' S=0.0100 '/' Capacity=8.41 cfs Outflow=1.95 cfs 0.264 af

Reach Drop Pipe: Drop Pipe Avg. Flow Depth=0.44' Max Vel=30.45 fps Inflow=13.10 cfs 1.360 af
18.0" Round Pipe n=0.013 L=30.0' S=0.4500 '/' Capacity=70.47 cfs Outflow=13.09 cfs 1.360 af

Reach REACH 1: Reach 1 Inflow=4.41 cfs 0.274 af
Outflow=4.41 cfs 0.274 af

Reach REACH 3: Reach 3 Inflow=1.97 cfs 0.134 af
Outflow=1.97 cfs 0.134 af

Reach REACH 4: Reach 4 Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach REACH 5: Reach 5 Inflow=11.41 cfs 2.101 af
Outflow=11.41 cfs 2.101 af

Reach REACH2: Reach2 Inflow=6.47 cfs 0.502 af
Outflow=6.47 cfs 0.502 af

Reach Road Swale: Road Swale Avg. Flow Depth=1.43' Max Vel=0.28 fps Inflow=4.22 cfs 0.596 af
n=0.300 L=550.0' S=0.0040 '/' Capacity=6.19 cfs Outflow=2.97 cfs 0.569 af

Reach So. Plateau Swale: So. Plateau Avg. Flow Depth=1.17' Max Vel=0.54 fps Inflow=11.85 cfs 0.836 af
n=0.300 L=330.0' S=0.0242 '/' Capacity=35.49 cfs Outflow=8.44 cfs 0.825 af

Reach Stone swale: stone swale Avg. Flow Depth=1.24' Max Vel=1.25 fps Inflow=7.16 cfs 0.434 af
n=0.300 L=351.0' S=0.1282 '/' Capacity=21.01 cfs Outflow=5.76 cfs 0.431 af

Reach Total Offsite Existing: Full site existing Inflow=70.77 cfs 6.176 af
Outflow=70.77 cfs 6.176 af

Reach TOTAL OFFSITE PROP: Full Site Prop Inflow=22.91 cfs 3.010 af
Outflow=22.91 cfs 3.010 af

Reach West Plateau Swale: West Avg. Flow Depth=0.86' Max Vel=0.58 fps Inflow=7.59 cfs 0.545 af
n=0.300 L=477.0' S=0.0419 '/' Capacity=46.67 cfs Outflow=4.99 cfs 0.535 af

Pond 3P: Detention Basin Peak Elev=109.97' Storage=82,085 cf Inflow=18.17 cfs 2.896 af
Outflow=2.04 cfs 1.284 af

Total Runoff Area = 34.402 ac Runoff Volume = 10.858 af Average Runoff Depth = 3.79"
96.32% Pervious = 33.135 ac 3.68% Impervious = 1.267 ac

Summary for Subcatchment E-1: E-1

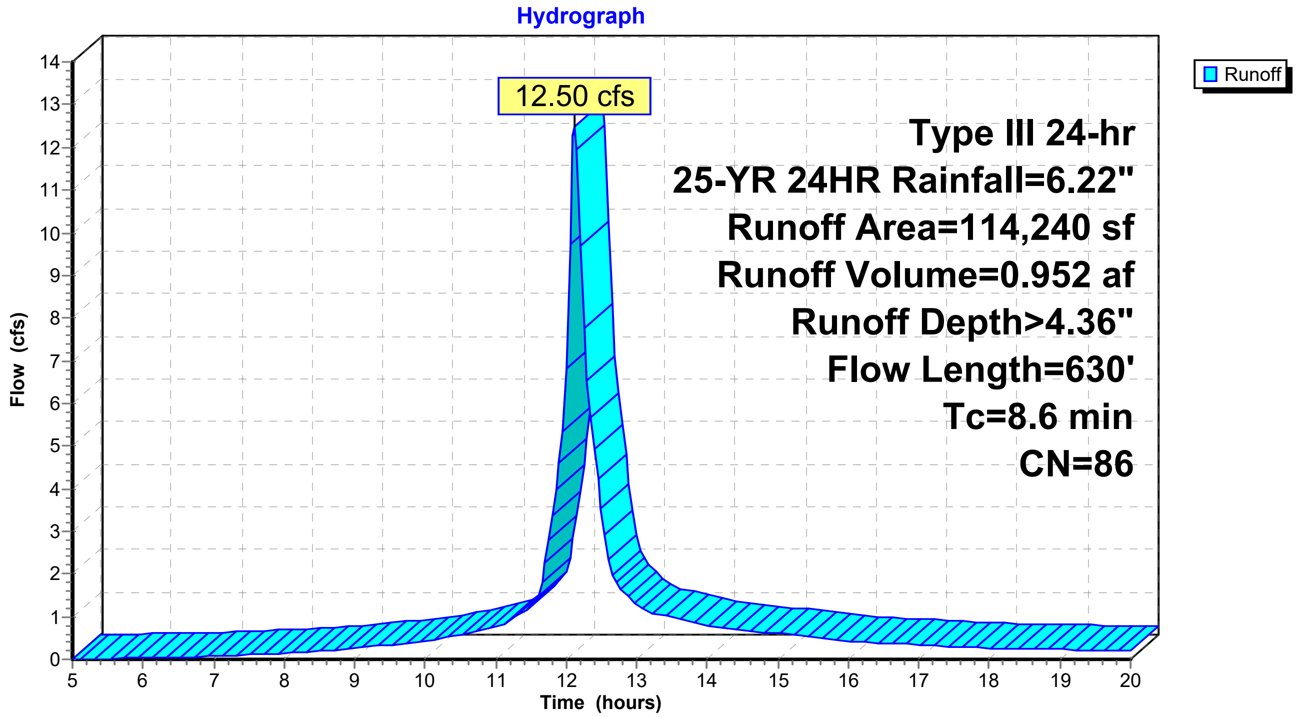
Runoff = 12.50 cfs @ 12.12 hrs, Volume= 0.952 af, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
114,240	86	<50% Grass cover, Poor, HSG C
114,240		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	320	0.3300	4.02		**Shallow Concentrated Flow, e1 1** Short Grass Pasture Kv= 7.0 fps
7.3	310	0.0050	0.71		**Shallow Concentrated Flow, e1 2** Nearly Bare & Untilled Kv= 10.0 fps
8.6	630	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

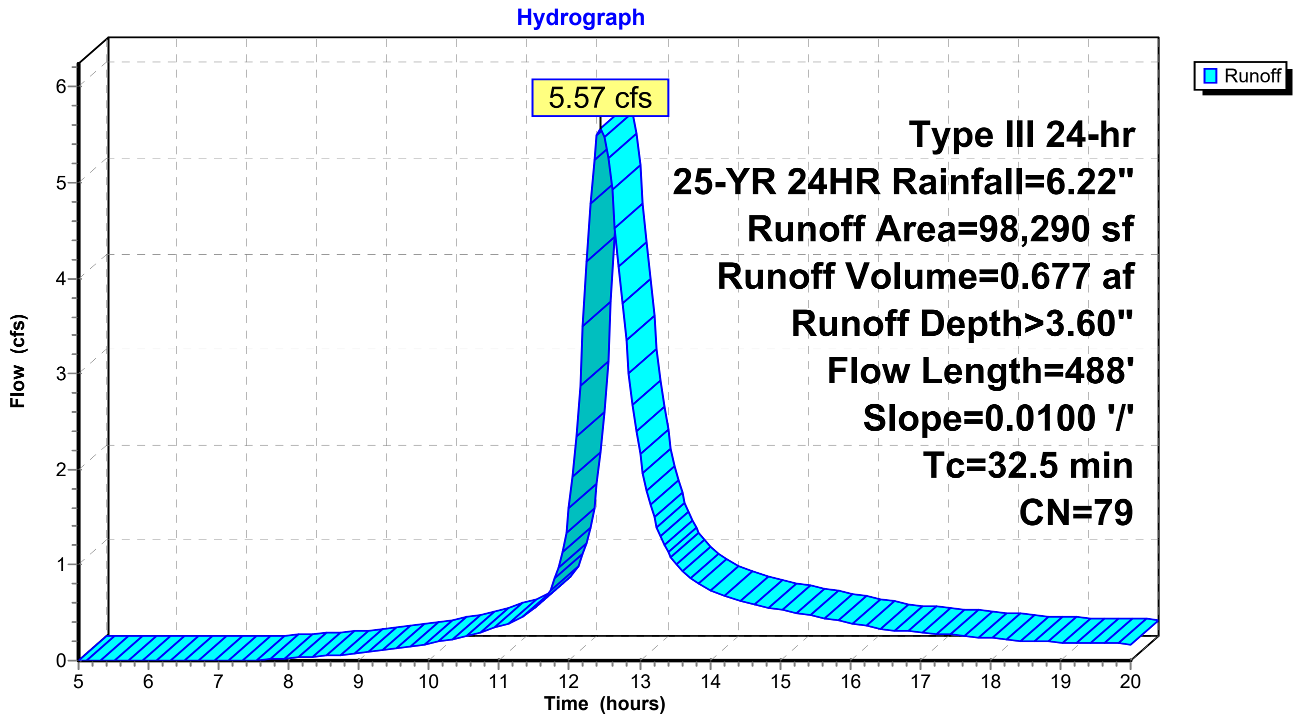
Runoff = 5.57 cfs @ 12.45 hrs, Volume= 0.677 af, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
54,000	86	<50% Grass cover, Poor, HSG C
44,290	70	Woods, Good, HSG C
98,290	79	Weighted Average
98,290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.5	488	0.0100	0.25		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps

Subcatchment E-2: E-2



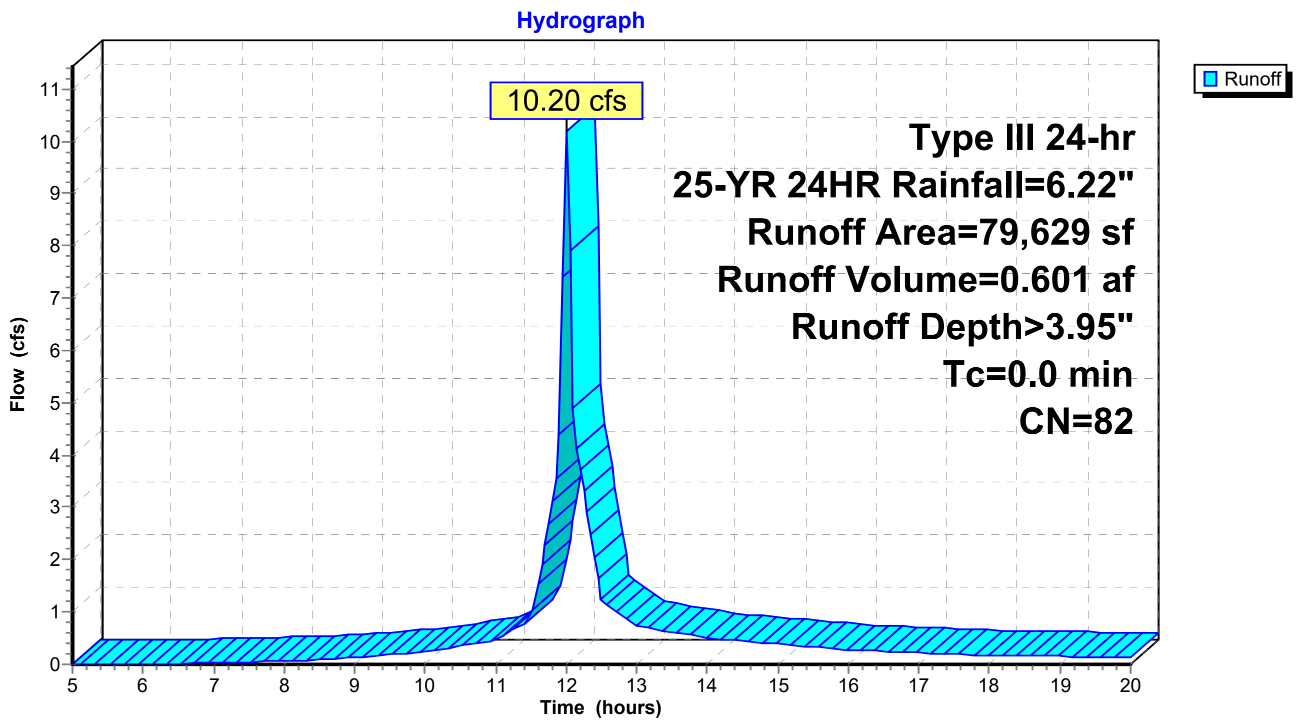
Summary for Subcatchment E-3: E-3

Runoff = 10.20 cfs @ 12.00 hrs, Volume= 0.601 af, Depth> 3.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
59,600	86	<50% Grass cover, Poor, HSG C
20,029	70	Woods, Good, HSG C
79,629	82	Weighted Average
79,629		100.00% Pervious Area

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

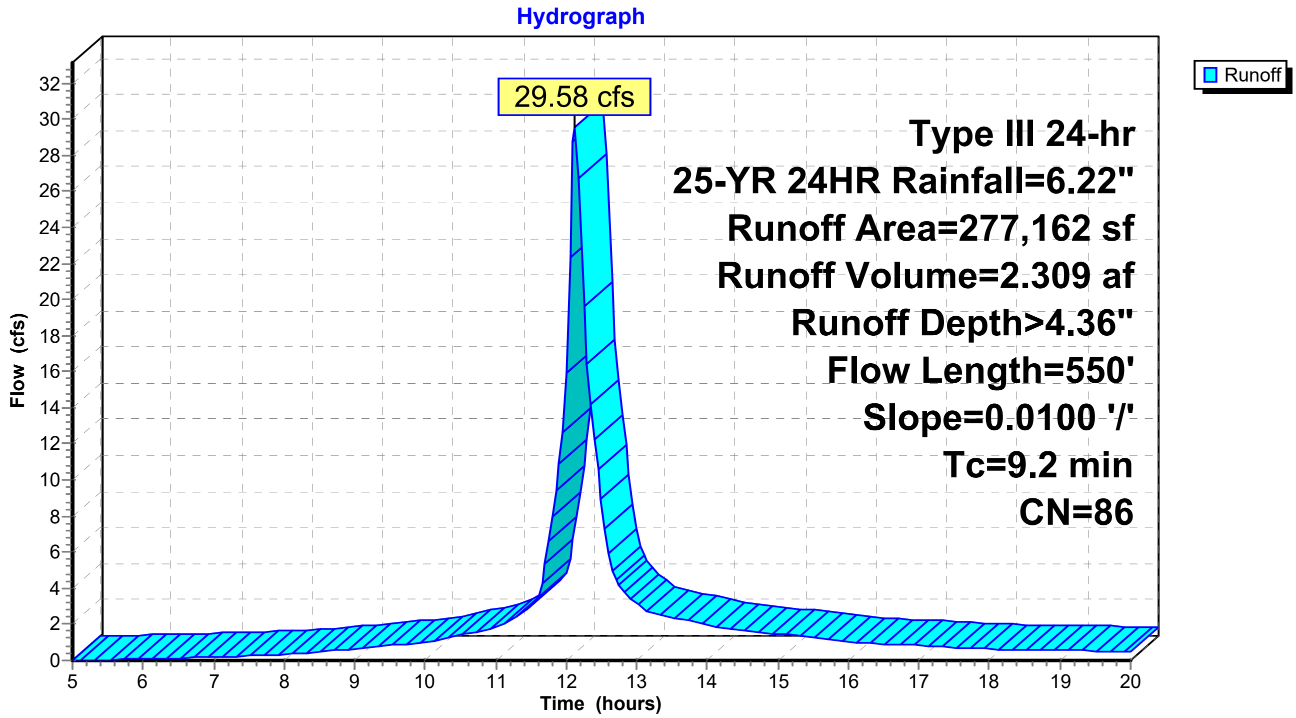
Runoff = 29.58 cfs @ 12.13 hrs, Volume= 2.309 af, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
277,162	86	<50% Grass cover, Poor, HSG C
277,162		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	550	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment E-4: E-4



Summary for Subcatchment E-5: E-5

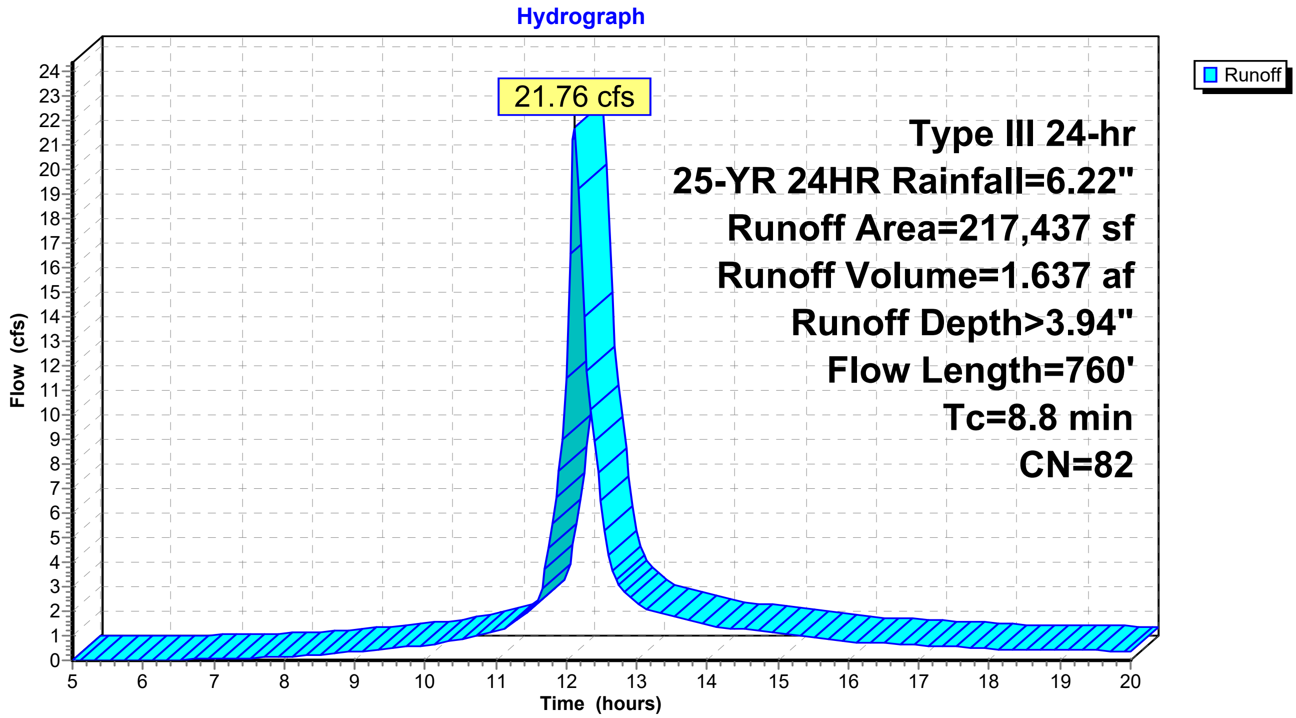
Runoff = 21.76 cfs @ 12.12 hrs, Volume= 1.637 af, Depth> 3.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
76,103	74	>75% Grass cover, Good, HSG C
141,334	86	<50% Grass cover, Poor, HSG C
217,437	82	Weighted Average
217,437		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	310	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.5	450	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
8.8	760	Total			

Subcatchment E-5: E-5



Summary for Subcatchment P-1: P-1

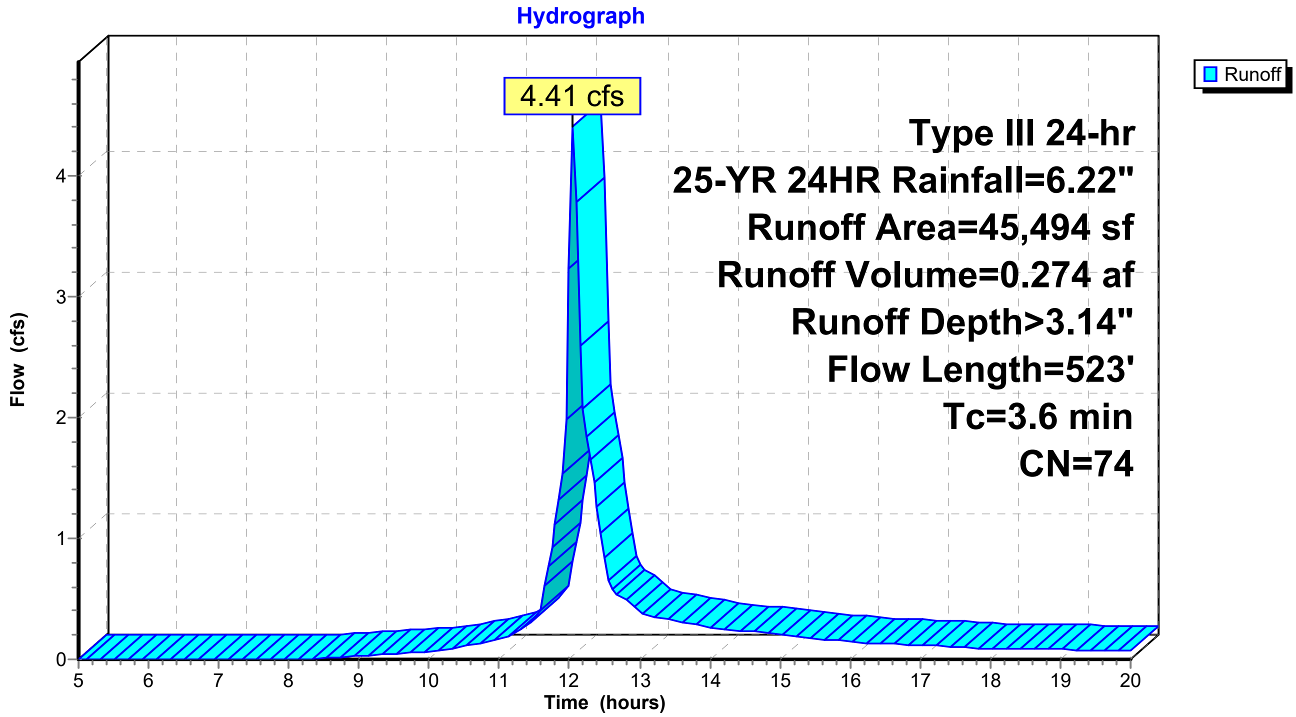
Runoff = 4.41 cfs @ 12.06 hrs, Volume= 0.274 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
45,494	74	>75% Grass cover, Good, HSG C
45,494		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	328	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.2	195	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.6	523	Total			

Subcatchment P-1: P-1



Summary for Subcatchment P-10: P-10

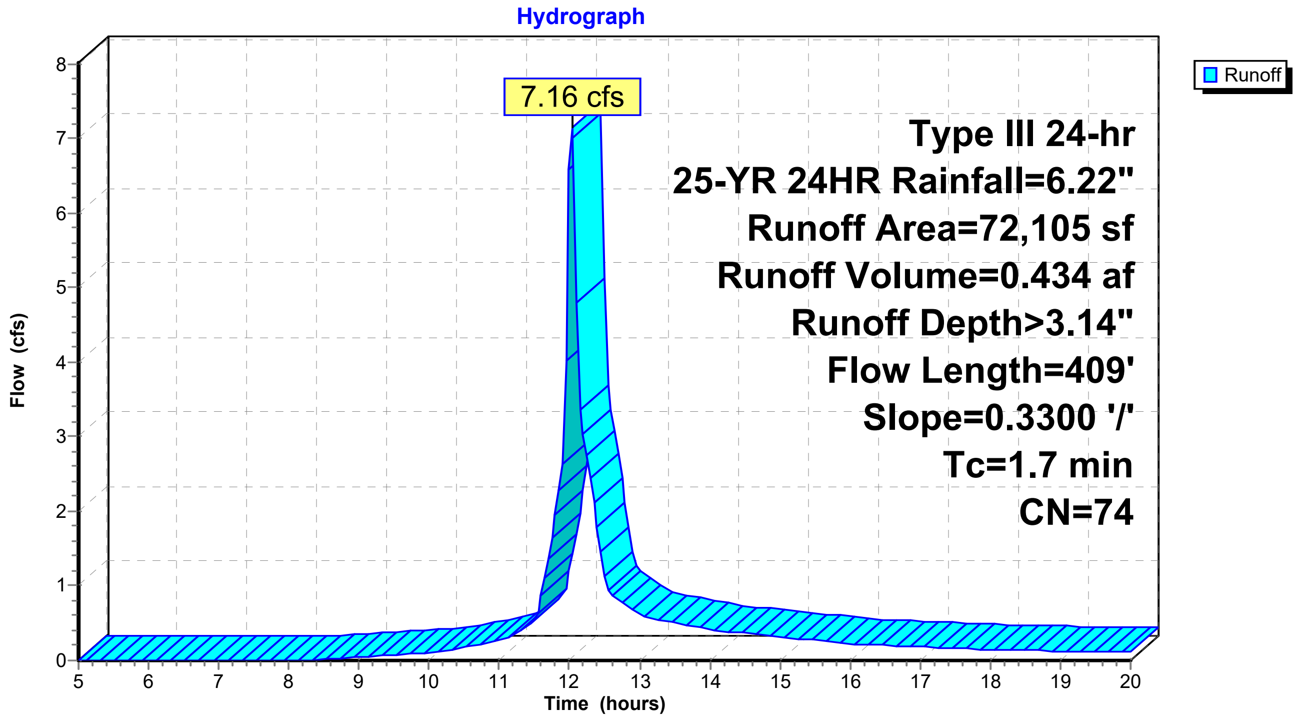
Runoff = 7.16 cfs @ 12.03 hrs, Volume= 0.434 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
72,105	74	>75% Grass cover, Good, HSG C
72,105		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	409	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-10: P-10



Summary for Subcatchment P-11: P-11

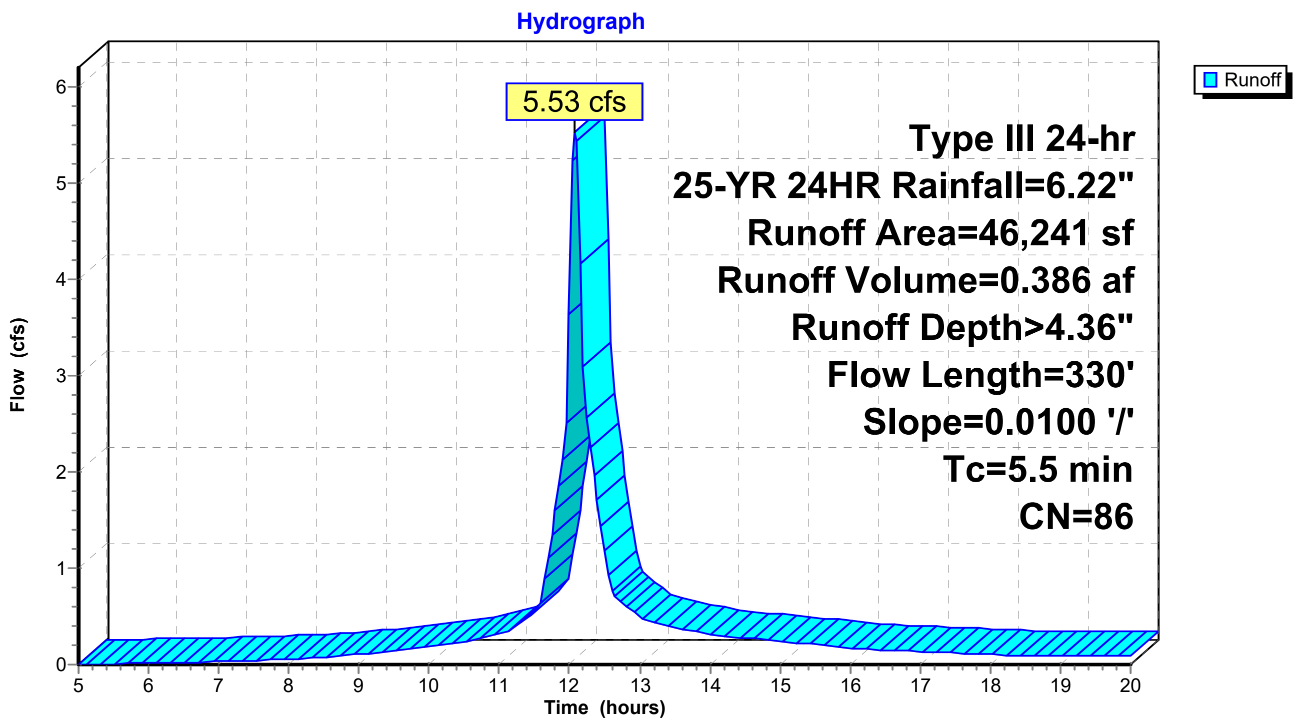
Runoff = 5.53 cfs @ 12.08 hrs, Volume= 0.386 af, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
46,241	86	<50% Grass cover, Poor, HSG C
46,241		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	330	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment P-11: P-11



Summary for Subcatchment P-2: P-2

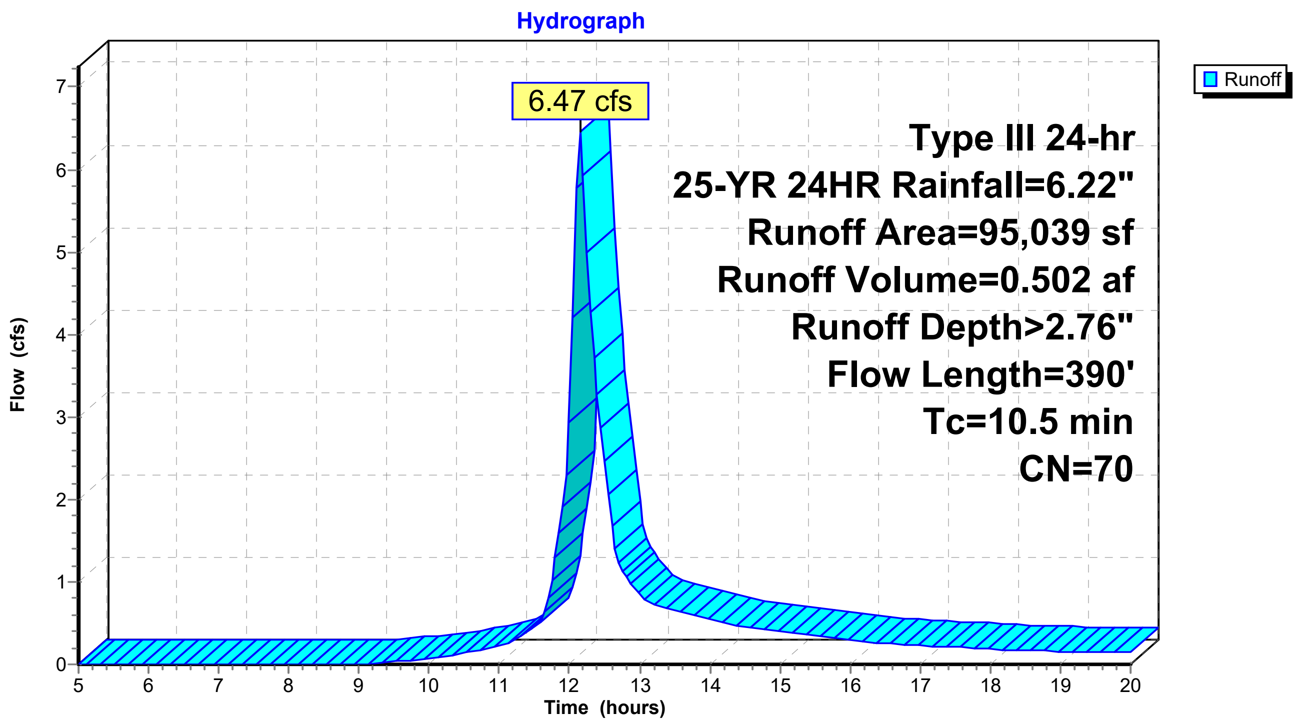
Runoff = 6.47 cfs @ 12.15 hrs, Volume= 0.502 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
95,039	70	Woods, Good, HSG C
95,039		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	110	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.3	280	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.5	390	Total			

Subcatchment P-2: P-2



Summary for Subcatchment P-3: P-3

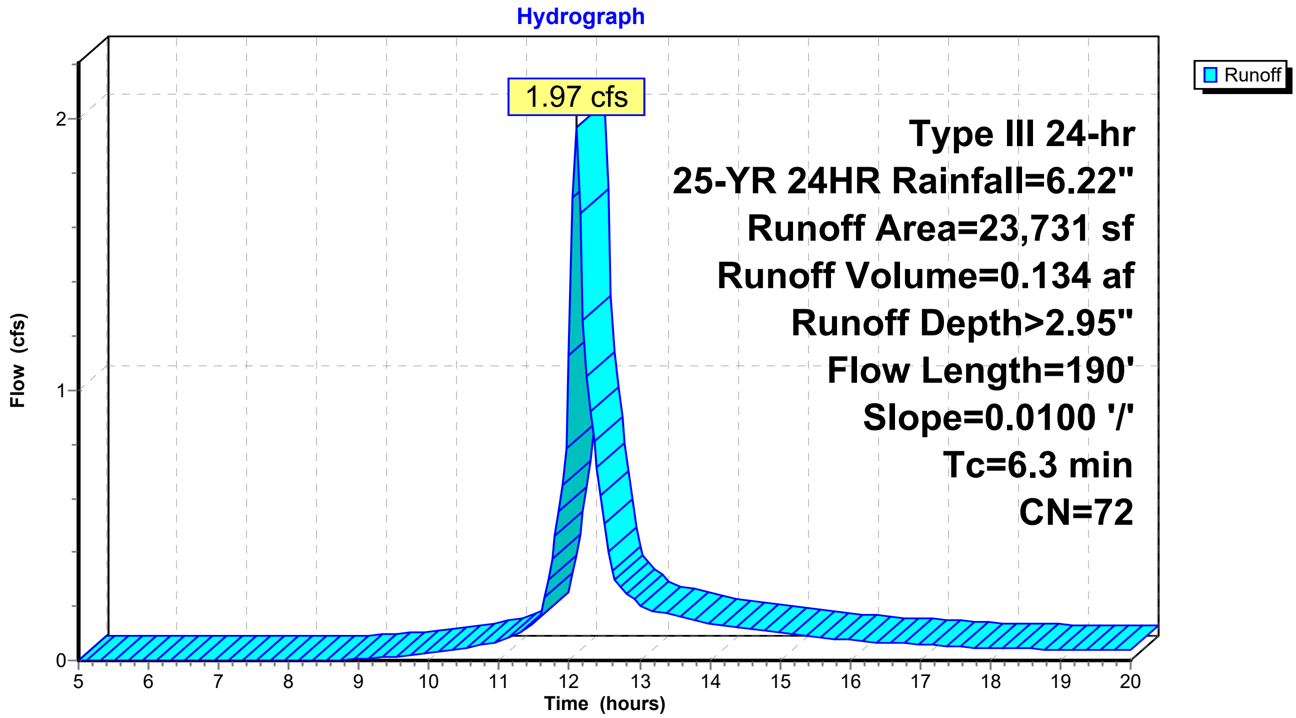
Runoff = 1.97 cfs @ 12.10 hrs, Volume= 0.134 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
23,731	72	Woods/grass comb., Good, HSG C
23,731		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	190	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment P-3: P-3



Summary for Subcatchment P-4: P-4

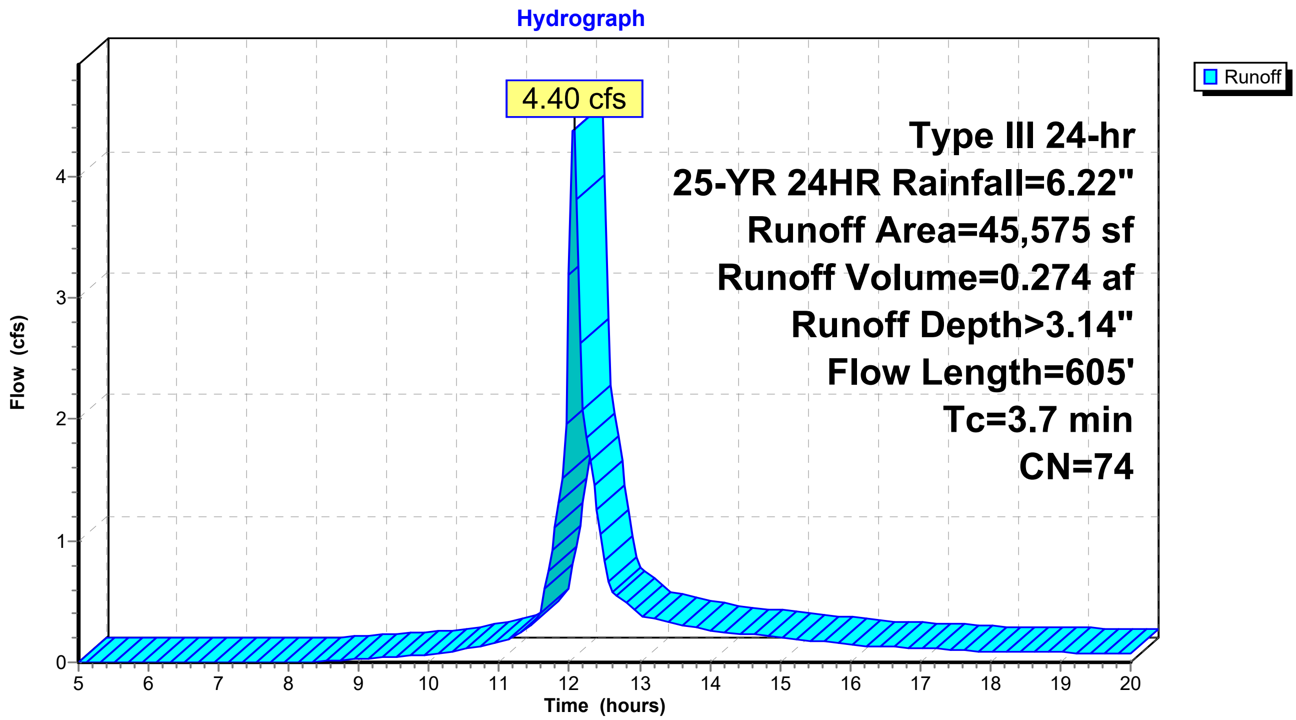
Runoff = 4.40 cfs @ 12.06 hrs, Volume= 0.274 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
45,575	74	>75% Grass cover, Good, HSG C
45,575		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	45	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.5	560	0.0100	2.70	10.78	**Trap/Vee/Rect Channel Flow, bench swale** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.040 Earth, cobble bottom, clean sides
3.7	605	Total			

Subcatchment P-4: P-4



Summary for Subcatchment P-5: P-5

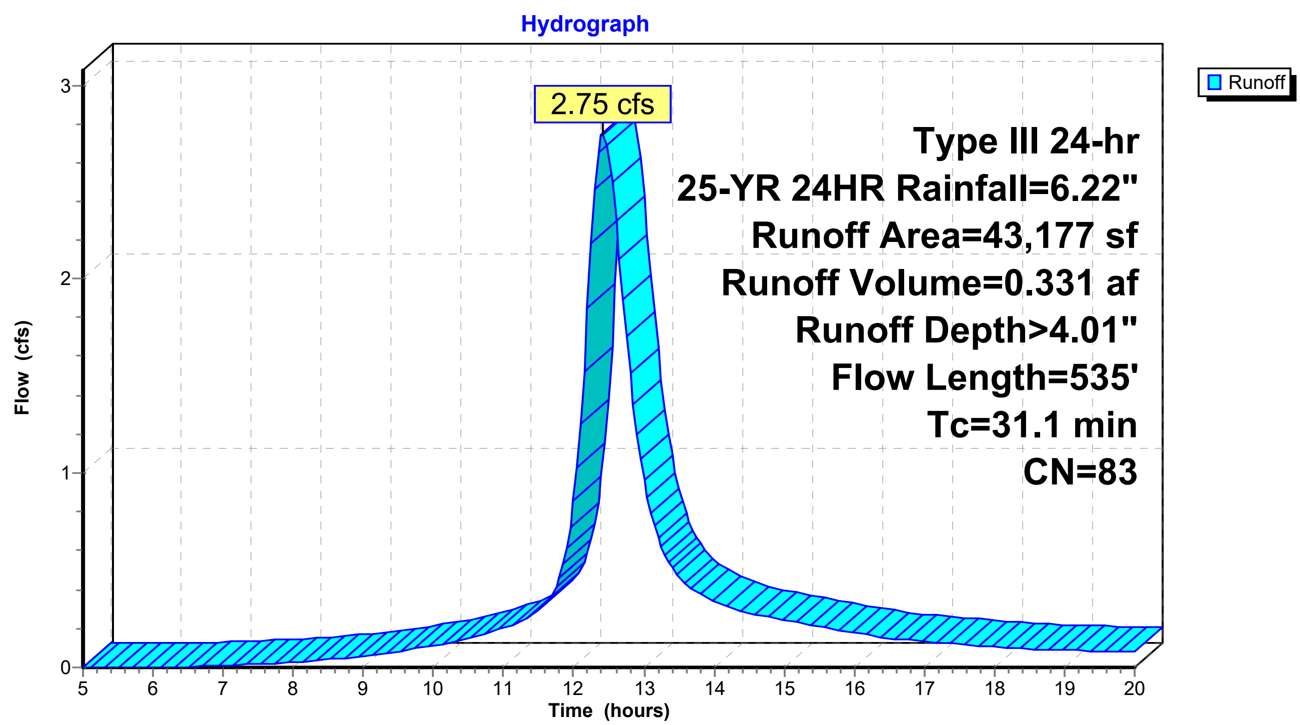
Runoff = 2.75 cfs @ 12.42 hrs, Volume= 0.331 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
22,177	79	50-75% Grass cover, Fair, HSG C
21,000	87	Dirt roads, HSG C
43,177	83	Weighted Average
43,177		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	35	0.3000	0.28		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
29.0	500	0.0030	0.29	4.60	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=2.00' Z= 3.0 '/' Top.W=14.00' n= 0.300
31.1	535	Total			

Subcatchment P-5: P-5



Summary for Subcatchment P-6: P-6

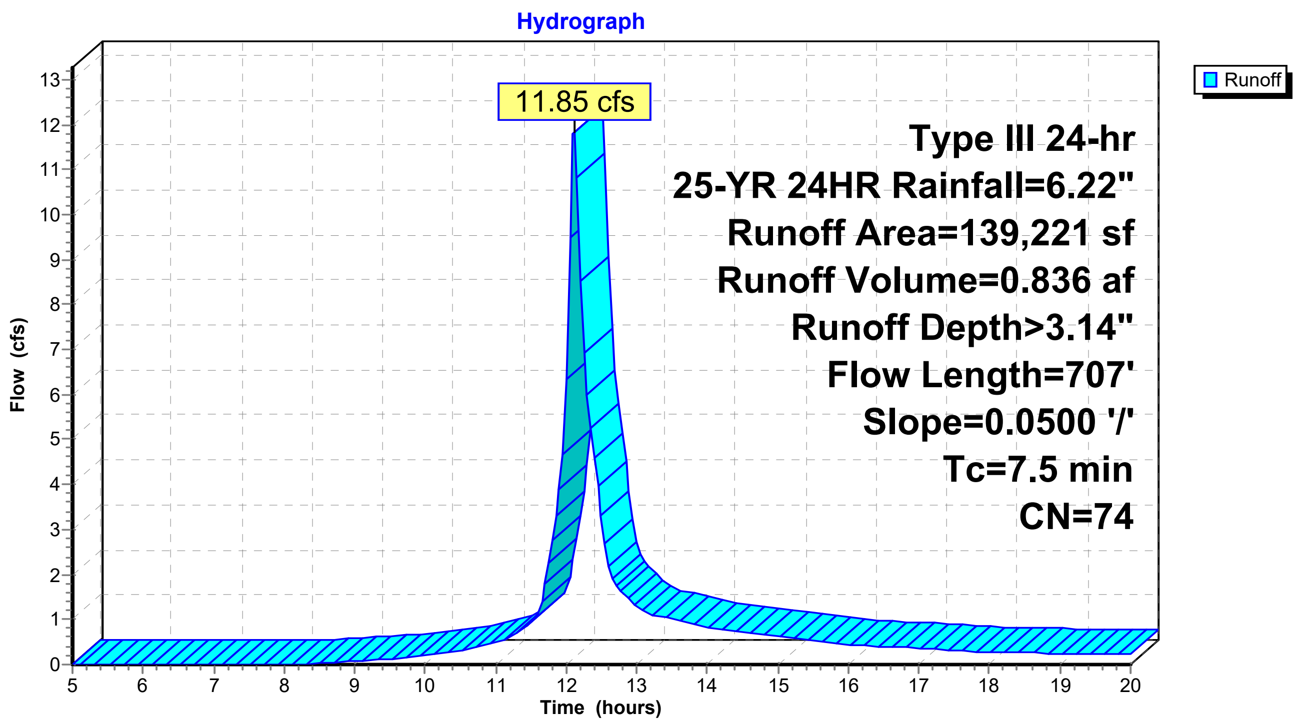
Runoff = 11.85 cfs @ 12.11 hrs, Volume= 0.836 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
139,221	74	>75% Grass cover, Good, HSG C
139,221		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	707	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-6: P-6



Summary for Subcatchment P-7: P-7

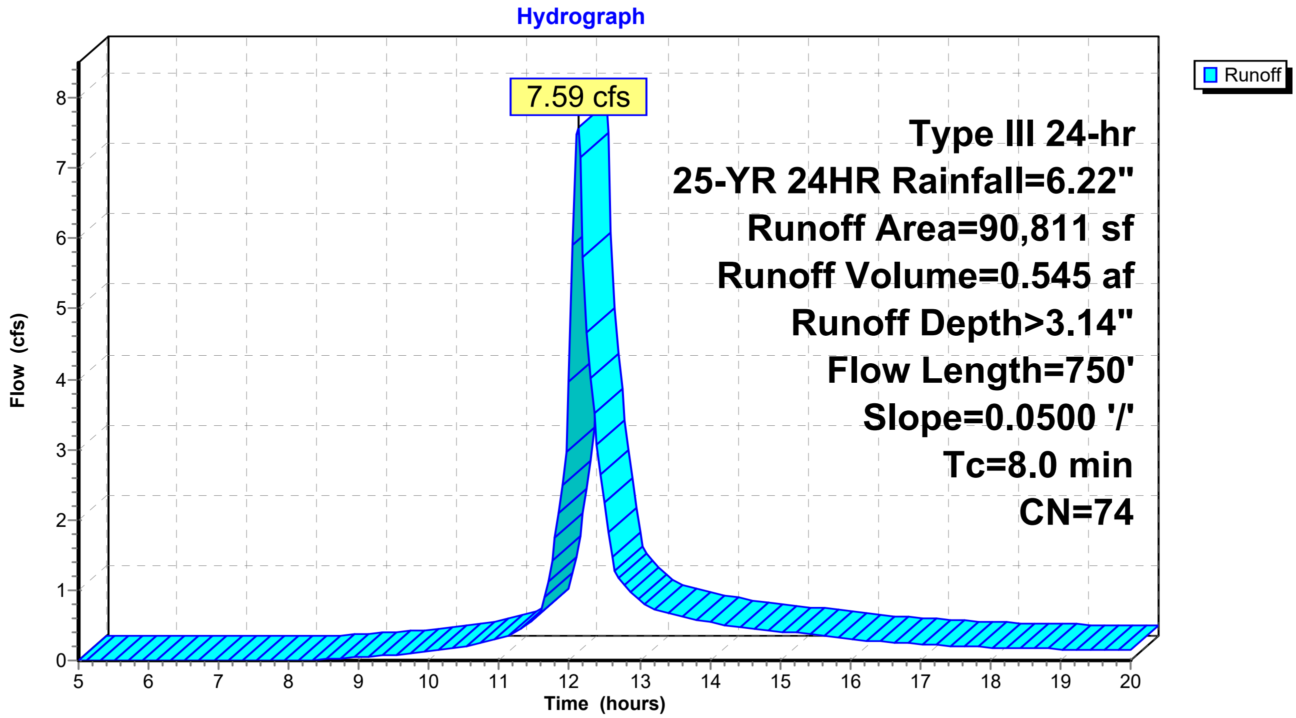
Runoff = 7.59 cfs @ 12.12 hrs, Volume= 0.545 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
90,811	74	>75% Grass cover, Good, HSG C
90,811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	750	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-7: P-7



Summary for Subcatchment P-8: P-8

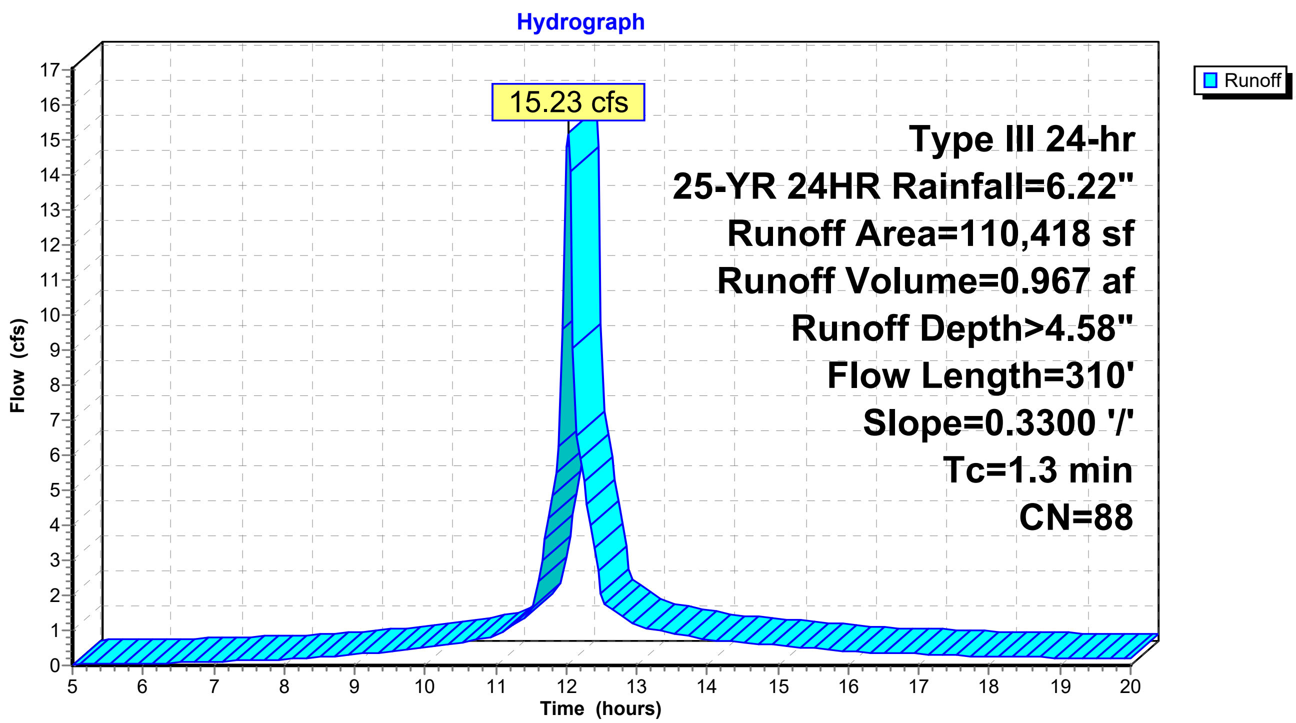
Runoff = 15.23 cfs @ 12.02 hrs, Volume= 0.967 af, Depth> 4.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"

Area (sf)	CN	Description
45,474	74	>75% Grass cover, Good, HSG C
9,735	96	Gravel surface, HSG C
55,209	98	Water Surface, HSG C
110,418	88	Weighted Average
55,209		50.00% Pervious Area
55,209		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	110	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	200		4.01		**Lake or Reservoir,** Mean Depth= 0.50'
1.3	310	Total			

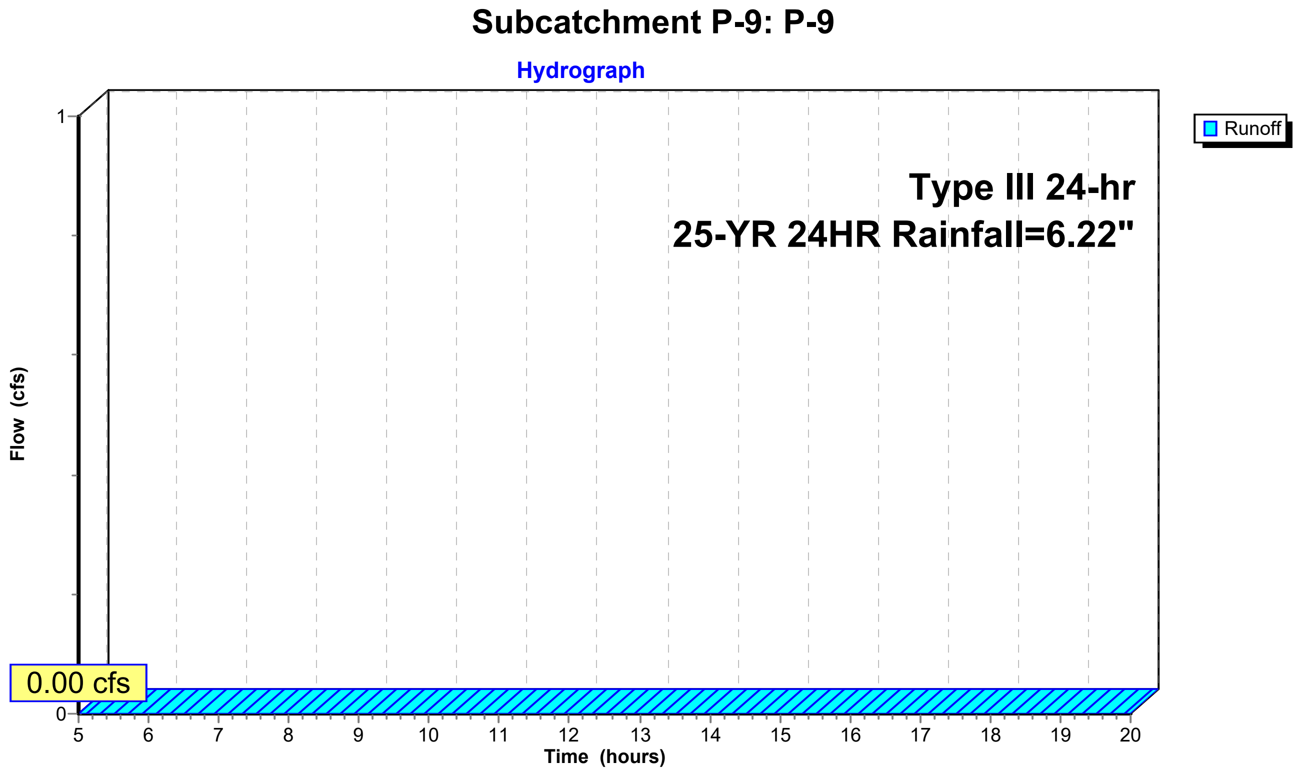
Subcatchment P-8: P-8



Summary for Subcatchment P-9: P-9

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR 24HR Rainfall=6.22"



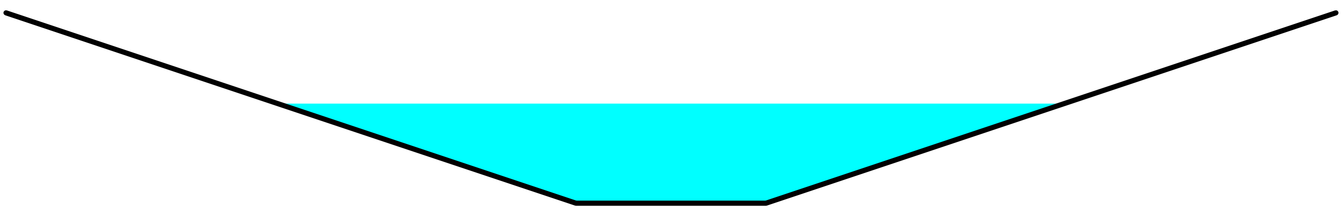
Summary for Reach Bench swale: Bench swale

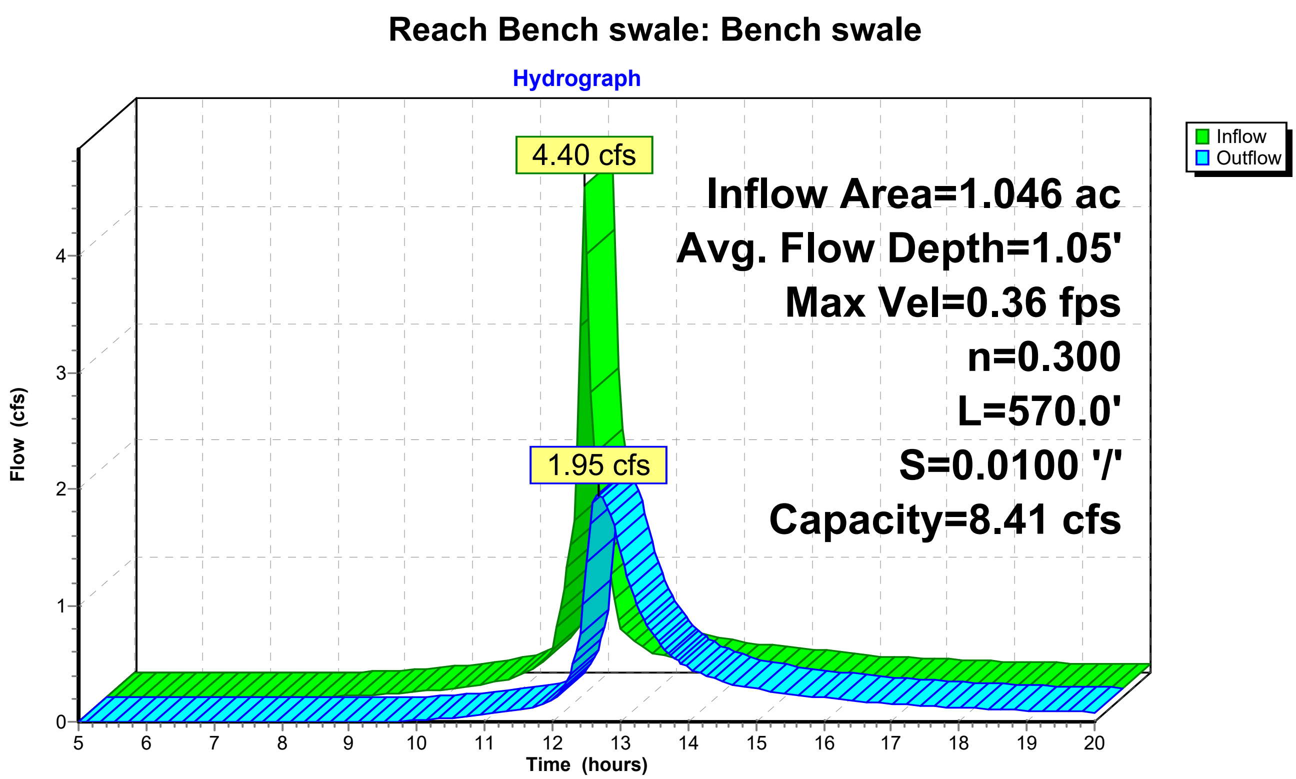
Inflow Area = 1.046 ac, 0.00% Impervious, Inflow Depth > 3.14" for 25-YR 24HR event
Inflow = 4.40 cfs @ 12.06 hrs, Volume= 0.274 af
Outflow = 1.95 cfs @ 12.67 hrs, Volume= 0.264 af, Atten= 56%, Lag= 36.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.36 fps, Min. Travel Time= 26.3 min
Avg. Velocity = 0.18 fps, Avg. Travel Time= 54.2 min

Peak Storage= 3,068 cf @ 12.23 hrs
Average Depth at Peak Storage= 1.05'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 8.41 cfs

2.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 570.0' Slope= 0.0100 '/'
Inlet Invert= 116.20', Outlet Invert= 110.50'





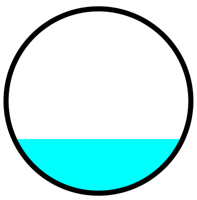
Summary for Reach Drop Pipe: Drop Pipe

Inflow Area = 5.281 ac, 0.00% Impervious, Inflow Depth > 3.09" for 25-YR 24HR event
Inflow = 13.10 cfs @ 12.42 hrs, Volume= 1.360 af
Outflow = 13.09 cfs @ 12.42 hrs, Volume= 1.360 af, Atten= 0%, Lag= 0.0 min

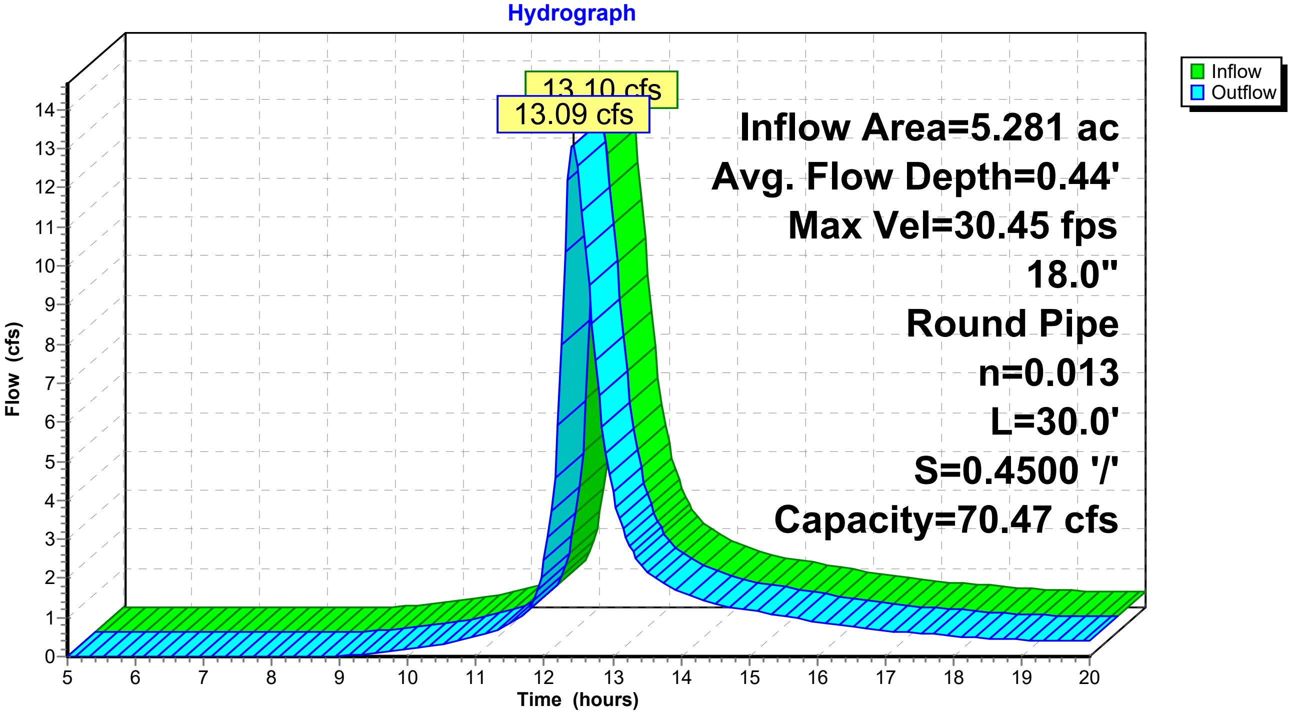
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 30.45 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 13.33 fps, Avg. Travel Time= 0.0 min

Peak Storage= 13 cf @ 12.42 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 70.47 cfs

18.0" Round Pipe
n= 0.013
Length= 30.0' Slope= 0.4500 '/'
Inlet Invert= 122.00', Outlet Invert= 108.50'



Reach Drop Pipe: Drop Pipe

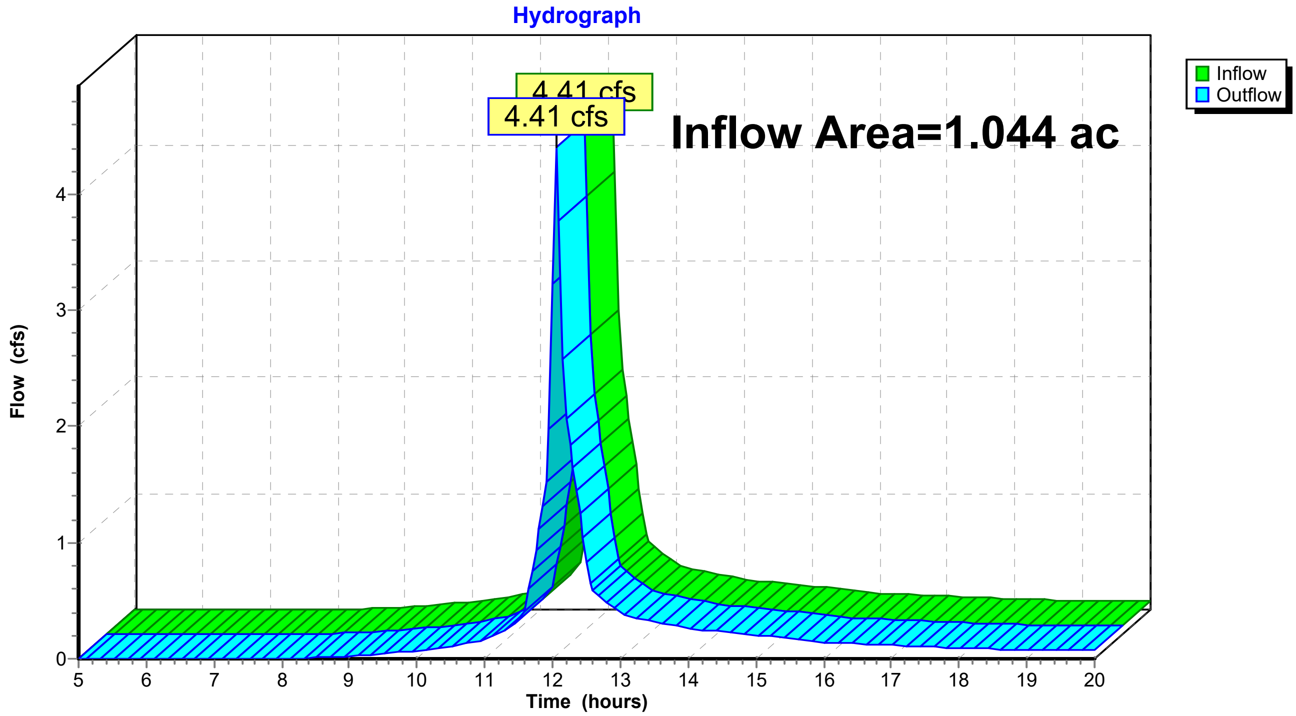


Summary for Reach REACH 1: Reach 1

Inflow Area = 1.044 ac, 0.00% Impervious, Inflow Depth > 3.14" for 25-YR 24HR event
Inflow = 4.41 cfs @ 12.06 hrs, Volume= 0.274 af
Outflow = 4.41 cfs @ 12.06 hrs, Volume= 0.274 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 1: Reach 1

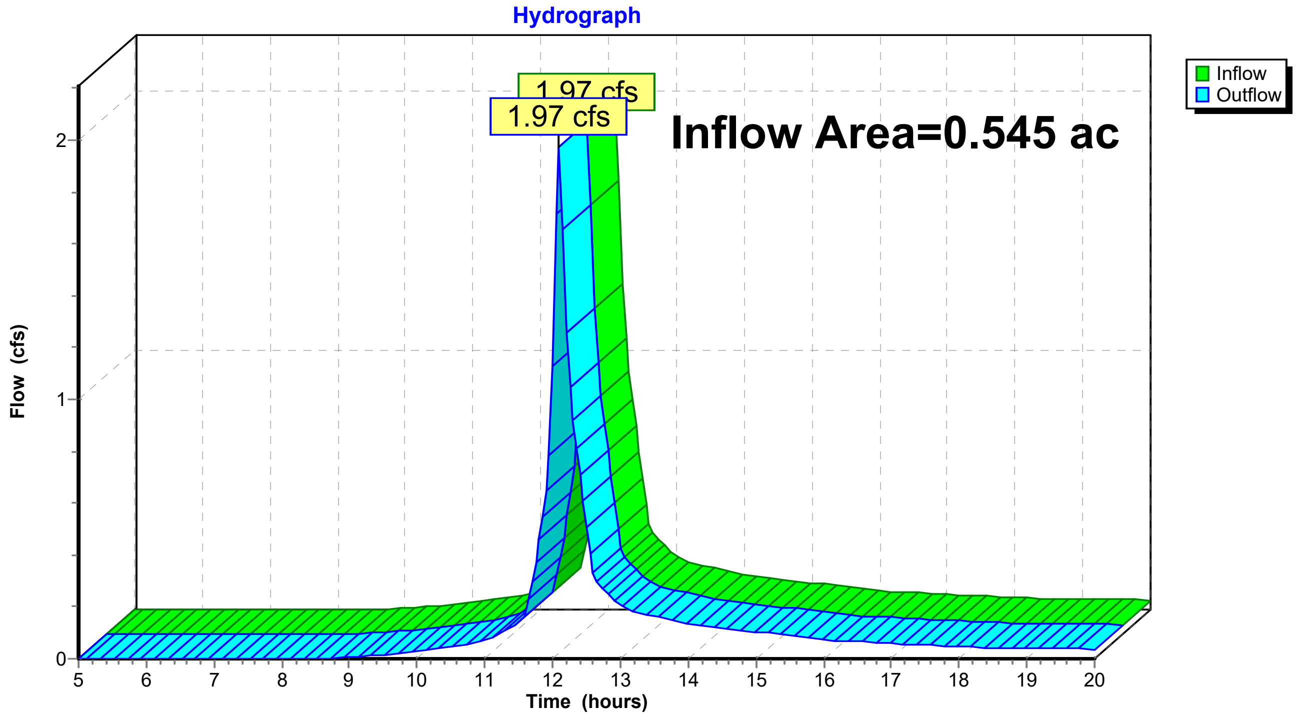


Summary for Reach REACH 3: Reach 3

Inflow Area = 0.545 ac, 0.00% Impervious, Inflow Depth > 2.95" for 25-YR 24HR event
Inflow = 1.97 cfs @ 12.10 hrs, Volume= 0.134 af
Outflow = 1.97 cfs @ 12.10 hrs, Volume= 0.134 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 3: Reach 3

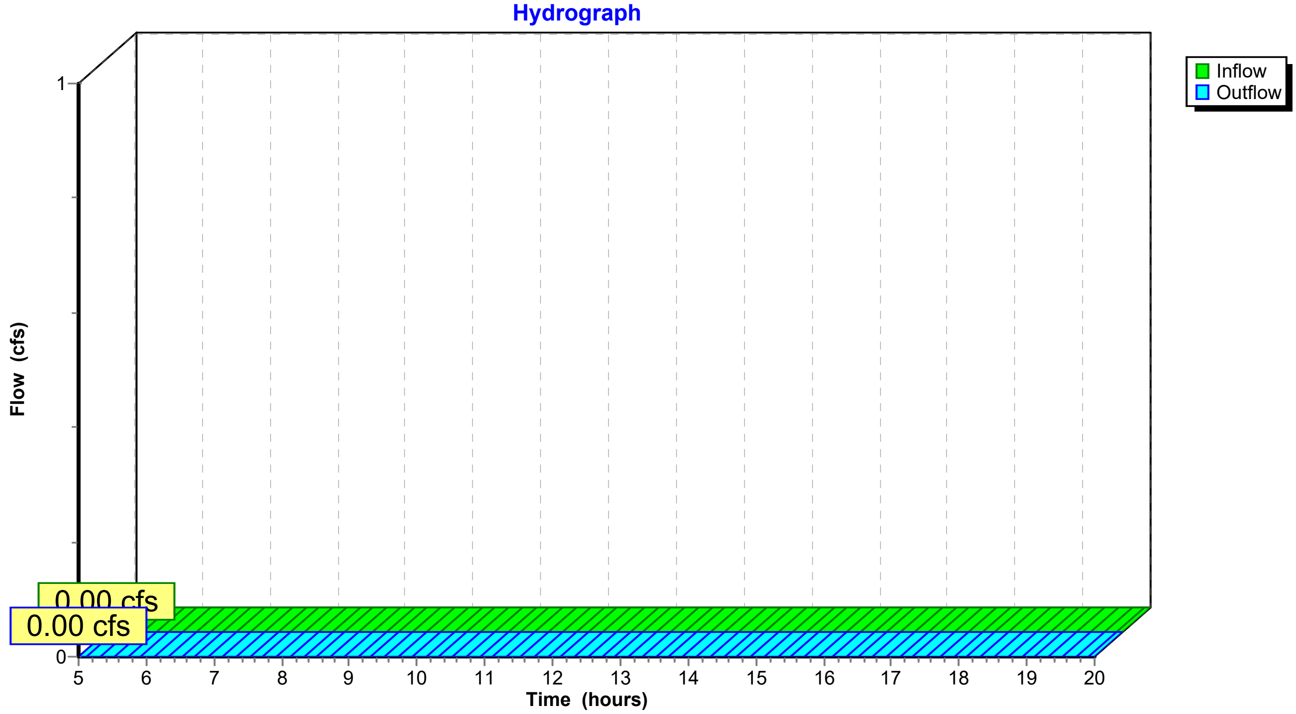


Summary for Reach REACH 4: Reach 4

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 4: Reach 4

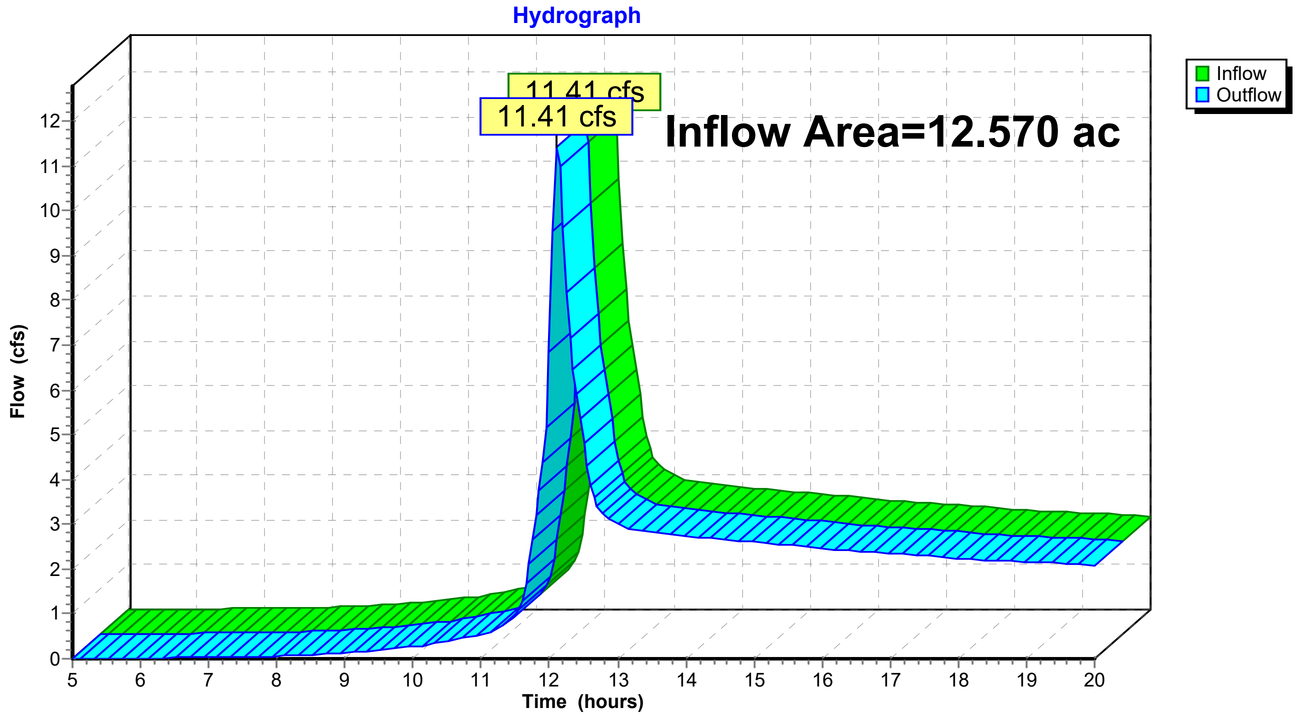


Summary for Reach REACH 5: Reach 5

Inflow Area =	12.570 ac,	10.08% Impervious,	Inflow Depth > 2.01"	for 25-YR 24HR event
Inflow =	11.41 cfs @	12.12 hrs, Volume=	2.101 af	
Outflow =	11.41 cfs @	12.12 hrs, Volume=	2.101 af, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

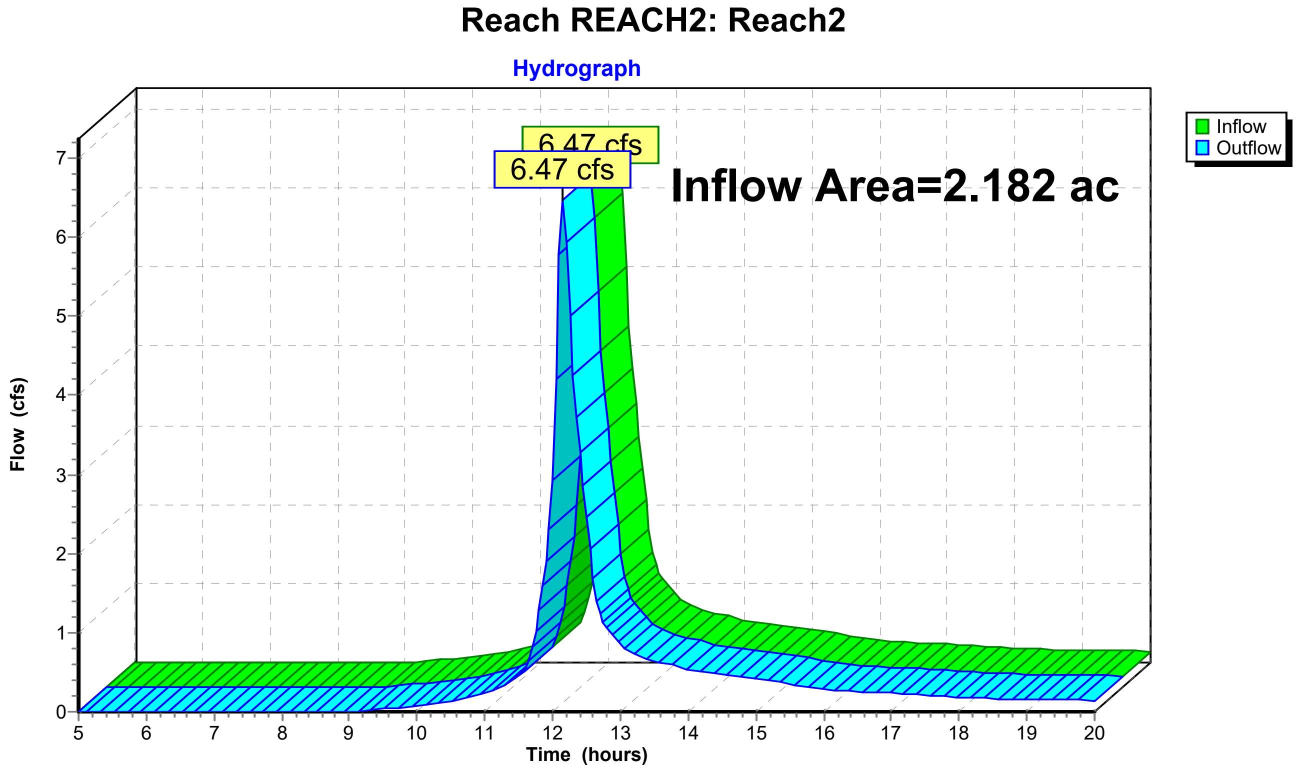
Reach REACH 5: Reach 5



Summary for Reach REACH2: Reach2

Inflow Area = 2.182 ac, 0.00% Impervious, Inflow Depth > 2.76" for 25-YR 24HR event
Inflow = 6.47 cfs @ 12.15 hrs, Volume= 0.502 af
Outflow = 6.47 cfs @ 12.15 hrs, Volume= 0.502 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



Summary for Reach Road Swale: Road Swale

Inflow Area = 2.037 ac, 0.00% Impervious, Inflow Depth > 3.51" for 25-YR 24HR event
Inflow = 4.22 cfs @ 12.57 hrs, Volume= 0.596 af
Outflow = 2.97 cfs @ 13.42 hrs, Volume= 0.569 af, Atten= 30%, Lag= 50.8 min

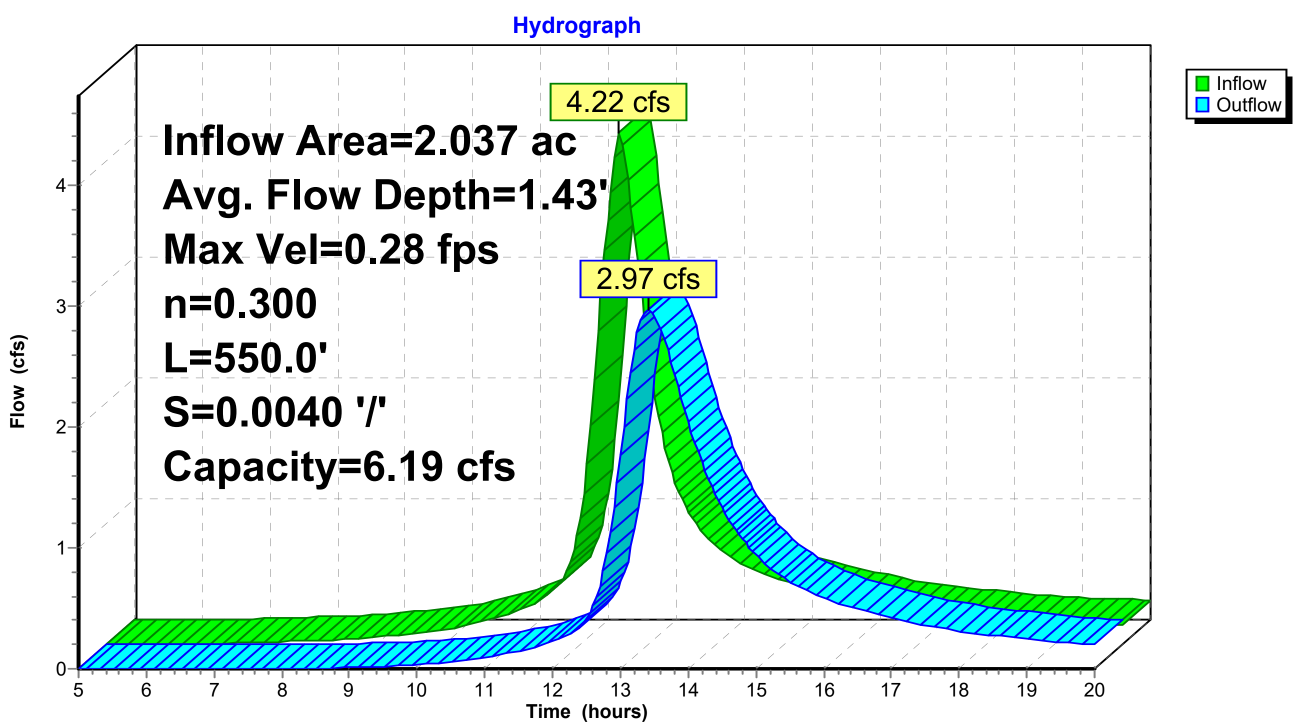
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.28 fps, Min. Travel Time= 32.2 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 67.3 min

Peak Storage= 5,747 cf @ 12.88 hrs
Average Depth at Peak Storage= 1.43'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 6.19 cfs

3.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 550.0' Slope= 0.0040 '/'
Inlet Invert= 110.50', Outlet Invert= 108.30'

‡

Reach Road Swale: Road Swale



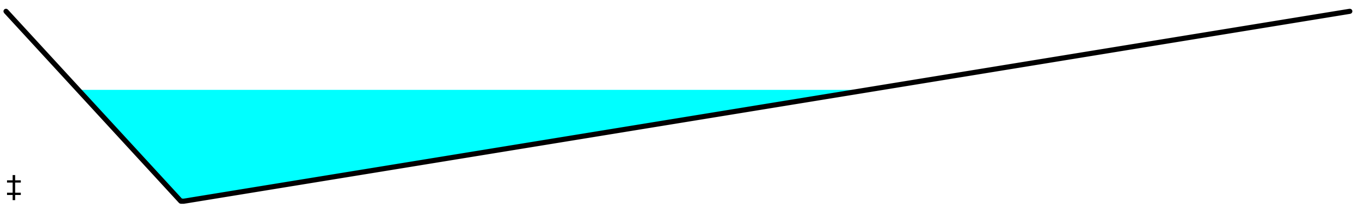
Summary for Reach So. Plateau Swale: So. Plateau Swale

Inflow Area = 3.196 ac, 0.00% Impervious, Inflow Depth > 3.14" for 25-YR 24HR event
Inflow = 11.85 cfs @ 12.11 hrs, Volume= 0.836 af
Outflow = 8.44 cfs @ 12.38 hrs, Volume= 0.825 af, Atten= 29%, Lag= 16.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.54 fps, Min. Travel Time= 10.2 min
Avg. Velocity = 0.26 fps, Avg. Travel Time= 21.5 min

Peak Storage= 5,253 cf @ 12.21 hrs
Average Depth at Peak Storage= 1.17'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 35.49 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 20.0 '/' Top Width= 46.10'
Length= 330.0' Slope= 0.0242 '/'
Inlet Invert= 130.00', Outlet Invert= 122.00'



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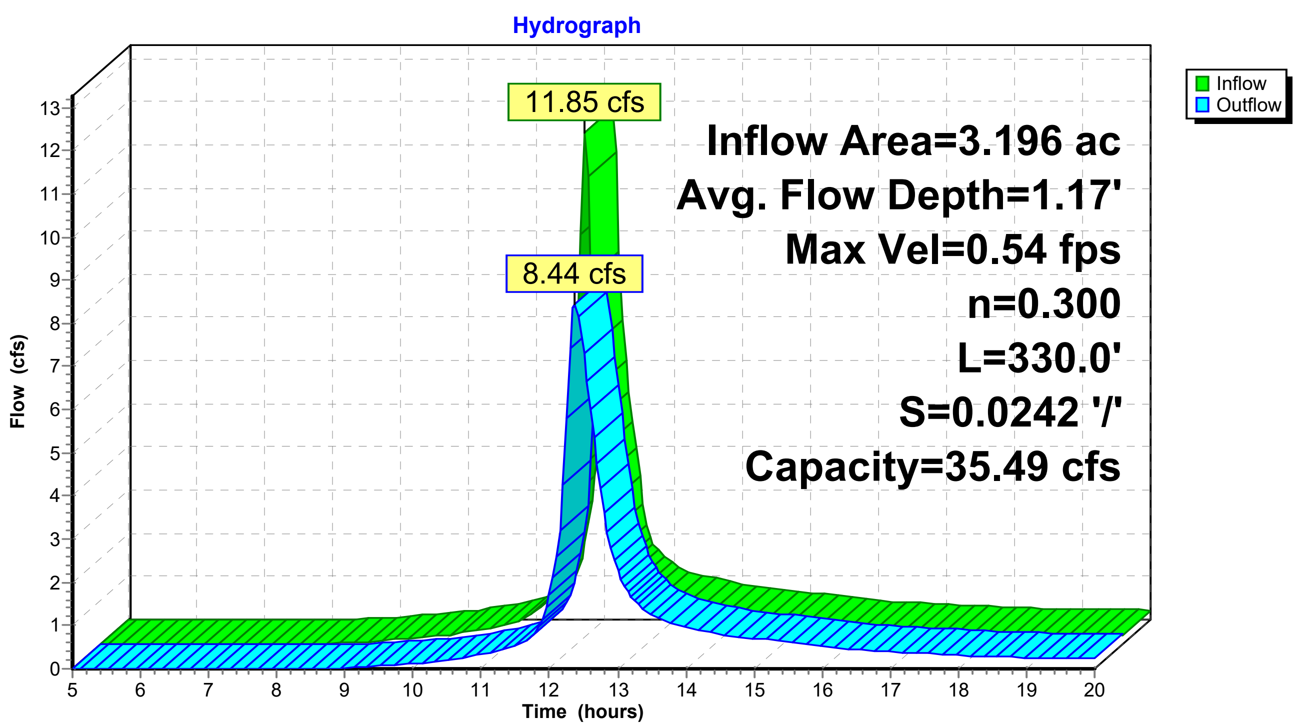
Reach So. Plateau Swale: So. Plateau Swale



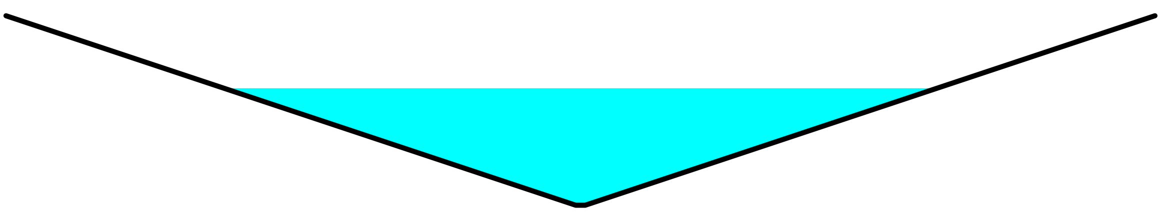
Summary for Reach Stone swale: stone swale

Inflow Area = 1.655 ac, 0.00% Impervious, Inflow Depth > 3.14" for 25-YR 24HR event
Inflow = 7.16 cfs @ 12.03 hrs, Volume= 0.434 af
Outflow = 5.76 cfs @ 12.16 hrs, Volume= 0.431 af, Atten= 20%, Lag= 7.7 min

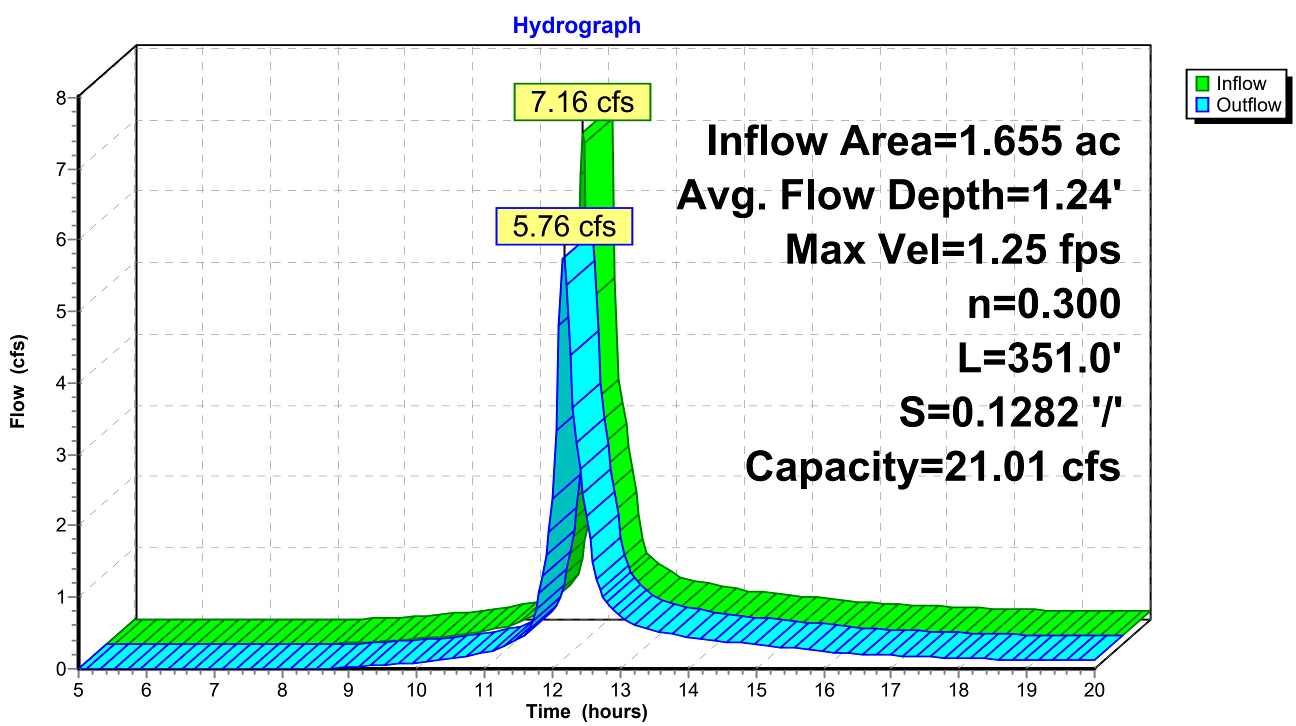
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.25 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 10.5 min

Peak Storage= 1,651 cf @ 12.08 hrs
Average Depth at Peak Storage= 1.24'
Bank-Full Depth= 2.00' Flow Area= 12.2 sf, Capacity= 21.01 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 12.10'
Length= 351.0' Slope= 0.1282 '/'
Inlet Invert= 155.00', Outlet Invert= 110.00'



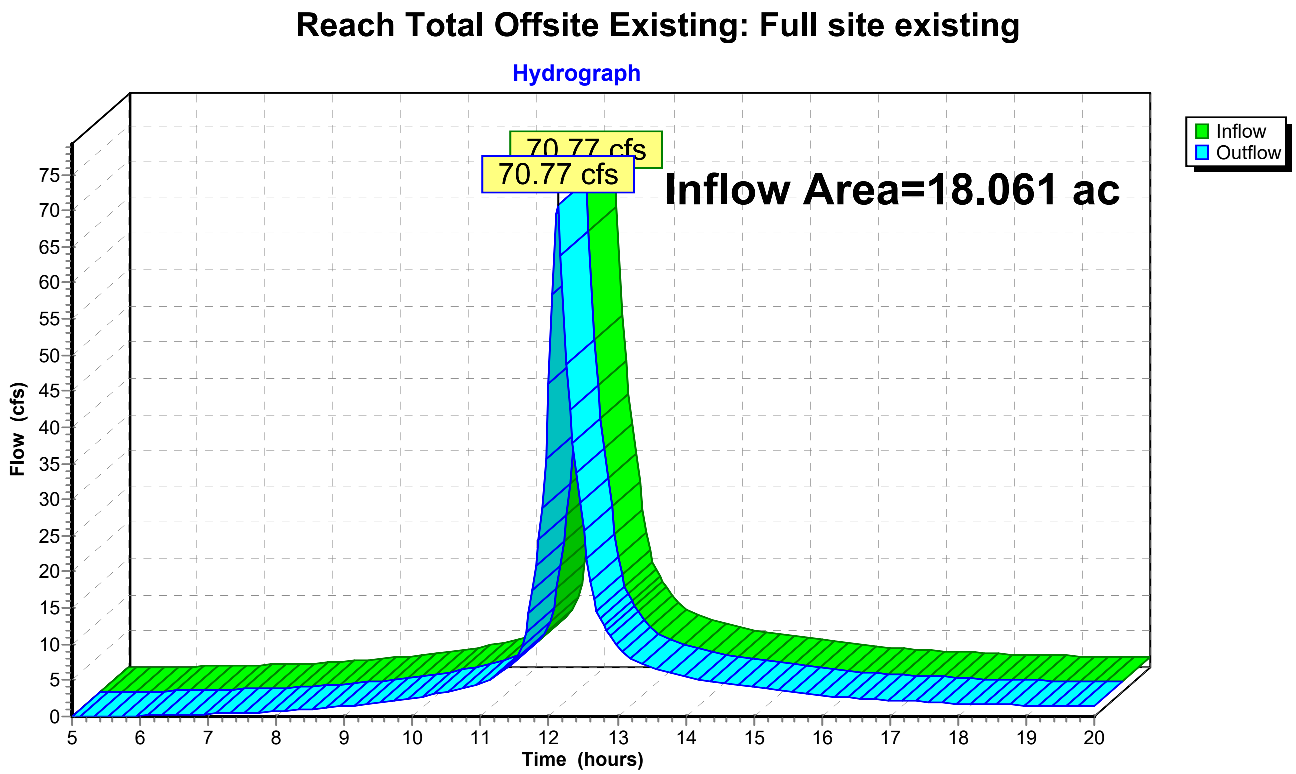
Reach Stone swale: stone swale



Summary for Reach Total Offsite Existing: Full site existing

Inflow Area = 18.061 ac, 0.00% Impervious, Inflow Depth > 4.10" for 25-YR 24HR event
Inflow = 70.77 cfs @ 12.12 hrs, Volume= 6.176 af
Outflow = 70.77 cfs @ 12.12 hrs, Volume= 6.176 af, Atten= 0%, Lag= 0.0 min

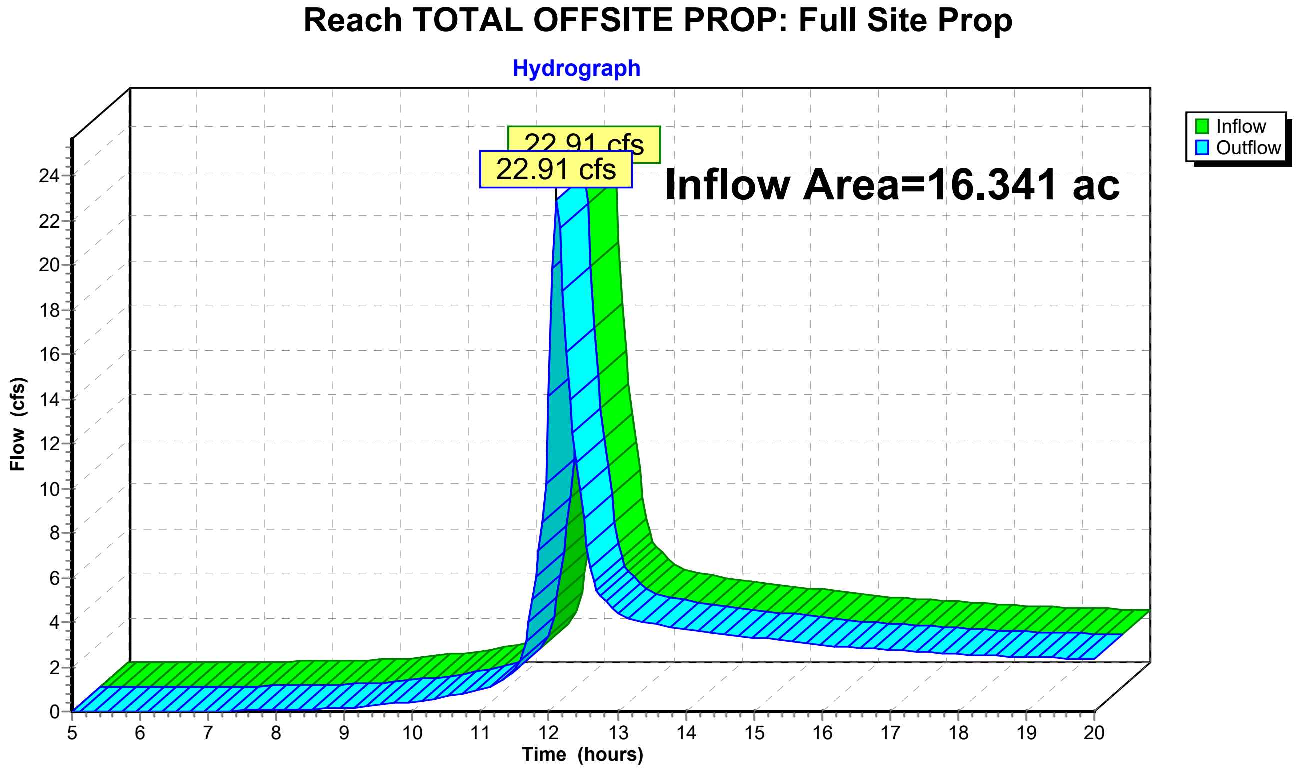
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



Summary for Reach TOTAL OFFSITE PROP: Full Site Prop

Inflow Area = 16.341 ac, 7.76% Impervious, Inflow Depth > 2.21" for 25-YR 24HR event
Inflow = 22.91 cfs @ 12.11 hrs, Volume= 3.010 af
Outflow = 22.91 cfs @ 12.11 hrs, Volume= 3.010 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



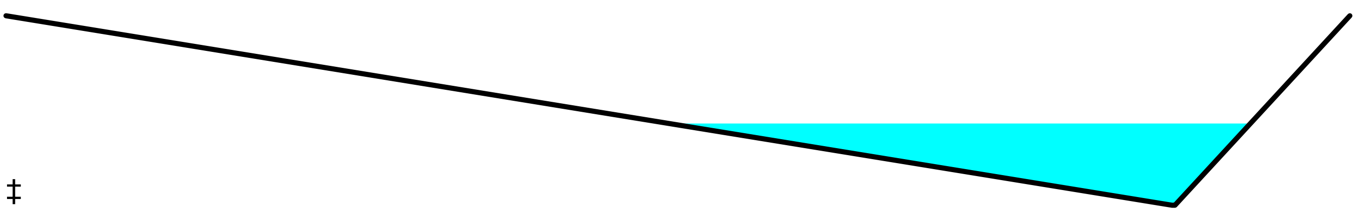
Summary for Reach West Plateau Swale: West Plateau Swale

Inflow Area = 2.085 ac, 0.00% Impervious, Inflow Depth > 3.14" for 25-YR 24HR event
Inflow = 7.59 cfs @ 12.12 hrs, Volume= 0.545 af
Outflow = 4.99 cfs @ 12.47 hrs, Volume= 0.535 af, Atten= 34%, Lag= 21.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.58 fps, Min. Travel Time= 13.8 min
Avg. Velocity = 0.28 fps, Avg. Travel Time= 28.1 min

Peak Storage= 4,130 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.86'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 46.67 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 20.0 3.0 '/' Top Width= 46.10'
Length= 477.0' Slope= 0.0419 '/'
Inlet Invert= 142.00', Outlet Invert= 122.00'



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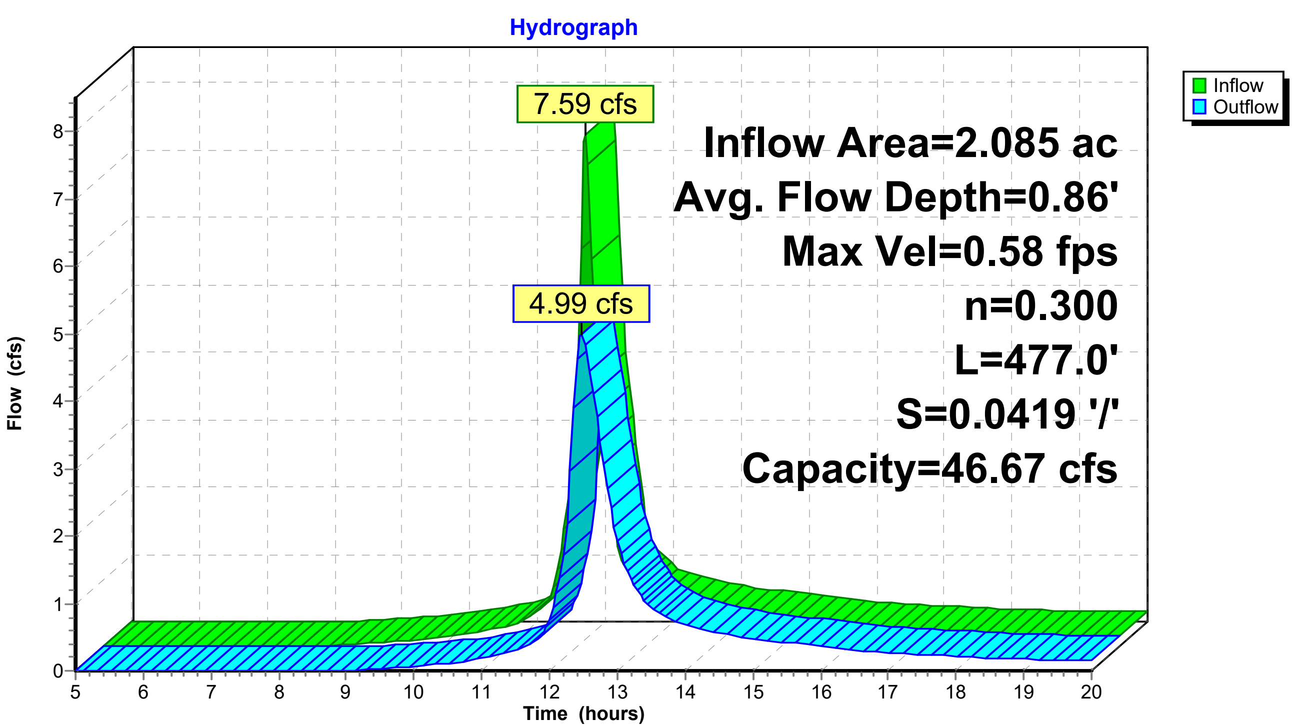
Reach West Plateau Swale: West Plateau Swale



Summary for Pond 3P: Detention Basin

Inflow Area = 9.853 ac, 12.86% Impervious, Inflow Depth > 3.53" for 25-YR 24HR event
Inflow = 18.17 cfs @ 12.02 hrs, Volume= 2.896 af
Outflow = 2.04 cfs @ 15.76 hrs, Volume= 1.284 af, Atten= 89%, Lag= 224.4 min
Primary = 2.04 cfs @ 15.76 hrs, Volume= 1.284 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 109.97' @ 15.76 hrs Surf.Area= 57,597 sf Storage= 82,085 cf

Plug-Flow detention time= 256.9 min calculated for 1.280 af (44% of inflow)
Center-of-Mass det. time= 157.5 min (965.0 - 807.4)

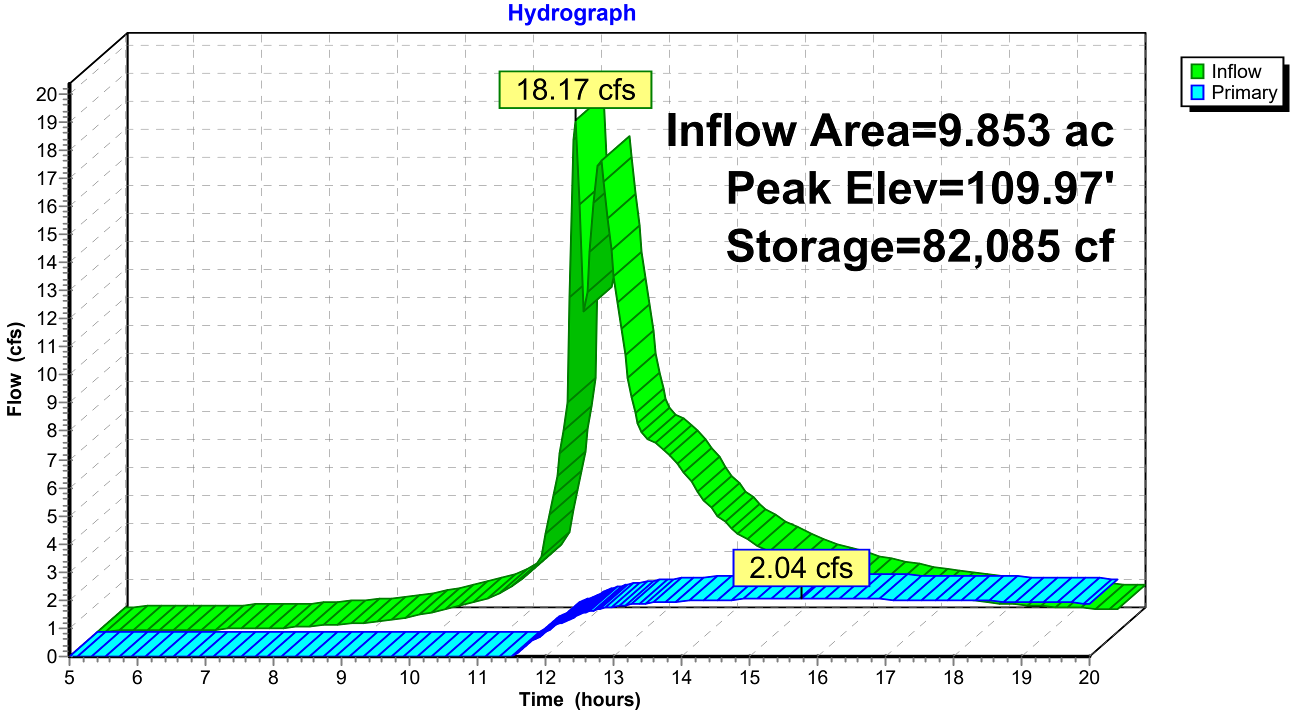
Volume	Invert	Avail.Storage	Storage Description
#1	108.20'	204,236 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
108.20	30,000	0	0
108.50	42,000	10,800	10,800
109.00	44,377	21,594	32,394
110.00	57,942	51,160	83,554
112.00	62,740	120,682	204,236

Device	Routing	Invert	Outlet Devices
#1	Primary	108.50'	**2.0" Horiz. Orifice/Grate X 4.00 columns** X 4 rows C= 0.600 Limited to weir flow at low heads
#2	Primary	110.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.04 cfs @ 15.76 hrs HW=109.97' (Free Discharge)
1=Orifice/Grate (Orifice Controls 2.04 cfs @ 5.85 fps)
2=Orifice/Grate (Controls 0.00 cfs)

Pond 3P: Detention Basin



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: E-1 Runoff Area=114,240 sf 0.00% Impervious Runoff Depth>6.94"
Flow Length=630' Tc=8.6 min CN=86 Runoff=19.42 cfs 1.516 af

Subcatchment E-2: E-2 Runoff Area=98,290 sf 0.00% Impervious Runoff Depth>6.06"
Flow Length=488' Slope=0.0100 '/' Tc=32.5 min CN=79 Runoff=9.21 cfs 1.140 af

Subcatchment E-3: E-3 Runoff Area=79,629 sf 0.00% Impervious Runoff Depth>6.48"
Tc=0.0 min CN=82 Runoff=16.33 cfs 0.987 af

Subcatchment E-4: E-4 Runoff Area=277,162 sf 0.00% Impervious Runoff Depth>6.94"
Flow Length=550' Slope=0.0100 '/' Tc=9.2 min CN=86 Runoff=45.93 cfs 3.677 af

Subcatchment E-5: E-5 Runoff Area=217,437 sf 0.00% Impervious Runoff Depth>6.47"
Flow Length=760' Tc=8.8 min CN=82 Runoff=34.91 cfs 2.690 af

Subcatchment P-1: P-1 Runoff Area=45,494 sf 0.00% Impervious Runoff Depth>5.51"
Flow Length=523' Tc=3.6 min CN=74 Runoff=7.61 cfs 0.479 af

Subcatchment P-10: P-10 Runoff Area=72,105 sf 0.00% Impervious Runoff Depth>5.51"
Flow Length=409' Slope=0.3300 '/' Tc=1.7 min CN=74 Runoff=12.33 cfs 0.760 af

Subcatchment P-11: P-11 Runoff Area=46,241 sf 0.00% Impervious Runoff Depth>6.94"
Flow Length=330' Slope=0.0100 '/' Tc=5.5 min CN=86 Runoff=8.58 cfs 0.614 af

Subcatchment P-2: P-2 Runoff Area=95,039 sf 0.00% Impervious Runoff Depth>5.01"
Flow Length=390' Tc=10.5 min CN=70 Runoff=11.70 cfs 0.912 af

Subcatchment P-3: P-3 Runoff Area=23,731 sf 0.00% Impervious Runoff Depth>5.26"
Flow Length=190' Slope=0.0100 '/' Tc=6.3 min CN=72 Runoff=3.48 cfs 0.239 af

Subcatchment P-4: P-4 Runoff Area=45,575 sf 0.00% Impervious Runoff Depth>5.51"
Flow Length=605' Tc=3.7 min CN=74 Runoff=7.60 cfs 0.480 af

Subcatchment P-5: P-5 Runoff Area=43,177 sf 0.00% Impervious Runoff Depth>6.55"
Flow Length=535' Tc=31.1 min CN=83 Runoff=4.38 cfs 0.541 af

Subcatchment P-6: P-6 Runoff Area=139,221 sf 0.00% Impervious Runoff Depth>5.50"
Flow Length=707' Slope=0.0500 '/' Tc=7.5 min CN=74 Runoff=20.49 cfs 1.465 af

Subcatchment P-7: P-7 Runoff Area=90,811 sf 0.00% Impervious Runoff Depth>5.50"
Flow Length=750' Slope=0.0500 '/' Tc=8.0 min CN=74 Runoff=13.14 cfs 0.956 af

Subcatchment P-8: P-8 Runoff Area=110,418 sf 50.00% Impervious Runoff Depth>7.17"
Flow Length=310' Slope=0.3300 '/' Tc=1.3 min CN=88 Runoff=23.30 cfs 1.515 af

Subcatchment P-9: P-9
Runoff=0.00 cfs 0.000 af

Reach Bench swale: Bench swale Avg. Flow Depth=1.40' Max Vel=0.43 fps Inflow=7.60 cfs 0.480 af
n=0.300 L=570.0' S=0.0100 '/' Capacity=8.41 cfs Outflow=3.70 cfs 0.467 af

Reach Drop Pipe: Drop Pipe Avg. Flow Depth=0.61' Max Vel=36.08 fps Inflow=24.16 cfs 2.392 af
18.0" Round Pipe n=0.013 L=30.0' S=0.4500 '/' Capacity=70.47 cfs Outflow=24.15 cfs 2.392 af

Reach REACH 1: Reach 1 Inflow=7.61 cfs 0.479 af
Outflow=7.61 cfs 0.479 af

Reach REACH 3: Reach 3 Inflow=3.48 cfs 0.239 af
Outflow=3.48 cfs 0.239 af

Reach REACH 4: Reach 4 Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach REACH 5: Reach 5 Inflow=19.46 cfs 3.770 af
Outflow=19.46 cfs 3.770 af

Reach REACH2: Reach2 Inflow=11.70 cfs 0.912 af
Outflow=11.70 cfs 0.912 af

Reach Road Swale: Road Swale Avg. Flow Depth=1.90' Max Vel=0.33 fps Inflow=7.73 cfs 1.008 af
n=0.300 L=550.0' S=0.0040 '/' Capacity=6.19 cfs Outflow=5.52 cfs 0.974 af

Reach So. Plateau Swale: So. Plateau Avg. Flow Depth=1.47' Max Vel=0.62 fps Inflow=20.49 cfs 1.465 af
n=0.300 L=330.0' S=0.0242 '/' Capacity=35.49 cfs Outflow=15.50 cfs 1.450 af

Reach Stone swale: stone swale Avg. Flow Depth=1.54' Max Vel=1.44 fps Inflow=12.33 cfs 0.760 af
n=0.300 L=351.0' S=0.1282 '/' Capacity=21.01 cfs Outflow=10.22 cfs 0.757 af

Reach Total Offsite Existing: Full site existing Inflow=111.61 cfs 10.010 af
Outflow=111.61 cfs 10.010 af

Reach TOTAL OFFSITE PROP: Full Site Prop Inflow=39.97 cfs 5.400 af
Outflow=39.97 cfs 5.400 af

Reach West Plateau Swale: West Avg. Flow Depth=1.09' Max Vel=0.67 fps Inflow=13.14 cfs 0.956 af
n=0.300 L=477.0' S=0.0419 '/' Capacity=46.67 cfs Outflow=9.23 cfs 0.942 af

Pond 3P: Detention Basin Peak Elev=110.79' Storage=130,370 cf Inflow=30.78 cfs 4.881 af
Outflow=5.84 cfs 2.399 af

Total Runoff Area = 34.402 ac Runoff Volume = 17.972 af Average Runoff Depth = 6.27"
96.32% Pervious = 33.135 ac 3.68% Impervious = 1.267 ac

Summary for Subcatchment E-1: E-1

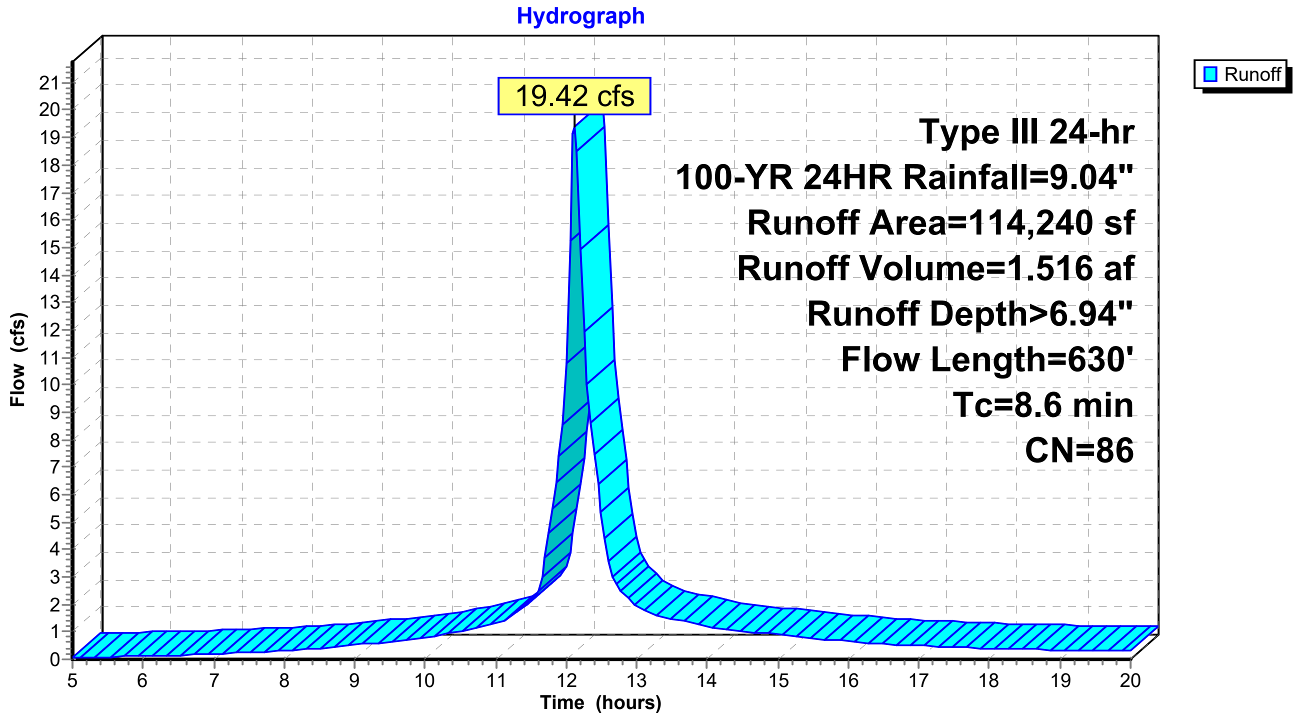
Runoff = 19.42 cfs @ 12.12 hrs, Volume= 1.516 af, Depth> 6.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
114,240	86	<50% Grass cover, Poor, HSG C
114,240		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	320	0.3300	4.02		**Shallow Concentrated Flow, e1 1** Short Grass Pasture Kv= 7.0 fps
7.3	310	0.0050	0.71		**Shallow Concentrated Flow, e1 2** Nearly Bare & Untilled Kv= 10.0 fps
8.6	630	Total			

Subcatchment E-1: E-1



Summary for Subcatchment E-2: E-2

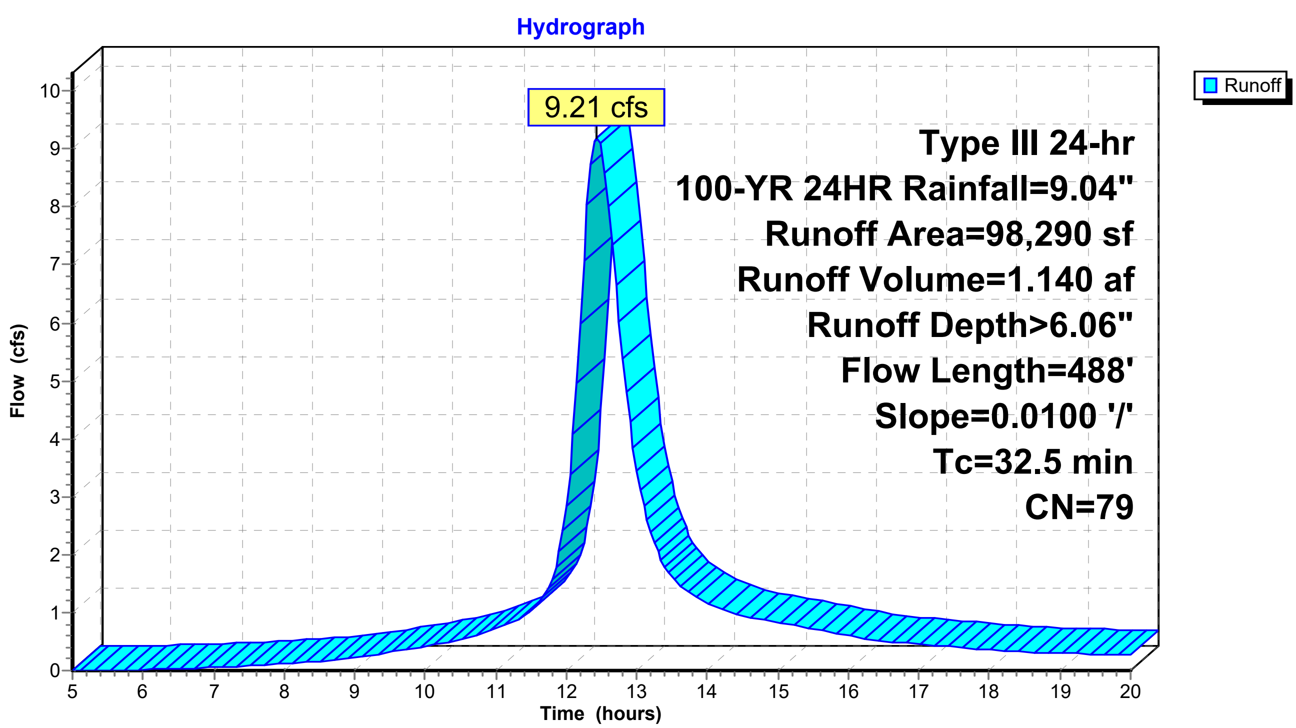
Runoff = 9.21 cfs @ 12.44 hrs, Volume= 1.140 af, Depth> 6.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
54,000	86	<50% Grass cover, Poor, HSG C
44,290	70	Woods, Good, HSG C
98,290	79	Weighted Average
98,290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.5	488	0.0100	0.25		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps

Subcatchment E-2: E-2



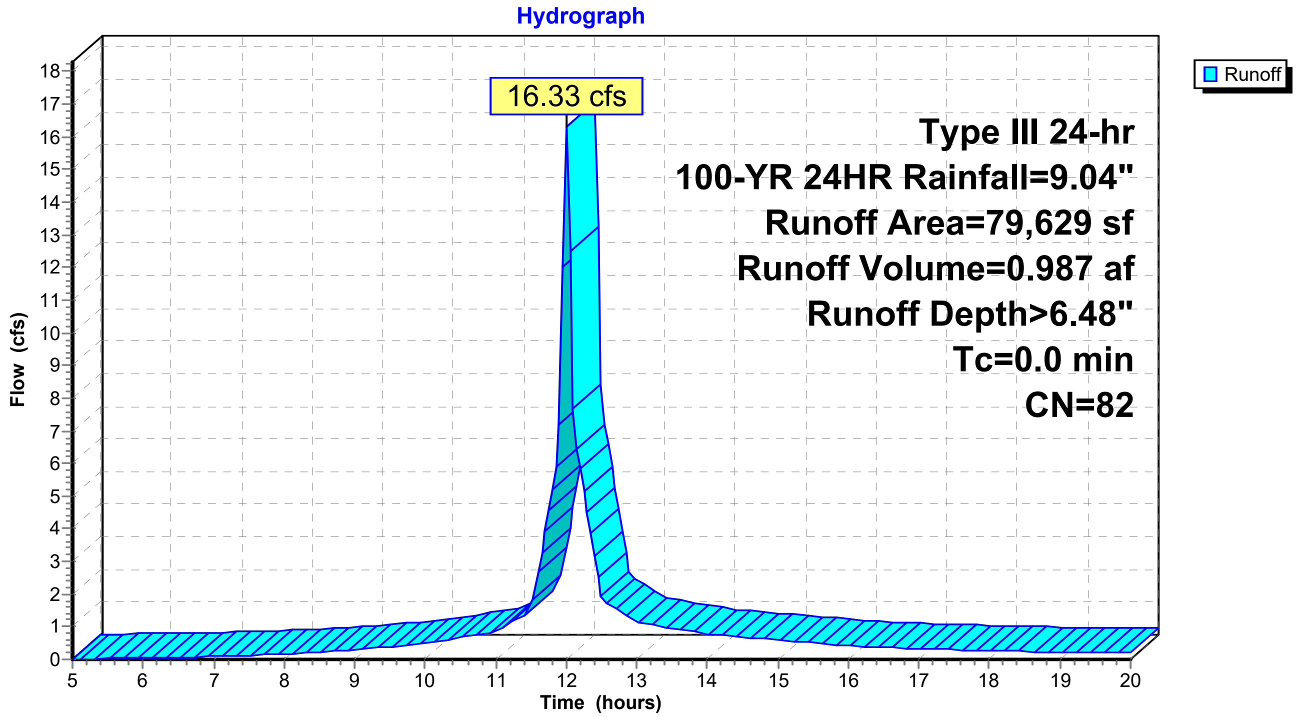
Summary for Subcatchment E-3: E-3

Runoff = 16.33 cfs @ 12.00 hrs, Volume= 0.987 af, Depth> 6.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
59,600	86	<50% Grass cover, Poor, HSG C
20,029	70	Woods, Good, HSG C
79,629	82	Weighted Average
79,629		100.00% Pervious Area

Subcatchment E-3: E-3



Summary for Subcatchment E-4: E-4

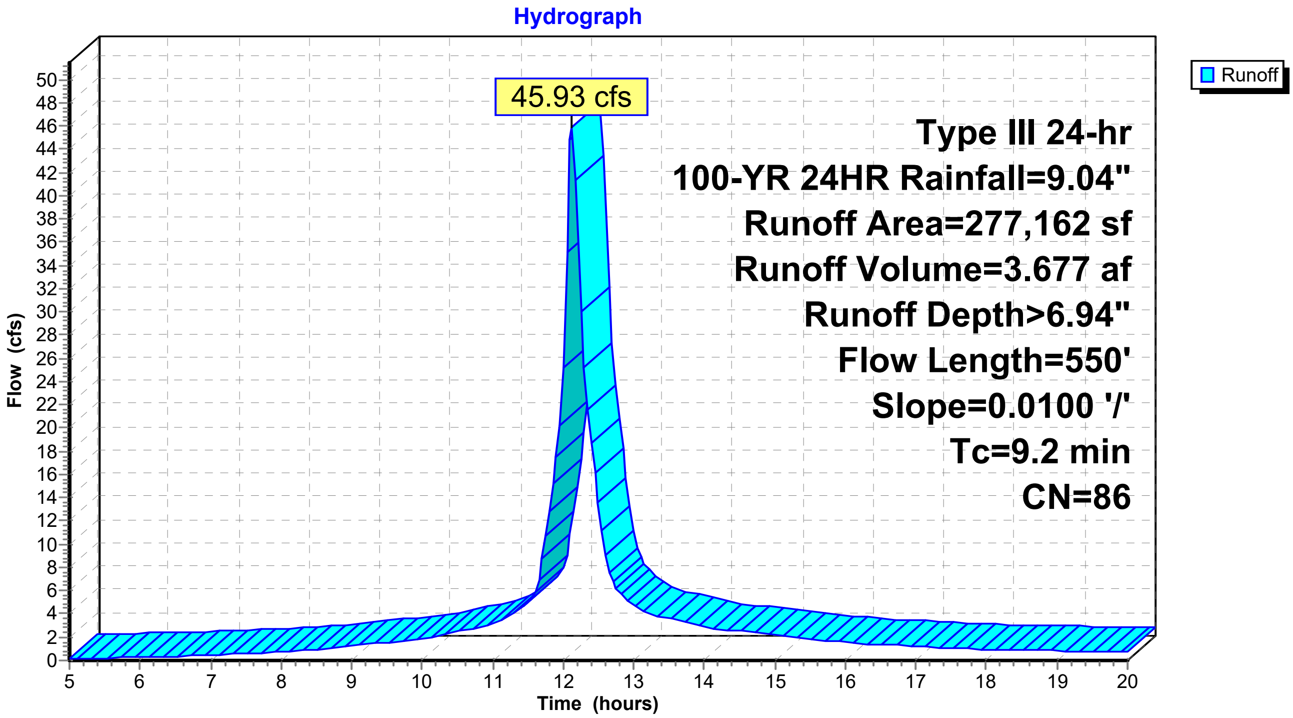
Runoff = 45.93 cfs @ 12.13 hrs, Volume= 3.677 af, Depth> 6.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
277,162	86	<50% Grass cover, Poor, HSG C
277,162		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	550	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment E-4: E-4



Summary for Subcatchment E-5: E-5

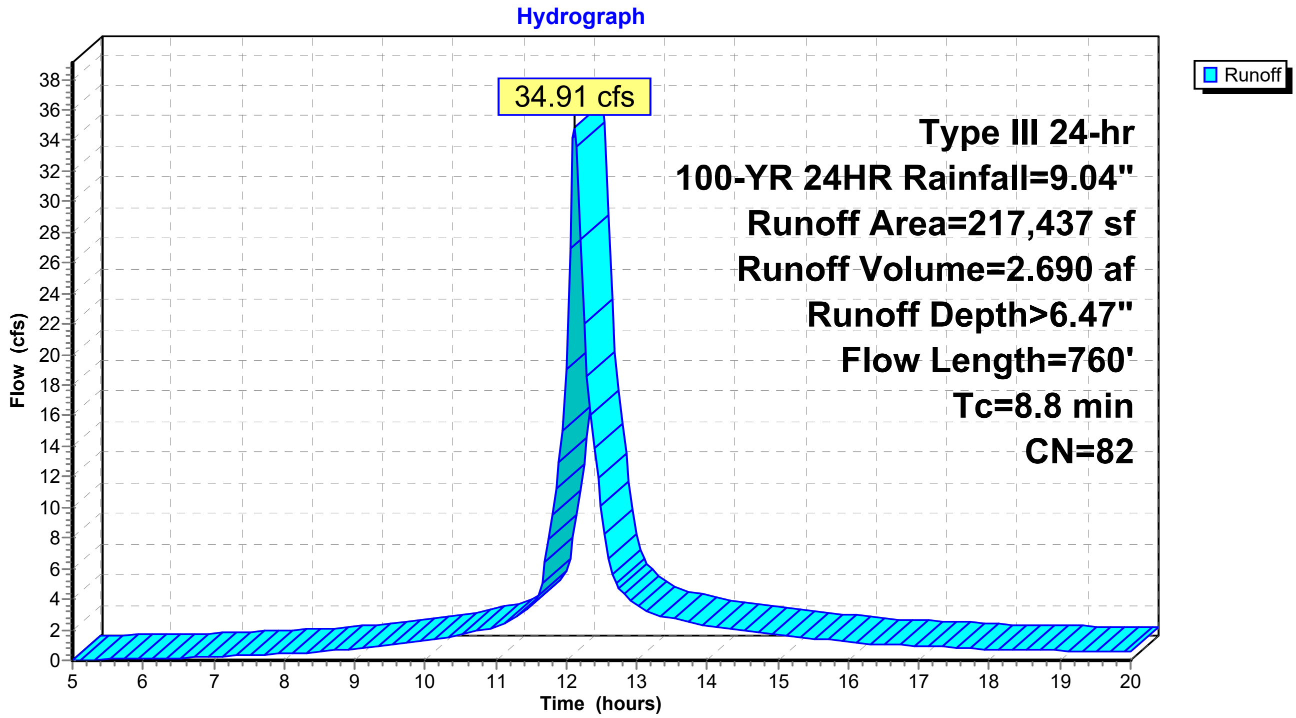
Runoff = 34.91 cfs @ 12.12 hrs, Volume= 2.690 af, Depth> 6.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
76,103	74	>75% Grass cover, Good, HSG C
141,334	86	<50% Grass cover, Poor, HSG C
217,437	82	Weighted Average
217,437		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	310	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.5	450	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
8.8	760	Total			

Subcatchment E-5: E-5



Summary for Subcatchment P-1: P-1

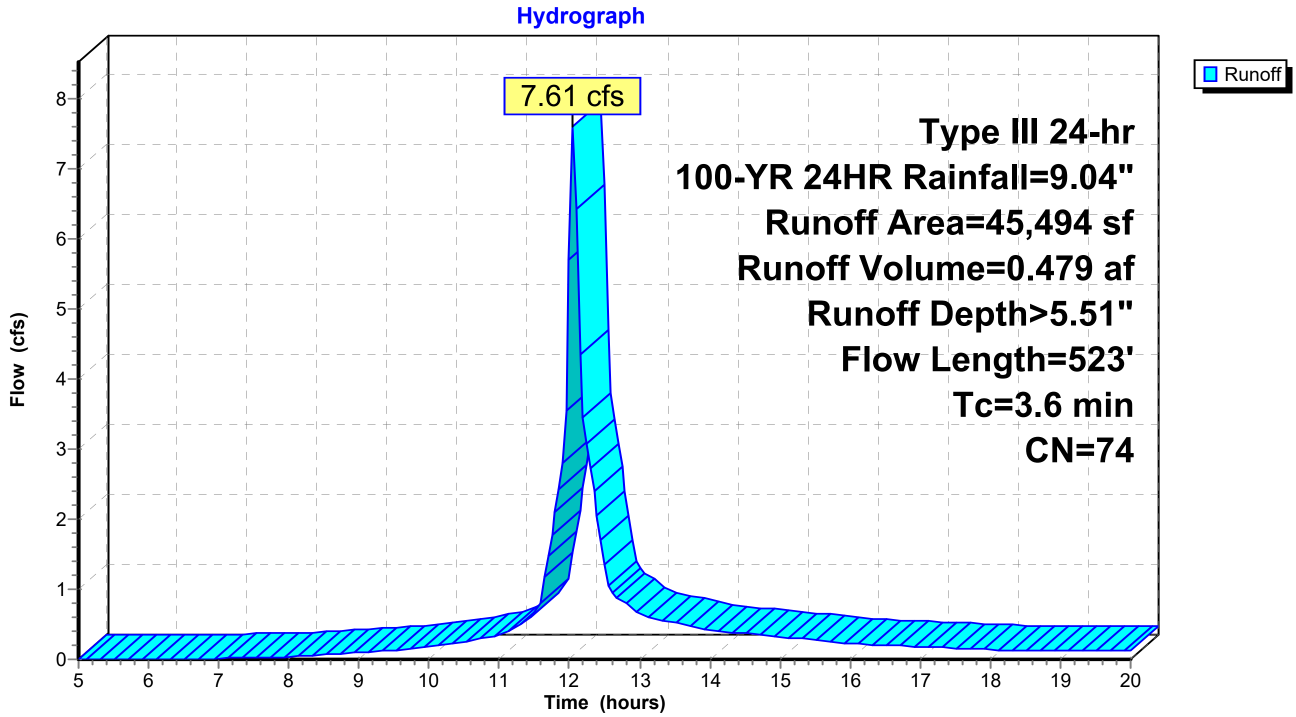
Runoff = 7.61 cfs @ 12.06 hrs, Volume= 0.479 af, Depth> 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
45,494	74	>75% Grass cover, Good, HSG C
45,494		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	328	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.2	195	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.6	523	Total			

Subcatchment P-1: P-1



Summary for Subcatchment P-10: P-10

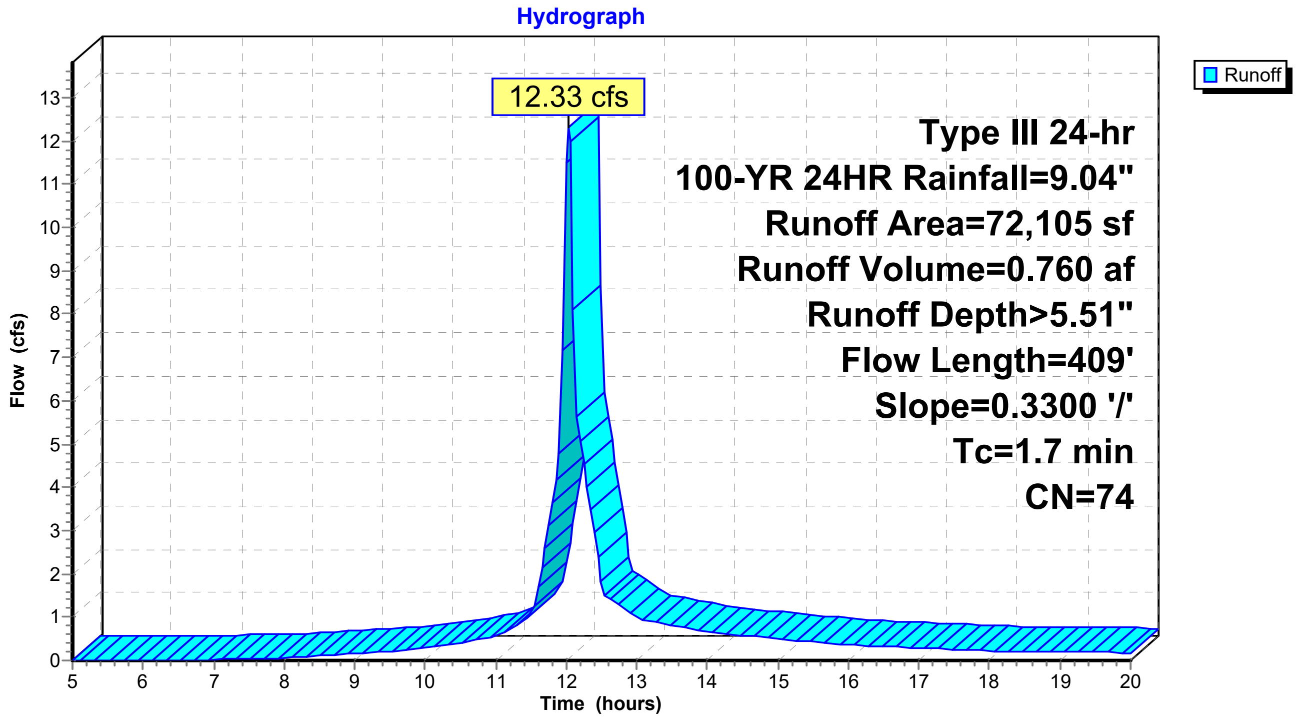
Runoff = 12.33 cfs @ 12.03 hrs, Volume= 0.760 af, Depth> 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
72,105	74	>75% Grass cover, Good, HSG C
72,105		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	409	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-10: P-10



Summary for Subcatchment P-11: P-11

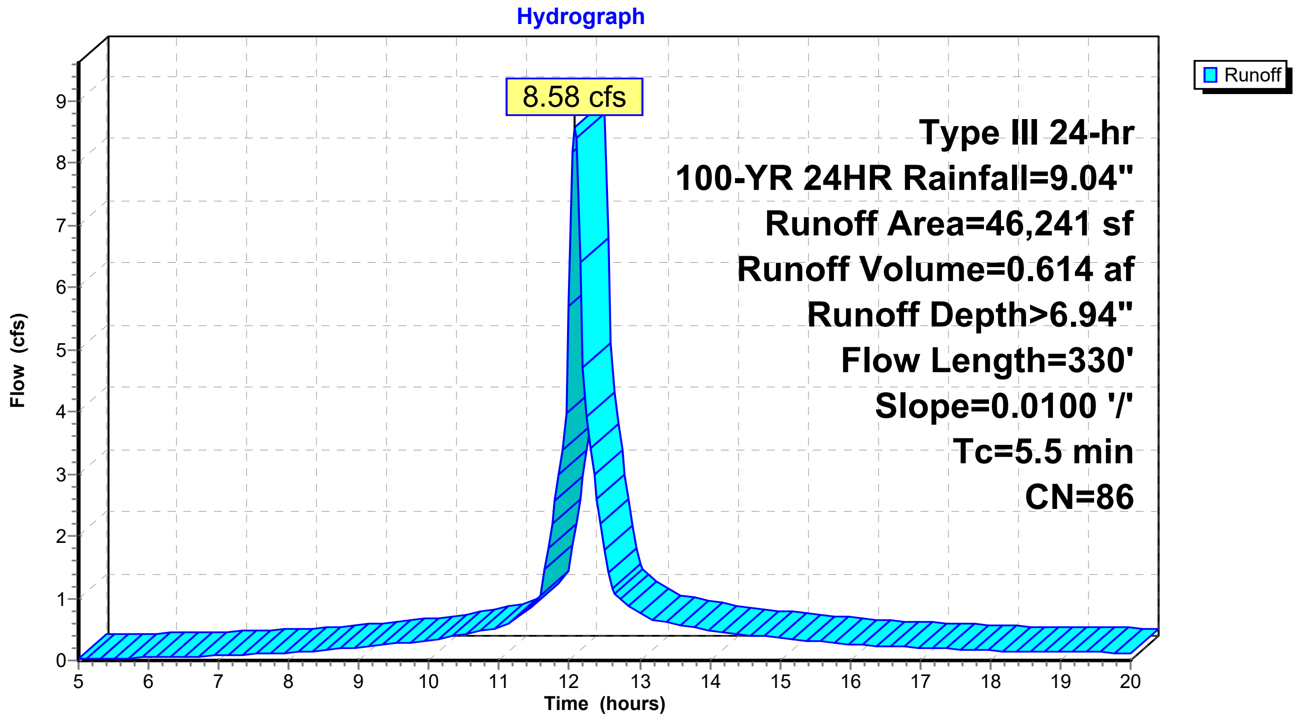
Runoff = 8.58 cfs @ 12.08 hrs, Volume= 0.614 af, Depth> 6.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
46,241	86	<50% Grass cover, Poor, HSG C
46,241		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	330	0.0100	1.00		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps

Subcatchment P-11: P-11



Summary for Subcatchment P-2: P-2

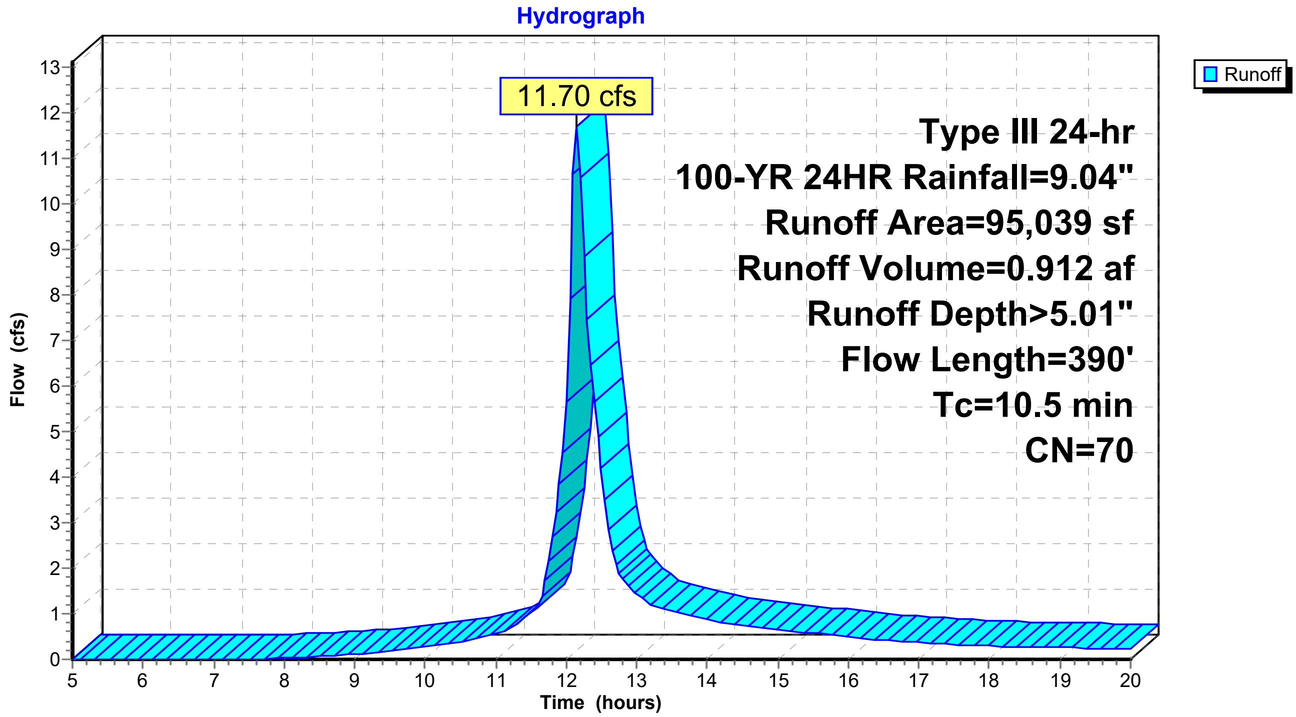
Runoff = 11.70 cfs @ 12.15 hrs, Volume= 0.912 af, Depth> 5.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
95,039	70	Woods, Good, HSG C
95,039		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	110	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.3	280	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.5	390	Total			

Subcatchment P-2: P-2



Summary for Subcatchment P-3: P-3

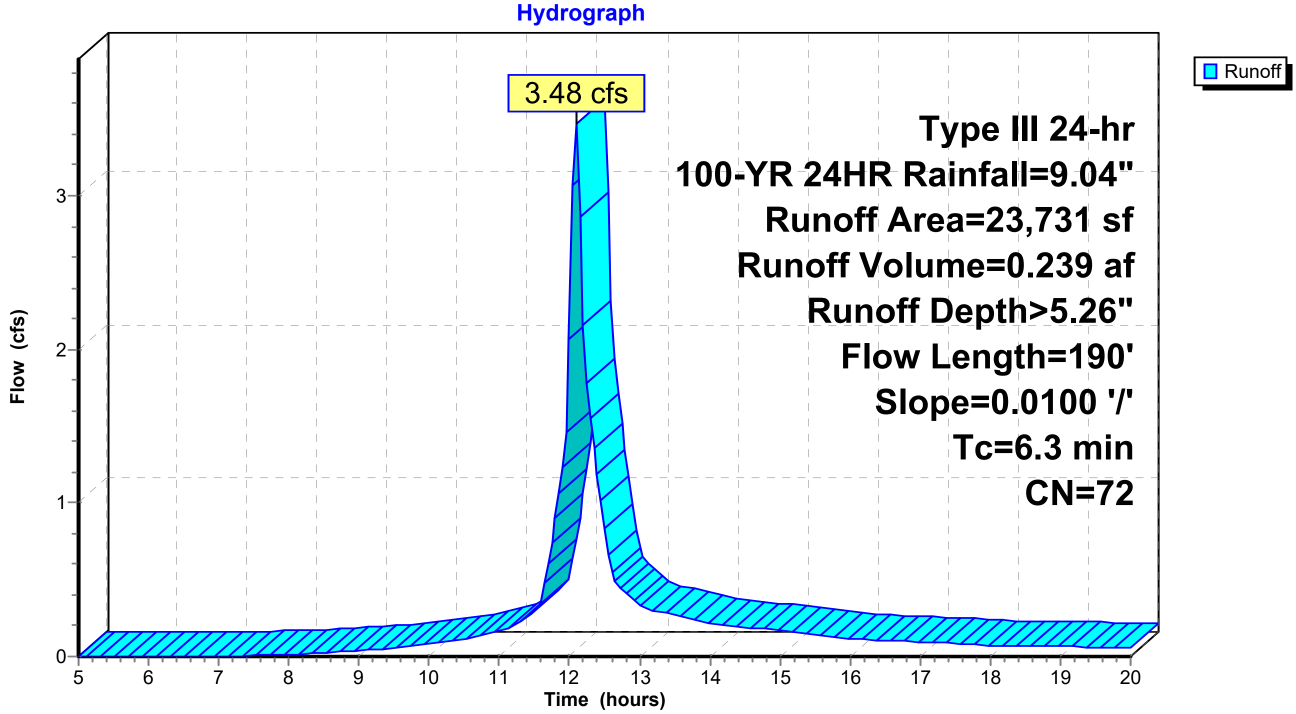
Runoff = 3.48 cfs @ 12.09 hrs, Volume= 0.239 af, Depth> 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
23,731	72	Woods/grass comb., Good, HSG C
23,731		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	190	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps

Subcatchment P-3: P-3



Summary for Subcatchment P-4: P-4

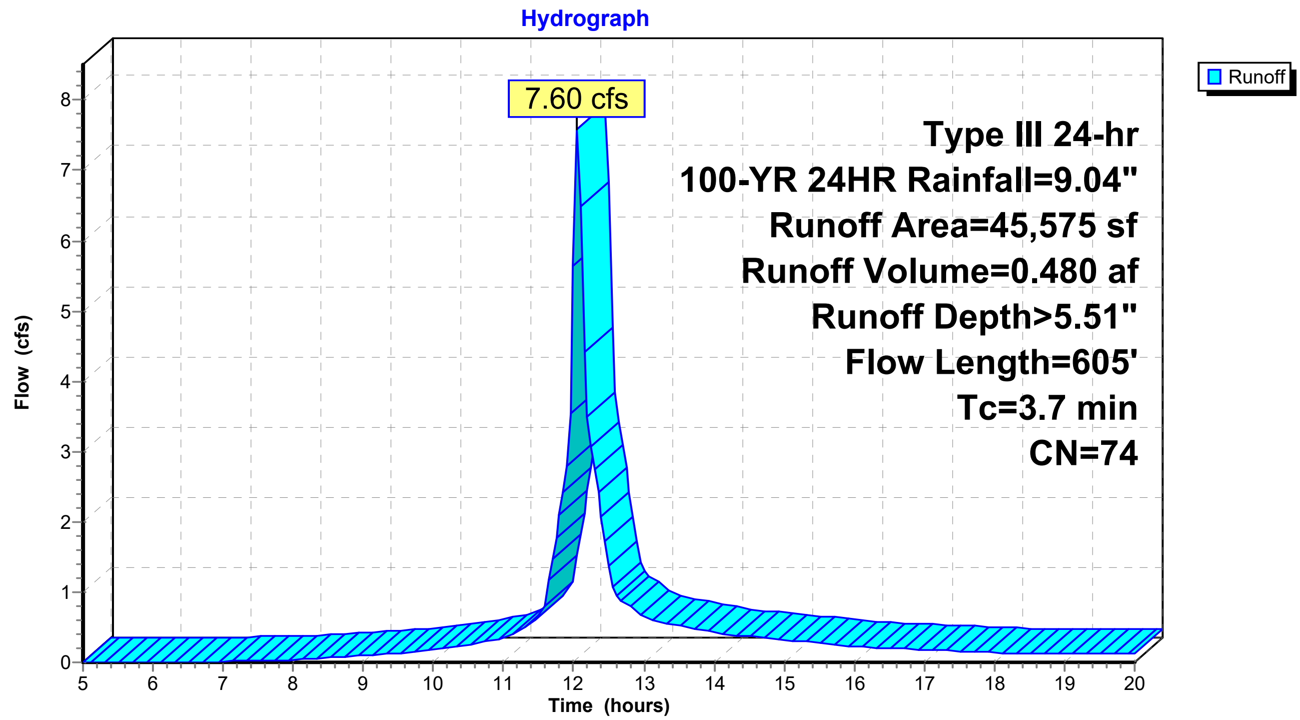
Runoff = 7.60 cfs @ 12.06 hrs, Volume= 0.480 af, Depth> 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
45,575	74	>75% Grass cover, Good, HSG C
45,575		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	45	0.3000	3.83		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.5	560	0.0100	2.70	10.78	**Trap/Vee/Rect Channel Flow, bench swale** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.040 Earth, cobble bottom, clean sides
3.7	605	Total			

Subcatchment P-4: P-4



Summary for Subcatchment P-5: P-5

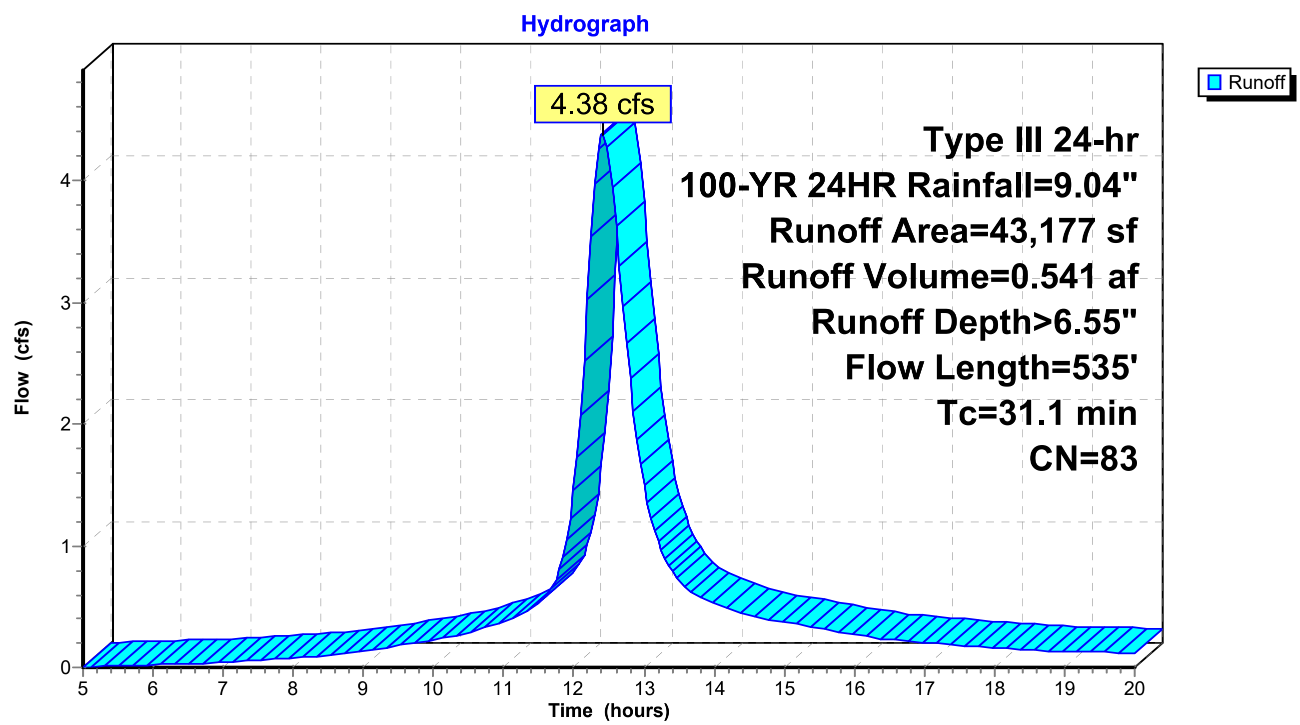
Runoff = 4.38 cfs @ 12.41 hrs, Volume= 0.541 af, Depth> 6.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
22,177	79	50-75% Grass cover, Fair, HSG C
21,000	87	Dirt roads, HSG C
43,177	83	Weighted Average
43,177		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	35	0.3000	0.28		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
29.0	500	0.0030	0.29	4.60	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=2.00' Z= 3.0 '/' Top.W=14.00' n= 0.300
31.1	535	Total			

Subcatchment P-5: P-5



Summary for Subcatchment P-6: P-6

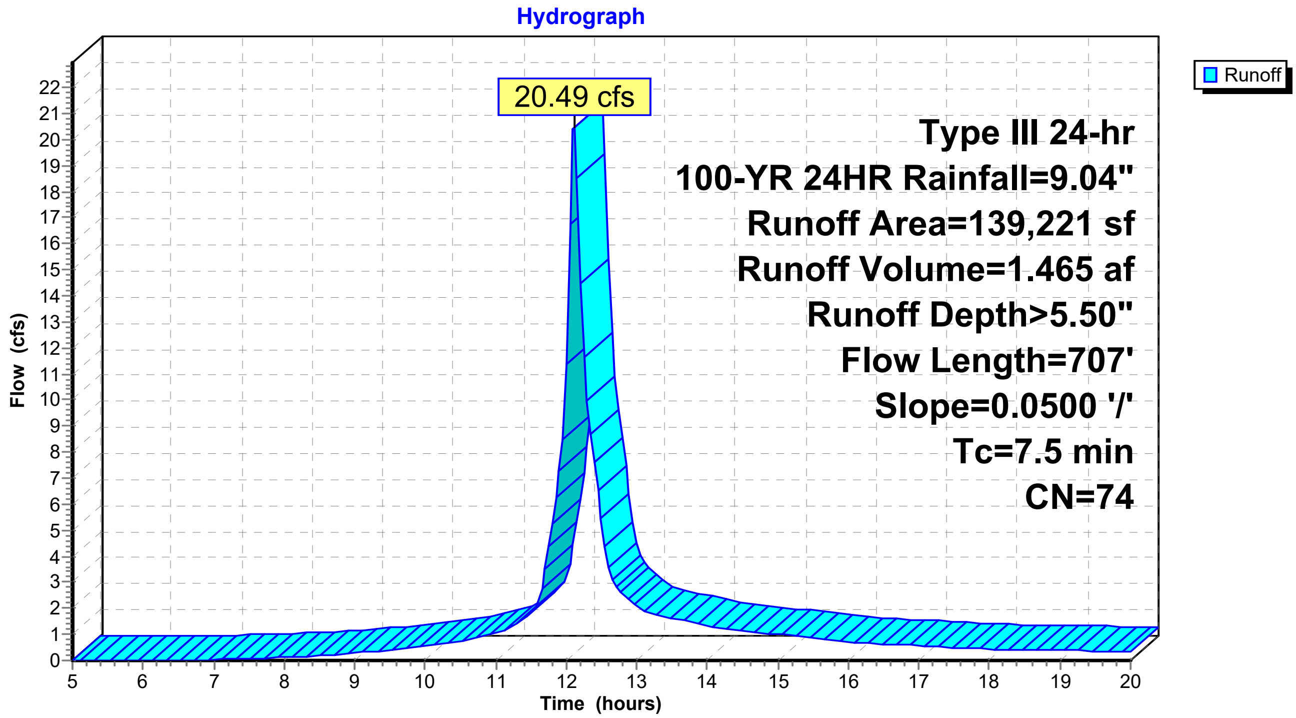
Runoff = 20.49 cfs @ 12.11 hrs, Volume= 1.465 af, Depth> 5.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
139,221	74	>75% Grass cover, Good, HSG C
139,221		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	707	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-6: P-6



Summary for Subcatchment P-7: P-7

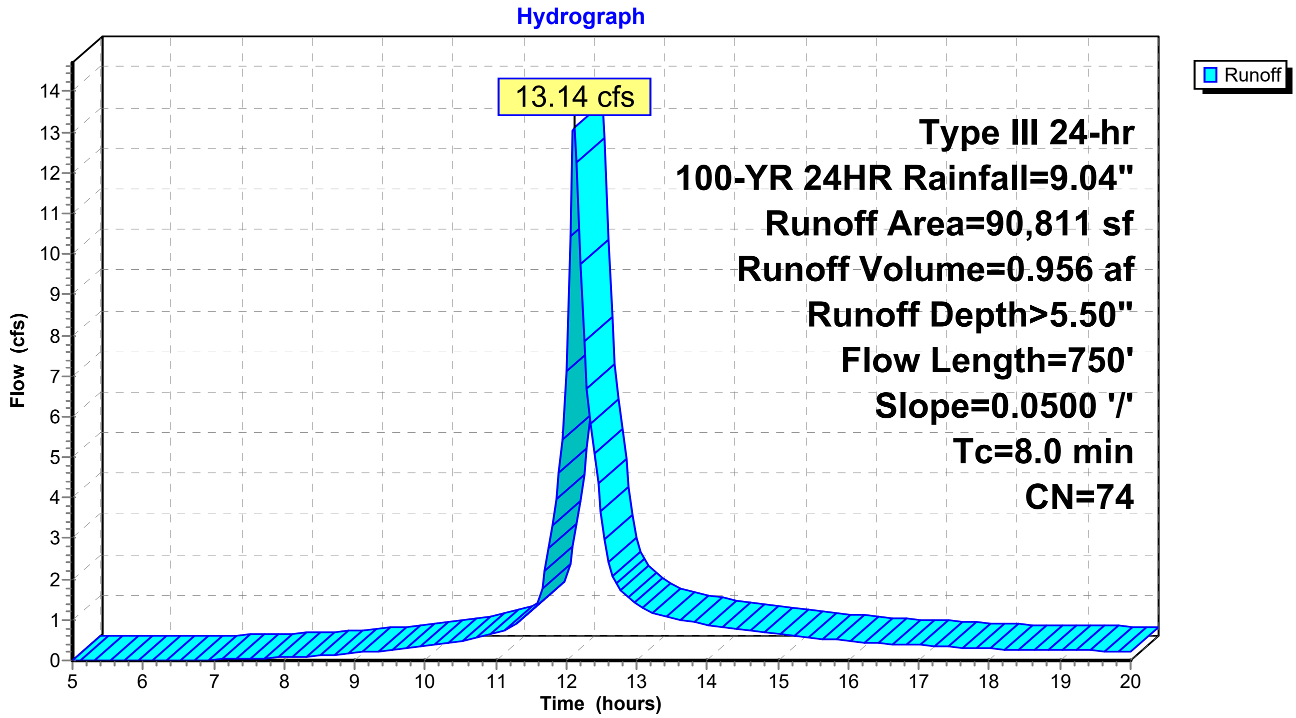
Runoff = 13.14 cfs @ 12.11 hrs, Volume= 0.956 af, Depth> 5.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
90,811	74	>75% Grass cover, Good, HSG C
90,811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	750	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps

Subcatchment P-7: P-7



Summary for Subcatchment P-8: P-8

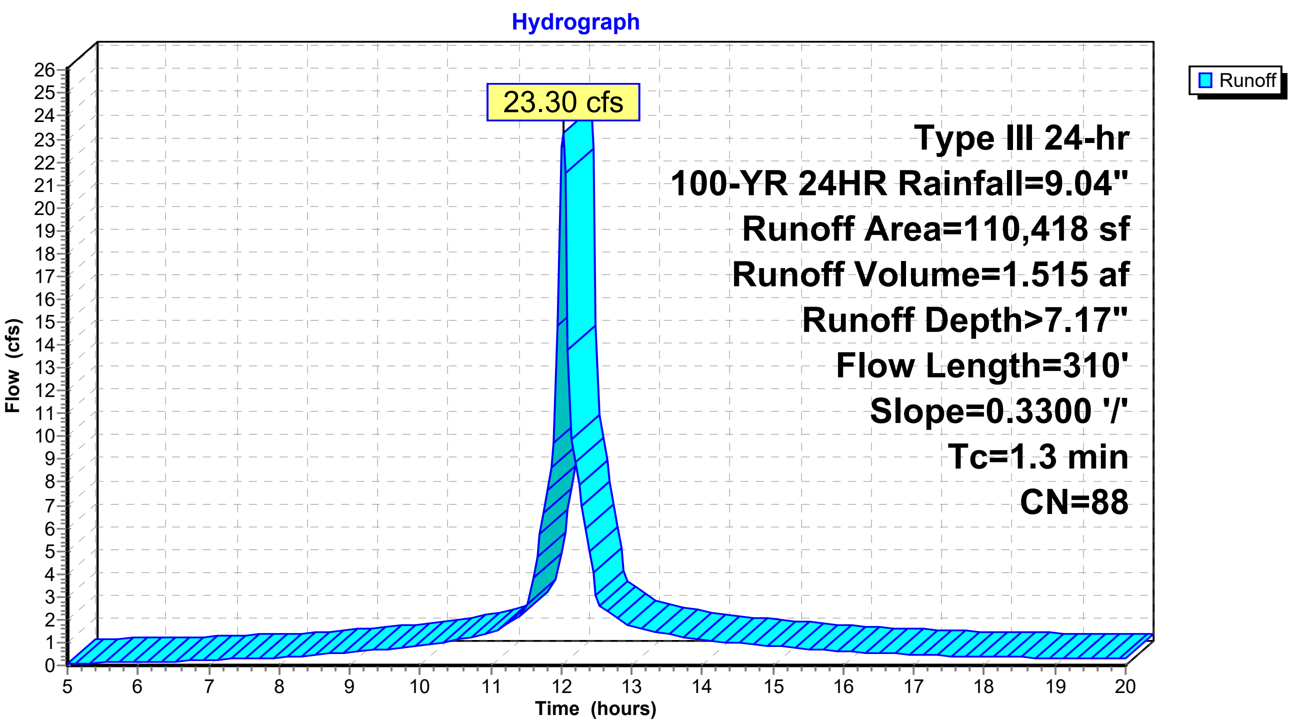
Runoff = 23.30 cfs @ 12.02 hrs, Volume= 1.515 af, Depth> 7.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"

Area (sf)	CN	Description
45,474	74	>75% Grass cover, Good, HSG C
9,735	96	Gravel surface, HSG C
55,209	98	Water Surface, HSG C
110,418	88	Weighted Average
55,209		50.00% Pervious Area
55,209		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	110	0.3300	4.02		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	200		4.01		**Lake or Reservoir,** Mean Depth= 0.50'
1.3	310	Total			

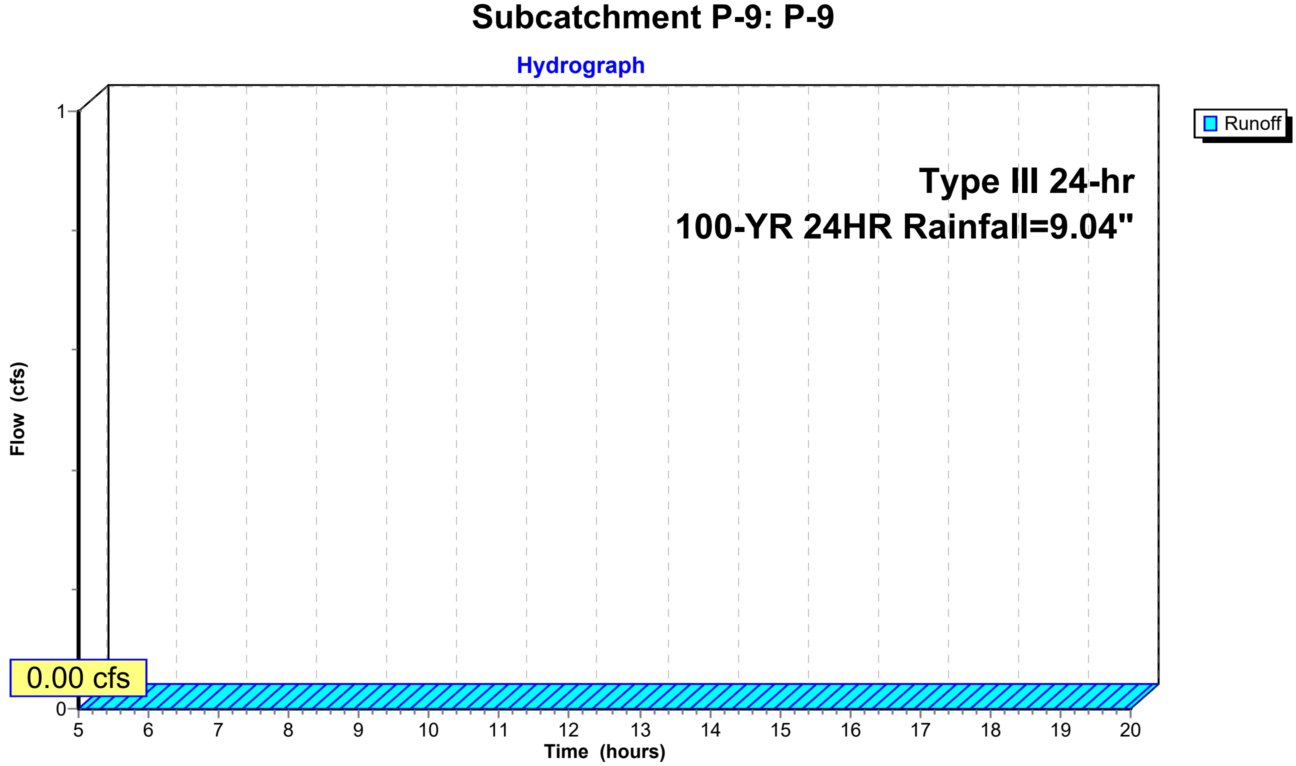
Subcatchment P-8: P-8



Summary for Subcatchment P-9: P-9

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR 24HR Rainfall=9.04"



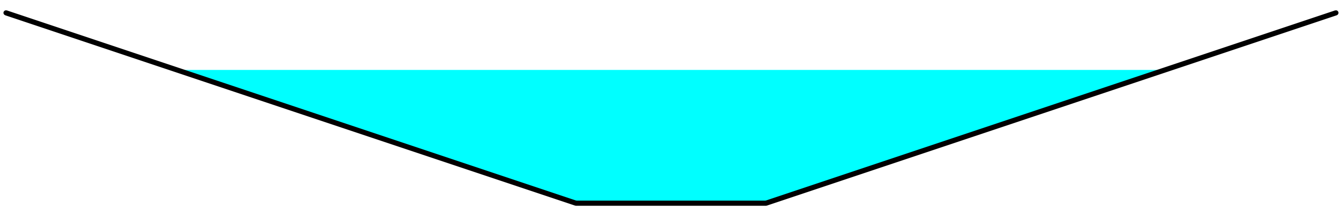
Summary for Reach Bench swale: Bench swale

Inflow Area = 1.046 ac, 0.00% Impervious, Inflow Depth > 5.51" for 100-YR 24HR event
Inflow = 7.60 cfs @ 12.06 hrs, Volume= 0.480 af
Outflow = 3.70 cfs @ 12.57 hrs, Volume= 0.467 af, Atten= 51%, Lag= 30.8 min

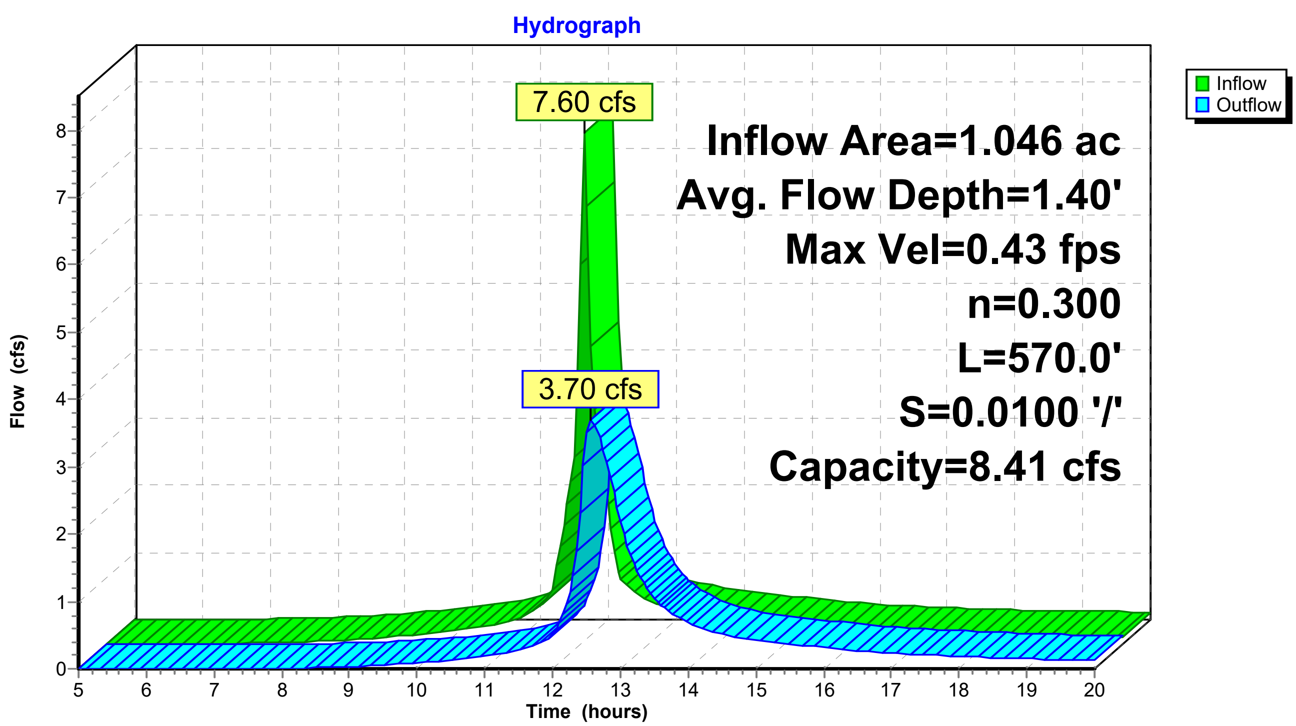
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.43 fps, Min. Travel Time= 22.3 min
Avg. Velocity = 0.19 fps, Avg. Travel Time= 48.7 min

Peak Storage= 4,951 cf @ 12.20 hrs
Average Depth at Peak Storage= 1.40'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 8.41 cfs

2.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 570.0' Slope= 0.0100 '/'
Inlet Invert= 116.20', Outlet Invert= 110.50'



Reach Bench swale: Bench swale



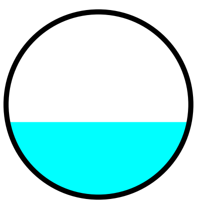
Summary for Reach Drop Pipe: Drop Pipe

Inflow Area = 5.281 ac, 0.00% Impervious, Inflow Depth > 5.44" for 100-YR 24HR event
Inflow = 24.16 cfs @ 12.37 hrs, Volume= 2.392 af
Outflow = 24.15 cfs @ 12.37 hrs, Volume= 2.392 af, Atten= 0%, Lag= 0.0 min

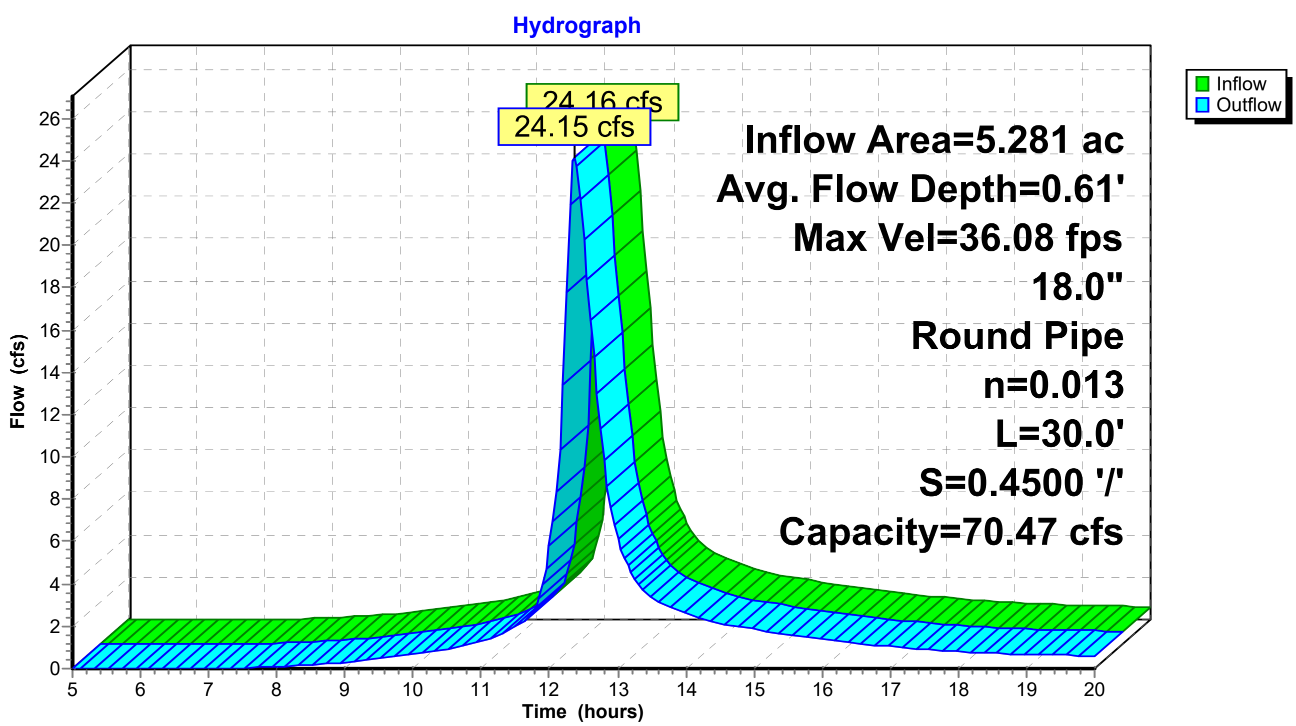
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 36.08 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 14.93 fps, Avg. Travel Time= 0.0 min

Peak Storage= 20 cf @ 12.37 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 70.47 cfs

18.0" Round Pipe
n= 0.013
Length= 30.0' Slope= 0.4500 '/'
Inlet Invert= 122.00', Outlet Invert= 108.50'



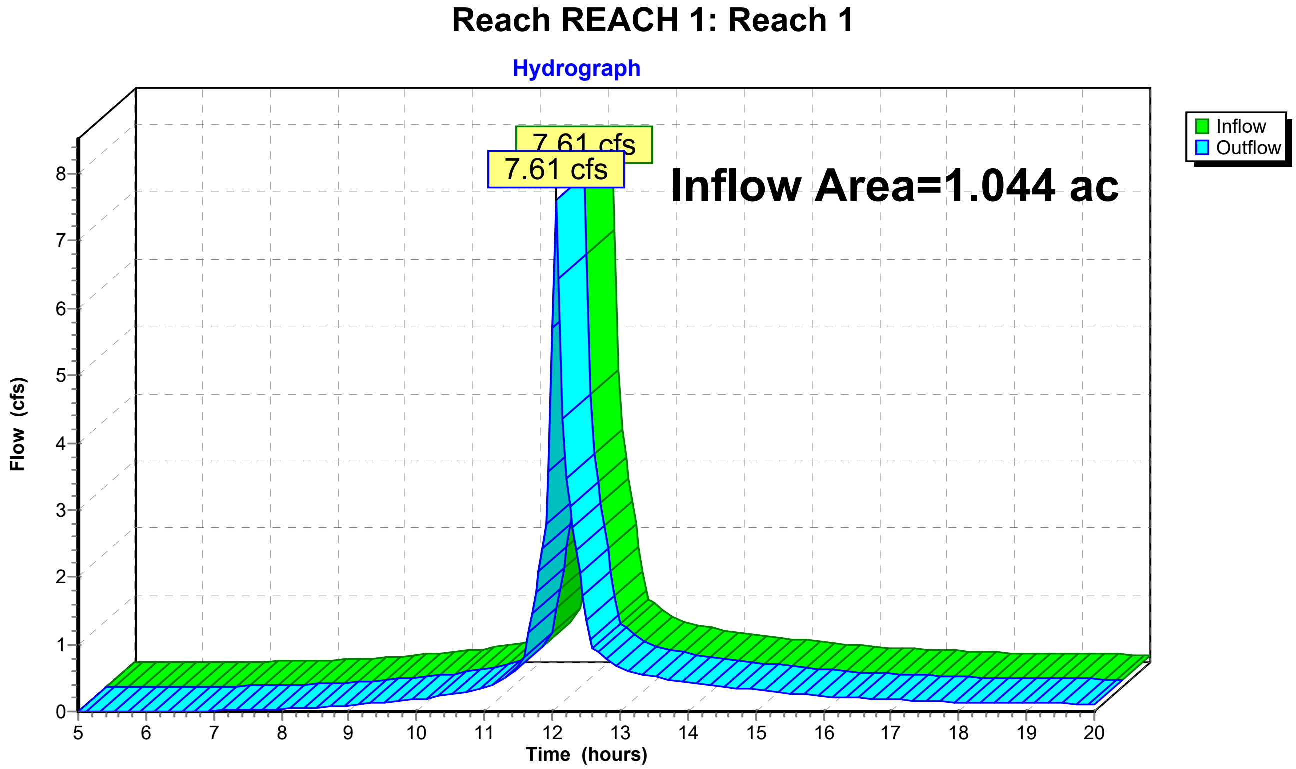
Reach Drop Pipe: Drop Pipe



Summary for Reach REACH 1: Reach 1

Inflow Area =	1.044 ac,	0.00% Impervious, Inflow Depth >	5.51"	for 100-YR 24HR event
Inflow =	7.61 cfs @	12.06 hrs, Volume=	0.479 af	
Outflow =	7.61 cfs @	12.06 hrs, Volume=	0.479 af, Atten= 0%, Lag= 0.0 min	

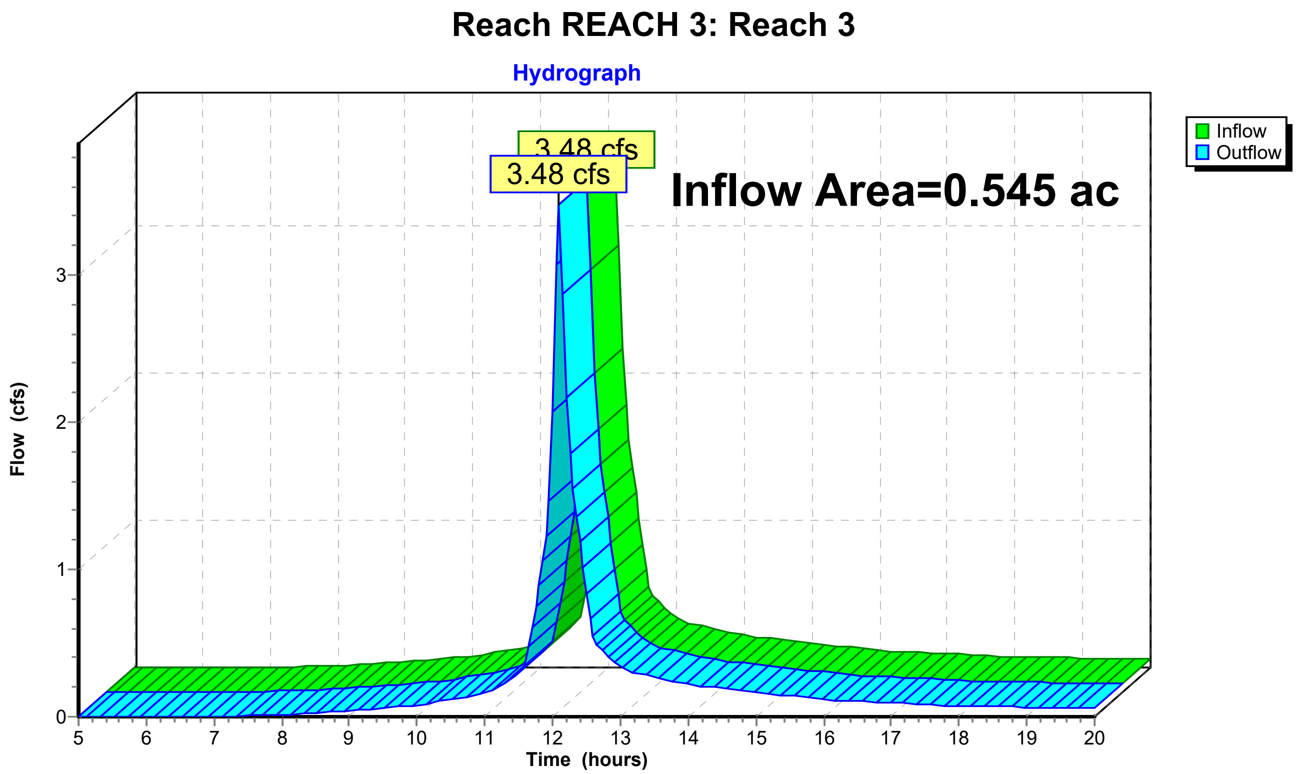
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



Summary for Reach REACH 3: Reach 3

Inflow Area = 0.545 ac, 0.00% Impervious, Inflow Depth > 5.26" for 100-YR 24HR event
Inflow = 3.48 cfs @ 12.09 hrs, Volume= 0.239 af
Outflow = 3.48 cfs @ 12.09 hrs, Volume= 0.239 af, Atten= 0%, Lag= 0.0 min

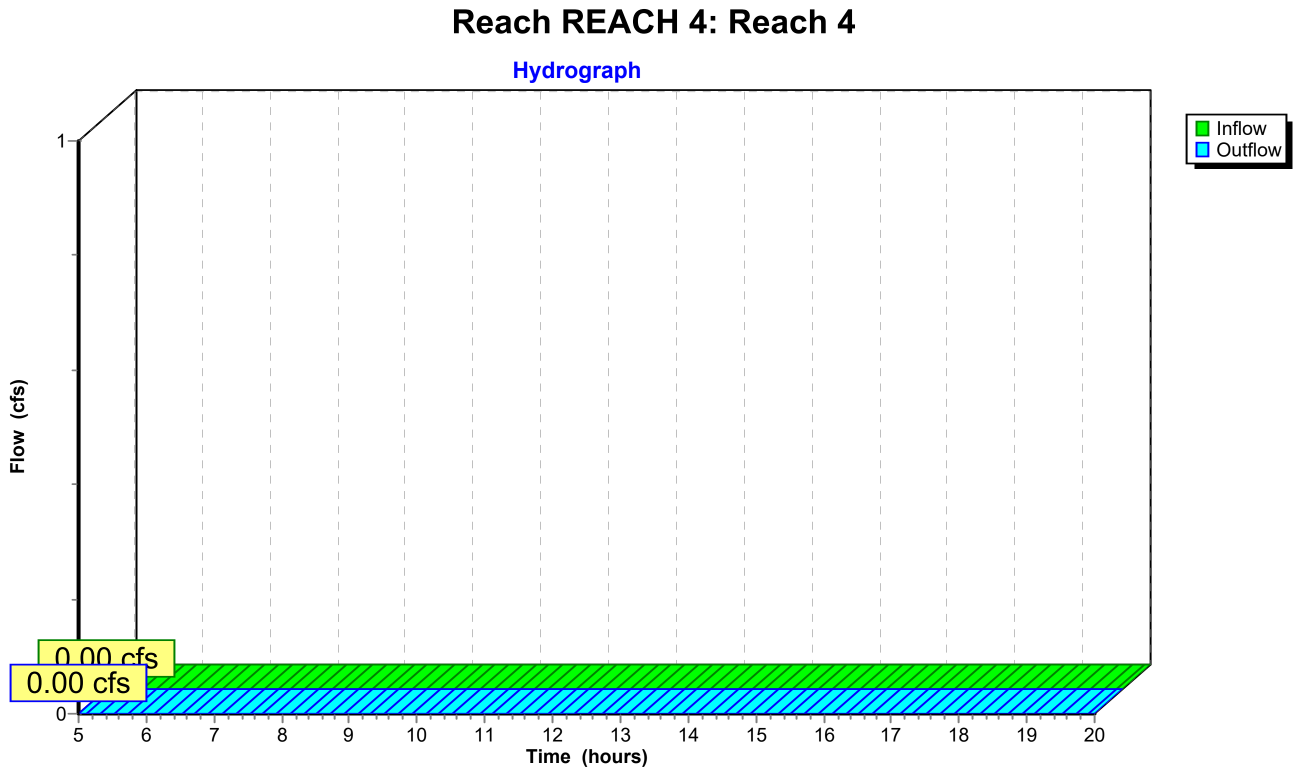
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



Summary for Reach REACH 4: Reach 4

Inflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Outflow	=	0.00 cfs @	5.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

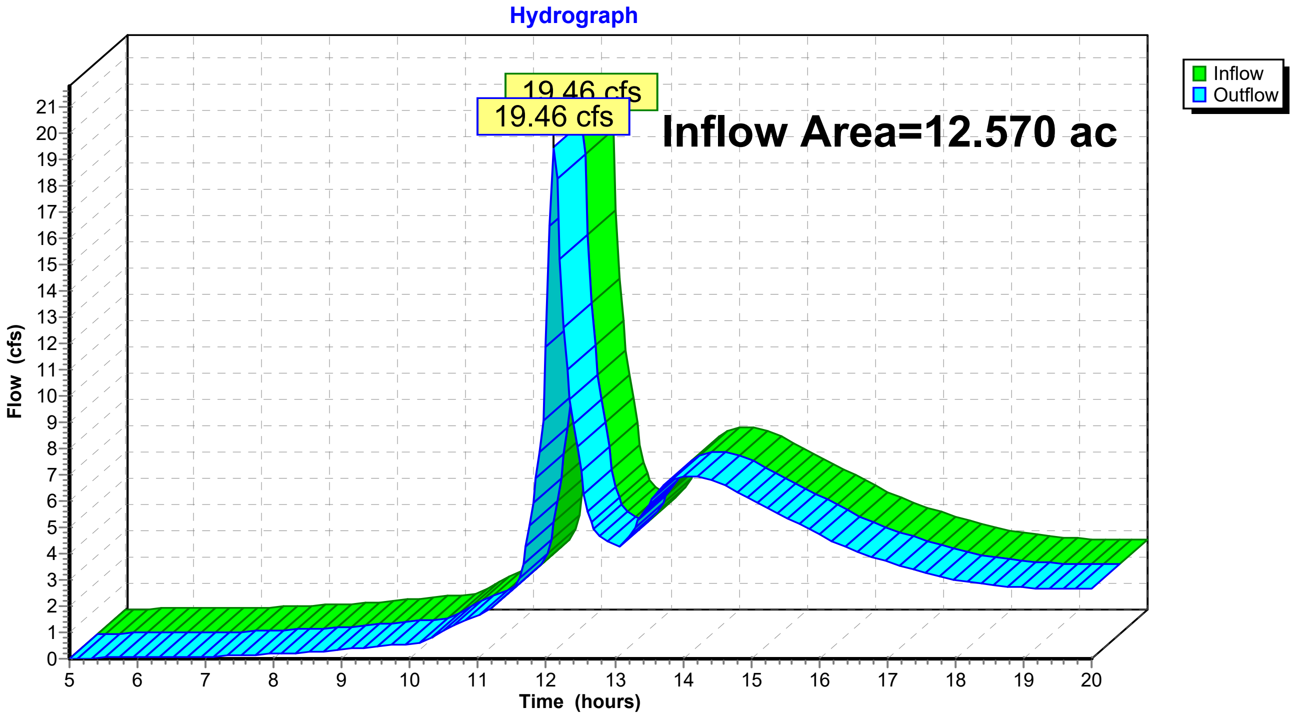


Summary for Reach REACH 5: Reach 5

Inflow Area = 12.570 ac, 10.08% Impervious, Inflow Depth > 3.60" for 100-YR 24HR event
Inflow = 19.46 cfs @ 12.11 hrs, Volume= 3.770 af
Outflow = 19.46 cfs @ 12.11 hrs, Volume= 3.770 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH 5: Reach 5

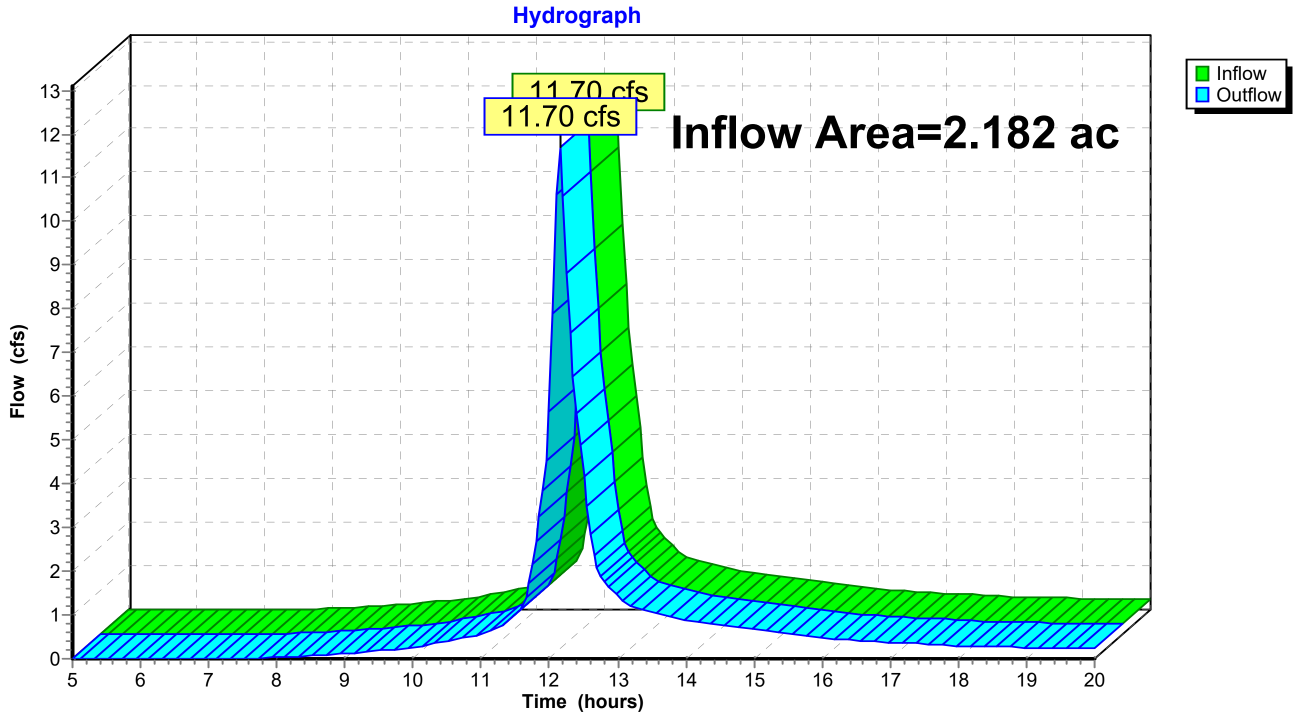


Summary for Reach REACH2: Reach2

Inflow Area =	2.182 ac,	0.00% Impervious, Inflow Depth > 5.01"	for 100-YR 24HR event	
Inflow =	11.70 cfs @	12.15 hrs, Volume=	0.912 af	
Outflow =	11.70 cfs @	12.15 hrs, Volume=	0.912 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach REACH2: Reach2



Summary for Reach Road Swale: Road Swale

Inflow Area = 2.037 ac, 0.00% Impervious, Inflow Depth > 5.94" for 100-YR 24HR event
Inflow = 7.73 cfs @ 12.52 hrs, Volume= 1.008 af
Outflow = 5.52 cfs @ 13.25 hrs, Volume= 0.974 af, Atten= 29%, Lag= 44.1 min

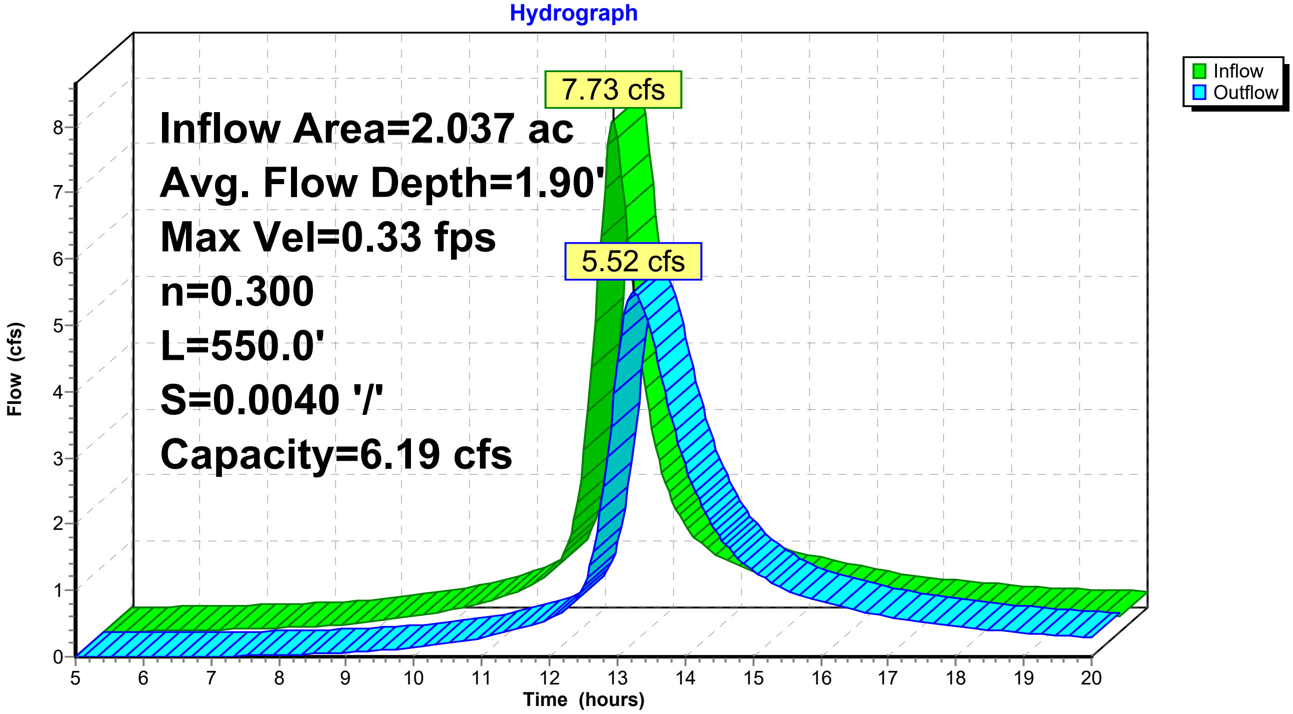
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.33 fps, Min. Travel Time= 27.4 min
Avg. Velocity = 0.16 fps, Avg. Travel Time= 58.3 min

Peak Storage= 9,092 cf @ 12.79 hrs
Average Depth at Peak Storage= 1.90'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 6.19 cfs

3.00' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 15.00'
Length= 550.0' Slope= 0.0040 '/'
Inlet Invert= 110.50', Outlet Invert= 108.30'

‡

Reach Road Swale: Road Swale



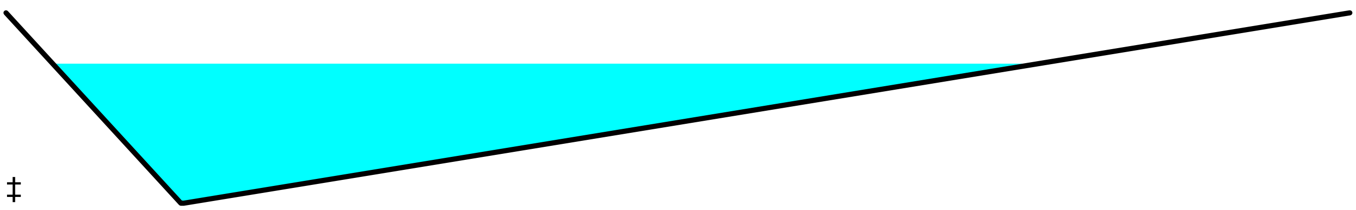
Summary for Reach So. Plateau Swale: So. Plateau Swale

Inflow Area = 3.196 ac, 0.00% Impervious, Inflow Depth > 5.50" for 100-YR 24HR event
Inflow = 20.49 cfs @ 12.11 hrs, Volume= 1.465 af
Outflow = 15.50 cfs @ 12.34 hrs, Volume= 1.450 af, Atten= 24%, Lag= 14.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.62 fps, Min. Travel Time= 8.8 min
Avg. Velocity = 0.28 fps, Avg. Travel Time= 19.5 min

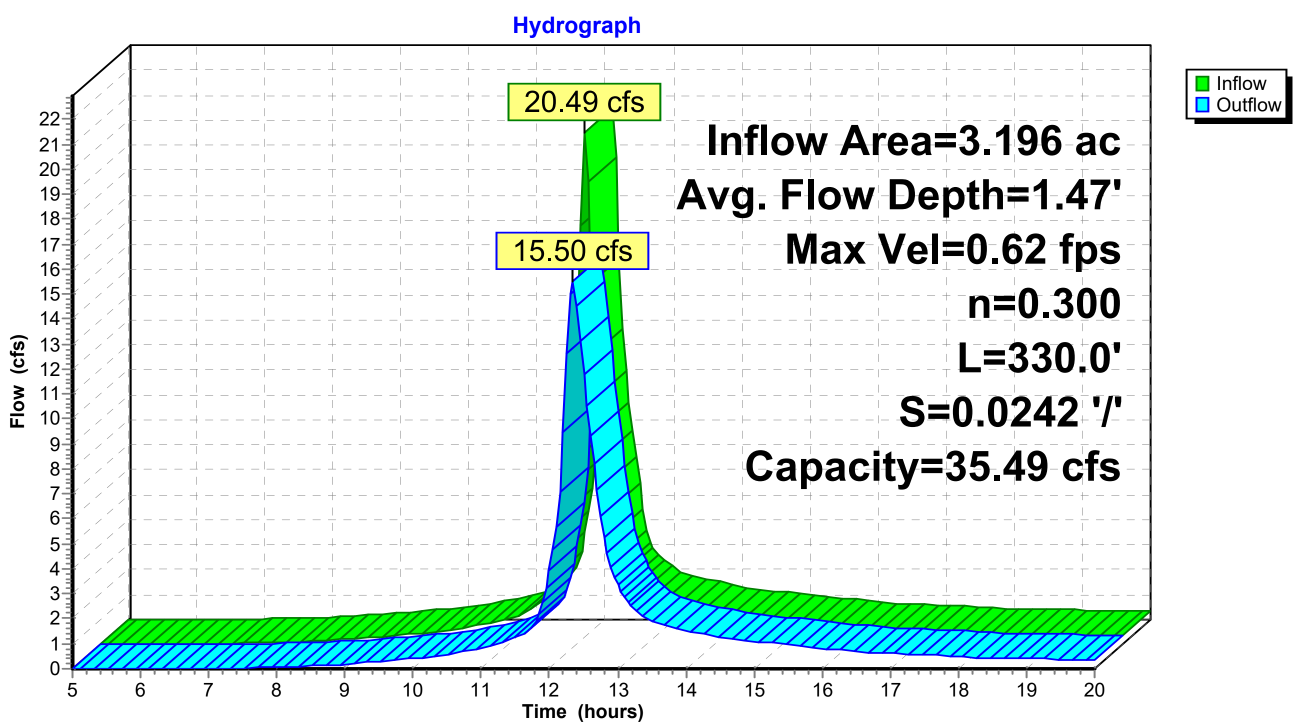
Peak Storage= 8,212 cf @ 12.19 hrs
Average Depth at Peak Storage= 1.47'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 35.49 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 20.0 '/' Top Width= 46.10'
Length= 330.0' Slope= 0.0242 '/'
Inlet Invert= 130.00', Outlet Invert= 122.00'



‡

Reach So. Plateau Swale: So. Plateau Swale



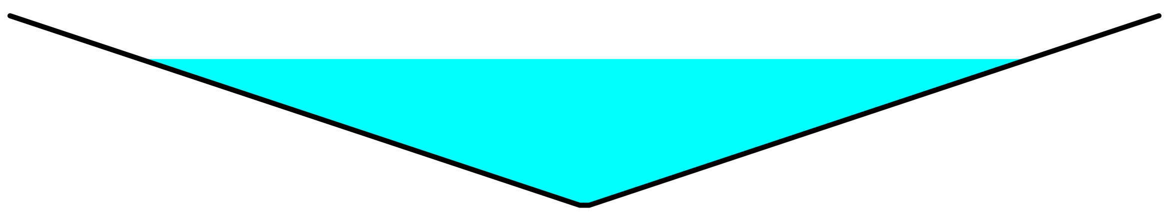
Summary for Reach Stone swale: stone swale

Inflow Area = 1.655 ac, 0.00% Impervious, Inflow Depth > 5.51" for 100-YR 24HR event
Inflow = 12.33 cfs @ 12.03 hrs, Volume= 0.760 af
Outflow = 10.22 cfs @ 12.14 hrs, Volume= 0.757 af, Atten= 17%, Lag= 6.7 min

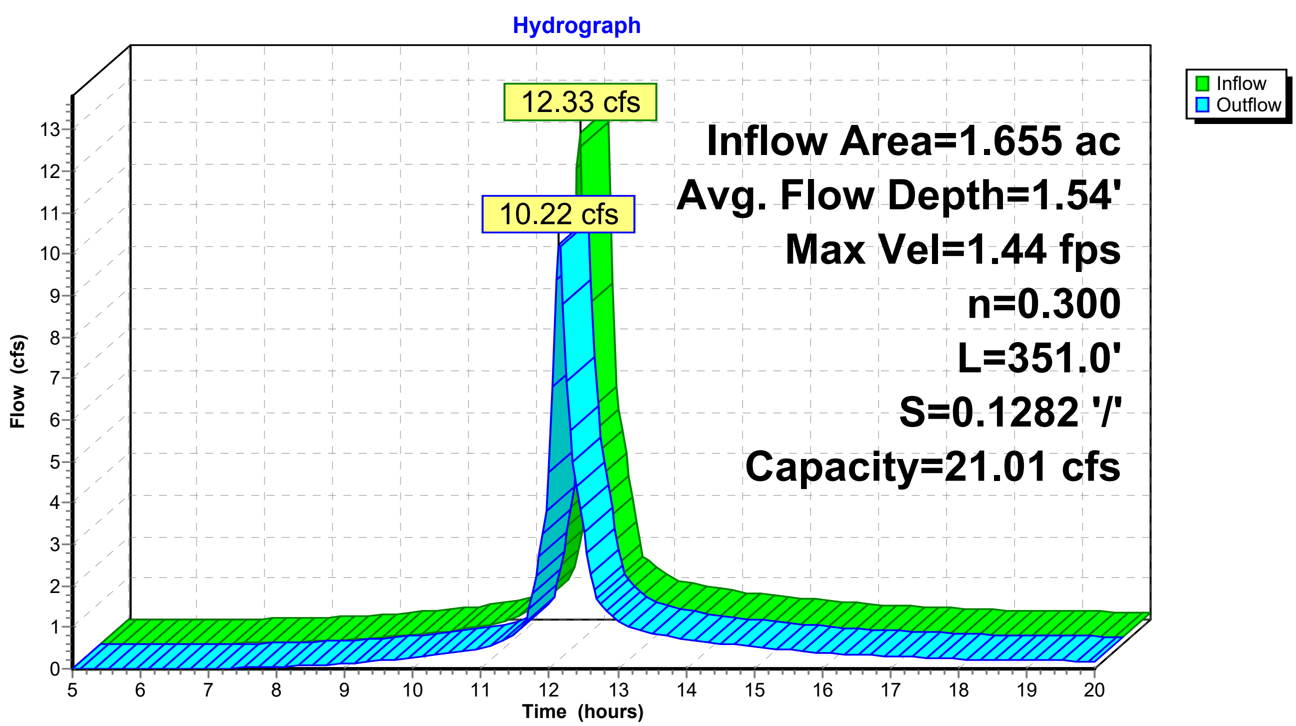
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.44 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 9.5 min

Peak Storage= 2,561 cf @ 12.07 hrs
Average Depth at Peak Storage= 1.54'
Bank-Full Depth= 2.00' Flow Area= 12.2 sf, Capacity= 21.01 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 3.0 '/' Top Width= 12.10'
Length= 351.0' Slope= 0.1282 '/'
Inlet Invert= 155.00', Outlet Invert= 110.00'



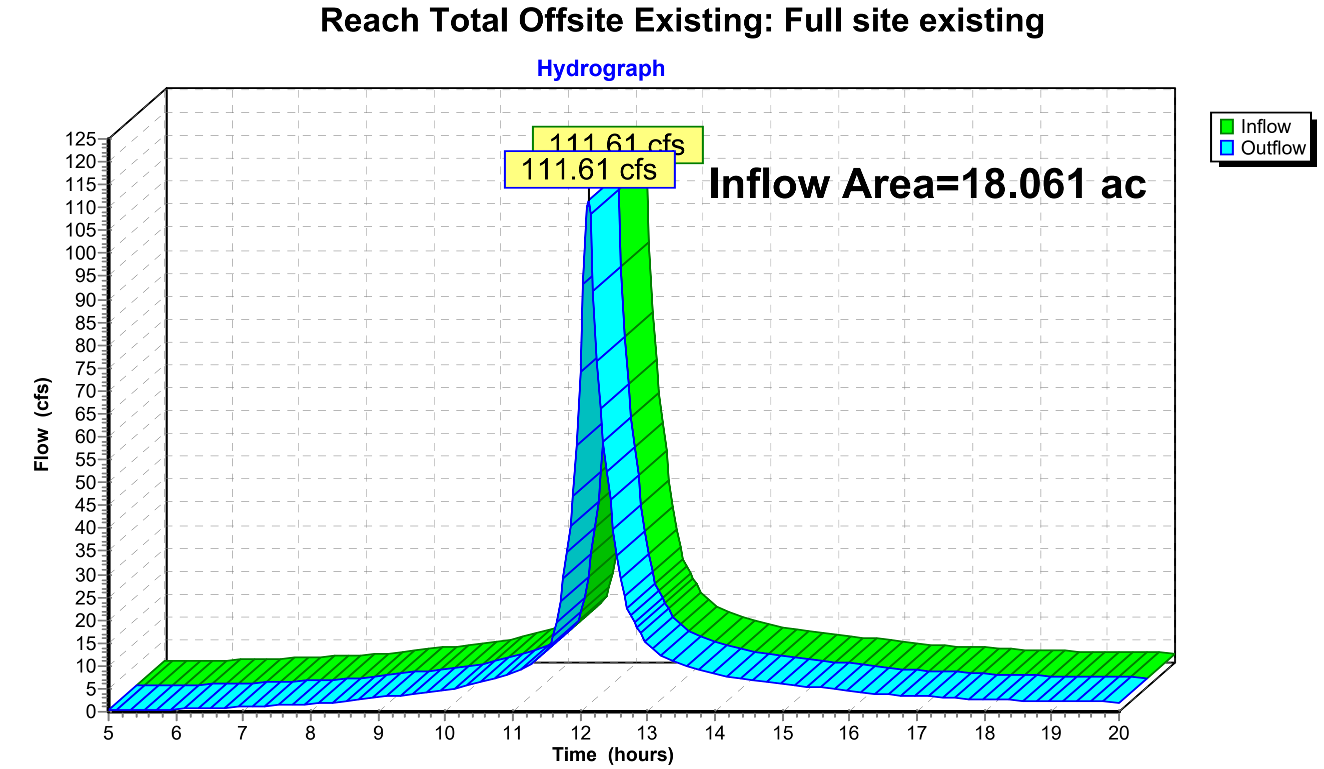
Reach Stone swale: stone swale



Summary for Reach Total Offsite Existing: Full site existing

Inflow Area = 18.061 ac, 0.00% Impervious, Inflow Depth > 6.65" for 100-YR 24HR event
Inflow = 111.61 cfs @ 12.12 hrs, Volume= 10.010 af
Outflow = 111.61 cfs @ 12.12 hrs, Volume= 10.010 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

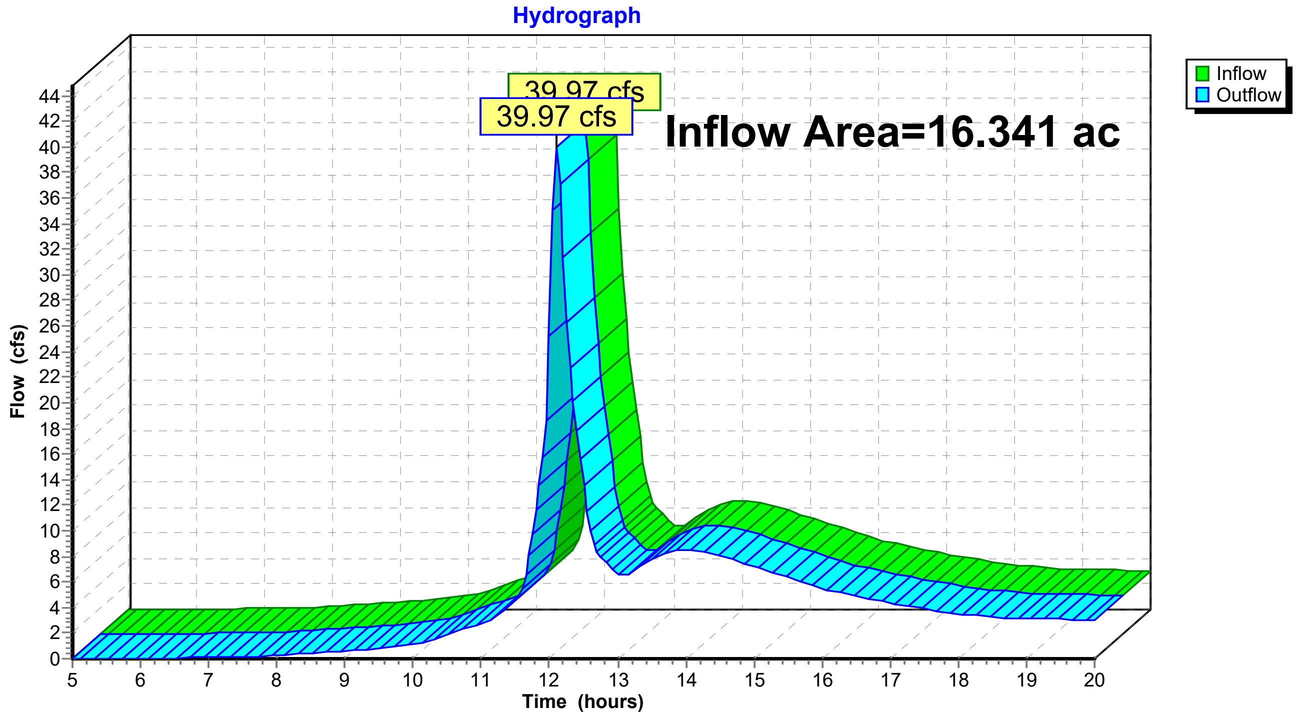


Summary for Reach TOTAL OFFSITE PROP: Full Site Prop

Inflow Area = 16.341 ac, 7.76% Impervious, Inflow Depth > 3.97" for 100-YR 24HR event
Inflow = 39.97 cfs @ 12.11 hrs, Volume= 5.400 af
Outflow = 39.97 cfs @ 12.11 hrs, Volume= 5.400 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach TOTAL OFFSITE PROP: Full Site Prop



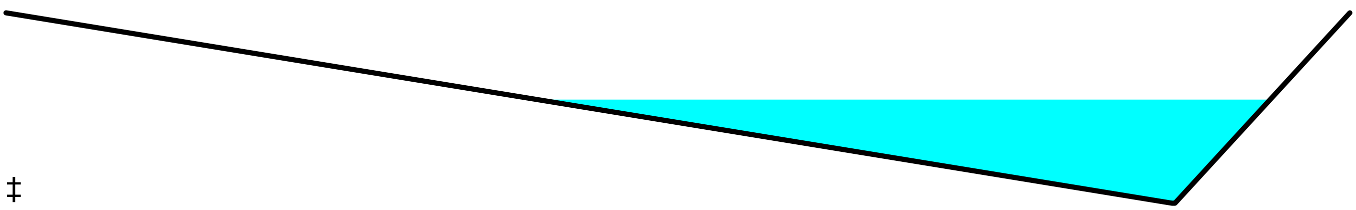
Summary for Reach West Plateau Swale: West Plateau Swale

Inflow Area = 2.085 ac, 0.00% Impervious, Inflow Depth > 5.50" for 100-YR 24HR event
Inflow = 13.14 cfs @ 12.11 hrs, Volume= 0.956 af
Outflow = 9.23 cfs @ 12.42 hrs, Volume= 0.942 af, Atten= 30%, Lag= 18.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.67 fps, Min. Travel Time= 11.8 min
Avg. Velocity = 0.31 fps, Avg. Travel Time= 25.7 min

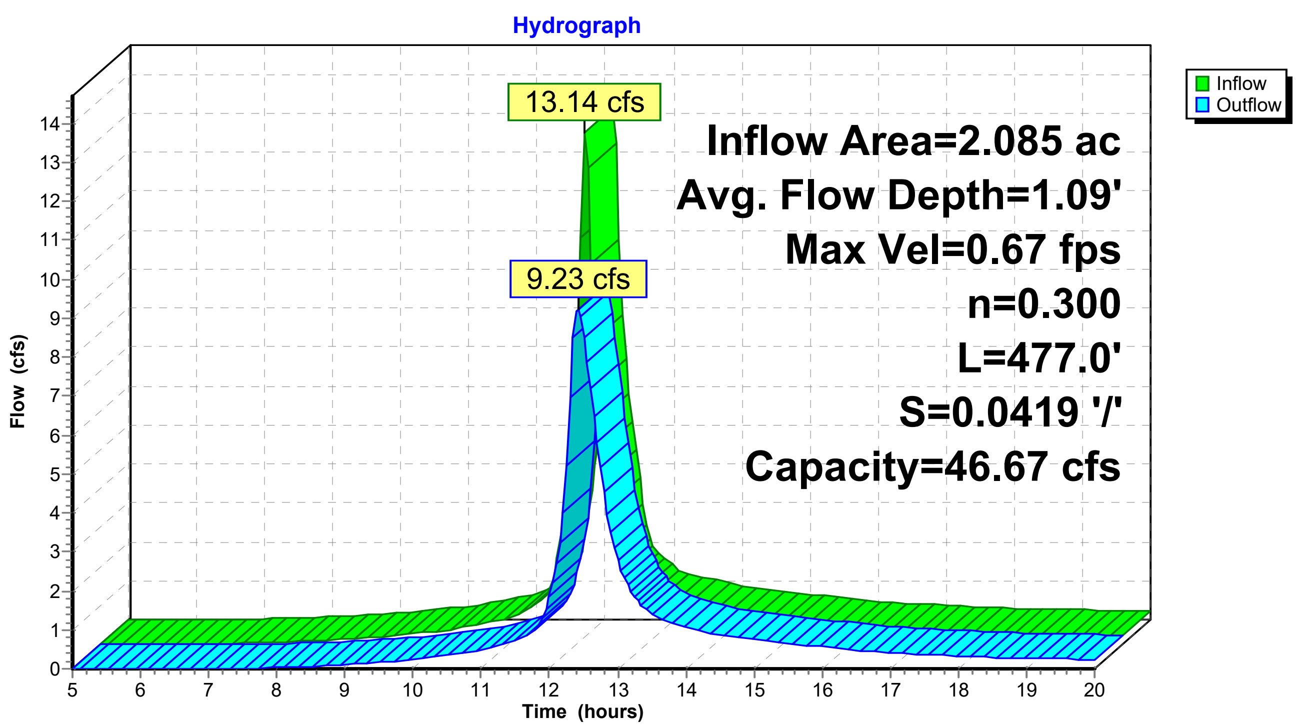
Peak Storage= 6,545 cf @ 12.22 hrs
Average Depth at Peak Storage= 1.09'
Bank-Full Depth= 2.00' Flow Area= 46.2 sf, Capacity= 46.67 cfs

0.10' x 2.00' deep channel, n= 0.300
Side Slope Z-value= 20.0 3.0 '/' Top Width= 46.10'
Length= 477.0' Slope= 0.0419 '/'
Inlet Invert= 142.00', Outlet Invert= 122.00'



‡

Reach West Plateau Swale: West Plateau Swale



Summary for Pond 3P: Detention Basin

Inflow Area = 9.853 ac, 12.86% Impervious, Inflow Depth > 5.94" for 100-YR 24HR event
Inflow = 30.78 cfs @ 12.35 hrs, Volume= 4.881 af
Outflow = 5.84 cfs @ 14.19 hrs, Volume= 2.399 af, Atten= 81%, Lag= 110.7 min
Primary = 5.84 cfs @ 14.19 hrs, Volume= 2.399 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 110.79' @ 14.19 hrs Surf.Area= 59,849 sf Storage= 130,370 cf

Plug-Flow detention time= 231.5 min calculated for 2.391 af (49% of inflow)
Center-of-Mass det. time= 138.8 min (933.2 - 794.4)

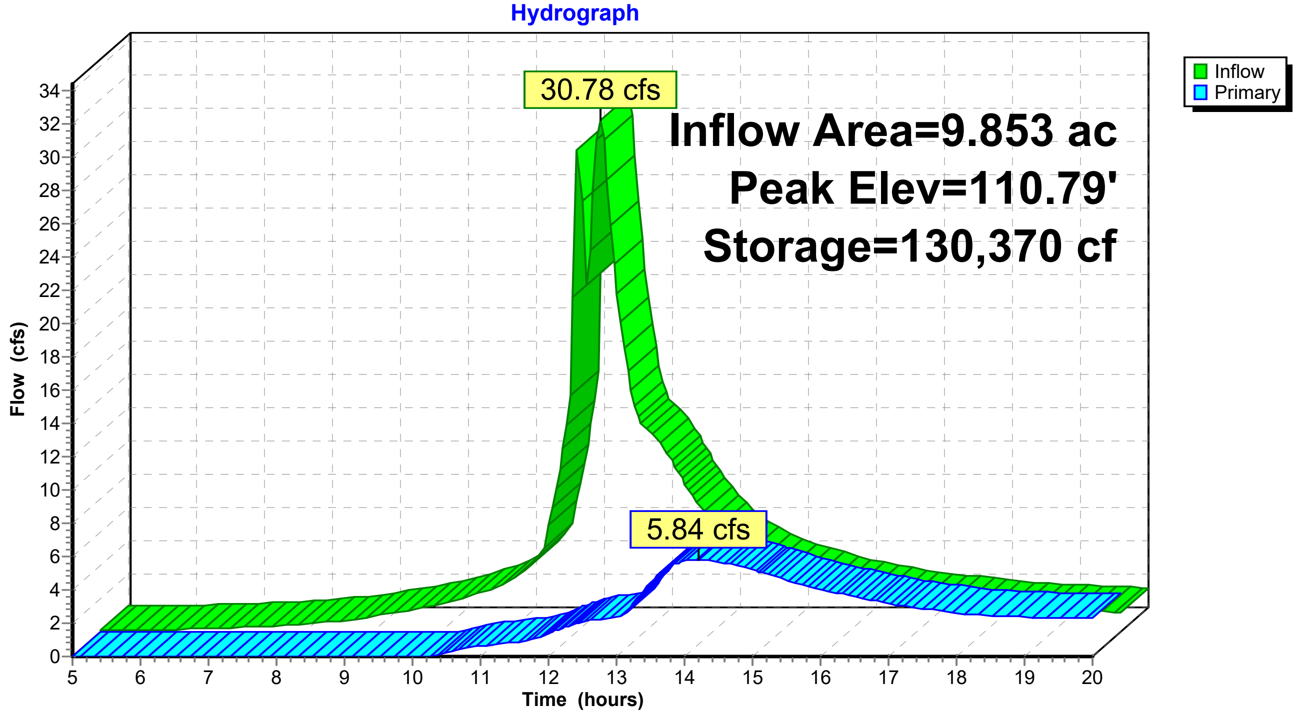
Volume	Invert	Avail.Storage	Storage Description
#1	108.20'	204,236 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

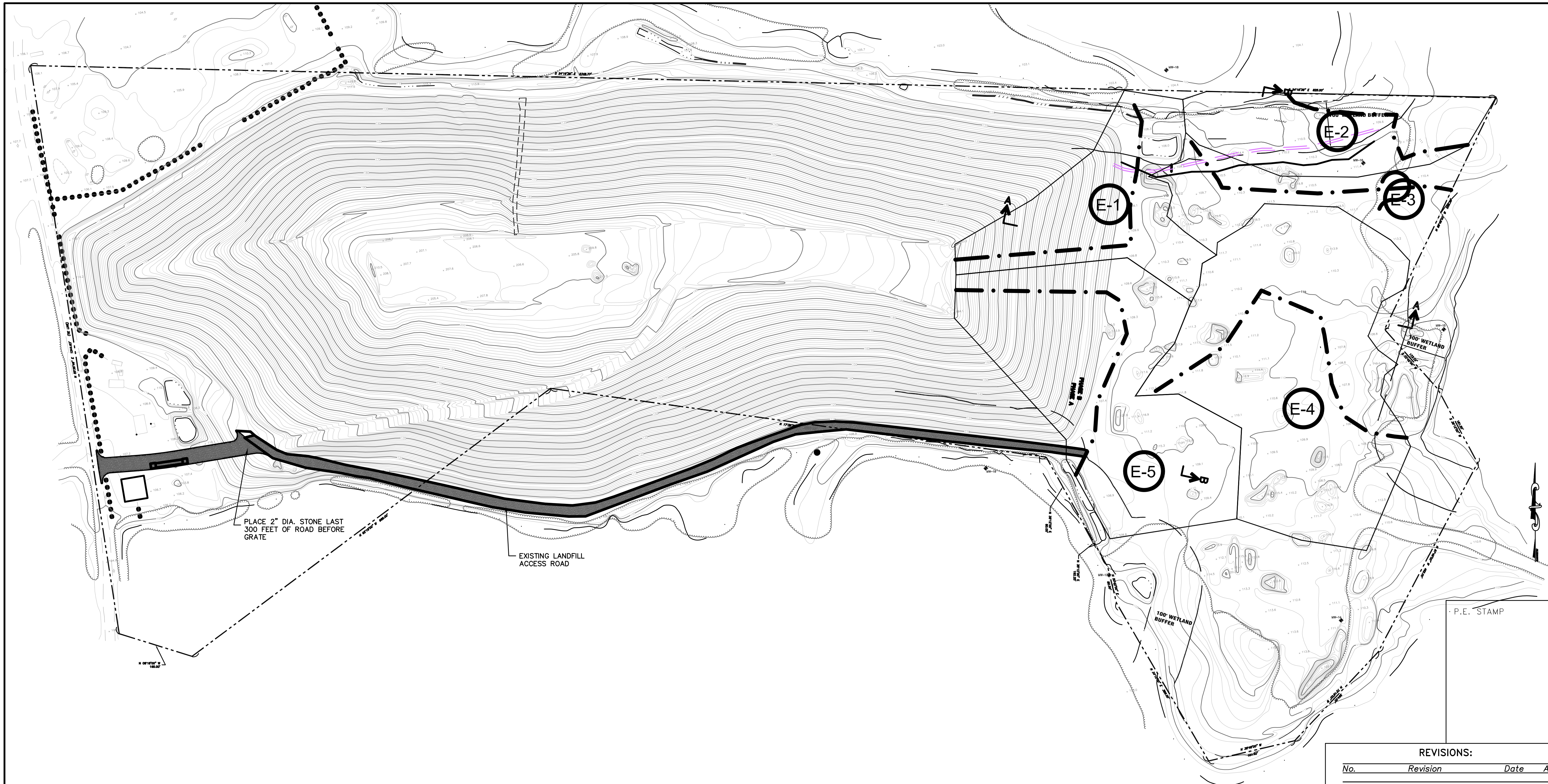
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
108.20	30,000	0	0
108.50	42,000	10,800	10,800
109.00	44,377	21,594	32,394
110.00	57,942	51,160	83,554
112.00	62,740	120,682	204,236

Device	Routing	Invert	Outlet Devices
#1	Primary	108.50'	**2.0" Horiz. Orifice/Grate X 4.00 columns** X 4 rows C= 0.600 Limited to weir flow at low heads
#2	Primary	110.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=5.84 cfs @ 14.19 hrs HW=110.79' (Free Discharge)
1=Orifice/Grate (Orifice Controls 2.55 cfs @ 7.29 fps)
2=Orifice/Grate (Weir Controls 3.29 cfs @ 1.78 fps)

Pond 3P: Detention Basin





LEGEND

PROPERTY LINE
250 EXISTING CONTOURS
PROPOSED CONTOURS
WL 12 EXISTING WETLAND

P.E. STAMP

REVISIONS:

No.	Revision	Date	Appr. By

RICHARD R. DEBENEDICTIS, P.E.

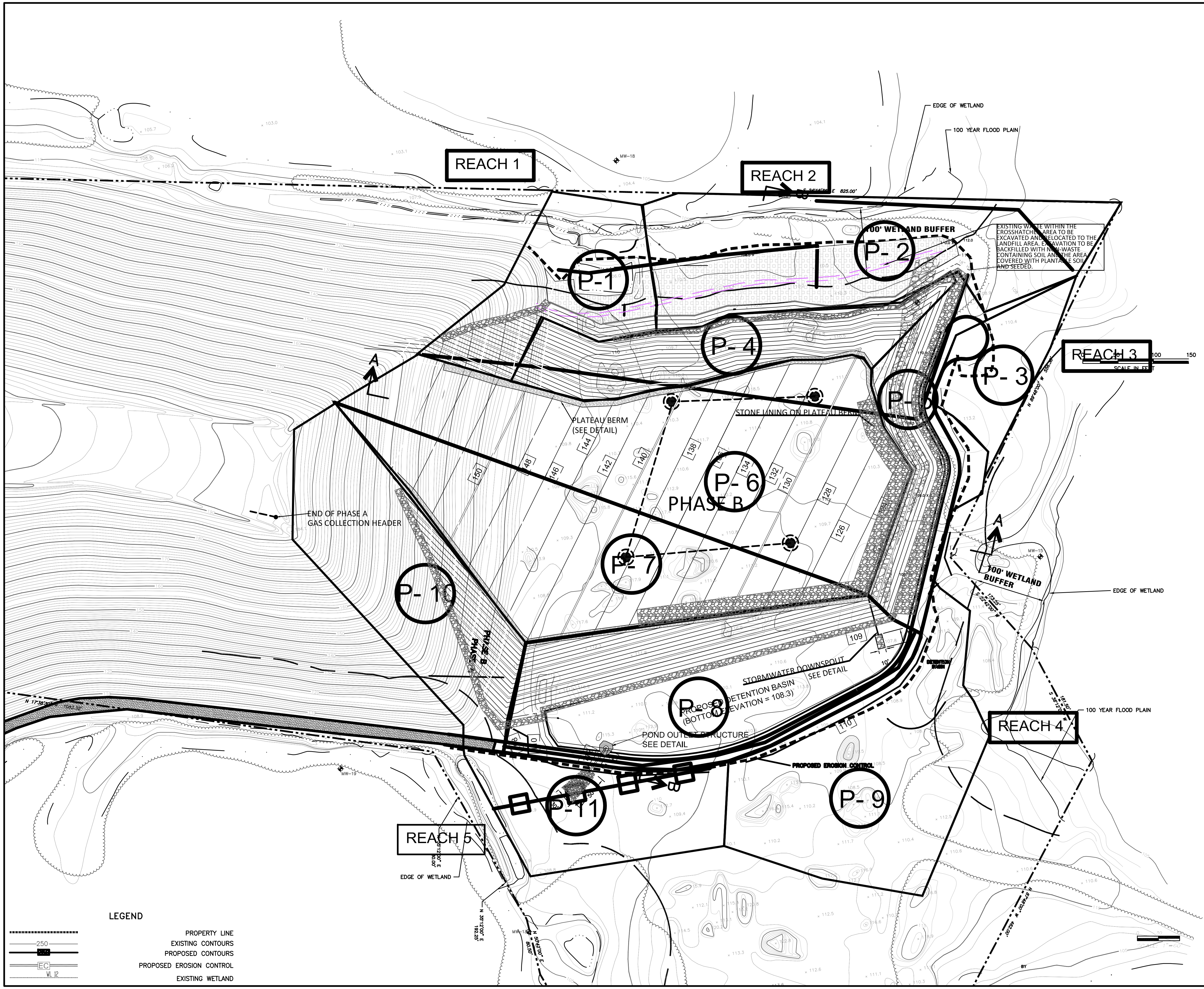
57 SANDERSON DRIVE, PLYMOUTH MASSACHUSETTS (781) 249-9435

	DRAWN	CHECKED	CAD FILE NO.
BY	JMC	RRD	
DATE	11/15/17	10/20/16	

ATTLEBORO LANDFILL CLOSURE PROJECT
EXISTING DRAINAGE AREAS
179 PECKHAM STREET
Attleboro, Massachusetts

PREPARED FOR:
ENVIRO-CYCLE, LLC
50 HOMERS WHARF
NEW BEDFORD, MASSACHUSETTS 02740

SCALE	PROJECT NO.	SHEET NUMBER
AS NOTED		Existing DA



P.E. STAMP

REVISIONS:

No.	Revision	Date	Appr. By

RICHARD R. DEBENEDICTIS, P.E.

57 SANDERSON DRIVE, PLYMOUTH MASSACHUSETTS (781) 249-9435

	DRAWN	CHECKED	CAD FILE NO.
BY	JMC	RRD	
DATE	11/15/17	11/20/17	

ATTLEBORO LANDFILL CLOSURE PROJECT

PROP. DRAINAGE AREAS

179 PECKHAM STREET

Attleboro, Massachusetts

PREPARED FOR:

ENVIRO-CYCLE, LLC

50 HOMERS WHARF

NEW BEDFORD, MASSACHUSETTS 02740

SCALE	PROJECT NO.	SHEET NUMBER
AS NOTED		PROP DA

Appendix H

Test Pit Logs

TEST PIT FIELD LOG

TEST PIT NO:	TP-1
JOB NO:	

PROJECT: Attleboro Landfill
CONTRACTOR:
TIME STARTED:
ADDRESS: 1 Rathbun Willard Dr
TIME COMPLETED:
DATE:
LOCATION:
CLIENT: Attleboro Landfill
ECE REPRESENTATIVE: B. Cummings

East Coast Engineering, Inc.
156A Front Street, P.O. Box 745
Marion, Massachusetts

DEPTH	SOIL DESCRIPTION	EXCAV. EFFORT	FIELD TESTING	NOTES
0	Recent Fill/Silty Gravel			
6"				
12"				
18"				
24"				
30"				
32"				
36"	Clay Medium Silt			
42"				
48"				
54"	C & D /Metal/Bricks			
60"				
66"				
70"				
72"				
78"				
84"				
90"				
96"				
102"				
108"				
114"				
120"				
126"				
132"				
138"				
144"				
150"				
156"				

NOTES:
1. Field testing values refr to soil sampls taken at the designated depth.

PROPORTIONS USED		ABBREVIATIONS	
TRACE (TR.)	0-10%	F-FINE	V-VERY
LITTLE (LI.)	10-20%	M-MEDIUM	GR-GRAY
SOME (SO.)	20-35%	C-COARSE	BN-BROWN
AND	35-50%	F/M-FINE TO MEDIUM	Y-YELLOW

TEST PIT FIELD LOG

TEST PIT NO: TP-2
JOB NO:

PROJEC' Attleboro Landfill
ADDRES 1 Rathbun Willard Dr
LOCATION:
CLIENT: Attleboro Landfill
ECE REPRESENTATIVE: B. Cummings

CONTRACTOR:
TIME STARTED:
TIME COMPLETED:
DATE:

East Coast
Engineering, Inc.
156A Front Street, P.O. Box 745
Marion, Massachusetts

DEPTH	SOIL DESCRIPTION	EXCAV. EFFORT	FIELD TESTING	NOTES
0	Recent Fill (Silty Sand)			
6"				
12"				
18"				
24"				
30"	Old Fill (Silty Sands)			
36"				
42"				
48"				
54"				
60"				
66"	Wood Waste/Water at 72"			
72"				
78"				
84"				
90"				
96"				
102"				
108"				
114"				
120"				
126"				
132"				
138"				
144"				
150"				
156"				

NOTES:
1. Field testing values refr to soil sampls taken at the designated depth.

PROPORTIONS USED	ABBREVIATIONS	
TRACE (TR.)..0-	F-FINE	V-VERY
LITTLE (LI.)..10	M-MEDIUM	GR-GRAY
SOME (SO.)..20-	C-COARSE	BN-BROWN
AND..35-5	F/M-FINE TO MEDIUM	Y-YELLOW

TEST PIT FIELD LOG

TEST PIT NO: TP-3
JOB NO:

PROJEC' Attleboro Landfill
ADDRES 1 Rathbun Willard Dr
LOCATION:
CLIENT: Attleboro Landfill
ECE REPRESENTATIVE: B. Cummings

CONTRACTOR:
TIME STARTED:
TIME COMPLETED:
DATE:

East Coast Engineering, Inc.
156A Front Street, P.O. Box 745
Marion, Massachusetts

DEPTH	SOIL DESCRIPTION	EXCAV. EFFORT	FIELD TESTIN G	NOTES
0				
6"				
12"				
18"				
24"				
30"				
36"				
42"				
48"				
54"				
60"	Med Sand /Silt (0"-18" Some New Fill)			
66"				
72"				
78"				
84"				
90"				
96"				
102"				
108"				
114"				
120"				
126"				
132"				
138"				
144"				
150"				
156"				

NOTES:
1. Field testing values refr to soil sampls taken at the designated depth.

PROPORTIONS USED	ABBREVIATIONS	
TRACE (TR.)..0-	F-FINE	V-VERY
LITTLE (LI.)..10	M-MEDIUM	GR-GRAY
SOME (SO.)..20-	C-COARSE	BN-BROWN
AND..35-	F/M-FINE TO MEDIUM	Y-YELLOW

TEST PIT FIELD LOG

TEST PIT NO:	TP-4
JOB NO:	

PROJEC Attleboro Landfill	CONTRACTOR:
	TIME STARTED:
ADDRES 1 Rathbun Willard Dr	TIME COMPLETED:
	DATE:
LOCATION:	
CLIENT: Attleboro Landfill	
ECE REPRESENTATIVE:	B. Cummings

East Coast
Engineering, Inc.
156A Front Street, P.O. Box 745
Marion, Massachusetts

DEPTH	SOIL DESCRIPTION	EXCAV. EFFORT	FIELD TESTIN G	NOTES
0				
6"				
12"	New Fill (From Silty Sand)			
18"				
24"				
30"				
36"				
42"				
48"				
54"				
60"	Silty Sand (Original Grade) (Oxidation at 60")			
66"				
72"				
78"				
84"				
90"				
96"				
102"				
108"				
114"				
120"				
126"				
132"				
138"				
144"				
150"				
156"				

NOTES:
1. Field testing values refr to soil sampls taken at the designated depth.

PROPORTIONS USED	ABBREVIATIONS	
TRACE (TR.)..0-	F-FINE	V-VERY
LITTLE (LI.)..10	M-MEDIUM	GR-GRAY
SOME (SO.)..20-	C-COARSE	BN-BROWN
AND..35-5	F/M-FINE TO MEDIUM	Y-YELLOW

tp5

TEST PIT FIELD LOG

TEST PIT NO: TP-5
JOB NO:

PROJEC Attleboro Landfill
CONTRACTOR:
TIME STARTED:
ADDRES: 1 Rathbun Willard Dr
TIME COMPLETED:
DATE:
LOCATION:
CLIENT: Attleboro Landfill
ECE REPRESENTATIVE: B. Cummings

East Coast
Engineering, Inc.
156A Front Street, P.O. Box 745
Marion, Massachusetts

DEPTH	SOIL DESCRIPTION	EXCAV. EFFORT	FIELD TESTING	NOTES
0	New Fill			
6"				
12"				
18"				
24"				
30"	Old Fill - Fine Sand Remains Burning Dump			
36"				
42"				
48"				
54"				
60"	Sandy Silt			
66"				
72"				
78"				
84"				
90"				
96"				
102"				
108"				
112"				
114"				
120"				
126"				
132"				
138"				
144"				
150"				
156"				

NOTES:
1. Field testing values refr to soil sampls taken at the designated depth.

PROPORTIONS USED	ABBREVIATIONS	
TRACE (TR.)..0-	F-FINE	V-VERY
LITTLE (LI.)..10-	M-MEDIUM	GR-GRAY
SOME (SO.)..20-	C-COARSE	BN-BROWN
AND..35-5	F/M-FINE TO MEDIUM	Y-YELLOW

TEST PIT FIELD LOG

TEST PIT NO: TP-6
JOB NO:

PROJEC` Attleboro Landfill
CONTRACTOR:
TIME STARTED:
ADDRES 1 Rathbun Willard Dr
TIME COMPLETED:
DATE:
LOCATION:
CLIENT: Attleboro Landfill
ECE REPRESENTATIVE: B. Cummings

East Coast
Engineering, Inc.
156A Front Street, P.O. Box 745
Marion, Massachusetts

DEPTH	SOIL DESCRIPTION	EXCAV. EFFORT	FIELD TESTIN G	NOTES
0				
6"				
12"	Miscellaneous New Fill			
18"				
24"				
30"				
36"				
42"				
48"				
54"	Medium to Course Sands and S,H No Water			
60"				
66"				
72"				
78"				
84"				
90"				
96"				
102"				
108"				
114"				
120"				
126"				
132"				
138"				
144"				
150"				
156"				

NOTES:
1. Field testing values refr to soil sampls taken at the designated depth.

PROPORTIONS USED	ABBREVIATIONS	
TRACE (TR.)..0-	F-FINE	V-VERY
LITTLE (LI.)...10	M-MEDIUM	GR-GRAY
SOME (SO.)..20-	C-COARSE	BN-BROWN
AND...35-!	F/M-FINE TO MEDIUM	Y-YELLOW

TEST PIT FIELD LOG

TEST PIT NO: TP-7
JOB NO:

PROJEC⁻ Attleboro Landfill
ADDRES: 1 Rathbun Willard Dr
LOCATION:
CLIENT: Attleboro Landfill
ECE REPRESENTATIVE: B. Cummings

CONTRACTOR:
TIME STARTED:
TIME COMPLETED:
DATE:

East Coast
Engineering, Inc.
156A Front Street, P.O. Box 745
Marion, Massachusetts

DEPTH	SOIL DESCRIPTION	EXCAV. EFFORT	FIELD TESTIN G	NOTES
0	Recent Fill (Silty Sand)			
6"				
12"				
15"				
18"	Old Fill Silty Sand			
24"				
30"				
36"				
42"				
48"				
54"				
60"				
66"	C & D Layer			
72"				
78"				
84"	Fine Sand			
90"				
96"				
102"				
108"				
114"				
120"				
126"				
132"				
138"				
144"				
150"				
156"				

NOTES:
1. Field testing values refr to soil sampls taken at the designated depth.

PROPORTIONS USED	ABBREVIATIONS	
TRACE (TR.)..........0-	F-FINE	V-VERY
LITTLE (LI.)..........10-	M-MEDIUM	GR-GRAY
SOME (SO.)..........20-	C-COARSE	BN-BROWN
AND..........35-5	F/M-FINE TO MEDIUM	Y-YELLOW

TEST PIT FIELD LOG

TEST PIT NO: TP-8
JOB NO:

PROJEC' Attleboro Landfill
CONTRACTOR:
TIME STARTED:
ADDRES: 1 Rathbun Willard Dr
TIME COMPLETED:
DATE:
LOCATION:
CLIENT: Attleboro Landfill
ECE REPRESENTATIVE: B. Cummings

East Coast Engineering, Inc.
156A Front Street, P.O. Box 745
Marion, Massachusetts

DEPTH	SOIL DESCRIPTION	EXCAV. EFFORT	FIELD TESTIN G	NOTES
0	Fill (Cover)			
6"				
12"				
18"				
24"	C & D Some Tires - Some Paper			
30"				
36"				
42"				
48"				
54"				
60"				
66"				
72"				
78"				
80"				
84"				
90"				
96"				
102"				
108"				
114"				
120"				
126"				
132"				
138"				
144"				
150"				
156"				

NOTES:
1. Field testing values refr to soil sampls taken at the designated depth.

PROPORTIONS USED	ABBREVIATIONS	
TRACE (TR.)..0-	F-FINE	V-VERY
LITTLE (LI.)..10-	M-MEDIUM	GR-GRAY
SOME (SO.)..20-	C-COARSE	BN-BROWN
AND..35-5	F/M-FINE TO MEDIUM	Y-YELLOW


DIRT PILES AVERAGE ELEVATION 111.0
DIRT PILES AVERAGE ELEVATION 113.0
TP1
TP2
TP#3
TP4
TP5
#7
#8
TP#8
0"-18"
130
120
110
+ 109.5
+ 109.5
+ 109.5
110.3
+ 105.9
+ 104.2
+ 104.1
+ 104.0
+ 108.6
+ 105.7
110.6
106.8
113.0
+ 107.0
+ 107.0
+ 107.4
+ 109.9
+ 108.9
+ 108.6
112.6
112.6
112.1
111.6
111.5
110.9
116.0
108.3

SUPPLEMENTAL TEST PITS

ATTLEBORO LANDFILL

PHASE B AREA

CONDUCTED BY:

Engineering & Management Services, Inc.
7 Allen Road
Rochester, MA 02770

AUGUST 13, 2009

<u>Test Pit BC-1</u>
0’ – 2’ Fill
2’ – 12’ C&D type fill, some burned
12’ + Old ground

Water @ 6’

Test Pit BC-2

0' – 3.5' Fill

3.5' – 11' Buried stumps and logs

11' + Old ground

Water @ 7'

Test Pit BC-3

0' – 4' Fill

4' – 12' C&D debris

12' + Old ground

Water @ 8'

Test Pit BC-4

0' – 2'   Fill

2' – 9'   C&D type fill

9' +   Old ground

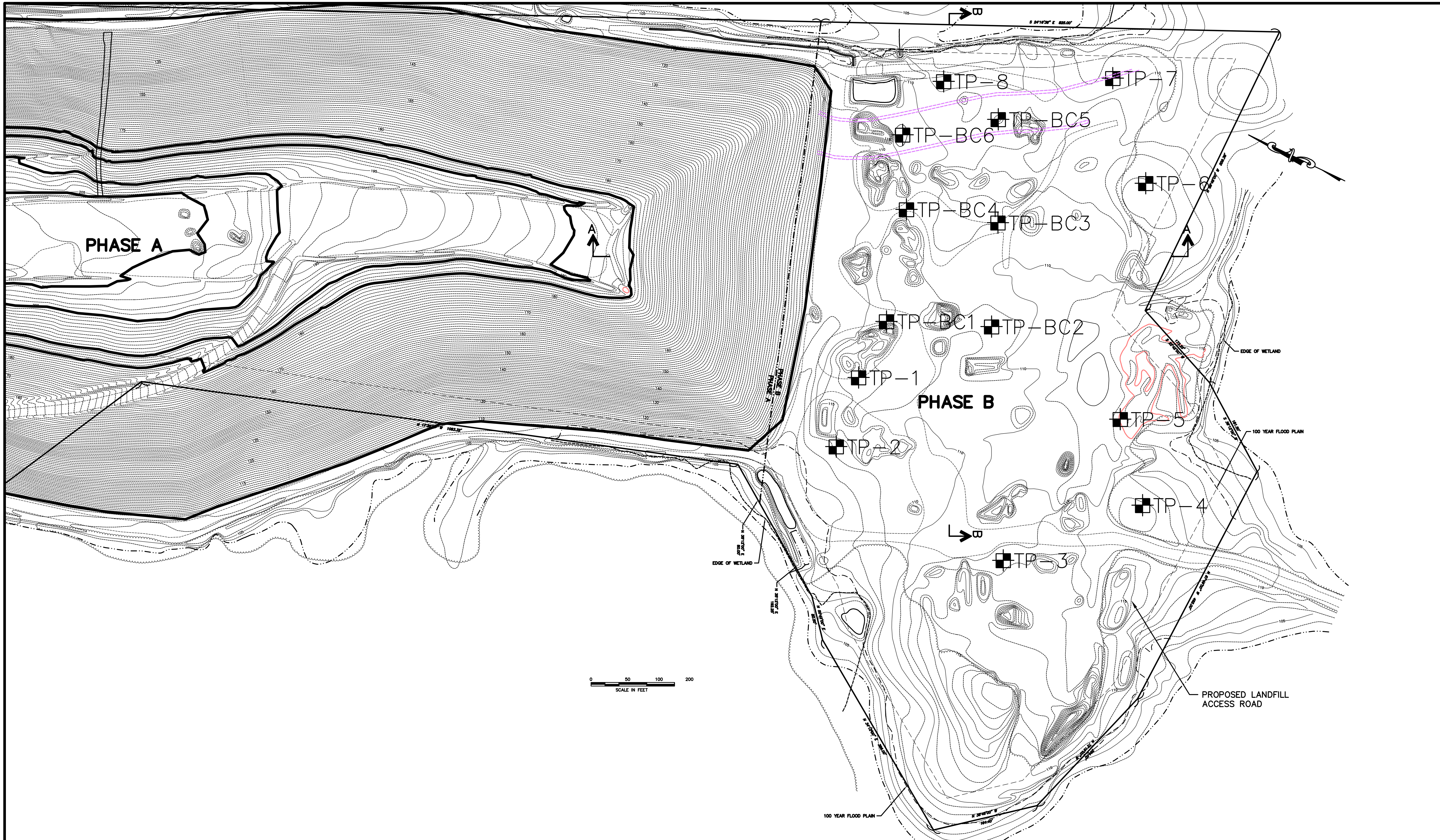
Water @ 5'

Test Pit BC-5
0' – 3' Fill
3' – 11' Logs, stumps
11' + Old ground

Water @ 7'

Test Pit BC-6
0’ – 3’ Fill
3’ – 10’ tires and debris
10’ + Old ground

Water @ 5’



REV.	DATE	DESCRIPTION	BY	APP.

SCALE: AS -NOTED

DATE: AUGUST 2009

DRAWN BY: RMS

DESIGNED BY: RSC

CHECKED BY: RSC

FILE NO:

EMS
ENGINEERING & MANAGEMENT SERVICES, INC.
7 ALLEN ROAD, ROCHESTER, MA 02770
TEL:(508) 763-8800 FAX (508) 763-2020

CLIENT: ENDCAP TECHNOLOGIES
ATTLEBORO LANDFILL,

DRAWING TITLE: PHASE B
TEST PIT PLAN

DRAWING NO: TP – 1

Appendix I

Administrative Consent Order

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

In the Matter of:

Albert Dumont and
Attleboro Landfill, Inc.
1 Rathbun Willard Drive
Attleboro, Massachusetts 02703

&

Enviro-Cycle, LLC
50 Homers Wharf
New Bedford, MA 02740

Enforcement Document Number: 00002501
Issuing Bureau: BAW
Issuing Region/Office: SERO
Issuing Program: SW
Primary Program Cited: SW
FMF/Program ID # 132263

ADMINISTRATIVE CONSENT ORDER

I. THE PARTIES

1. The Department of Environmental Protection (the "MassDEP" or the "Department") is a duly constituted agency of the Commonwealth of Massachusetts established pursuant to M.G.L. c. 21A, § 7. MassDEP maintains its principal office at One Winter Street, Boston, Massachusetts 02108, and its Southeast Regional Office at 20 Riverside Drive, Lakeville, Massachusetts, 02347.

2. Attleboro Landfill, Inc. is a Massachusetts corporation with its principal office located at One Rathbun Willard Drive, Attleboro, Massachusetts 02703. Attleboro Landfill, Inc.'s mailing address for the purpose of this Consent Order is One Rathbun Willard Drive, Attleboro, Massachusetts 02703. Albert Dumont ("Dumont") is the sole officer and director of Attleboro Landfill, Inc. For purposes of this Consent Order Attleboro Landfill, Inc. and Albert Dumont are referred to collectively as ALI.

3. Enviro-Cycle, LLC ("Enviro-Cycle" and/or the "Operator") is a Massachusetts Limited Liability Company which maintains its principal offices at 50 Homers Wharf, New Bedford, Massachusetts 02740. Enviro-Cycle's mailing address for the purpose of this Consent Order is 50 Homers Wharf, New Bedford, Massachusetts 02740.

4. Hereinafter, ALI and Enviro-Cycle shall be referred to and collectively known as the "Respondents".

5. Hereinafter, MassDEP and the Respondents will be referred to and collectively known as the "Parties".

II. STATEMENT OF FACTS AND LAW

6. MassDEP is responsible for the implementation and enforcement of M.G.L. c. 111, §§ 150A and 150A1/2, the Solid Waste Management Regulations at 310 CMR 19.000, the Site Assignment Regulations for Solid Waste Facilities at 310 CMR 16.00, and the Massachusetts Contingency Plan ("MCP") at 310 CMR 40.0000. MassDEP has authority under M.G.L. c. 21A, § 16 and the Administrative Penalty Regulations at 310 CMR 5.00 to assess civil administrative penalties to persons in noncompliance with the laws and regulations set forth above.

7. Attleboro Landfill, Inc. is the owner/operator of a solid waste disposal facility (the "Landfill") located off Peckham Street, Attleboro, Massachusetts.

8. Enviro-Cycle is a Massachusetts Limited Liability Company established to market a recycled material known as "Re-Crete™" for various construction applications. Re-Crete™ is a mixture of construction and demolition ("C&D") material fines produced at C&D material processing facilities and concrete.

9. The following facts and allegations have led MassDEP to issue this Consent Order:

A. MassDEP records indicate that the Landfill consists of approximately 55 acres of land that have been divided into two areas Phase A and Phase B. Phase A of the Landfill consists of approximately 32 acres and Phase B of the Landfill consists of approximately 23 acres. Solid waste has been disposed of in both Phase A and in approximately 9.9 acres of Phase B. Phase A is unlined and capped. The disposal area of Phase B is unlined and uncapped. The Landfill has been granted a solid waste site assignment in accordance with M.G.L. c. 111, §§ 150A and 150A1/2, by the City of Attleboro as a solid waste disposal facility.

B. The Landfill operated as an open dump from approximately 1942 to 1975. In 1975, the solid waste disposal operation at the Landfill (i.e., Phase A) was converted to a solid waste sanitary landfill under the terms and conditions of a plan approval issued by MassDEP. ALI operated Phase A from 1975 to 1994.

C. On December 30, 1992, MassDEP issued a partial approval for the closure and capping of Phase A. The partial approval was based on proposed plans to develop and operate the Phase B area as a lateral expansion of the solid waste Landfill. According to the regulations at the time of permit issuance, the Phase B area was required to be constructed with a liner and leachate collection system. As proposed, the liner of Phase B would serve as the cap for the rear side-slope of Phase A.

D. On or about December 24, 1993, ALI advised MassDEP that ALI was not going to pursue plans for the development of Phase B.

E. On or about June 30, 1994, ALI ceased accepting solid waste in Phase A.

F. On or about May 5, 1995, ALI submitted final closure plans for Phase A.

G. On June 16, 1995, MassDEP issued a provisional permit to ALI to complete the capping of Phase A.

H. Subsequent to June 16, 1995, and after numerous inspections, meetings and discussions, and the failure of ALI to successfully close/cap Phase A, MassDEP and ALI entered into an Administrative Consent Order (#ACO-SE-01-4004) (2001 Consent Order) on September 7, 2001. The 2001 Consent Order established specific compliance timeframes, deadlines and requirements for: the capping and continued maintenance of Phase A, the capping of Phase B, the establishment of a Financial Assurance Mechanism ("FAM"), the remediation of impacted wetland resource areas, the continued routine performance of quarterly environmental monitoring, and the continued routine performance of monthly landfill gas characterization for the facility's landfill gas to energy plant. The 2001 Consent Order also required that ALI achieve and maintain overall compliance with all applicable solid waste regulations and requirements applicable to the Landfill.

I. On February 1, 2002, MassDEP amended the 2001 Consent Order (“2002 Amendment”) by extending the deadline for the submittal of a BWPSW25 closure plan for Phase B until March 7, 2002.

J. On August 23, 2002, ALI submitted a Closure Certification Report pursuant to 310 CMR 19.140 certifying the final closure of Phase A.

K. In November of 2003 representatives of ALI and representatives of MassDEP met to discuss compliance issues associated with the 2001 Consent Order and 2002 Amendment and ALI’s conceptual proposal for closure of Phase B in accordance with the “Revised Guidelines for Determining Closure Activities at Inactive Unlined Landfill Sites” dated July 6, 2001 (“Closure Guidelines”). Representatives of ALI submitted Phase B closure proposals and held numerous discussions with MassDEP in 2004 concerning the Phase B closure. In the Fall of 2004 MassDEP informed ALI that MassDEP would not approve the Phase B closure proposal then being discussed, and ALI withdrew it in October 2004.

L. On February 11, 2005, MassDEP issued a Unilateral Administrative Order (UAO – SE-05-4003) ("UAO") and a Penalty Assessment Notice (PAN-SE-05-4001) ("PAN") to ALI as a result of non-compliance with the 2002 Amendment. ALI subsequently appealed these actions to the Division of Administrative Law Appeals ("DALA"), which later transferred the case to MassDEP's Office of Appeals and Dispute Resolution ("OADR"). Based on ALI's financial situation, the Parties requested that the appeal be stayed while the Parties attempted to resolve the issues; primarily, the proper capping and closure of Phase B and the funding mechanism for post-closure maintenance and monitoring of the Landfill. ALI has represented that it has limited financial resources to complete the Phase B closure and associated Landfill monitoring and maintenance required under 310 CMR 19.000, the Solid Waste Management Regulations. The DALA Administrative Magistrate and the OADR Presiding Officer directed the Parties to submit periodic status reports concerning their settlement efforts (DEP Docket Nos. 2005-051 and 2005-072).

M. On May 8, 2006, ALI, through its environmental consultant, submitted an application for a minor modification of the Landfill permit seeking to reduce the groundwater monitoring program at the Landfill. ALI asserted that it was unable financially to perform the full scope of environmental monitoring.

N. On January 3, 2007, MassDEP issued a Provisional Approval of a Temporary Post-Closure Ground Water Monitoring Program for the Landfill. The Provisional Approval contained conditions, including reiterating ALI's obligation to continue its efforts to fund and perform the closure/capping of Phase B and to establish a Financial Assurance Mechanism ("FAM") for all closure/post-closure monitoring and maintenance costs for the Landfill.

O. From 2002 to 2012 ALI and its consultants submitted several conceptual proposals/plans to MassDEP under MassDEP's Closure Guidelines. The purpose of these conceptual proposals/plans was to provide a means to generate revenue for Phase B closure and Landfill monitoring and maintenance through the use of grading and shaping materials to reshape Phase B to meet the regulatory requirements for a proper landfill cap. The conceptual proposals/plans were submitted in an effort to resolve the noncompliance and settle the appeals of the UAO and PAN.

P. In 2013 ALI retained Enviro-Cycle, LLC, to develop a new closure plan for Phase B of the Landfill (hereinafter, the "Site") on behalf of ALI.

Q. In November 2013, Enviro-Cycle submitted to MassDEP a conceptual closure proposal, on behalf of ALI, to grade and shape Phase B with "Re-Crete™" which is a mixture of C&Dmaterial fines produced at C&D material processing facilities and concrete. The use of C&D fines was intended to provide the necessary funding to cover expenses associated with the Phase B grading and shaping activities, Phase B final cover system construction, and post closure monitoring and maintenance of the Landfill. Representatives of ALI, Enviro-Cycle, and MassDEP discussed the technical specifications of the project at various times in 2014.

R. On May 14, 2014, MassDEP conducted an inspection of the Landfill and reviewed the Landfill files. MassDEP determined that many of the previously observed violations of 310 CMR 19.000, as described in UAO–SE-05-4003, had not been corrected. The issues of noncompliance included:

i. **310 CMR 19.051 – Financial Assurance Mechanism ("FAM")** – A FAM for the Landfill final cover system and post-closure monitoring and maintenance has not been secured and maintained.

ii. **310 CMR 19.112 – Landfill Final Cover Systems** - A final cover system on the Phase B area of the Landfill has not been installed.

iii. **310 CMR 19.132(1)&(4) – Environmental Monitoring Requirements** - Environmental monitoring data/reports for ground water, surface water, and landfill gas have not been submitted.

iv. **310 CMR 19.140 – Landfill Closure Requirements** – A final closure/capping plan has not been submitted and Phase B has not been capped.

v. **310 CMR 19.142 – Landfill Post-Closure Requirements –** The Landfill has not been maintained in accordance with applicable post-closure requirements.

S. Enviro-Cycle prepared and submitted to MassDEP a "Conceptual Closure Proposal" for Phase B, dated December 2, 2014, in accordance with MassDEP's Closure Guidelines. As proposed in the Conceptual Closure Proposal, the project would include the on-Site production of "Re-Crete™" for landfill grading and shaping material and the following:

i. A closure timeframe of approximately three (3) years would be established, whereby approved Site closure grading/shaping materials would be delivered and placed during approximately the first two (2) years for six days a week, in order to achieve a proper minimum 5 percent closure grades/configuration, and during the third year, the Site's final capping system would be constructed;

ii. The total amount of Re-Crete™ would be approximately 201,000 cubic-yards ("yds3");

iii. All C&D fines would be delivered to the Site and the mixing of the C&D fines, concrete and water would take place at the Landfill to produce Re-Crete™;

iv. The final maximum peak elevation of the capped Site (Phase B) will be approximately 140-feet above mean sea level, approximately 30 feet above existing grade and which is approximately 70 feet below the peak elevation of 210 feet of the completed Phase A;

v. Over the first two years approximately 9,136 trucks will deliver Re-Crete™ to the Site; and

vi. All truck traffic to and from the Landfill was proposed through the Town of Norton.

T. On March 10, 2015, pursuant to the Closure Guidelines, ALI and Enviro-Cycle sponsored a public information session to describe the Phase B Conceptual Closure Proposal. On March 10, 2015, MassDEP also established a twenty-one (21) day Public Comment Period that ended on April 11, 2015. MassDEP provided the comments received during the public comment period to Enviro-Cycle for review.

U. Enviro-Cycle developed a traffic control plan and met with City of Attleboro and Town of Norton officials on July 26, 2016 to review the Draft Traffic Control Plan.

V. ALI, Enviro-Cycle and MassDEP prepared responses to the comments received on the Conceptual Closure Proposal and held several meetings to discuss the proposal with state and local officials.

W. On February 16, 2017, Enviro-Cycle prepared and submitted to MassDEP a document entitled "Attleboro Landfill Inc. Response to Public Comments on the Attleboro Conceptual Closure Project" ("Response to Comments") and a separate Traffic Control Plan with revised haul routes.

X. As proposed in the February 16, 2017, Response to Comments, the project was modified to include the following:

i. A closure timeframe of approximately three (3) years would be established, whereby existing Phase B waste would be consolidated and approved. Grading/shaping materials would be delivered and placed during approximately the first two (2) years, five days a week, in order to achieve proper Site closure grades/configuration, and during the third year, the Site's final capping system would be constructed;

ii. The total amount of Re-Crete™ would be approximately 231,000 cubic-yards (“yds3”). The increase in volume is to allow sufficient funds to pay for additional mitigation funds for the city of Attleboro and Town of Norton to cover road construction work;

iii. All Re-Crete™ used would be pre-mixed at the site of C&D fines generation and delivered to the Site ready to be placed;

iv. The final maximum peak elevation of the capped Site (Phase B) will be approximately 150-feet above mean sea level, which is approximately 60 feet below the peak elevation of 210 feet of Phase A;

v. During the first two years approximately 6,571 trucks will deliver Re-Crete™ to the Site; and

vi. A separate Traffic Control Plan with revised routes with incoming Re-Crete™ loaded vehicles traveling through the City of Attleboro and empty, outgoing vehicles travelling through the Town of Norton.

Y. As directed by the DALA Administrative Magistrate and OADR Presiding Officer, the parties have submitted periodic status reports concerning their settlement efforts (DEP Docket Nos. 2005-051 and 2005-072). On March 27, 2018, the parties participated in a Status Conference with the Presiding Officer to discuss their settlement efforts.

Z. MassDEP has determined that Enviro-Cycle’s revised Conceptual Closure Proposal as described in Paragraph 9.X., above, meets the requirements of the Solid Waste Regulations and the Closure Guidelines, and notified the Respondents that they may proceed with the preparation and submittal of requisite permit applications pursuant to the applicable requirements set forth at 310 CMR 19.000, and as required by this Consent Order regarding the Corrective Action for Phase B of the Landfill.

III. DISPOSITION and ORDER

For the reasons set forth above, MassDEP hereby issues, and the Respondents hereby consent to the following:

10. The Parties have agreed to enter into this Consent Order because they agree that it is in their own interests, and in the public interest, to proceed promptly with the actions called for herein rather than to expend additional time and resources litigating the matters set forth above. Respondents enter into this Consent Order without admitting or denying the facts or allegations set forth herein. However, Respondents agree not to contest such facts and allegations for the limited purposes of the issuance or enforcement of this Consent Order.

11. MassDEP's authority to issue this Consent Order is conferred by the Statutes and Regulations cited in Part II of this Consent Order.

12. Respondents shall perform the following actions:

A. The Respondents shall submit all required permit applications associated with this project (including responses to any MassDEP comments) in accordance with the provisions of 310 CMR 4.00 "Timely Action Schedule and Fee Provisions" regulations. MassDEP shall conduct its review of the Respondents' permit applications in accordance with the timelines and requirements of 310 CMR 4.00 and shall not unreasonably withhold its approval of such permit applications.

IMPLEMENTATION OF ENVIRONMENTAL SITE ASSESSMENT

B. Within sixty (60) days of the Effective Date of this Consent Order, the Respondents shall submit to MassDEP a BWPSW12 – ISA/CSA-Scope of Work ("ISA/CSA-SOW") permit application for the Landfill. The ISA/CSA-SOW application shall comply with all applicable provisions and requirements outlined at 310 CMR 19.150 and MassDEP's "Landfill Technical Guidance Manual" dated May 1997 (the "Manual").

C. Within one-hundred and twenty (120) days of MassDEP's approval of the ISA/CSA-SOW permit application, the Respondents shall complete installation of any additional monitoring locations (i.e., groundwater monitoring wells, soil gas monitoring wells, etc.) in accordance with the terms and conditions of the ISA/CSA-SOW permit decision.

D. Within three-hundred-sixty-five (365) days of the Effective Date of this Consent Order, the Respondents shall complete the Comprehensive Site Assessment ("CSA") in accordance with the terms and conditions of the ISA/CSA-SOW approval and/or as may be supplemented pursuant to MassDEP's review determination of the interim ISA/CSA report as described in Paragraph 12.B.

E. Within four-hundred and fifty-five (455) days of the Effective Date of this Consent Order, the Respondents shall submit a CSA Report that discusses the findings of the environmental site assessment of the Landfill. The CSA Report shall include a recommendation as to whether additional corrective actions beyond the MassDEP's final approved CAD permit (as referenced in Paragraph 12.I) for the Site in the form of a Corrective Action Alternatives Analysis ("CAAA") is necessary.

i. If MassDEP determines that a CAAA is not necessary, the Respondents shall proceed with the implementation of MassDEP's final approved CAD permit.

ii. If MassDEP determines that a CAAA is necessary, and that the Site's final capping system will need to be of a different design from that which has been previously described in MassDEP's final approved CAD permit (as referenced in Paragraph 12.I, the Respondents shall, within sixty (60) days of MassDEP's issuance of written approval of the final CSA Report, submit a BWPSW24 - CAAA application to MassDEP for review and approval.

iii. In addition, if MassDEP determines that a CAAA is necessary, and if MassDEP determines that the Site's final capping system will be of a different design from that which had been previously described in MassDEP's final approved CAD permit, the Respondents shall prepare and submit a revised BWPSW25 – CAD application to MassDEP for review and approval. Nothing herein shall prohibit a phased final closure.

F. Environmental monitoring of the Landfill shall be performed on a routine schedule throughout the duration of the Site closure project pursuant to MassDEP's approval of the ISA/CSA-SOW. The environmental monitoring results shall be submitted to MassDEP in accordance with 310 CMR 19.132, *Environmental Monitoring Requirements*, or in accordance with a schedule established in the approved ISA/CSA-SOW and/or CAD permits, or as otherwise specified by MassDEP. Until the ISA/CSA-SOW is approved the Respondents shall perform environmental monitoring in accordance with the Provisional Approval, Temporary Post-Closure Ground Water Monitoring Program dated January 3, 2007.

CORRECTIVE ACTION DESIGN ("CAD") PLANS

G. Within ninety (90) days of the Effective Date of this Consent Order, the Respondents shall submit to MassDEP a BWPSW25 – CAD permit application for the closure/capping of the Site. The CAD application shall comply with all applicable provisions of 310 CMR 4.00, 310 CMR 19.000, the Manual, and all applicable Guidelines and Policies. In addition to the "standard" features of a landfill closure plan, as required under 310 CMR 19.112, the CAD application shall also include the following components:

i. a description of the types and amounts of the total in-place volume of approved landfill closure grading and shaping materials (Re-Crete™) that will be used to achieve the proposed final grades and configuration of the Site;

ii. a "Materials Management Plan" that at a minimum describes:

1. Methods and procedures for the testing and management of the C&D Fines used to manufacture the Re-Crete; and
2. Methods and procedures for the placement and management of the materials in various weather conditions;

iii. details regarding the areas and amounts of any solid waste to be excavated/consolidated from the Site's existing foot-print perimeter in order to consolidate and reduce the size of the Site's footprint;

iv. details and construction features of all associated appurtenances, equipment, and structures at the Landfill that will be associated with the Site's closure activities;

v. a "Health and Safety Plan" ("HASP") as it pertains to worker safety and environmental measures that will be employed during the excavation/management of all waste materials as well as the Site closure activities in order to protect the workers from any dangers associated thereto. The HASP plan shall address the methods and procedures concerning the handling of any excavated waste materials that could potentially be dangerous and/or would be unsuitable for re-burial, and a plan as to how unacceptable waste would be disposed of at another appropriately permitted waste disposal facility. The HASP shall also address the materials management practices for the re-burial of the excavated wastes in the Site;

vi. a "Confirmatory Soil Sampling and Analysis Plan" regarding the procedures and practices for testing of all waste excavation areas of the Site in order to ensure that during and after the excavation/consolidation process, the excavated areas have been cleaned of all previously buried waste and that there is no residual contamination from the excavated areas. The confirmatory Soil Sampling and Analysis Plan shall adhere to the applicable Method 1: Soil Category pursuant to 310 CMR 40.0975, and shall, at a minimum, test for the following parameters: EPH with target PAHs, VPH, PCBs, and eight RCRA metals. MassDEP shall be provided with confirmatory sampling results within 45 days of sample collection;

vii. all appropriate design features, details and calculations for storm water controls at the Site for a 24-hour/25-year storm event at the Site during the Site closure project and during the post-closure period. The storm water control plan shall comply with all applicable local, state and federal requirements;

viii. all specific design features and details regarding the installation/construction of the final cover/capping system in accordance with all applicable provisions of 310 CMR 19.000 and the Manual;

ix. a "Hydrogen Sulfide and Odorous Landfill Gas Response Plan" in accordance with MassDEP's Guidance Document entitled "Control of Odorous Gas at Massachusetts Landfills, in Support of 310 CMR 19.000, Solid Waste Management Regulations (September 2007)";

x. all appropriate design features and specifications for the installation of a passive gas collection/control system that can be retro-fitted and operated as an active landfill gas collection/control system. The CAD application design shall also include provisions for the installation of an emergency active gas collection and control system including horizontal collection pipes and header lines, as well as all necessary utilities for the gas collection/control system to be potentially operated as an active gas control system (e.g. flare) should MassDEP determine such controls are necessary as a result of the release of offensive or harmful gases as a result of the Site's closure activities. The active gas collection system must be able to be installed and made operational within ten (10) days of receipt of written Notice from MassDEP to the Respondents that odors from the Site are creating an off-site nuisance condition or posing a risk or threat to the public health, safety welfare or the environment;

xi. all appropriate design features and control measures concerning a "Traffic Control Plan" regarding truck-traffic to/from the Landfill during the Site closure project. The Traffic Control Plan shall not be limited to the immediate vicinity of the Landfill, but shall also include all access roads that would be utilized during the Site closure project, including all major routes in abutting communities; and

xii. a conceptual "post-closure monitoring and maintenance plan" that will be implemented after the completion of the Site closure project. The "post-closure monitoring and maintenance plan" may be revised based on the findings of the Landfill assessment activities.

The CAD application shall not include any component that would constitute a lateral increase of the existing footprint of the Site, or a vertical increase in the proposed final height of the Site as indicated in Enviro-Cycle's Conceptual Closure Proposal dated December 2, 2014, as referenced in Paragraph 9.S, above, as amended on February 16, 2017, as referenced in Paragraph 9.X, above.

H. At the conclusion of its review of the CAD application MassDEP will issue a "Provisional Decision" on the CAD application pursuant to the provisions of 310 CMR 19.033(4)(a). MassDEP will provide the public with twenty-one (21) days to comment on the Provisional

Decision. MassDEP and the Respondents shall consider all relevant comments from interested persons regarding the Provisional Decision on the CAD application.

I. Within seven (7) days of the conclusion of the twenty-one (21) day public comment period, MassDEP will provide the Respondents copies of all public comments received.

J. Within twenty (20) days of receipt of public comments, the Respondents shall submit a written response to public comments for MassDEP review and comment.

K. MassDEP may request a revised response to public comments document within twenty (20) days of MassDEP's receipt of the Respondents' initial response to public comments, and any subsequent revised response(s) to public comments. MassDEP will issue a final CAD permit decision within sixty (60) days of the Respondents' response to public comments or, if no public comments are submitted, MassDEP will issue a final CAD permit decision within sixty (60) days of the end of the public comment period.

<u>FINANCIAL ASSURANCE MECHANISM ("FAM")</u>

L. After MassDEP's issuance of its final CAD permit decision (as referenced in Paragraph 12.K, above), and prior to the acceptance of grading and shaping material, the Respondents shall provide MassDEP with documentation that a FAM in the amount of approximately One Million Nine Hundred Eighty Thousand Dollars ($1,980,000.00) has been established by the Respondents that will be managed in accordance with the provisions of 310 CMR 19.051 for the implementation and completion of the Site closure plan. The amount of the FAM will be established after approval of the CAD.

M.The FAM shall also include provisions for the establishment of a separate "Post-Closure Monitoring and Maintenance Account", in the amount of approximately Five Hundred Thousand ($500,000.00) dollars, in accordance with the provisions of 310 CMR 19.051, for the monitoring, maintenance and care of the Landfill after the Site has been capped and closed. Prior to the acceptance of grading and shaping material, twenty-five percent (25%) of the "Post Closure Monitoring and Maintenance Account" shall be funded. The remaining seventy-five percent (75%) of the "Post-Closure Monitoring and Maintenance" account shall be funded through a portion of the proceeds from the delivery and use of the approved Site closure grading and shaping materials (Re-Crete™) during the Site closure project within one year of Respondents' commencement of acceptance of grading and shaping material at the Site. The "Post-Closure Monitoring and Maintenance" account shall be managed by a third party for the performance of all required post-closure monitoring and maintenance activities associated with the Landfill during the "post-closure period" (30-years) after the Site has been closed/capped. The FAM amounts referenced in Paragraphs 12.L and 12.M may be altered by agreement of the parties.

IMPLEMENTATION OF LANDFILL CLOSURE

N. Upon the effectiveness of MassDEP's final CAD permit decision (as referenced in Paragraph 12.K) and establishment of a FAM (as referenced in Paragraphs 12.L and 12.M), the Respondents may commence the delivery, acceptance, stockpiling, and placement of approved Site closure grading/shaping materials (ReCrete™) at the Site.

O. The acceptance/placement of the approved landfill closure grading/shaping materials (ReCrete™) shall be allowed to continue for a period of time not to exceed two (2) years from the date of initial placement of the approved landfill closure grading/shaping materials, in order to achieve the approved closure grades in the CAD permit, unless MassDEP has determined after consultation with the Respondents that the closure activities have caused nuisance conditions or an adverse impact to the environment, in which case placement of materials will be suspended until the nuisance conditions are addressed and all necessary measures are taken to prevent reoccurrence of nuisance conditions from the identified cause.

P. The Respondents shall notify MassDEP in writing immediately upon the commencement of the delivery/placement of the approved Site closure grading/shaping materials.

Q. The Respondents shall maintain a daily records management system documenting all materials delivered to and/or shipped from the Site as part of the closure/capping project. Amounts of all such materials shall be recorded in units of weight and volume.

R. The Site shall be equipped with wheel-washing equipment or other similar equipment in order to prevent dirt and debris from leaving the Site and "soiling" roadways that will be utilized as part of the project. The Site shall also be equipped with street sweeping equipment in order to routinely clean all impacted roadways that will be utilized as part of the project.

S. All on-site diesel fuel powered construction equipment associated with the project shall be equipped with or suitably retrofitted with oxidation catalysts or particulate traps in order to reduce air pollution emission from the combustion of fossil fuels. NOTE: Equipment which currently meets EPA Tier 2 and EU Stage 2 Off-Highway Emissions Limits does not require after engine controls.

T. Enviro-Cycle shall be excused from performance of the obligations in Paragraph 12 of this Consent Order if MassDEP determines that the Respondents have submitted a complete and proper CAD application and the Respondents have adequately responded to all public comments and MassDEP does not issue a final decision approving the CAD pursuant to Paragraph 12.K.

U. ALI shall be excused from performance of the obligations in Paragraphs 12.G through 12.Z of this Consent Order if MassDEP determines that the Respondents have submitted a complete and proper CAD application and the Respondents have adequately responded to all public comments and MassDEP does not issue a final decision approving the CAD pursuant to Paragraph 12.K.

V. Paragraph 12.U does not relieve ALI from obligations to comply with MassDEP's solid waste management regulations, including submittal of a new BWPSW25 – CAD permit application for the closure/capping of the Site that does not incorporate the use of Re-Crete™. Such CAD application shall comply with all applicable provisions of 310 CMR 4.00, 310 CMR 19.000, the Manual, and all applicable Guidelines and Policies, including but not limited to the "standard" features of a landfill closure plan, as required under 310 CMR 19.112.

ANNUAL COMPLIANCE FEES

W. Within 365 days of Respondents' written notification to MassDEP that acceptance of approved grading/shaping material has commenced, as required by Paragraph 12.P., Respondents shall pay the past due annual compliance fee of $1,400.00 on invoice INTACF1710279X132263 for fiscal year 2017 and $1,400.00 on invoice INTACF1810278X132263 for fiscal year 2018 for the total amount of Two Thousand Eight Hundred Dollars ($2,800.00). In addition, the Respondents shall pay the annual compliance fee for fiscal year 2019 within sixty (60) days of the date of the invoice or within 365 days of Respondents' written notification to MassDEP that acceptance of approved grading/shaping material has commenced, whichever is later. Consistent with the language of Paragraph 37, below, the Respondents shall be responsible for the timely payment of future annual compliance fees invoiced for the period covered by this Consent Order; that is, until a Landfill Closure Certification Report is submitted to MassDEP pursuant to Paragraph 12.Y., below. All payments shall be made in accordance with the provisions of Paragraph 36.

COMPLETION OF SITE (PHASE B) CLOSURE

X. Within three (3) years of the Effective Date of this Consent Order, the Respondents shall complete the installation of the final approved CAD cover/capping system. More specifically, and unless extended pursuant to the provisions of Paragraph 27, the placement of the approved grading/shaping materials will occur during the first two (2) years of operation in order to achieve proper Site closure grades/configuration, and the installation of the final capping system shall be completed no later than within (1) year thereafter of achieving the final approved grades as described in the final CAD approval, or upon stopping the delivery of acceptable landfill closure grading/shaping materials to the Site, whichever occurs first.

CERTIFICATION OF SITE (PHASE B) CLOSURE

Y. Within one hundred and twenty (120) days of completing the installation of the final cover/capping system, the Respondents shall submit to MassDEP a BWPSW43 - Landfill Closure Certification Report in accordance with the provisions of 310 CMR 19.130(31) and 19.140. The Certification Report shall serve as documentation that the closure/capping activities at the Site have been completed in accordance with the approved CAD permit, the regulations, the Manual, and all relevant policies, guidelines and requirements.

Z. MassDEP will review the BWPSW43-Landfill Closure Certification Report in accordance with the provisions of 310 CMR 4.00, *Timely Action Schedule and Fee Provisions*, which establish application review timelines.

13. Respondents shall not conduct any activity, or suffer or allow any other party to conduct any activity, that causes or contributes to a public nuisance condition, as a result of dust, noise, odors, etc., or causes or poses a risk or threat to the public health, safety, welfare or the environment.

14. All engineering work performed pursuant to the Consent Order shall be under the general direction and supervision of a qualified Massachusetts Registered Professional Engineer ("PE") experienced in solid waste management and design. The manufacture of all Re-Crete™ to be used as grading/shaping materials shall be overseen by a PE, prior to use at the Site. Any contractual relationship between the Respondents and the engineer for work required hereunder shall require the engineer, as a condition of the contract, to implement work consistent with the provisions of this Consent Order.

15. Respondents shall pay such permit application fee(s) in accordance with the instructions set forth in the permit application, and shall simultaneously deliver a copy of the payment to:

Mark Dakers, Section Chief
Solid Waste Management Section
Department of Environmental Protection
Southeast Regional Office
20 Riverside Drive
Lakeville, MA 02347

16. Except as otherwise provided herein, all notices, submittals and other communications required by this Consent Order shall be directed to:

Mark Dakers, Section Chief
Solid Waste Management Section
Department of Environmental Protection
Southeast Regional Office
20 Riverside Drive
Lakeville, MA 02347

Such notices, submittals and other communications shall be considered delivered by Respondents upon receipt by MassDEP.

If to Respondents:

Robert Cummings, P.E.
Enviro-Cycle, LLC
50 Homers Wharf
New Bedford, MA 02740

With a copy to:

Michelle N. O'Brien, Esq.
Pierce Atwood LLP
100 Summer Street, 22nd Floor
Boston, MA 02110

17. Actions required by this Consent Order shall be taken in accordance with all applicable federal, state, and local laws, regulations and approvals. This Consent Order shall not be construed as, nor operate as, relieving Respondents or any other person of the necessity of complying with all applicable federal, state, and local laws, regulations and approvals.

18. Respondents understand, and hereby waive, their right to an adjudicatory hearing before MassDEP on, and judicial review of, the issuance and terms of this Consent Order and to notice of any such rights of review. This waiver does not extend to any other order issued by the MassDEP.

19. This Consent Order may be modified only by written agreement of the Parties hereto.

20. MassDEP hereby determines, and Respondents hereby agree, that any deadlines set forth in this Consent Order constitute reasonable periods of time for Respondents to take the actions described.

21. Each Respondent is a Permittee, as that term is defined in 310 CMR 4.02, for the purpose of assessing and collecting annual compliance assurance fees.

22. The provisions of this Consent Order are severable, and if any provision of this Consent Order or the application thereof is held invalid, such invalidity shall not affect the validity of other provisions of this Consent Order, or the application of such other provisions, which can be given effect without the invalid provision or application, provided however, that MassDEP shall have the discretion to void this Consent Order in the event of any such invalidity.

23. Nothing in this Consent Order shall be construed or operate as barring, diminishing, adjudicating or in any way affecting (i) any legal or equitable right of MassDEP to issue any additional order or to seek any other relief with respect to the subject matter covered by this Consent Order, or (ii) any legal or equitable right of MassDEP to pursue any other claim, action, suit, cause of action, or demand which MassDEP may have with respect to the subject matter covered by this Consent Order, including, without limitation, any action to enforce this Consent Order in an administrative or judicial proceeding.

24. This Consent Order shall not be construed or operate as barring, diminishing, adjudicating, or in any way affecting, any legal or equitable right of MassDEP or Respondents with respect to any subject matter not covered by this Consent Order.

25. This Consent Order shall be binding upon Respondents and their successors and assigns. Respondents shall not violate this Consent Order and shall not allow or suffer Respondents' directors, officers, members, managers, employees, agents, contractors or consultants to violate this Consent Order. Until Respondents have fully complied with this Consent Order, Respondents shall provide a copy of this Consent Order to each successor or assignee at such time that any succession or assignment occurs.

26. If the Respondents violate any provision of this Consent Order the Respondents shall pay stipulated civil administrative penalties to the Commonwealth in the amount of five hundred dollars ($500.00) per day for each day, or portion thereof, each such violation continues.

Stipulated civil administrative penalties shall begin to accrue on the day a violation occurs and shall continue to accrue until the day Respondents correct the violation or complete performance, whichever is applicable. Stipulated civil administrative penalties shall accrue regardless of whether MassDEP has notified Respondents of a violation or act of noncompliance. All stipulated civil administrative penalties accruing under this Consent Order shall be paid within thirty (30) days of the date MassDEP issues Respondents a written demand for payment. If simultaneous violations occur, separate penalties shall accrue for separate violations of this Consent Order. The payment of stipulated civil administrative penalties shall not alter in any way Respondents' obligation to complete performance as required by this Consent Order.

MassDEP reserves its right to elect to pursue alternative remedies and alternative civil and criminal penalties which may be available by reason of Respondents' failure to comply with the requirements of this Consent Order. In the event MassDEP collects alternative civil administrative penalties, Respondents shall not be required to pay stipulated civil administrative penalties pursuant to this Consent Order for the same violations.

Respondents reserve whatever rights they may have to contest MassDEP's determination that Respondents failed to comply with the Consent Order and/or to contest the accuracy of MassDEP's calculation of the amount of the stipulated civil administrative penalty. Upon exhaustion of such rights, if any, Respondents agree to assent to the entry of a court judgment if such court judgment is necessary to execute a claim for stipulated penalties under this Consent Order.

27. MassDEP agrees to extend the time for performance of any requirement of this Consent Order if MassDEP determines that such failure to perform is caused by a Force Majeure event. The failure to perform a requirement of this Consent Order shall be considered to have been caused by a Force Majeure event if the following criteria are met: (1) an event delays performance of a requirement of this Consent Order beyond the deadline established herein; (2) such event is beyond the control and without the fault of Respondents and Respondents' employees, agents, consultants, and contractors; and (3) such delay could not have been prevented, avoided or minimized by the exercise of due care by Respondents or Respondents' employees, agents, consultants, and contractors.

28. Financial inability and unanticipated or increased costs and expenses associated with the performance of any requirement of this Consent Order shall not be considered a Force Majeure Event.

29. If any event occurs that delays or may delay the performance of any requirement of this Consent Order, Respondents shall immediately, but in no event later than five (5) days after obtaining knowledge of such event, notify MassDEP in writing of such event. The notice shall describe in detail: (i) the reason for and the anticipated length of the delay or potential delay; (ii) the measures taken and to be taken to prevent, avoid, or minimize the delay or potential delay; and (iii) the timetable for taking such measures. If Respondents intend to attribute such delay or potential delay to a Force Majeure event, such notice shall also include the rationale for attributing such delay or potential delay to a Force Majeure event and shall include all available documentation supporting a claim of Force Majeure for the event. Failure to comply with the notice requirements set forth herein shall constitute a waiver of Respondents' right to request an extension based on the event.

30. If MassDEP determines that Respondents' failure to perform a requirement of this Consent Order is caused by a Force Majeure event, and Respondents otherwise comply with the notice provisions set forth in paragraph 29, above, MassDEP agrees to extend in writing the time for performance of such requirement. The duration of this extension shall be equal to the period of time the failure to perform is caused by the Force Majeure event. No extension shall be provided for any period of time that Respondents' failure to perform could have been prevented, avoided or minimized by the exercise of due care. No penalties shall become due for Respondents' failure to perform a requirement of this Consent Order during the extension of the time for performance resulting from a Force Majeure event.

31. A delay in the performance of a requirement of this Consent Order caused by a Force Majeure event shall not, of itself, extend the time for performance of any other requirement of this Consent Order.

32. Failure on the part of MassDEP to complain of any action or inaction on the part of Respondents shall not constitute a waiver by MassDEP of any of its rights under this Consent Order. Further, no waiver by MassDEP of any provision of this Consent Order shall be construed as a waiver of any other provision of this Consent Order.

33. To the extent authorized by the current owner, Respondents agree to provide MassDEP, and MassDEP's employees, representatives and contractors, access at all reasonable times to 179 Peckham Street, Attleboro, Massachusetts for purposes of conducting any activity related to its oversight of this Consent Order. Notwithstanding any provision of this Consent Order, MassDEP retains all of its access authorities and rights under applicable state and federal law.

34. This Consent Order may be executed in one or more counterpart originals, all of which when executed shall constitute a single Consent Order.

35. This Consent Order does not relieve Respondents of the obligation to ensure payment of annual compliance fees pursuant to 310 CMR 4.00, et seq. during the performance of closure activities at the Site, until a Landfill Closure Certification Report for the Site is submitted.

36. Respondents shall pay annual compliance fees by certified check or cashier's check made payable to the Commonwealth of Massachusetts, or by electronic funds transfer. If payment is made by certified check or cashier's check, Respondents shall clearly print on the face of the payment Respondents' (or payor's) full name and Federal Employer Identification Number, and the invoice number or the enforcement document number appearing on the first page of this Consent Order (00002501), and shall mail it along with the invoice remit slip or a copy of the invoice to:

Commonwealth of Massachusetts
Department of Environmental Protection
Commonwealth Master Lockbox
P.O. Box 3982

Boston, Massachusetts 02241-3982

37. This Consent Order does not relieve ALI's obligation to pay annual compliance fees pursuant to 310 CMR 4.00, et seq. during the Landfill post-closure period, subject to ALI's rights to assert financial hardship.

38. All applicable transmittal fees shall accompany any submissions(s) required by this Consent Order.

39. This Consent Order does not relieve ALI of the obligation to maintain and monitor the Landfill as required by 310 CMR 19.142 (Landfill Post-Closure Requirements) and does not limit MassDEP's authority to require additional assessment and/or actions pursuant to 310 CMR 19.150 (Landfill Assessment Requirements) or 310 CMR 19.151 (Corrective Action Requirements).

40. The undersigned certify that they are fully authorized to enter into the terms and conditions of this Consent Order and to legally bind the party on whose behalf they are signing this Consent Order.

41. This Consent Order shall become effective on the date it is executed by MassDEP.

42. This Consent Order shall terminate upon the Respondents' submission of a complete Landfill Closure Certification Report for the Site (including responses to any MassDEP comments), as referenced in Paragraph 12.Y., Respondents' submission of proof of filing a Notice of Landfill Operation pursuant to 310 CMR 19.141, and MassDEP's written determination that closure of the Site has been completed. MassDEP shall provide the Respondents with written acknowledgement of the termination of this Consent Order.

Consented To:

By: Albert Dumont

Albert Dumont Albert Dumont Pres,

By: Albert Dumont

Printed Name: Albert Dumont
Title: President President
Attleboro Landfill, Inc. (the "Owner")
1 Rathbun Willard Drive
Attleboro, Massachusetts 02703
Federal Employee Identification No. : 04-2563326

Date: 6-15-18

Consented To:

By:

Printed Name: Robert S. Cummings

Title: Manager

Enviro-Cycle, LLC (the "Operator")
50 Homers Wharf
New Bedford, MA 02740
Federal Employee Identification No. : 83-3377297

Date: 6/13/18

IMPORTANT INSTRUCTIONS

1) Sign TWO (2) copies of the ACO and send the TWO (2) signed copies to the address below.
   (MassDEP will return to you a signed duplicate original for your records.)

   Department of Environmental Protection
   Southeast Regional Office
   20 Riverside Drive
   Lakeville, MA 02347
   Attention: Mark Dakers, Chief
   Solid Waste Management Section
2) DO NOT INCLUDE ANY PAYMENT with the two (2) signed copies of this Administrative Consent Order (ACO).

Issued By:

DEPARTMENT OF ENVIRONMENTAL PROTECTION

By: Millie Garcia-Serrano

Millie Garcia-Serrano
Regional Director
MassDEP Southeast Regional Office
20 Riverside Drive
Lakeville, MA 02347

Date: June 21, 2018

Appendix J

Reduced Scale Project Drawings

VOLUME CALCULATIONS Attleboro Landfill Phase B

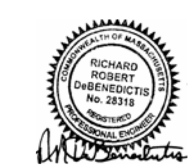
ELEV	AREA (S.F.)	INC. VOL	VOLUME (CF)	VOLUME (CY)
110	290482		0	0
		2753070		
120	260132		2753070	101965.5556
		2255890		
130	191046		5008960	185517.037
		1443105		
140	97575		6452065	238965.3704
		636185		
150	29662		7088250	262527.7778
		104520		
156	5178		7192770	266398.8889

Minus:	
Loam Layer	10186.08333
Sand Layer	13581.44444
Vent Layer	6790.722222
Subtotal	30558.25
Net Volume	235840.6389
Waste Relocation	7000
Volume for Re-Crete	228840.6389

ATTLEBORO LANDFILL PHASE B
CLOSURE PLAN

INDEX OF DRAWINGS

P.E. STAMP



REVISIONS:

No.	Revision	Date	Appr. By
1.	Per DEP Comments	9/02/18	RRD
2.	Issued for Final Permit	9/24/18	RRD

RICHARD R. DEBENEDICTIS, P.E.

57 SANDERSON DRIVE, PLYMOUTH MASSACHUSETTS (781) 249-9435

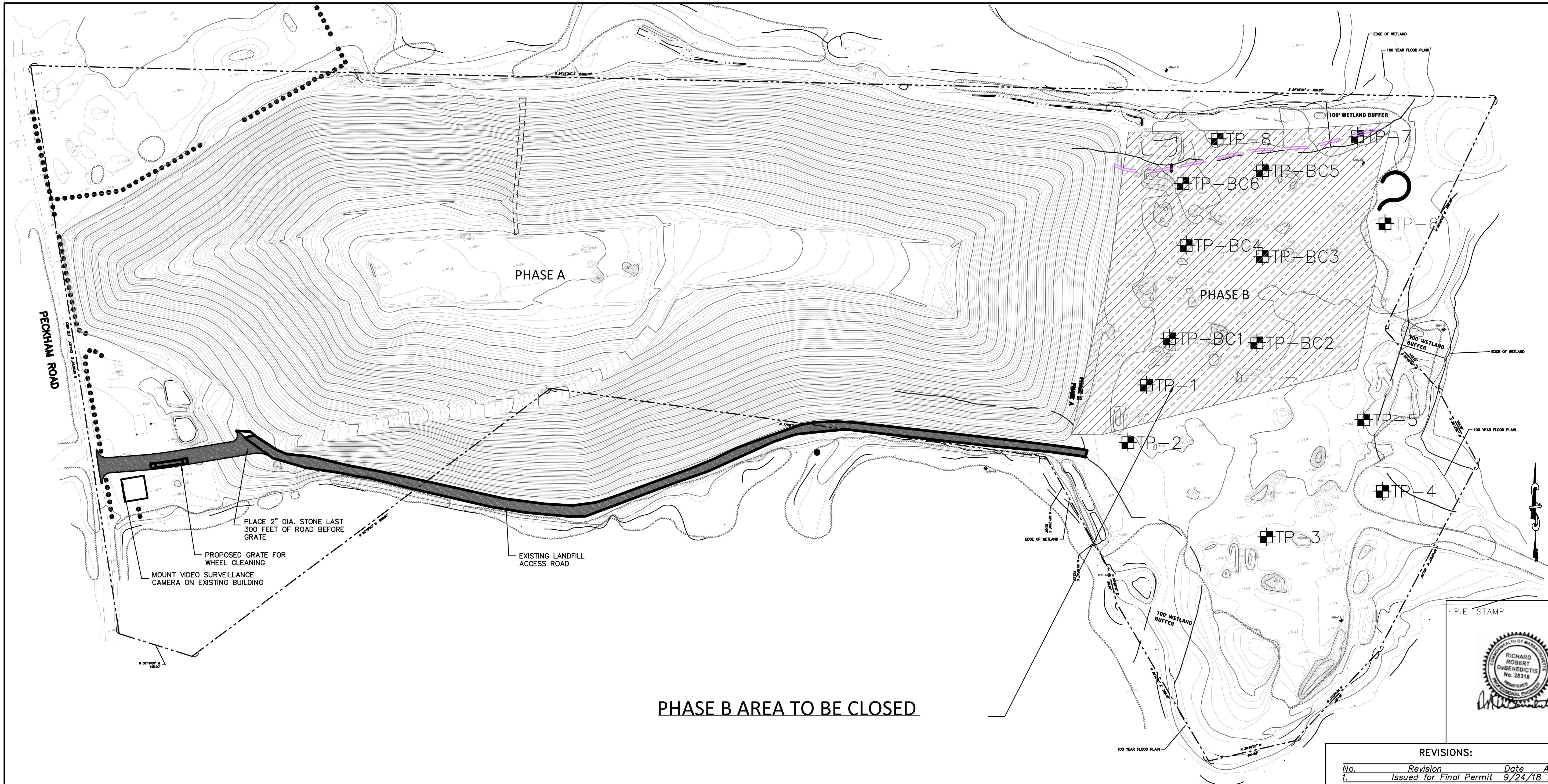
	DRAWN	CHECKED	CAD FILE NO.
BY	JMC	RRD	
DATE	6/15/18	6/20/18	

ATTLEBORO LANDFILL CLOSURE PROJECT

179 PECKHAM STREET
Attleboro, Massachusetts

PREPARED FOR:
ENVIRO-CYCLE, LLC
50 HOMERS WHARF
NEW BEDFORD, MASSACHUSETTS 02740

SCALE	PROJECT NO.	SHEET NUMBER
AS NOTED		1 of 6



P.E. STAMP

RICHARD ROBERT DeBENEDICTIS No. 28318 REGISTERED PROFESSIONAL ENGINEER COMMONWEALTH OF MASSACHUSETTS

REVISIONS:

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RICHARD R. DEBENEDICTIS, P.E.

57 SANDERSON DRIVE, PLYMOUTH MASSACHUSETTS (781) 249-9435

	DRAWN	CHECKED	CAD FILE NO.
BY	JMC	RRD	
DATE	6/15/18	6/20/18	

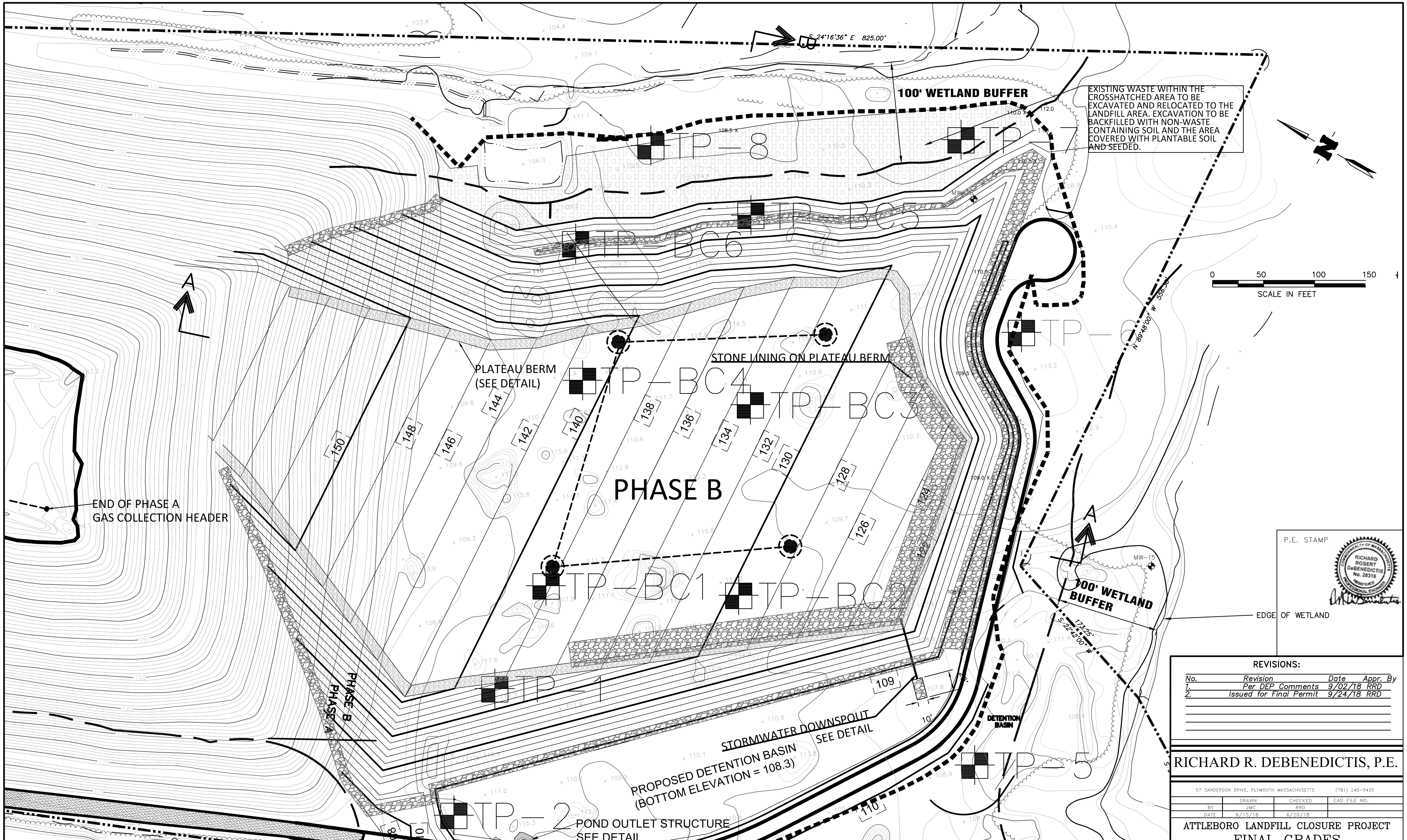
ATTLEBORO LANDFILL CLOSURE PROJECT
EXISTING CONDITIONS PLAN
179 PECKHAM STREET
Attleboro, Massachusetts

PREPARED FOR:
ENVIRO-CYCLE, LLC
50 HOMERS WHARF
NEW BEDFORD, MASSACHUSETTS 02740

SCALE	PROJECT NO.	SHEET NUMBER
AS NOTED		2 of 6

LEGEND

PROPERTY LINE
250 EXISTING CONTOURS
PROPOSED CONTOURS
WL 12 EXISTING WETLAND



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RICHARD R. DEBENEDICTIS, P.E.

57 SANDERSON DRIVE, PLYMOUTH MASSACHUSETTS (781) 249-9435

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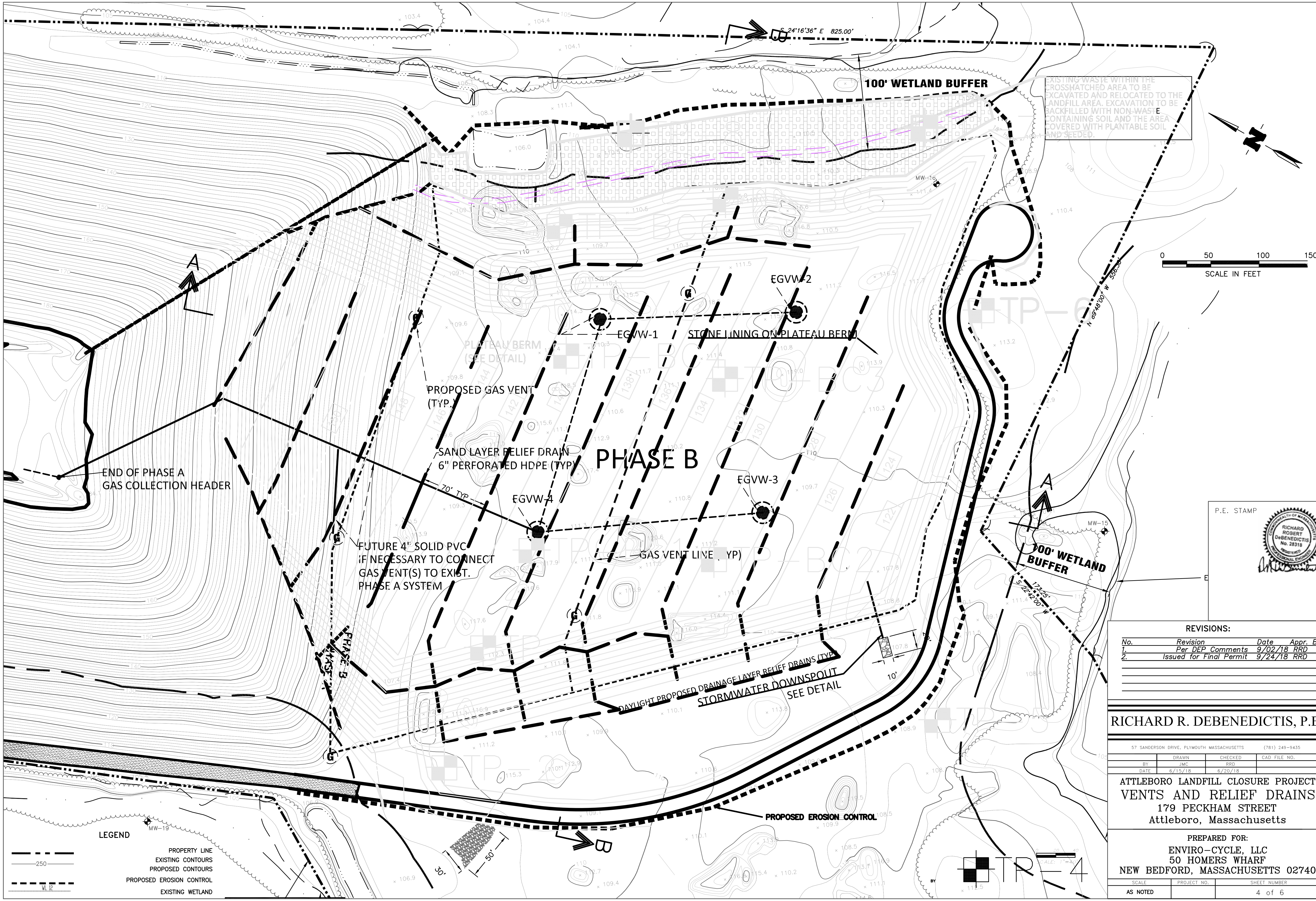
BY	JMC	RRD	
DATE	6/15/18	6/20/18	

ATTLEBORO LANDFILL CLOSURE PROJECT
FINAL GRADES
179 PECKHAM STREET
Attleboro, Massachusetts

PREPARED FOR:
ENVIRO-CYCLE, LLC
50 HOMERS WHARF
NEW BEDFORD, MASSACHUSETTS 02740

SCALE	PROJECT NO.	SHEET NUMBER
AS NOTED		3 of 6



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57 SANDERSON DRIVE, PLYMOUTH MASSACHUSETTS (781) 249-9435

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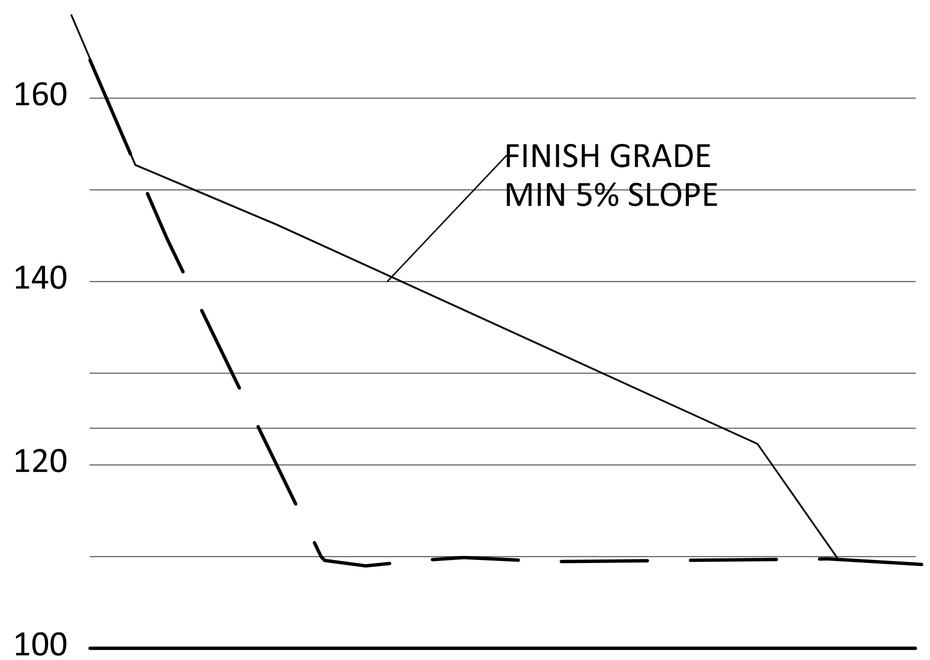
BY	JMC	RRD	
DATE	6/15/18	6/20/18	

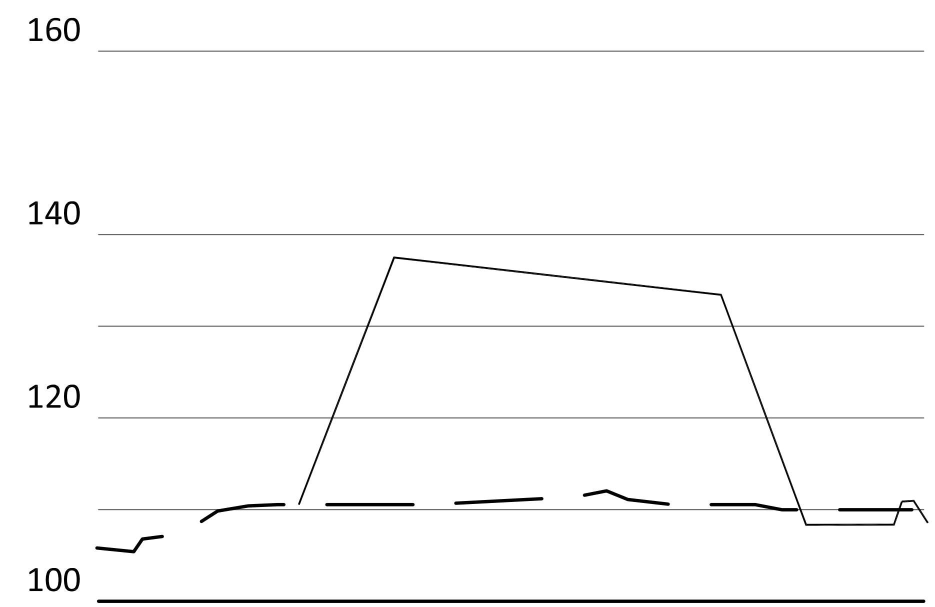
ATTLEBORO LANDFILL CLOSURE PROJECT
VENTS AND RELIEF DRAINS
179 PECKHAM STREET
Attleboro, Massachusetts

PREPARED FOR:
ENVIRO-CYCLE, LLC
50 HOMERS WHARF
NEW BEDFORD, MASSACHUSETTS 02740

SCALE	PROJECT NO.	SHEET NUMBER
AS NOTED		4 of 6



SECTION A-A
SCALES: HORIZ 1"=100'
VERT. 1"=10'



SECTION B-B
SCALES: HORIZ 1"=100'
VERT. 1"=10'

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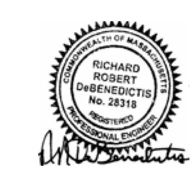

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57 SANDERSON DRIVE, PLYMOUTH MASSACHUSETTS (781) 249-9435

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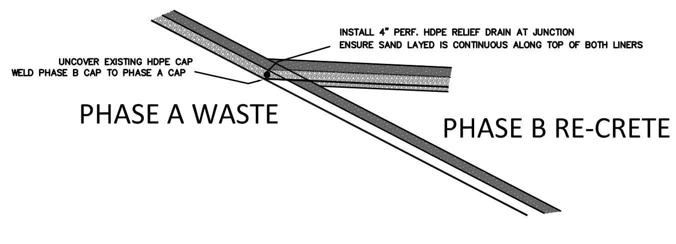
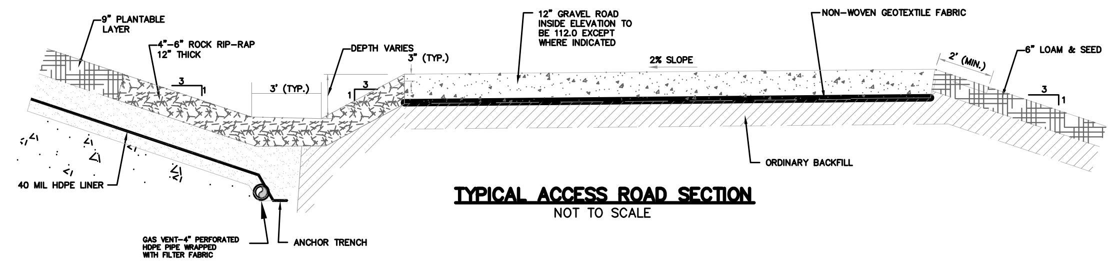
ATTLEBORO LANDFILL CLOSURE PROJECT
CROSS SECTIONS
179 PECKHAM STREET
Attleboro, Massachusetts

PREPARED FOR:
ENVIRO-CYCLE, LLC
50 HOMERS WHARF
NEW BEDFORD, MASSACHUSETTS 02740

SCALE	PROJECT NO.	SHEET NUMBER
AS NOTED		5 of 6



PROPOSED DETAIL AT PHASE A CAP
NOT TO SCALE



TYPICAL ACCESS ROAD SECTION
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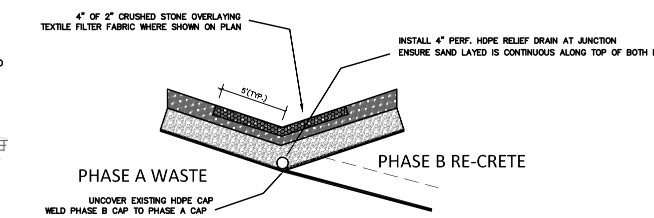

DETAIL AT INTERSECTION OF SIDESLOPES
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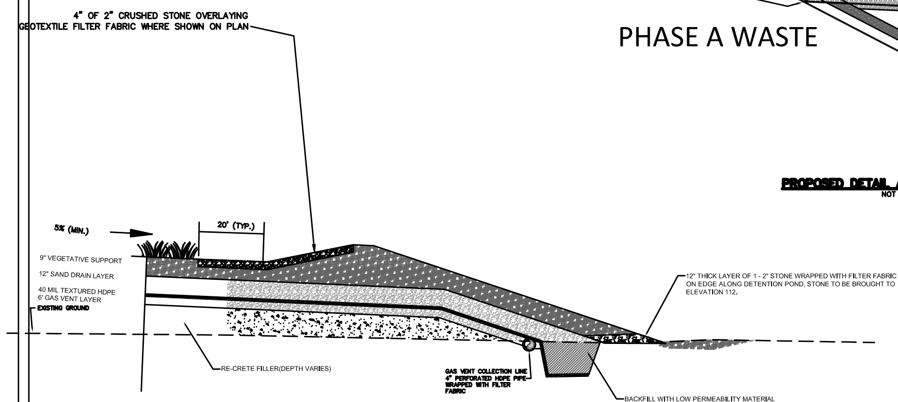

ANCHOR TRENCH DETAIL
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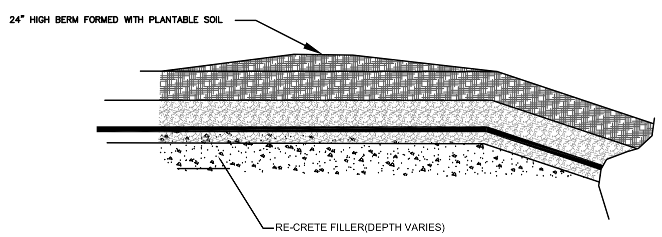

PLATEAU BERM
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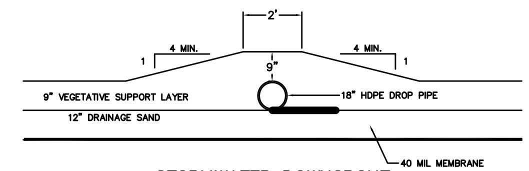

STORMWATER DOWNSPOUT
TYPICAL DETAIL ON LANDFILL SIDE SLOPE
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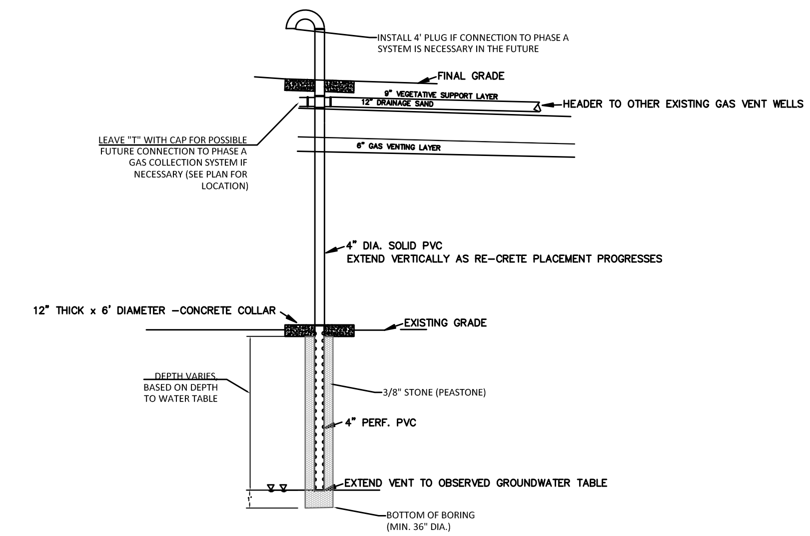

PROPOSED EXISTING WASTE GAS VENT WELL
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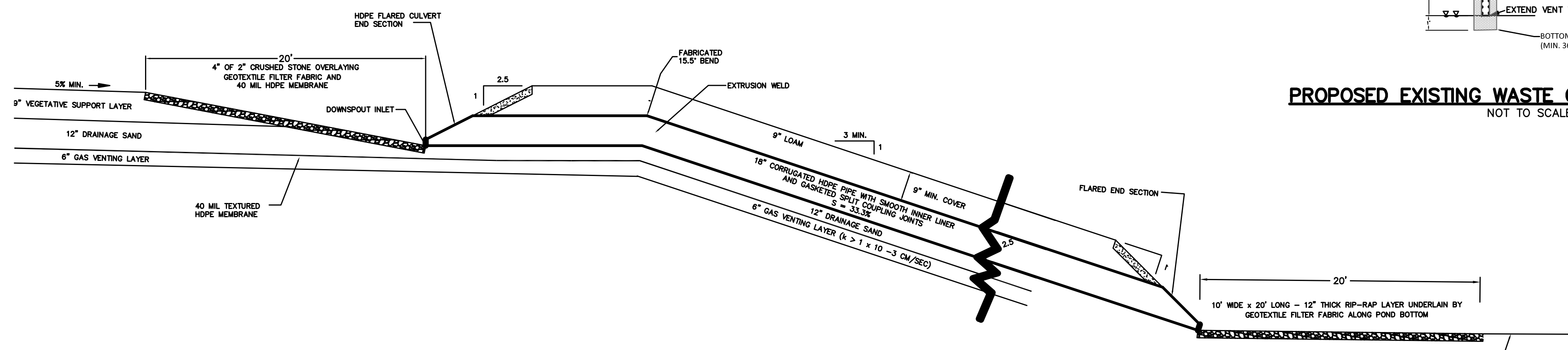

TYPICAL DETAIL OF STORMWATER DOWNSPOUT
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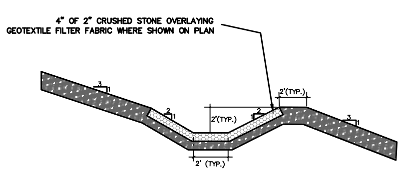

TERRACE SWALE DETAIL
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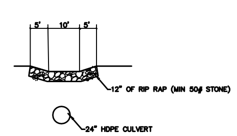

SECTION A-A EMERGENCY SPILLWAY
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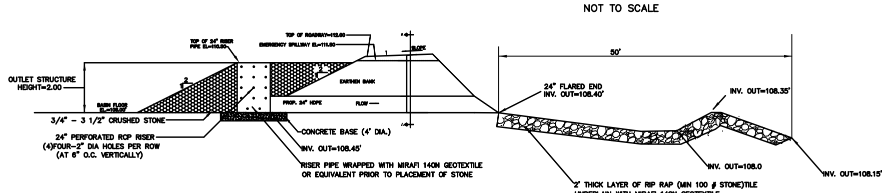

PROPOSED DETENTION POND OUTLET DETAIL
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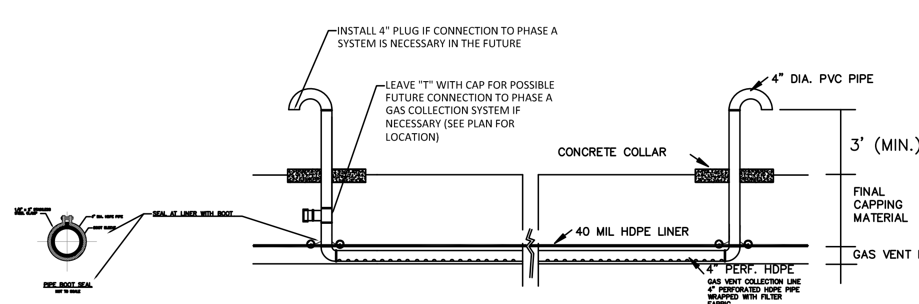

GAS VENTILATION COLLECTION LINE AND VENTILATION RISERS

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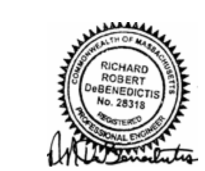

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57 SANDERSON DRIVE, PLYMOUTH MASSACHUSETTS (781) 249-9435

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ATTLEBORO LANDFILL CLOSURE PROJECT
DETAILS
179 PECKHAM STREET
Attleboro, Massachusetts

PREPARED FOR:
ENVIRO-CYCLE, LLC
50 HOMERS WHARF
NEW BEDFORD, MASSACHUSETTS 02740

SCALE	PROJECT NO.	SHEET NUMBER
AS NOTED		6 of 6