

Post Construction Stormwater Management Plan Narrative

Atlantic Sunrise Project Permanent Access Roads Ralpho Township Northumberland County Pennsylvania

Prepared For:



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APPENDICES

<u>Appendix</u>	<u>Description</u>
Appendix A	Intentionally Omitted by Applicant
Appendix B	Intentionally Omitted by Applicant
Appendix C	United States Department of Agriculture Natural Resources Conservation Service Custom Soil Resource Report (Included under separate cover in Appendix C of the E&SC Narrative for Northumberland County included in Section 2 of the ESCGP-2 NOI.)
Appendix D	Supporting Information
Appendix N*	AR-CO-085.1.3 Specific Narrative and Calculations

* Road-specific Appendix letters correspond to the road-specific Appendix included in the **E&SC Narrative for Northumberland County included in Section 2 of the ESCGP-2 NOI**. Supporting calculations are provided for permanent access roads only in this narrative.

GENERAL INFORMATION

Project Description

The following post construction stormwater management (PCSM) narrative describes the PCSM designs for the permanent access roads to be constructed within Northumberland County (County), Pennsylvania as part of the Transcontinental Gas Pipe Line Company, LLC (Transco) Atlantic Sunrise Project (“Project”). This narrative supplements the Erosion & Sediment Control (E&SC) Plan and Site Restoration (SR) Plan Narrative included in **Section 2 of the Erosion and Sediment Control General Permit 2 (ESCGP-2) Notice of Intent (NOI)**.

The Project includes modifications to the existing Transco Mainline system to reverse the direction of flow, enabling new north-to-south capabilities (bi-directional flow) to transport this new source of natural gas to existing markets. In Northumberland County, the main Project improvements that the temporary and permanent access roads will support include installation of a 42-inch-diameter greenfield pipeline referred to as the Central Penn Line (CPL) South pipeline.

Where possible, existing public and private roads will be utilized to provide access to the pipeline ROW during and after construction. During construction, E&SC BMPs will be installed along all access roads as shown on the road-specific Soil Erosion Control Plans included in the Erosion & Sediment Control and Layout Plans for Access Roads in **Section 2 of the ESCGP-2 NOI**.

Permanent gravel access roads will be installed, and maintained by Transco, to provide access to mainline valves (MLVs) and select portions of the pipeline right of way (ROW) for pipeline maintenance and inspections in accordance with applicable regulatory guidelines. The increase in impervious area for the permanent access roads that provide access to the MLVs is permanent. However, the proposed increase in impervious area for the permanent access roads to the pipeline ROW is temporary. Similar to temporary access roads, upon construction completion, the proposed road materials will be removed and the impacted areas will be restored to pre-construction conditions. Transco operations will use the restored road surface to access the ROW as necessary in the future. Typically, pickup trucks will be used to perform routine maintenance and inspections and the trucks are capable of driving over grassy areas similar to the pipeline ROW. The permanent access roads to be restored to pre-construction conditions are not included in this PCSM Narrative. Only the access roads to MLV sites with permanent improvements are included in this PCSM Narrative.

References

E&SC Best Management Practices (E&SC BMPs), in accordance with the standards and specifications in the Pennsylvania Department of Environmental Protection's (PADEP's) "Erosion and Sediment Pollution Control Program Manual," Technical Guidance No. 363-2134-008, as amended and updated (E&SC Manual) will be used during the construction phase of the project. The proposed practices are designed to achieve the regulatory standard of minimizing the potential for accelerated erosion and sedimentation associated with temporary earth disturbance activities. The E&SC BMPs will remain in place until the surrounding area has reached final stabilization. An area shall be considered to have achieved final stabilization when it has a minimum uniform 70% perennial vegetative cover or other permanent non-vegetative cover with a density sufficient to resist accelerated surface erosion and subsurface characteristic sufficient to resist sliding and other movements.

PCSM BMPs, in accordance with the PADEP's "Pennsylvania Stormwater Best Management Practices Manual," Technical Guidance No. 363-0300-002, as amended and updated (PCSM Manual), will be used for site restoration and post construction stormwater management measures.

Impacts to wetlands, streams or waterbodies will be avoided to the maximum extent practicable. Refer to the Wetland Delineation Report provided as **Section 5 of the ESCGP-2 NOI** for information supporting wetland mapping shown on the E&SC Plans (**Section 2 of the ESCGP-2 NOI**).

Permanent Access Road Table

The following permanent access roads that will provide access to an MLV are proposed to be constructed in Northumberland County to support the CPL South pipeline:

Access Road	Mile Post (MP)	Major River Basin	Receiving Water	Existing Use	Chapter 93 Designated Use	Impairment	Total Maximum Daily Load
CO-085.1.3	M-0167 MP 0.0	Susquehanna	UNT to Miller Run	None	CWF, MF	Source Unknown (Pathogens)	TMDL, 1999 (PCBs)

1.0 COMMON INFORMATION

1.1 Topographic Features

See **Appendices E, F, M and N** for road-specific United States Geological Survey mapping.

1.2 Soil Characteristics

AECOM prepared the United States Department of Agriculture Natural Resources Conservation Service (NRCS) Custom Soil Resource Report for the counties crossed by the CPL South pipeline. The NRCS Custom Soil Resource Report for Northumberland County, Pennsylvania and the Soil Association Maps prepared by Wood Group Mustang Inc. are included in Appendix C of the **E&SC Narrative for Northumberland County included in Section 2 of the ESCGP-2 NOI**. County-specific soil type and use limitations are presented in Table 1.2.1 below.

Table 1.2.1

Soil Type and Use Limitations for Northumberland County

Map Symbol	Soil Name	Slope	Cut Banks Cave	Corrosive to Concrete or Steel	Droughty	Easily Erodible	Flooding	High Water Table	Hydric/Hydric Inclusions	Low Strength	Slow Percolation	Piping	Poor Source of Topsoil	Frost Action	Shrink-Swell	Potential Sinkhole	Ponding	Wetness
CaB CaC	Calvin-Klinesville shaly silt loams	3-8% 8-15%	X	C/S	X	X			X		X	X	X	X				
MkB	Meckesville very stony loam	3-8%	X	C/S				X		X	X	X	X	X				X

Source: Appendix E, Table E-1, PADEP, *Erosion and Sediment Pollution Control Program Manual*, Technical Guidance Number 363-2134-008.

Table 1.2.2
Soil Use Limitations Resolutions

Limitation	Resolution
Slopes	Excavations should be stabilized to prevent erosion and contractor should employ proper construction techniques to ensure safety on steep slope areas.
Cut Banks Cave	Excavations will be properly supported by sheeting and shoring to prevent caves.
Corrosive to Concrete or Steel	No concrete or steel piping is proposed without appropriate coatings and protection.
Droughty	Existing suitable topsoil and soil amendments will be used during construction as necessary.
Easily Erodible	Temporary and permanent E&SC BMPs will be employed throughout the construction and operation of the access roads.
Flooding	Ensure that the access roads have has proper drainage and no obstructions within floodway/floodplain.
High Water Table	A geotechnical investigation was conducted to minimize conflicts with saturated zones.
Hydric/Hydric Inclusions	A wetland investigation was completed. Impacts to wetlands have been minimized by modifying the access road alignment to avoid wetlands and/or protecting wetlands with E&SC BMPs where existing roads are adjacent to wetlands.
Low Strength	A maximum of 3:1 slopes area proposed.
Slow Percolation	A field investigation of percolation rates at the infiltration areas will be performed to verify the soils percolation capacity.
Piping	Watertight pipe, antiseep collars, clay cores through basin berms, and concrete endwalls will be used to minimize water movement via pipe bedding.
Poor Source of Topsoil	Existing topsoil, which has proven to be suitable, will be reused on the site.
Frost Action	Gravel specified in lieu of pavement to minimize frost effects.
Shrink-Swell	Gravel specified in lieu of pavement.
Potential Sinkhole	Geotechnical Engineer of record recommendations will be followed for any potential occurrences.
Ponding	Surface grading and drainage facilities will be provided to minimize ponding affects.
Wetness	Wet weather construction recommendations, per the Geotechnical Engineer's recommendations, will be employed to minimize the effects of wetness during construction, surface grading. Surface grading and drainage will be provided to minimize wetness affects after construction.

1.3 Earth Disturbance Activity

The proposed permanent access roads are located in areas of woodland, agricultural and meadow lands. Portions of the roads are located along existing dirt, gravel, or paved roads. The proposed land use is for a permanent access road intended to

provide a means of ingress/egress to/from the MLV site for operations. The proposed alteration of the land includes modifying the existing access road ROW to accommodate a 14 foot wide gravel access road. Installing the access road requires grading activity to construct the new road. See the **E&SC Plans for Northumberland County included in Section 2 of the ESCGP-2 NOI.**

Characterization of Land Use

The characterization of land use within the proposed CPL South project areas is based on interpretation of aerial photographs taken in the spring of 2014 and information gathered from field surveys conducted during 2014 and 2015. Transco classified land uses within the proposed Project areas into the following eight broad types:

1. Agricultural Land – land associated with active cultivation of ROW and field crops; areas of grasses planted for livestock grazing or for the production of hay crops; orchards; and specialty crops, including vineyards, Christmas trees, and fruits and vegetables.
2. Upland Forest/Woodland – includes upland deciduous forest, evergreen forest, and mixed (deciduous and evergreen) forest, but does not include forested wetlands.
3. Industrial/Commercial Land – land used for mines or quarries and associated processing plants; manufacturing or other industrial facilities; and land developed for commercial or retail uses, including malls, strip plazas, business parks, and medical facilities.
4. Transportation Land – land used for transportation purposes, including interstate highways; state, county, and local highways and roads; and railroad lines.
5. Residential Land – residential areas, including yards of individual residences.
6. Open Land – non-forested and undeveloped land not classified for another use, including land maintained as utility ROWs for overhead and underground electric transmission, natural gas transmission, and oil transmission facilities.
7. Wetlands – includes wetlands covered with emergent, scrub-shrub, and forested vegetation.
8. Open Water – include rivers, streams, creeks, canals, and other linear waterbodies, as well as lakes, ponds, and other non-flowing waterbodies.

Area Types

The access road construction ROW is comprised of the following area types:

- **Limit of Disturbance (LOD) Area** – The LOD area is the construction ROW for the access roads. For most roads, this area is 50 feet wide and centered on the centerline of the access road. In areas where grading and/or E&SC BMPs require more room, the LOD has been expanded to encompass the proposed improvement area.
- **ESCGP-2 Permit Boundary/Site Area** – The ESCGP-2 Permit Boundary/Site Area is the area to be permitted for improvements with the Chapter 102 Application. This area is slightly larger than the LOD area. The limit of the ESCGP-2 Permit Boundary/Site Area is typically offset 5 feet from the LOD limit for access roads.

Future changes made to the LOD area that are still within the ESCGP-2 Permit Boundary/ Site Area would likely be considered a minor modification to the Project's Chapter 102 Permit. However, future changes to the LOD area that are outside the ESCGP-2 Permit Boundary/Site Area may require a major modification to the Permit.
- **Area of Minimum Disturbance/Reduced Grading** – The Area of Minimum Disturbance/Reduced Grading is the area within the LOD area that is outside the proposed grading area. Disturbances within the Area of Minimum Disturbance/Reduced Grading will be minimal.
- **LOD Area within Floodway/Floodplain** – The LOD Area within Floodway/Floodplain is the area within the LOD that is within a FEMA (Federal Emergency Management Agency) designated Floodplain or an assumed floodway that extends approximately 50 feet from the top of bank of a stream landward. The LOD Area within Floodway/Floodplain have been coordinated with the Chapter 105 Permit application. For most of the access roads, where the LOD crosses a floodway/floodplain, the LOD area has been minimized and the existing road will be used. Where the existing road cannot support the intended traffic loads, timber matting will be installed to provide an adequate driving surface.
- **Stormwater Management Area** – The Stormwater Management Area is calculated using Worksheet #3. For the permanent access roads, the Stormwater Management Area is equal to the LOD Area because no credit is taken for protected areas. The LOD is minimized at wetlands and streams to minimize impacts. Where the LOD crosses a floodway/floodplain, the existing road will be used with matting, as necessary.

- Area Controlled by BMPs – The Area Controlled by BMPs is the drainage area that discharges to either the vegetated channel or MLV pad. The pre- and post-construction cover types for the Area Controlled by BMPs are summarized in Worksheet #4.

Minimize Soil Compaction in Infiltration Areas

Prior to installing the pipeline, the infiltration bed area will be protected by construction fence. A portion of the MLV site infiltration bed is within the construction travel way for the pipe installation and cannot be protected by the construction fence. Timber matting will be installed across the proposed MLV site to spread construction vehicle loads and minimize soil compaction during construction of the pipeline. Once the travel way is no longer needed, the timber matting will be removed.

The top 20 inches of soil within the footprint of the timber matting installed across the MLV infiltration area will be tilled with a solid-shank ripper to loosen the soil and promote infiltration. If necessary, the tilling operations will be extended to the other infiltration areas if compaction has occurred during installation of the pipeline. Tilling will be performed when the soil is dry.

During grading operations for the PCSM BMPs and access road, construction equipment shall avoid excessive compaction and/or land disturbance. If excavation leads to substantial compaction of the subgrade, 18 inches shall be removed and replaced with a blend of topsoil and sand to promote infiltration and biological growth. At the very least, topsoil shall be thoroughly deep plowed into the subgrade to penetrate the compacted zone and promote aeration and the formation of macropores. Following this, the area should be disked prior to final grading.

1.4 Project Site Runoff

The E&SC BMPs for the access roads are sized using Worksheets 1 and 11 of the PADEP E&SC Manual. These worksheets take into consideration the slope length above the sediment barrier and the drainage area contributing to the channel, respectively. (See the road-specific appendices of the **E&SC Narrative for Northumberland County included in Section 2 of the ESCGP-2 NOI** for road-specific worksheets.)

For temporary access roads and permanent access roads that provide access to the pipeline ROW only, no permanent change in cover is proposed. Disturbed areas will be

restored to pre-construction conditions. Therefore, no change in runoff rate or volume is anticipated.

For permanent access roads that provide access to MLVs, a summary table presenting the change in runoff volume for the 2-year design storm and the change in peak rate of runoff for the 2-year, 5-year, 10-year, 25-year, 50-year and 100-year design storms for pre-construction and post construction conditions, along with the supporting calculations, are provided for each permanent access road in the road-specific narratives appended to this narrative.

Where applicable, Act 167 Plan names and adoption dates for each access road watershed are included in the road-specific narratives appended to this narrative.

1.5 Surface Water Classification

The locations and Chapter 93 designation of the streams and wetlands near the LOD for the permanent access roads are shown on the PCSM Plans (**Section 3 of the ESCGP-2 NOI**).

1.6 BMP Description

E&SC BMPs, consistent with the PADEP E&SC Manual, are planned to be used along the temporary and permanent access roads before, during, and after earth disturbance activities. E&SC BMPs will be installed prior to disturbance. Installation and maintenance guidelines, as well as E&SC BMP locations are described in the **E&SC Narrative for Northumberland County included in Section 2 of the NOI** and shown on the E&SC Plans (**Section 2 of the ESCGP-2 NOI**) and the Best Management Practices and Quantities Plan.

For permanent access roads that require an increase in impervious area, additional PCSM BMPs will be installed to manage the additional runoff created by the change in pre- and post-development conditions. The PCSM BMPs that will be used for the permanent access roads include the following:

PCSM BMPs

- **Vegetated Channel:** Vegetated Channel shall be installed to collect and attenuate runoff volume from adjacent impervious areas, allowing some pollutants to settle out in the process. Permanent Check Dams are used to enhance attenuation and pollutant removal.
- **Check Dams:** Check Dams will be installed as shown on the Plans and Detail Sheets. Check Dams help dissipate energy from the concentrated flow in roadside ditches and channels to prevent erosion of the channel and at the

outlet. The Check Dams will be earthen check dams with a height of 12 inches, typically.

- Stone Valve Site Void Storage: Runoff from the proposed permanent access roads may be detained in the void space between the stone at the MLV sites (mainline valves) to attenuate the peak rate of runoff for up to the 100-year design storm event. The valve sites will be comprised of 6 inches of AASHTO #8 aggregate over a heavy nonwoven geotextile over 12 inches to 30 inches of AASHTO #57 aggregate. The depth of the AASHTO #57 aggregate varies based on the detention volume needed to attenuate the volume of runoff for the 100-year storm. Dewatering calculations for the valve sites are included in the road-specific narratives appended to this narrative.
- Riprap Aprons/Outlet Protection: Riprap Aprons shall be installed to dissipate energy from flow concentrated at culverts and drainage channels. Permanent Riprap Aprons will remain in place and be part of the final PCSM design.
- Permanent Vegetative Stabilization: Upon reaching final grades, and upon cessation of earth disturbance activities, disturbed areas will receive topsoil, seed, and mulch to establish permanent vegetative stabilization.

1.7 BMP Installation Sequence

Refer to the E&SC Plans (**Section 2 of the ESCGP-2 NOI**) for the location of the proposed work and the associated E&SC and PCSM BMPs. A road-specific construction sequence is provided in **Appendix N**.

1.8 Supporting Calculations and Measurements

Supporting calculations for each permanent access road design are provided in the road-specific narratives appended to this narrative.

The access roads have been designed to meet the requirements of 25 Pa. Code §§ 102.8, including sections 102.8(g)(2) & 102.8(g)(3) as reproduced below:

(g) PCSM Plan stormwater analysis. Except for regulated activities that require site restoration or reclamation, and small earth disturbance activities identified in subsection (n), PCSM Plans for proposed activities requiring a permit under this chapter require the following additional information:

- (1) Predevelopment site characterization and assessment of soil and geology including appropriate infiltration and geotechnical studies that identify location and depths of test sites and methods used.

(2) Analysis demonstrating that the PCSM BMPs will meet the volume reduction and water quality requirements specified in an applicable Department approved and current Act 167 stormwater management watershed plan; or manage the net change for storms up to and including the 2-year/24-hour storm event when compared to preconstruction runoff volume and water quality. The analysis for the 2-year/24-hour storm event shall be conducted using the following minimum criteria:

(i) Existing predevelopment nonforested pervious areas must be considered meadow in good condition or its equivalent except for repair, reconstruction or restoration of roadways or rail lines, or construction, repair, reconstruction or restoration of utility infrastructure when the site will be returned to existing condition.

(ii) When the existing project site contains impervious area, 20% of the existing impervious area to be disturbed must be considered meadow in good condition or better, except for repair, reconstruction or restoration of roadways or rail lines, or construction, repair, reconstruction, or restoration of utility infrastructure when the site will be returned to existing condition.

(iii) When the existing site contains impervious area and the existing site conditions have public health, safety or environmental limitations, the applicant may demonstrate to the Department that it is not practicable to satisfy the requirement in subparagraph (ii), but the stormwater volume reduction and water quality treatment will be maximized to the extent practicable to maintain and protect existing water quality and existing and designated uses.

(iv) Approaches other than that required under paragraph (2) may be proposed by the applicant when the applicant demonstrates to the Department that the alternative will either be more protective than required under paragraph (2) or will maintain and protect existing water quality and existing and designated uses by maintaining the site hydrology, water quality, and erosive impacts of the conditions prior to initiation of any earth disturbance activities.

(3) Analysis demonstrating that the PCSM BMPs will meet the rate requirements specified in an applicable Department approved and current Act 167 stormwater management watershed plan; or manage the net change in peak rate for the 2-, 10-, 50-, and 100-year/24-hour storm events in a manner not to exceed preconstruction rates.

- (i) Hydrologic computations or a routing analysis are required to demonstrate that this requirement has been met.
- (ii) Exempt from this requirement are Department- approved direct discharges to tidal areas or Department-approved no detention areas.
- (iii) Approaches other than that required under paragraph (3) may be proposed by the applicant when the applicant demonstrates to the Department that the alternative will either be more protective than required under paragraph (3) or will maintain and protect existing water quality and existing and designated uses by maintaining the preconstruction site hydrologic impact.

1.9 Plan Drawings

Full size copies of the permanent access road PCSM Plans have been provided under separate cover in **Section 3 of the ESCGP-2 NOI**.

Preparer Qualifications are included in **Appendix D**.

1.10 Long Term Operation and Maintenance Schedule

E&SC BMPs shall be maintained properly throughout Project construction as described in the **E&SC Narrative for Northumberland County included in Section 2 of the NOI**. Until an access road is stabilized, the associated E&SC BMPs shall be maintained properly. Maintenance shall include inspections of E&SC BMPs after each runoff event and on a weekly basis. Preventative and remedial maintenance work, including clean out, repair, replacement, re-grading, reseeding, and re-mulching must be initiated immediately. If the E&SC BMPs fail to perform as expected, replacement E&SC BMPs, or modifications of those installed will be required.

After project completion, the PCSM BMPs will be monitored and maintained as described below:

Monitoring

Transco's personnel (Operations) will perform visual inspections on an annual basis after permit closure to ascertain that the PCSM BMPs are functioning and operating effectively to ensure the MLV sites and associated permanent access roads are causing no undue burden on the property owner or adjacent owners. Repairs of deficiencies will be initiated within ten business days of discovery.

Maintenance

The Contractor will be responsible for the maintenance of the PCSM BMPs during construction. After construction, the PCSM BMPs will be owned and maintained by Transco.

Maintenance of the PCSM BMPs after acceptance by the Owner will consist of routine cleaning of accumulated sediment and debris. The specific maintenance steps and schedule are listed below:

PCSM BMPs Inspection

PCSM BMPs (vegetated channels and rock within the MLV site) are to be inspected annually for sediment, build-up and erosion debris. The sediment, debris, trash and any other waste material removed from the PCSM BMPs shall be disposed of at a suitable disposal or recycling site and in compliance with local, state and federal waste regulations.

- Vegetated Channel and Check Dams: Vegetated channels shall be inspected annually and within 48 hours after every major storm event (> 1 inch rainfall depth) as follows:
 - Inspect and correct erosion problems, damage to vegetation, and sediment and debris accumulation (address when > 3 inches at any spot or covering vegetation);
 - Inspect vegetation on side slopes for erosion and formation of rills or gullies, correct as needed;
 - Inspect for pools of standing water; dewater and discharge to an approved location and restore to design grade;
 - Mow and trim vegetation to ensure safety, aesthetics, proper vegetated channel operation, or to suppress weeds and invasive vegetation; dispose of cuttings in a local composting facility; mow only when vegetated channel is dry to avoid rutting;
 - Inspect for litter; remove prior to mowing;
 - Inspect for uniformity in cross-section and longitudinal slope, correct as needed; and
 - Inspect vegetated channel inlet and outlet for signs of erosion or blockage, correct as needed.

Maintenance activities to be done as needed:

- Plant alternative grass species in the event of unsuccessful establishment;
- Reseed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming;
- Rototill and replant vegetated channel if draw down time is more than 48 hours;
- Inspect and correct check dams when signs of altered water flow (channelization, obstructions, erosion, etc.) are identified; and
- Water during dry periods, fertilize, and apply pesticide only when absolutely necessary.
- Stone Valve Site Void Storage: MLV sites shall be inspected annually as follows:
 - Inspect and correct erosion problems, disruption to stone, and sediment and debris accumulation;
 - Inspect stone for erosion and formation of rills or gullies, correct as needed;
 - Inspect for pools of standing water; dewater and discharge to an approved location and decompact the top AASHTO #8 layer to address ponding; and
 - Remove litter.

Annual Records of Maintenance Procedures

The Owner shall maintain a checklist whenever the PCSM BMPs are inspected and cleaned. An annual list of inspections and major cleaning operations and repairs shall be maintained. Upon request, the local CCD or enforcement officials shall have access to those records. The Owner shall ensure compliance with ESCGP-2 Permit requirements by meeting all ongoing recordkeeping maintenance, and other applicable ESCGP-2 and PADEP permit conditions.

1.11 Material Recycling and Disposal

Maintenance of the permanent access roads that provide access to the MLV sites will require the removal of materials (i.e., sediment, debris, and litter). The materials shall be disposed of at suitable disposal or recycling sites in compliance with local, state and federal regulations.

Transco has prepared a Spill Plan for Oil and Hazardous Materials to assist in prevention of any spills that may occur at the MLV site and to respond to any spills that do occur. The Spill Plan for Oil and Hazardous Materials is included as **Attachment 9**

to the Environmental Construction Plan (ECP) provided as Section 4 of the ESCGP-2 NOI.

1.12 Soil Conditions and Geologic Formations

AECOM conducted a review of the proposed CPL South pipeline for the potential of geologic formation which may cause pollution if disturbed or exposed during construction.

Karst Bedrock Formations

As identified by AECOM, naturally-occurring bedrock formations and soils types that may cause pollution are present along portions of the CPL South construction ROW. Bedrock formations that may cause pollution are associated with karst or acid-forming conditions include the following:

- Conestoga Formation
- Vintage Formation
- Buffalo Springs Formation
- Ledger Formation
- Zooks Corner Formation
- Snitz Creek Formation
- Millbach Formation
- Stonehenge Formation
- Epler Formation
- Richenbach Formation
- Ontelaunee Formation
- Annville Formation
- Hershey-Myerstown Formation
- Keyser-Tonoloway Formation

There are two bedrock formations that do not form significant karst terrain along the proposed CPL South pipelines, which include Hamburg Sequence/limestone unit and Hamilton Group/Tully limestone unit.

Acid-Producing Sulfide Bedrock Formations

In the review of the NRCS data for the proposed CPL South pipeline route, several acid-producing sulfide bedrock formations are located along the proposed route. These formations are as follows:

- Pottsville Formation (anthracite coal-bearing)
- Llewelyn Formation (anthracite coal bearing)

Formations containing variable amounts of pyrite or other sulfide minerals that may only locally be acid-producing are found along the proposed CPL South pipeline. These formations can be determined only by site-specific acid-drainage investigation, and are identified as follows:

- Octoraro schist
- Conestoga phyllite
- Antietam-Harpers schist
- Kinzers shale
- Cocalico shale
- Hamburg/Martinsburg shale

Table 6 in the Best Management Practices and Quantities Plan provides the locations of the acidic bedrock.

Acidic Soils

For the proposed CPL South pipeline, based on review of the attached NRCS Custom Soil Resource Report provided in **Appendix C**, acidity levels of the soils found along the proposed CPL South route do not fall within the pH range that is considered to be a potential source of pollution that must be mitigated. Should acidic soils deemed to be a potential source of pollution (pH of 4.0 or lower) be encountered during the construction of the temporary and permanent access roads, the following Acid Producing Soils and Bedrock Control Plan shall be implemented. Table 5 in the Best Management Practices and Quantities Plan provides the locations of soils and their respective acidity levels. A road specific Soil Acidity Table is included for each road in the road specific appendices attached to this document.

Acid Producing Soils and Bedrock Control Plan

The following acid producing soils control plan was developed to identify BMPs and procedures for minimizing the potential for pollution associated with the disturbance of the areas associated with the construction of the temporary and permanent access roads that contain acid-producing soils with a pH less than 4.0, as recommended by the Natural Resources Conservation Service (NRCS).

1. Contractor shall limit the excavation area and exposure time when high acid-producing soils are encountered. Locations where acidic soils are anticipated to be present along the access roads are provided in the road specific narratives included in this document and on the E&SC plans included in **Section 2 of the ESCGP-2 NOI**.
2. Contractor shall separately store topsoil stripped from the site away from temporarily stockpiled high acid-producing soils and bedrock.
3. Contractor shall stockpile high acid-producing soils and bedrock material on level ground to minimize its movement, especially when these materials have a high clay content.
4. Contractor shall cover temporarily stockpiled high acid-producing soil and bedrock material to be exposed more than 7 days with properly anchored, heavy-

grate sheets of polyethylene, where possible. If not possible, stockpiles shall be covered with a minimum of three to six inches of wood chips to minimize erosion of the stockpile. In addition, the contractor shall install silt fence at the toe of the stockpile slope to contain movement of material. Contractor shall not apply topsoil to the high acid-producing soil or bedrock stockpiles to prevent topsoil contamination.

5. Contractor shall ultimately dispose of high acid-producing soils or bedrock with a pH of four or less, or containing iron sulfide (including borrow from cuts) by placing the material combined with limestone at the rate of 6 tons per acre (or 275 pounds per 1,000 square feet of surface area) and covering the mixture with a minimum of 12 inches of settled soils with a pH of five or more except as follows:
 - a. In the areas where trees or shrubs are to be planted, the contractor shall cover the limestone/soil mixture with a minimum of 24 inches of soils with a pH of five or more.
 - b. Contractor shall not locate any disposal area within 24 inches of any surface of a slope or bank, such as berms, stream banks, ditches, and other surface waters to prevent potential lateral leaching damages.
6. At the end of each day, contractor shall clean all equipment used to handle high acid-producing soils or bedrock to prevent spreading of high-acid materials to other parts of the proposed right-of-way, into streams, or stormwater conveyances, and to protect machinery from accelerated corrosion.
7. Contractor shall provide and install non-vegetative erosion controls (stone tracking pads, strategically-place limestone check dams, silt fences, wood chips) to limit the movement of high acid-producing soils from, around, or off areas disturbed for access road construction.
8. Following the burial or removal of high acid-producing soils and bedrock, top soiling, and seeding of the areas restored after the removal of the temporary access roads and permanent access roads that provide access to the pipeline right-of-way, Transco shall monitor the site for approximately six to 12 months to assure there is adequate stabilization and that no high-acid soil or bedrock problems emerge. Contractor shall correct any problems that are discovered within this time period.
9. If problems occur where high acid-producing soils or bedrock have been placed or buried, the applicant shall monitor these areas for at least two years to assure there is no migration of potential acid leachate.

1.13 Thermal Impacts

Thermal impacts associated with access roads will be avoided to the maximum extent practicable by implementing the following measures:

- Minimize permanent changes in land cover to only that necessary to construct the required access roads;
- Limit removal of vegetation, especially tree cover, to only that necessary for construction;
- Minimize permanent impervious surfaces;
- Collect runoff from the permanent impervious areas and direct runoff to PCSM BMPs;
- Install a gravel surface for the permanent access roads rather than asphalt;
- Incorporate the use of stone at mainline valves and vegetated channels with earthen check dams to provide storage for stormwater runoff; and
- Minimize impacts to existing riparian corridors.

See the road-specific narratives for a road-specific discussion on thermal impacts.

1.14 E&SC Plan and PCSM Plan Consistency

The E&SC Plans (**Section 2 of the ESCGP-2 NOI**), the E&SC Narrative, and this PCSM Narrative have been designed and will be constructed to be consistent with the PCSM Plans (**Section 3 of the ESCGP-2 NOI**). Following completion of construction, disturbed areas shall be stabilized and the long-term maintenance of the PCSM BMPs will begin.

1.15 Riparian Forest Buffer Waiver

No access roads within Northumberland County require a riparian forest buffer waiver.

1.16 Antidegradation Requirements

The proposed permanent access road to the MLV site is not located within a special protection or siltation impaired watershed.

1.17 TMDL

Road-specific Total Maximum Daily Load (TMDL) discussions are provided in the road-specific narratives.

APPENDIX A

Intentionally Omitted by Applicant

APPENDIX B

Intentionally Omitted by Applicant

APPENDIX C

United States Department of Agriculture Natural Resources Conservation Service Custom Soil Resource Report

Included under separate cover in Appendix C of the E&SC Narrative for
Northumberland County included in Section 2 of the ESCGP-2 NOI

APPENDIX D

Supporting Information

Appendix D.1 – Preparer Qualifications

Appendix D.2 – North American Green Product Data

Appendix D.1 – Preparer Qualifications

NAME OF PLAN PREPARER: Suzanne Marie King, PE

FORMAL EDUCATION:

Name of College or Technical Institute: Roger Williams University / Stanford University

Curriculum or Program: General Engineering / Structural Engineering

Dates of Attendance: **From:** RWU: 9/1998 / SU: 9/2002 **To:** RWU: 5/2002 / SU: 5/2003

Degree Received RWU: Bachelor of Science - General Engineering
SU: Masters of Science - Structural Engineering

OTHER TRAINING:

Name of Training: _____

Presented By: _____

Date: _____

EMPLOYMENT HISTORY:

Current Employer: BL Companies

Telephone: 781-619-9500

Former Employer: Woodard & Curran BKF Engineers

Telephone: 401-273-1007 650-482-6300

RECENT PERMANENT STORMWATER FACILITY PLANS PREPARED:

Name of Project:	<u>Treasure Island Redevelopment</u>	<u>Canal Street Improvements</u>	<u>Beechwood Museum</u>
County:	<u>San Francisco</u>	<u>Essex</u>	<u>Newport</u>
Municipality:	<u>San Francisco, CA</u>	<u>Salem, MA</u>	<u>Newport, RI</u>
Permit Number:	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Approving Agency:	<u>Treasure Island Development Authority (TIDA)</u>	<u>City of Salem & Massachusetts Emergency Management Agency</u>	<u>City of Newport & Coastal Resources Management Council</u>

Appendix D.2 – North American Green Product Data



Specification Sheet – EroNet™ DS75™ Erosion Control Blanket

DESCRIPTION

The ultra short-term single net erosion control blanket shall be a machine-produced mat of 100% agricultural straw with a functional longevity of up to 45 days. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a polypropylene netting having an approximate 0.50 x 0.50 (1.27 x 1.27 cm) mesh with photodegradable accelerators to provide breakdown of the netting within approximately 45 days, depending upon geographical location and elevation. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The DS75 shall meet Type 1.C specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content		
Matrix	100% Straw Fiber	0.5 lbs/sq yd (0.27 kg/sm)
Netting	Top side only, lightweight photodegradable with photo accelerators	1.5 lb/1000 sq ft (0.73 g/sm)
Thread	Degradable	

Standard Roll Sizes			
Width	6.67 (2.03 m)	8.0 ft (2.4 m)	16 ft (4.87 m)
Length	108 ft (32.92 m)	112 ft (34.14 m)	108 ft (32.92 m)
Weight ± 10%	40 lbs (18.14 kg)	50 lbs (22.68 kg)	96 lbs (43.54 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	192 sq yd (165.5 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.45 in. (11.43 mm)
Resiliency	ECTC Guidelines	78.8%
Water Absorbency	ASTM D1117	375%
Mass/Unit Area	ASTM 6475	8.57 oz/sy (291 g/sm)
Swell	ECTC Guidelines	15%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	6.31 oz-in
Light Penetration	ASTM D6567	10%
Tensile Strength - MD	ASTM D6818	105.6 lbs/ft (1.57 kN/m)
Elongation - MD	ASTM D6818	34%
Tensile Strength - TD	ASTM D6818	42.0 lbs/ft (0.62 kN/m)
Elongation - TD	ASTM D6818	25.2%
Biomass Improvement	ASTM D7322	286%

Design Permissible Shear Stress	
Unvegetated Shear Stress	1.55 psf (74 Pa)
Unvegetated Velocity	5.00 fps (1.52 m/s)

Slope Design Data: C Factors			
Slope Gradients (S)			
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.029	N/A	N/A
20-50 ft	0.11	N/A	N/A
≥ 50 ft (15.2 m)	0.19	N/A	N/A

Roughness Coefficients – Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.055
0.50 – 2.0 ft	0.055-0.021
≥ 2.0 ft (0.60 m)	0.021



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Specification Sheet – EroNet™ C125® Erosion Control Blanket

DESCRIPTION

The long-term double net erosion control blanket shall be a machine-produced mat of 100% coconut fiber with a functional longevity of up to 36 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with a heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and an approximate 0.63 x 0.63 in (1.59 x 1.59 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The C125 shall meet Type 4 specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content

Matrix	100% Coconut Fiber	0.5 lbs/sq yd (0.27 kg/sm)
Netting	Heavyweight photodegradable with UV additives	3 lbs/1000 sq ft (1.47 g/sm)
Thread	Black polypropylene	

Standard Roll Sizes

Width	6.67 (2.03 m)	8 ft (2.44 m)
Length	108 ft (32.92 m)	112 ft (35.14 m)
Weight ± 10%	44 lbs (19.95 kg)	56.25 (25.5 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.22 in. (5.59 mm)
Resiliency	ECTC Guidelines	82%
Water Absorbency	ASTM D1117	167%
Mass/Unit Area	ASTM 6475	7.73 oz/sy (262.8 g/sm)
Swell	ECTC Guidelines	13%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	0.75 oz-in
Light Penetration	ASTM D6567	16.6%
Tensile Strength - MD	ASTM D6818	472.8 lbs/ft (7.01 kN/m)
Elongation - MD	ASTM D6818	25.6%
Tensile Strength - TD	ASTM D6818	225.6 lbs/ft (3.35 kN/m)
Elongation - TD	ASTM D6818	33.9%
Biomass Improvement	ASTM 7322	257%

Design Permissible Shear Stress

Unvegetated Shear Stress	2.25 psf (108 Pa)
Unvegetated Velocity	10.0 fps (3.05 m/s)

Slope Design Data: C Factors

Slope Gradients (S)

Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.001	0.029	0.082
20-50 ft	0.036	0.060	0.096
≥ 50 ft (15.2 m)	0.070	0.090	0.110

Roughness Coefficients – Unveg.

Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.022
0.50 – 2.0 ft	0.022-0.014
≥ 2.0 ft (0.60 m)	0.014

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Specification Sheet – EroNet™ S75® Erosion Control Blanket

DESCRIPTION

The short-term single net erosion control blanket shall be a machine-produced mat of 100% agricultural straw with a functional longevity of up to 12 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a lightweight photodegradable polypropylene netting having an approximate 0.50 x 0.50 in. (1.27 x 1.27 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The S75 shall meet Type 2.C specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content

Matrix	100% Straw Fiber	0.5 lbs/sq yd (0.27 kg/sm)
Netting	Top side only, lightweight photodegradable	1.5 lb/1000 sq ft (0.73 kg/100 sm)
Thread	Degradable	

Standard Roll Sizes

Width	6.67 ft (2.03 m)	8.0 ft (2.4 m)	16 ft (4.87 m)
Length	108 ft (32.92 m)	112 ft (34.14 m)	108 ft (32.92 m)
Weight ± 10%	40 lbs (18.14 kg)	50 lbs (22.68 kg)	96 lbs (43.54 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	192 sq yd (165.5 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.50 in. (12.7 mm)
Resiliency	ECTC Guidelines	78.8%
Water Absorbency	ASTM D1117	301%
Mass/Unit Area	ASTM D6475	9.76 oz/sy (332 g/sm)
Swell	ECTC Guidelines	15%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	6.31 oz-in
Light Penetration	ASTM D6567	6.0%
Tensile Strength - MD	ASTM D6818	122.4 lbs/ft (1.81 kN/m)
Elongation - MD	ASTM D6818	36.1%
Tensile Strength - TD	ASTM D6818	79.2 lbs/ft (1.17 kN/m)
Elongation - TD	ASTM D6818	26.8%
Biomass Improvement	ASTM D7322	301%

Design Permissible Shear Stress

Unvegetated Shear Stress	1.55 psf (74 Pa)
Unvegetated Velocity	5.00 fps (1.52 m/s)

Slope Design Data: C Factors

Slope Gradients (S)

Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.029	N/A	N/A
20-50 ft	0.11	N/A	N/A
≥ 50 ft (15.2 m)	0.19	N/A	N/A

NTPEP Large-Scale Slope Testing
ASTM D6459 - C-factor = 0.012

Roughness Coefficients – Unveg.

Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.055
0.50 – 2.0 ft	0.055-0.021
≥ 2.0 ft (0.60 m)	0.021

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Specification Sheet – EroNet™ SC150® Erosion Control Blanket

DESCRIPTION

The extended-term double net erosion control blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut fiber with a functional longevity of up to 24 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and an approximate 0.63 x 0.63 in (1.59 x 1.59 cm) mesh, and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate 0.50 x 0.50 (1.27 x 1.27 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The SC150 shall meet Type 3.B specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content

Matrix	70% Straw Fiber	0.35 lbs/sq yd (0.19 kg/sm)
	30% Coconut Fiber	0.15 lbs/sq yd (0.08 kg/sm)
Netting	Top: Heavyweight photodegradable with UV additives	3 lbs/1000 sq ft (1.47 kg/100 sm)
	Bottom: lightweight photodegradable	1.5 lb/1000 sq ft (0.73 kg/100 sm)
Thread	Degradable	

Standard Roll Sizes

Width	6.67 ft (2.03 m)	8 ft (2.4 m)	16.0 ft (4.87 m)
Length	108 ft (32.92 m)	112 ft (34.14 m)	108 ft (32.92 m)
Weight ± 10%	44 lbs (19.95 kg)	55 lbs (24.95 kg)	105.6 lbs (47.9 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	192 sq yd (165.6 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.35 in. (8.89 mm)
Resiliency	ECTC Guidelines	75%
Water Absorbency	ASTM D1117	342%
Mass/Unit Area	ASTM D6475	7.87 oz/sy (267.6 g/sm)
Swell	ECTC Guidelines	30%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	1.11 oz-in
Light Penetration	ASTM D6567	6.2%
Tensile Strength - MD	ASTM D6818	362.4 lbs/ft (5.37 kN/m)
Elongation - MD	ASTM D6818	29.4%
Tensile Strength - TD	ASTM D6818	136.8 lbs/ft (2.03 kN/m)
Elongation - TD	ASTM D6818	27.6%
Biomass Improvement	ASTM D7322	481%

Design Permissible Shear Stress

Unvegetated Shear Stress	2.00 psf (96 Pa)
Unvegetated Velocity	8.0 fps (2.44 m/s)

Slope Design Data: C Factors

Slope Gradients (S)

Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.001	0.048	0.100
20-50 ft	0.051	0.079	0.145
≥ 50 ft (15.2 m)	0.10	0.110	0.190

NTPEP Large-Scale Slope
ASTM D6459 - C-factor = 0.031

Roughness Coefficients – Unveg.

Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.050
0.50 – 2.0 ft	0.050-0.018
≥ 2.0 ft (0.60 m)	0.018

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Specification Sheet – BioNet® SC150BN™ Erosion Control Blanket

DESCRIPTION

The extended-term double net erosion control blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut fiber with a functional longevity of up to 18 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with a 100% biodegradable woven natural organic fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as Leno weave) to form an approximate 0.50 x 1.0 in. (1.27 x 2.54 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The SC150BN shall meet Type 3.B specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content		
Matrix	70% Straw Fiber	0.35 lbs/sq yd (0.19 kg/sm)
	30% Coconut Fiber	0.15 lbs/sq yd (0.08 kg/sm)
Netting	Top: Leno woven 100% biodegradable jute	9.35 lb/1000 sq ft (4.5 kg/100 sm)
	Bottom: 100% biodegradable organic jute	7.7 lb/1000 sq ft (3.76 kg/100 sm)
Thread	Biodegradable	

Standard Roll Sizes			
Width	6.67 ft (2.03 m)	8.0 ft (2.4 m)	15.5 ft (4.72 m)
Length	108 ft (32.92 m)	112 ft (34.14 m)	90 ft (27.43 m)
Weight ± 10%	52.22 lbs (23.69 kg)	65.28 lbs (29.61 kg)	101.2 lbs (45.9 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	155 sq yd (129.6 sm)
	Leno weave top only	Leno top and bottom	Leno top and bottom

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.25 in. (6.35 mm)
Resiliency	ECTC Guidelines	86%
Water Absorbency	ASTM D1117	311%
Mass/Unit Area	ASTM D6475	8.32 oz/sy (282.9 g/sm)
Swell	ECTC Guidelines	46%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	0.42 oz-in
Light Penetration	ASTM D6567	7.6%
Tensile Strength - MD	ASTM D6818	201.6 lbs/ft (2.99 kN/m)
Elongation - MD	ASTM D6818	13.4%
Tensile Strength - TD	ASTM D6818	164.4 lbs/ft (2.44 kN/m)
Elongation - TD	ASTM D6818	14.2%
Biomass Improvement	ASTM D7322	641 %

Design Permissible Shear Stress	
Unvegetated Shear Stress	2.10 psf (100 Pa)
Unvegetated Velocity	8.00 fps (2.44 m/s)

Slope Design Data: C Factors			
Slope Gradients (S)			
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.001	0.029	0.063
20-50 ft	0.051	0.055	0.092
≥ 50 ft (15.2 m)	0.10	0.080	0.120

Roughness Coefficients – Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.050
0.50 – 2.0 ft	0.050-0.018
≥ 2.0 ft (0.60 m)	0.018

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Specification Sheet – VMax® P550® Turf Reinforcement Mat

DESCRIPTION

The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 100% UV stable polypropylene fiber matrix incorporated into permanent three-dimensional turf reinforcement matting. The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between an ultra heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, an ultra heavy UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.5 x 0.5 inch (1.27 x 1.27 cm) openings, and covered by an ultra heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The middle corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 inch (3.81cm) centers with UV stabilized polypropylene thread to form permanent three-dimensional turf reinforcement matting. All mats shall be manufactured with a colored thread stitched along both outer edges as an overlap guide for adjacent mats.

The P550 shall meet Type 5A, 5B, and 5C specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.18

Material Content

Matrix	100% UV stable polypropylene fiber	0.5 lb/sy (0.27 kg/sm)
Netting	Top and Bottom, UV-Stabilized Polypropylene	24 lb/1000 sf (11.7 kg/100 sm)
	Middle, Corrugated UV-Stabilized Polypropylene	24 lb/1000 sf (11.7 kg/100 sm)
Thread	Polypropylene, UV Stable	

Standard Roll Sizes

Width	6.5 ft (2.0 m)
Length	55.5 ft (16.9 m)
Weight ± 10%	52 lbs (23.59 kg)
Area	40 sy (33.4 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.72 in. (18.29 mm)
Resiliency	ASTM 6524	95%
Density	ASTM D792	0.892 g/cm ³
Mass/Unit Area	ASTM 6566	21.25 oz/sy (723 g/sm)
UV Stability	ASTM D4355/ 1000 HR	100%
Porosity	ECTC Guidelines	96%
Stiffness	ASTM D1388	366.3 oz-in.
Light Penetration	ASTM D6567	16.5%
Tensile Strength - MD	ASTM D6818	1421 lbs/ft (21.07 kN/m)
Elongation - MD	ASTM D6818	40.5%
Tensile Strength - TD	ASTM D6818	1191.6 lbs/ft (17.67 kN/m)
Elongation - TD	ASTM D6818	28.8%
Biomass Improvement	ASTM D7322	378%

Design Permissible Shear Stress

	Short Duration	Long Duration
Phase 1: Unvegetated	4.0 psf (191 Pa)	3.25 psf (156 Pa)
Phase 2: Partially Veg.	12.0 psf (576 Pa)	12.0 psf (576 Pa)
Phase 3: Fully Veg.	14.0 psf (672 Pa)	12.0 psf (576 Pa)
Unvegetated Velocity	12.5 fps (3.8 m/s)	
Vegetated Velocity	25 fps (7.6 m/s)	

NTPEP ASTM D6460 Large Scale Channel

Vegetated Shear Stress	>13.2 psf (632 Pa)
Vegetated Velocity	>24.5 fps (7.47 m/s)

Slope Design Data: C Factors

Slope Length (L)	Slope Gradients (S)		
	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.0005	0.015	0.043
20-50 ft	0.0173	0.031	0.050
≥ 50 ft (15.2 m)	0.035	0.047	0.057

Roughness Coefficients – Unveg.

Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.041
0.50 – 2.0 ft	0.040-0.013
≥ 2.0 ft (0.60 m)	0.013

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EC_RMX_MPDS_VMP550_5.13



Specification Sheet – VMax® SC250® Turf Reinforcement Mat

DESCRIPTION

The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 70% straw and 30% coconut fiber matrix incorporated into permanent three-dimensional turf reinforcement matting. The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between a heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, an ultra heavy UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.5 x 0.5 inch (1.27 x 1.27 cm) openings, and covered by an heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The middle corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 inch (3.81cm) centers with UV stabilized polypropylene thread to form permanent three-dimensional turf reinforcement matting. All mats shall be manufactured with a colored thread stitched along both outer edges as an overlap guide for adjacent mats.

The SC250 shall meet Type 5A, 5B, and 5C specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.18

Material Content

Matrix	70% Straw Fiber	0.35 lb/sq yd (0.19 kg/sm)
	30% Coconut Fiber	0.15 lbs/sq yd (0.08 kg/sm)
Netting	Top and Bottom, UV-Stabilized Polypropylene	5 lb/1000 sq ft (2.44 kg/100 sm)
	Middle, Corrugated UV-Stabilized Polypropylene	24 lb/1000 sf (11.7 kg/100 sm)
Thread	Polypropylene, UV Stable	

Standard Roll Sizes

Width	6.5 ft (2.0 m)
Length	55.5 ft (16.9 m)
Weight ± 10%	34 lbs (15.42 kg)
Area	40 sq yd (33.4 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.62 in. (15.75 mm)
Resiliency	ASTM 6524	95.2%
Density	ASTM D792	0.891 g/cm ³
Mass/Unit Area	ASTM 6566	16.13 oz/sy (548 g/sm)
UV Stability	ASTM D4355/ 1000 HR	100%
Porosity	ECTC Guidelines	99%
Stiffness	ASTM D1388	222.65 oz-in.
Light Penetration	ASTM D6567	4.1%
Tensile Strength - MD	ASTM D6818	709 lbs/ft (10.51 kN/m)
Elongation - MD	ASTM D6818	23.9%
Tensile Strength - TD	ASTM D6818	712 lbs/ft (10.56 kN/m)
Elongation - TD	ASTM D6818	36.9%
Biomass Improvement	ASTM D7322	441%

Design Permissible Shear Stress

	Short Duration	Long Duration
Phase 1: Unvegetated	3.0 psf (144 Pa)	2.5 psf (120 Pa)
Phase 2: Partially Veg.	8.0 psf (383 Pa)	8.0 psf (383 Pa)
Phase 3: Fully Veg.	10.0 psf (480 Pa)	8.0 psf (383 Pa)
Unvegetated Velocity	9.5 fps (2.9 m/s)	
Vegetated Velocity	15 fps (4.6 m/s)	

Slope Design Data: C Factors

Slope Length (L)	Slope Gradients (S)		
	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.0010	0.0209	0.0507
20-50 ft	0.0081	0.0266	0.0574
≥ 50 ft (15.2 m)	0.0455	0.0555	0.081

Roughness Coefficients – Unveg.

Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.040
0.50 – 2.0 ft	0.040-0.012
≥ 2.0 ft (0.60 m)	0.011

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EC_RMX_MPDS_VMSC250_5.13



Specification Sheet – VMax® W3000™ High-Performance Turf Reinforcement Mat

DESCRIPTION

The VMax® W3000™ high performance turf reinforcement mat (HPTRM) is a machine-produced mat of 100% UV-stabilized high denier poly yarns woven into permanent, high strength three-dimensional turf reinforcement matting. The mat consists of a woven bottom layer integrally interlaced into a woven corrugated middle layer, with poly tendons on the top side spanning the entire machine direction. The mat is designed to provide sufficient thickness, optimum open area and three-dimensionality for effective erosion control and vegetation reinforcement against high flow induced shear forces. The mat has high tensile strength providing excellent damage resistance and increased bearing capacity of vegetated soils subject to heavy loads from maintenance equipment and other vehicular traffic. The corrugated structure provides a highly frictional surface to prevent sod slippage when sod is installed over the mat. When used as surface protection without sod overlay, the corrugated structure encapsulates the seed and soil in place while promoting self-soil infilling of the system.

Material Content

Bottom	100% UV stable poly fiber weave	Black/Green
Corrugated Middle	100% UV stable poly fiber weave	Black/Green
Top	100% UV stable Poly Tendons	Green

Standard Roll Sizes

Width	10 ft (3.05 m)
Length	90 ft (27.4 m)
Weight ± 10%	90 lbs (41.0 kg)
Area	100 sy (83.6 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.40 in. (10.2 mm)
Resiliency	ASTM D6524	98%
Mass/Unit Area	ASTM 6566	14.7oz/sy (495 g/m ²)
Tensile Strength - MD	ASTM D6818	3600 lbs/ft (52.6 kN/m)
Elongation - MD	ASTM D6818	35%*
Tensile Strength - TD	ASTM D6818	3800 lbs/ft (55.5 kN/m)
Elongation - TD	ASTM D6818	20%*
Light Penetration	ASTM D6567	12%
UV Stability	ASTM D4355	>80% @3000 hrs

* Measured on fabric prior to corrugation for true measurement of base fabric elongation

Design Permissible Shear Stress*

Vegetated Shear Stress	16 psf (766 Pa)
Vegetated Velocity	25 fps (7.6 m/s)

*Values extrapolated through ASTM D6460 testing

ASTM D6460 Large Scale Channel

Vegetated Shear Stress	>13.2 psf (632 Pa)
Vegetated Velocity	>24.5 fps (7.47 m/s)

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EC_RMX_MPDS_VW3000_5.13

APPENDIX N

AR-CO-085.1.3 Specific Narrative and Calculations

N.1 Site Specific Narrative

- a. Narrative
- b. TMDL Discussion
- c. Minimized Soil Compaction
- d. Thermal Impact Analysis
- e. Acidic Soil Management Plan
- f. Road Specific Construction Sequence
- g. Permanent Access Road Summary Sheet (NOI PCSM Table)

N.2 Location Map

N.3 Predevelopment Calculations

- a. Predevelopment Drainage Area Map
- b. 1-Year Rainfall Event
- c. 2-Year Rainfall Event
- d. 5-Year Rainfall Event
- e. 10-Year Rainfall Event
- f. 25-Year Rainfall Event
- g. 50-year Rainfall Event
- h. 100-Year Rainfall Event

N.4 Post Development Calculations

- a. Post Development Drainage Area Map
- b. 1-Year Rainfall Event
- c. 2-Year Rainfall Event
- d. 5-Year Rainfall Event
- e. 10-Year Rainfall Event
- f. 25-Year Rainfall Event
- g. 50-year Rainfall Event
- h. 100-Year Rainfall Event

N.5 Conveyance Calculations

- a. E&S Worksheet 11
- b. NAG Swale Lining Analysis
- c. Figure 9.3-Riprap Apron Design

N.6 PCSM BMP Calculations

- a. Check Dam Volume Calculations

N.7 Water Quality Worksheets

- a. Flow Chart A – Stormwater Calculation Process
- b. Worksheet 1. General Site Information
- c. Worksheet 2. Sensitive Natural Resources
- d. Worksheet 3. Nonstructural BMP Credits
- e. Flow Chart B – Control Guideline 1 Process
- f. Worksheet 4. Change in Runoff Volume for 2-Yr Storm Event
- g. Worksheet 5. Structural BMP Volume Credits
- h. Worksheet 10. Water Quality Compliance for Nitrate
- i. Worksheet 11. BMPs for Pollution Prevention*
- j. Worksheet 12. Water Quality Analysis of Pollutant Loading from All Disturbed Areas*
- k. Worksheet 13. Pollutant Reduction Through BMP Applications*

N.8 Infiltration Information

- a. Field Observation Report

N.9 Off-Site Discharge Analysis

- a. Adequacy of Off-Site Discharge

N.10 Storage Volume Analysis

- a. Storage Volume Analysis

N.11 Sediment Barrier Table

- a. E&S Worksheet #1

N.1 Site Specific Narrative

- a. Narrative
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- f. Road Specific Construction Sequence
- g. Permanent Access Road Summary Sheet (NOI PCSM Table)

ACCESS ROAD: AR-CO-085.1.3

ACT 167 PLAN: None

TMDL: None

NARRATIVE:

AR-CO-085.1.3 is a proposed permanent access road (PAR) located in Ralpho Township, Northumberland County, Pennsylvania. The intent of this PAR is to provide permanent maintenance and operational access to the proposed Main Line Valve 10 (CS-MLV-10) located on the proposed 42" Central Penn Line South Pipeline. The road begins at Reading Turnpike and terminates at the MLV site at approximate mile post M-0167 MP 0.0. The PAR is approximately 230 feet long and has an elevation change of approximately 12 feet. The road will be entirely located within the pipeline permanent right of way. Within the pipeline right of way, the proposed temporary sediment barriers are included in the Pipeline E&S Plan and shown in grey on the Access Road Plan for coordination purposes.

During construction, the access road will be 14 feet wide with a temporary rock construction entrance with compost filter sock. Upon completion of the construction activities, the temporary construction entrance will be removed and a permanent access road will be constructed. The proposed road will have a width of 14 feet and a cross slope of 2% directing runoff to the north westerly direction into a vegetated channel for infiltration with check dams.

The MLV site will be constructed with a 6-inch thick layer of AASHTO #8 stone on top of nonwoven geotextile and a 24-inch thick layer of AASHTO #57 stone. As summarized in the infiltration calculations in Appendix N.8, the detained water stored in the voids of the MLV stone pad will infiltrate to the surrounding ground over approximately 6 hours and the water detained behind the check dams will infiltrate to the surrounding ground over approximately 5 hours.

Water Quality Worksheet #4 was used to complete the Control Guideline 1 (CG-1) volume analysis for the 2-year 24-hour storm. The storage volume provided by MLV site and the stone check dams exceeds the required volume per Worksheet #4.

Pre-development and post-development runoff hydrographs were developed for the 1, 2, 5, 10, 25, 50 and 100 year 24-hour storm events using the SCS TR-20 method. Directing runoff from the proposed new gravel road to the vegetated channel for infiltration and MLV pad mitigates an increase in runoff from the proposed development.

TMDL DISCUSSION:

The nearest surface waters to receive runoff from this road are not subject to TMDL restrictions.

MINIMIZED SOIL COMPACTION:

The Project seeks to minimize soils compaction impacts associated with access roads to the maximum extent practicable. Construction and operations traffic will utilize the proposed road. The permanent access road is within the permanent right of way of the pipeline, reducing the area of impact. The roadway width has been minimized to 14 feet.

Prior to installing the pipeline, the infiltration bed area will be protected by construction fence. A portion of the MLV site infiltration bed is within the construction travel way for the pipe installation and cannot be protected by the construction fence. Timber matting will be installed across the proposed MLV site to spread construction vehicle loads and minimize soil compaction during construction of the pipeline. Once the travel way is no longer needed, the timber matting will be removed.

The top 20 inches of soil within the footprint of the timber matting installed across the MLV infiltration area will be tilled with a solid-shank ripper to loosen the soil and promote infiltration. If necessary, the tilling operations will be extended to the other infiltration areas if compaction has occurred during installation of the pipeline. Tilling will be performed when the soil is dry.

During grading operations for the PCSM BMPs and access road, construction equipment shall avoid excessive compaction and/or land disturbance. If excavation leads to substantial compaction of the subgrade, 18 inches shall be removed and replaced with a blend of topsoil and sand to promote infiltration and biological growth. At the very least, topsoil shall be thoroughly deep plowed into the subgrade to penetrate the compacted zone and promote aeration and the formation of macropores. Following this, the area should be disked prior to final grading.

THERMAL IMPACT ANALYSIS:

Thermal impacts associated with AR-CO-085.1.3 will be avoided to the maximum extent practicable. The following measures have been implemented to minimize thermal impacts:

- AR-CO-085.1.3 is approximately 230 linear feet, minimizing the total length of necessary temporary construction and, therefore, minimizing thermal impact of the road.
- A vegetated channel for infiltration with check dams is proposed adjacent to the proposed permanent access road. The vegetated channel for infiltration and check dams promote infiltration of the runoff from the proposed impervious road. Infiltration allows the runoff to assimilate to ground water temperatures which are minimally influenced by seasonal temperature changes, minimizing the thermal impact of this road.

ACIDIC SOIL MANAGEMENT PLAN:

AR-CO-085.1.3 Soil Acidity Table		
Soil Map Symbol	Soil Name	PH
CaB	Calvin-Klinesville shaly silt loams, 3 to 8 percent slopes	5.3
MkB	Meckesville silt loam, 3 to 8 percent slopes	4.6

An Acid Producing Soils Control Plan is included as part of this application. The plan identifies the measures to be used to control pollution associated with construction of access roads that contain acid-producing soils. The plan requires that these measures be applied only for soils with a pH less than 4.0 as recommended by the Natural Resources Conservation Service (NRCS). The table above depicts the soil types present on this road as well as the acidity of the soils. The pH of the soils on this road are outside the threshold established by the Acid Producing Soils Control Plan. Therefore, the measures prescribed in the plan do not need to be implemented for this road.

ROAD SPECIFIC CONSTRUCTION SEQUENCE:
ACCESS ROAD: AR-CO-085.1.3

1. At least 7 days prior to starting earth disturbance activities, including clearing and grubbing, the owner and/or operator shall invite all contractors, Environmental Inspectors, the landowner, appropriate municipal officials, the E&S plan preparer, the PCSM plan preparer, the licensed professional responsible for oversight of critical stages of implementation of the PCSM plan, and a representative from the local conservation district to an on-site preconstruction meeting.
2. At least 3 days prior to starting earth disturbance activities, or expanding into an area previously unmarked, the Pennsylvania One Call System Inc. shall be notified at 1-800-242-1776 for the location of existing underground utilities.
3. Hold pre-construction conference with the Environmental Inspectors, local County Conservation District (CCD), PADEP and Design Engineer.
4. Survey crews locate and stake all special areas of concern (i.e., wetlands, streams, culverts, other utilities, etc.), edge of proposed access road, and field locate the limit of disturbance.
5. Install orange construction fence around areas to be preserved, **including infiltration areas to be protected.**
6. Locate staging areas and access points including the rock construction entrance with wash rack. Install sediment barriers (compost filter sock) down slope of these areas.
7. Perform tree cutting where required. (Areas with tree cutting shall be restored to meadow in good condition.)
8. **Strip and stockpile topsoil; Install compost filter sock around stockpile. Stockpiled soil shall not exceed 35 feet in height, have maximum side slopes of 2:1, and be surrounded by 12" compost filter sock. Excavated material that is not to be reused in the work area is to be immediately removed from the site and properly disposed of at an approved facility or permitted waste area.**
9. Install rock construction entrance with wash rack.
10. Remove brush to effectively install **sediment barriers as shown on the Pipeline E&SC Plans under separate cover.**
11. The Compliance Manager shall provide PADEP at least three days' notice prior to bulk earth disturbance and upon completed installation of **sediment barriers.**

12. If applicable, install security fence. The necessity of a security fence will be at the discretion of the Contractor.
13. ***Install sediment barriers as shown on the pipeline E&SC plans. The pipeline improvements will be installed prior to the MLV site and permanent access road improvements.***
14. ***Install timber matting over infiltration area as shown on the E&SC Plans to minimize compaction due to construction traffic. Minimize traffic through this area.***
15. Proceed with major clearing and grubbing.
16. ***Install the pipeline.***
17. Upon ***completion of backfilling the pipeline trench***, temporary cessation of an earth disturbance activity, or stage of an activity where the cessation of earth disturbance activities will exceed four days, the disturbed areas shall be immediately seeded, mulched, or otherwise protected from accelerated erosion and sedimentation pending future earth disturbance activities. For an earth disturbance activity or stage of an activity to be considered temporarily stabilized, the disturbed areas shall be covered with one of the following: a minimum uniform coverage of mulch and seed, with a density capable of resisting accelerated erosion and sedimentation. Temporary stabilization will not occur on active vehicular travel ways within the right of way. The on-site environmental inspector will log daily activity within the limits of disturbance and notify the Contractor of areas requiring temporary stabilization (i.e., areas where work has ceased for at least four days).
18. Begin construction staking for layout of access road.
19. ***Remove the timber matting in the MLV site.***
20. Grade the access road and MLV site as shown on the E&SC Plans.
21. Remove excess excavated soil from the site and properly disposed of the material at an approved facility or permitted waste area.
22. ***Till the top 20 inches of soil within the footprint of the timber matting installed across the MLV infiltration area with a solid-shank ripper to loosen the soil and promote infiltration. Extend tilling operations to the other infiltration areas if compaction has occurred during installation of the pipeline and/or grading of the access road and MLV site. Tilling shall be performed when the soil is dry.***

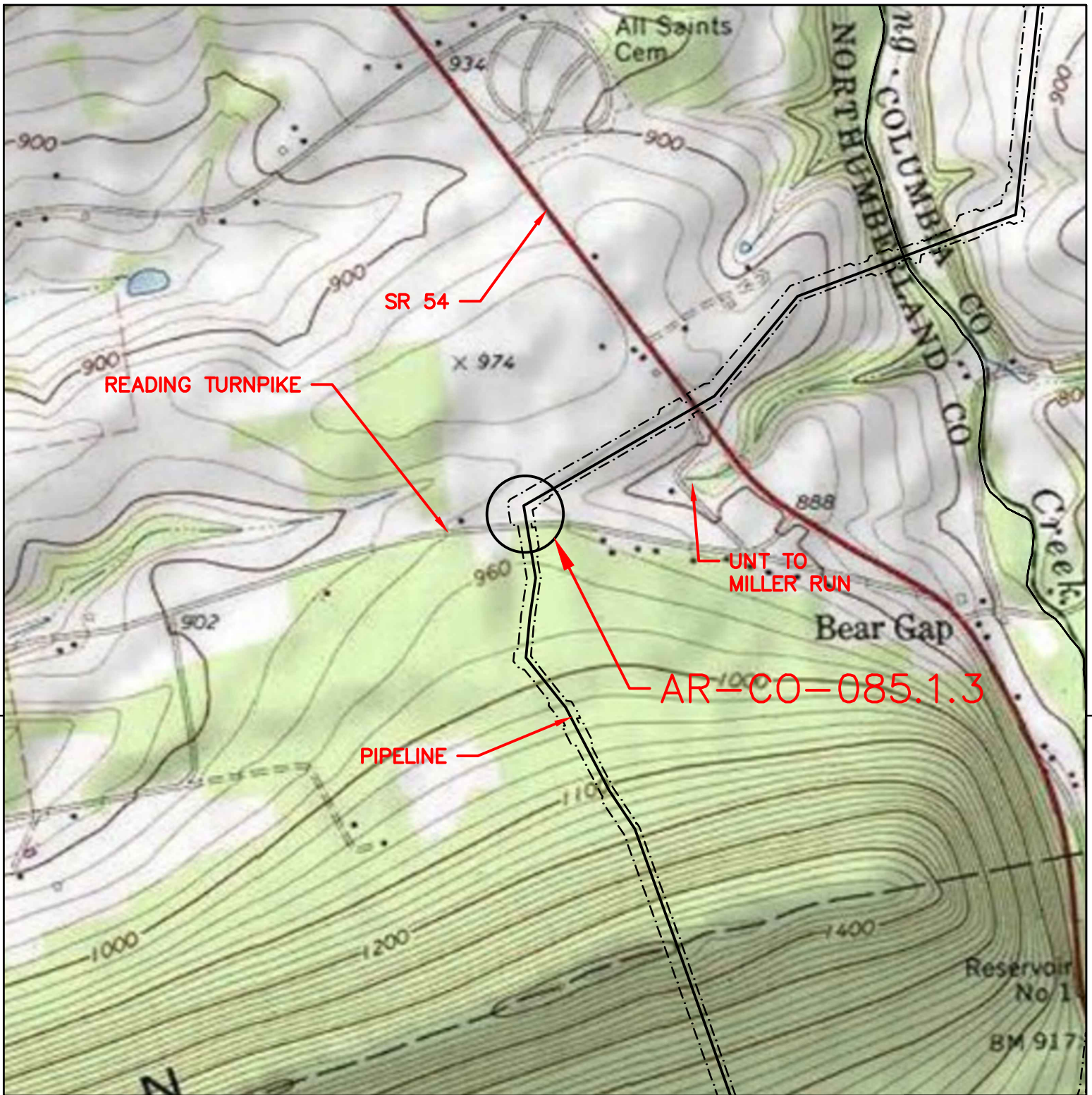
23. The Compliance Manager shall provide PADEP at least three days' notice prior to installing the vegetated channel and stone and geotextile fabric within the MLV pads.
- a. Install vegetated channel where specified on the E&SC & PCSM Plans (Section 2 of the ESCGP-2 NOI). Note: this is a critical stage of PCSM plan to be observed by a licensed professional or designee. Begin vegetated channel construction only when the upgradient temporary erosion and sediment control measures are in place. The vegetated channel should be constructed and stabilized early in the construction schedule, preferably before mass earthwork increase the rate and volume of runoff.
 - b. Rough grade the vegetated channel. Equipment shall avoid excessive compaction and/or land disturbance. Excavating equipment should operate from the side of the channel and never on the bottom. If excavation leads to substantial compaction of the subgrade (where infiltration is proposed), 18 inches shall be removed and replaced with a blend of topsoil and sand to promote infiltration and biological growth. At the very least, topsoil shall be thoroughly deep plowed into the subgrade in order to penetrate the compacted zone and promote aeration and the formation of macropores. Following this, the area should be disked prior to final grading.
 - c. Construct check dams.
 - d. Fine grade the vegetated channel. Accurate grading is crucial for channels. Even the smallest nonconformities may compromise flow conditions.
 - e. Seed, vegetate and install protective lining as per approved plans and according to final planting list. Vegetation should be established as soon as possible to prevent erosion and scour. Seed mix and season of planting are provided under separate cover in the Best Management Practices and Quantities Plan Set.
 - f. Rough grade the MLV pad. Equipment shall avoid excessive compaction and/or land disturbance. If excavation leads to substantial compaction of the subgrade, 18 inches shall be removed and replaced with a blend of topsoil and sand to promote infiltration and biological growth. At the very least, topsoil shall be thoroughly deep plowed into the subgrade in order to penetrate the compacted zone and promote aeration and the formation of macropores. Following this, the area should be disked prior to final grading.
 - g. Caution shall be observed when excavating above the recently installed gas pipeline. Prior to excavation over the gas pipeline, confirm the depth of cover over the pipe. Decompact the pipe trench backfill as described in the previous Step.

- h. Place the stone and geotextile fabric within the MLV pad as specified on the E&SC & PCSM Plans. NOTE: This is a critical stage of PCSM Plan to be observed by a licensed professional or designee.
- 24. Immediately stabilize the access road with geotextile and gravel surfacing where indicated in the E&SC Plans.
- 25. **Replace stockpiled topsoil as applicable and final grade the disturbed areas. Immediately fertilize, seed and stabilize disturbed areas at finished grade.**
- 26. Upon completion of all earth disturbance activities and permanent stabilization of all disturbed areas, the Owner shall contact the local CCD for an inspection prior to the removal of the **sediment barriers**. Vegetated areas must achieve a minimum uniform 70% perennial cover over the entire disturbed area to be considered stabilized. Roadways and parking areas should have at least a clean subbase in place to be considered stabilized. **In agricultural use areas, an area shall be considered to have achieved final stabilization if the above conditions are met or if an area exhibits ground cover conditions normally associated with active agricultural practices, including but not limited to bare earth on cultivated land, temporary vegetative cover on cultivated land, or pasture not meeting a minimum uniform 70% perennial vegetative cover.**
- 27. Upon local CCD and Transco approval of stabilization and re-vegetation **either:**
 - a. **Leave the compost filter sock in place, cut open the mesh, and spread the mulch as a soil supplement; or**
 - b. Remove the **compost filter sock**, stabilize areas disturbed by removal, and properly dispose/recycle the **compost filter sock**.
- 28. Remove orange construction fencing and security fence.
- 29. Upon completion of all earth disturbance activities, removal of the **sediment barriers**, and permanent stabilization of all disturbed areas, the Owner shall contact the local CCD for a final inspection.

Permanent Access Road Summary Sheet


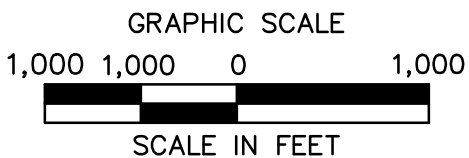
Access Road Number:	AR-CO-85.1.3			
Watershed Name:	Mahanoy-Shamokin Creeks, CWF, MF			
Act 167 Plan Name:	N/A	Date Adopted: --		
Design Storm Frequency	2 year	Pre-construction	Post-construction	Net Change
Rainfall Amount	2.93 inches			
Impervious area (acres)		0.00	0.18	0.18
Volume of stormwater runoff (cf) without planned stormwater BMPs		1,357	2,079	722
Volume of stormwater runoff (cf) with planned stormwater BMPs			666	(691)
Pre- vs. Post-construction Peak Rate of Flow Summary				
Stormwater discharge rate for the design frequency storm (cfs)		Pre-construction	Post-construction	Net Change
1) 1-Year/24-Hour		1.02	1.00	(0.02)
2) 2-Year/24-Hour		1.69	1.60	(0.09)
3) 5-Year/24-Hour		2.78	2.51	(0.27)
4) 10-Year/24-Hour		3.83	3.38	(0.45)
5) 25-Year/24-Hour		5.60	4.82	(0.78)
6) 50-Year/24-Hour		7.31	6.18	(1.13)
7) 100-Year/24-Hour		9.41	7.87	(1.54)
Summary Description of Restoration BMPs - Permanent Access Roads				
BMP	Function	Volume of stormwater treated (cf)	Acres treated	
Natural area conservation: Pre-construction drainage pattern intact		0	0	
Access road design: Ditches Culverts	Infiltration/ Recharge/Storage	925 <small>Included in Ditches</small>	0.25 <small>Included in Ditches</small>	
Stormwater energy dissipaters: Riprap Aprons	Infiltration/ Recharge/Storage	0	0	
Other: MLV Stone Pad Void Storage	Infiltration/ Recharge/Storage	488	0.11	
Off-site Discharge Analysis:				
The point of interest (POI) for the access road stormwater design is the downstream point where the access road watershed currently discharges off-site. As shown in the tables above, there is no increase in volume or peak rate of runoff at the POI. Therefore, the existing drainage pattern will be unchanged and erosion, damage, or nuisance to off-site properties is not anticipated to be caused by the Project improvements.				
Loading Ratio:				
	Channel	MLV Pad		
Maximum Impervious Loading Ratio	1.9 :1 (5:1 Max)	1.0 :1 (5:1 Max)		
Maximum Total Loading Ratio	5.6 :1 (8:1 Max)	1.0 :1 (8:1 Max)		
Supporting Areas	Channel	MLV Pad	Unit	
Impervious Drainage Area	0.09	0.11	Acres	
Infiltration Area	0.04	0.11	Acres	
Total Drainage Area	0.25	0.11	Acres	

N.2 Location Map




SHAMOKIN QUADRANGLE

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING

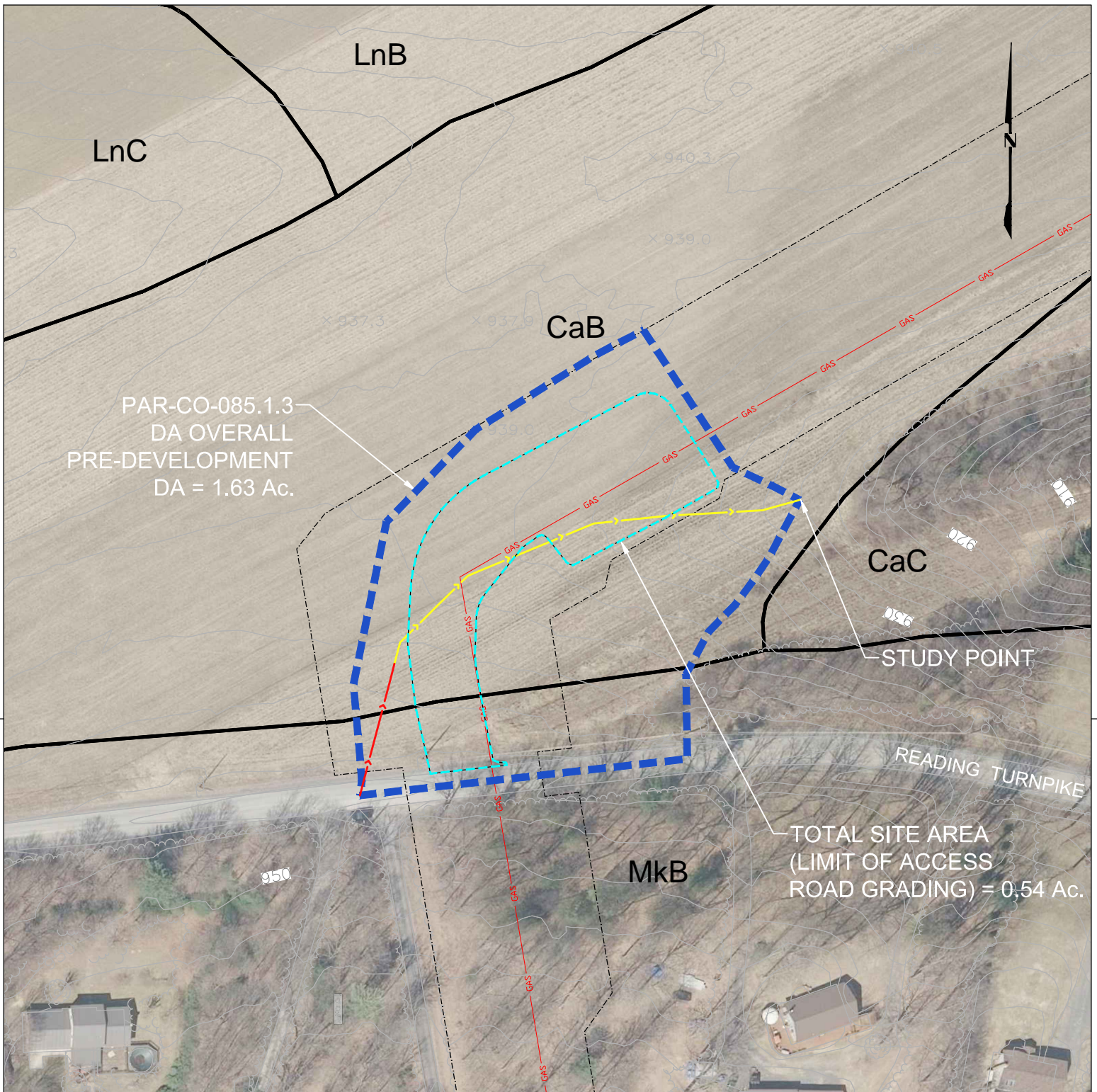
ATLANTIC SUNRISE
PROPOSED 42" NATURAL GAS PIPELINE
USGS LOCATION MAP
PERMANENT AR-CO-085.1.3
RALPHO TOWNSHIP
NORTHUMBERLAND COUNTY, PENNSYLVANIA



NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.	DRAWN BY: CLM	DATE: 11/11/15	ISSUED FOR BID:	SCALE: 1"=1,000'
				1161481			CHECKED BY:	DATE:	ISSUED FOR CONSTRUCTION:	
							APPROVED BY:	DATE:	DRAWING NUMBER: 24-1600-70-28-A/ LL113_9-AR-CO-085.1.3	SHEET 1 OF 1
							WO: 1161481			

N.3 Predevelopment Calculations

- a. Predevelopment Drainage Area Map
- b. 1-Year Rainfall Event
- c. 2-Year Rainfall Event
- d. 5-Year Rainfall Event
- e. 10-Year Rainfall Event
- f. 25-Year Rainfall Event
- g. 50-year Rainfall Event
- h. 100-Year Rainfall Event



PRE-DEVELOPMENT DRAINAGE AREA MAP

LEGEND

- TIME OF CONCENTRATION-SHEET FLOW → → → → →
- TIME OF CONCENTRATION-SHALLOW CONCENTRATED FLOW → → → → →
- DRAINAGE AREA - - - - -
- PROPOSED GAS PIPELINE — GAS — GAS —
- TOTAL SITE AREA - - - - -



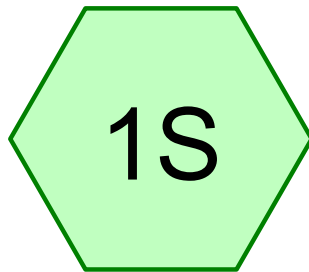
ISSUED FOR PERMITTING

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LAND SURVEYING

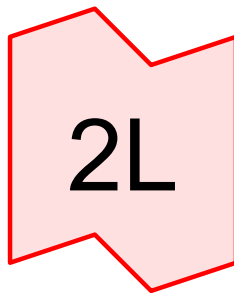
**ATLANTIC SUNRISE PROJECT -
CENTRAL PENN LINE SOUTH**

PROPOSED 42" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR-CO-085.1.3 PRE
RALPHO TOWNSHIP
NORTHUMBERLAND COUNTY, PENNSYLVANIA

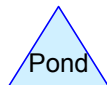
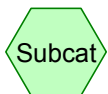
NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.	DRAWN BY: OLC	DATE: 01/19/17	ISSUED FOR BID:	SCALE: 1" = 100'
							CHECKED BY: SMK	DATE: 01/19/17	ISSUED FOR CONSTRUCTION:	
							APPROVED BY: SMK	DATE: 01/19/17	DRAWING NUMBER:	AR-CO-085.1.3 PRE
							WO:			



DA OVERALL
PRE-DEVELOPMENT



Existing Conditions



AR-CO-085-1-3

Prepared by BL Companies

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Page 2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.572	71	Meadow, Fair, HSG C (1S)
0.045	98	Paved Road, HSG C (1S)
0.016	70	Woods, Good, HSG C (1S)

Summary for Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Runoff = 1.02 cfs @ 12.05 hrs, Volume= 0.068 af, Depth= 0.50"

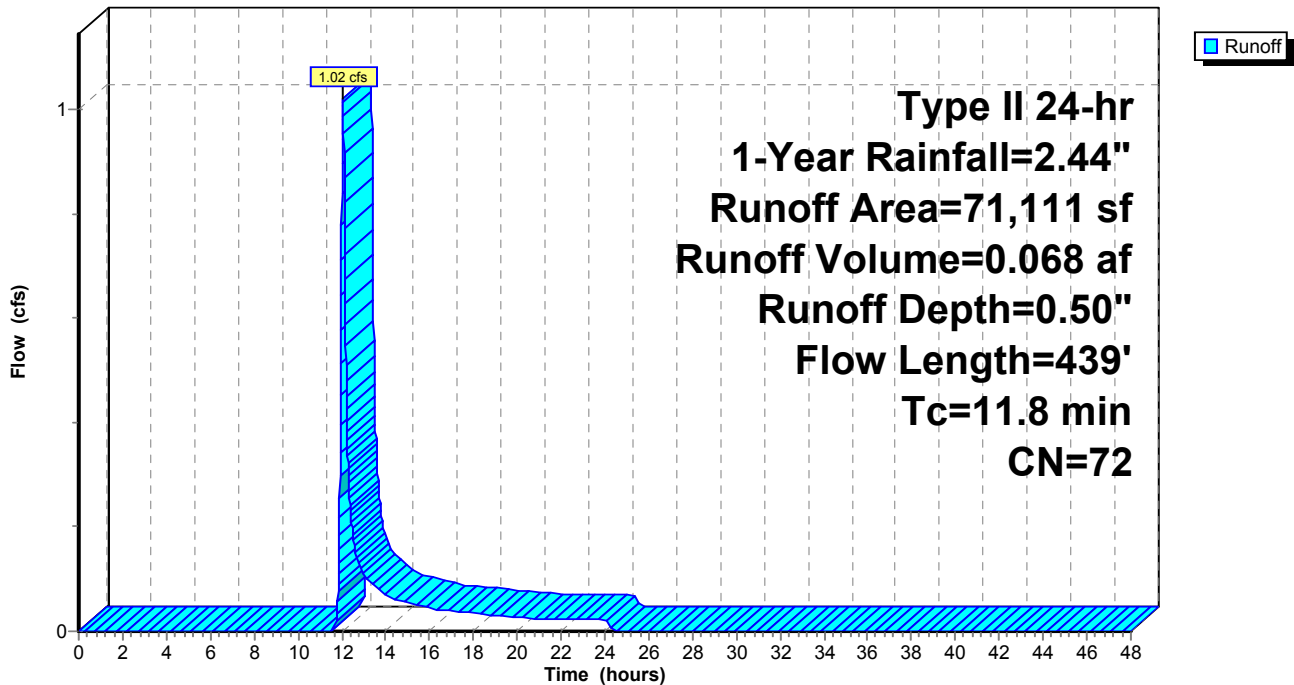
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 1-Year Rainfall=2.44"

Area (sf)	CN	Description
* 1,953	98	Paved Road, HSG C
* 68,478	71	Meadow, Fair, HSG C
680	70	Woods, Good, HSG C
71,111	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.85		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
7.8	89	0.0790	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
3.8	339	0.0440	1.47		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.8	439	Total			

Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Hydrograph



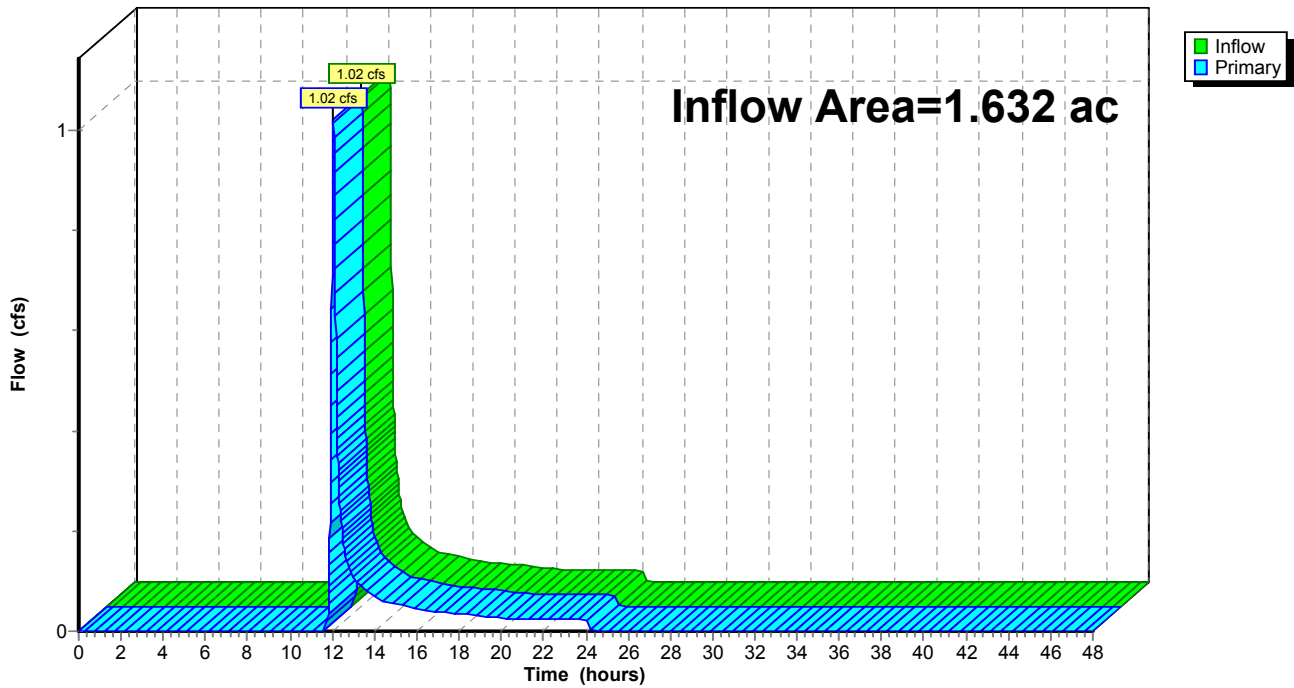
Summary for Link 2L: Existing Conditions

Inflow Area = 1.632 ac, Inflow Depth = 0.50" for 1-Year event
Inflow = 1.02 cfs @ 12.05 hrs, Volume= 0.068 af
Primary = 1.02 cfs @ 12.05 hrs, Volume= 0.068 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: Existing Conditions

Hydrograph



Summary for Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Runoff = 1.69 cfs @ 12.05 hrs, Volume= 0.104 af, Depth= 0.77"

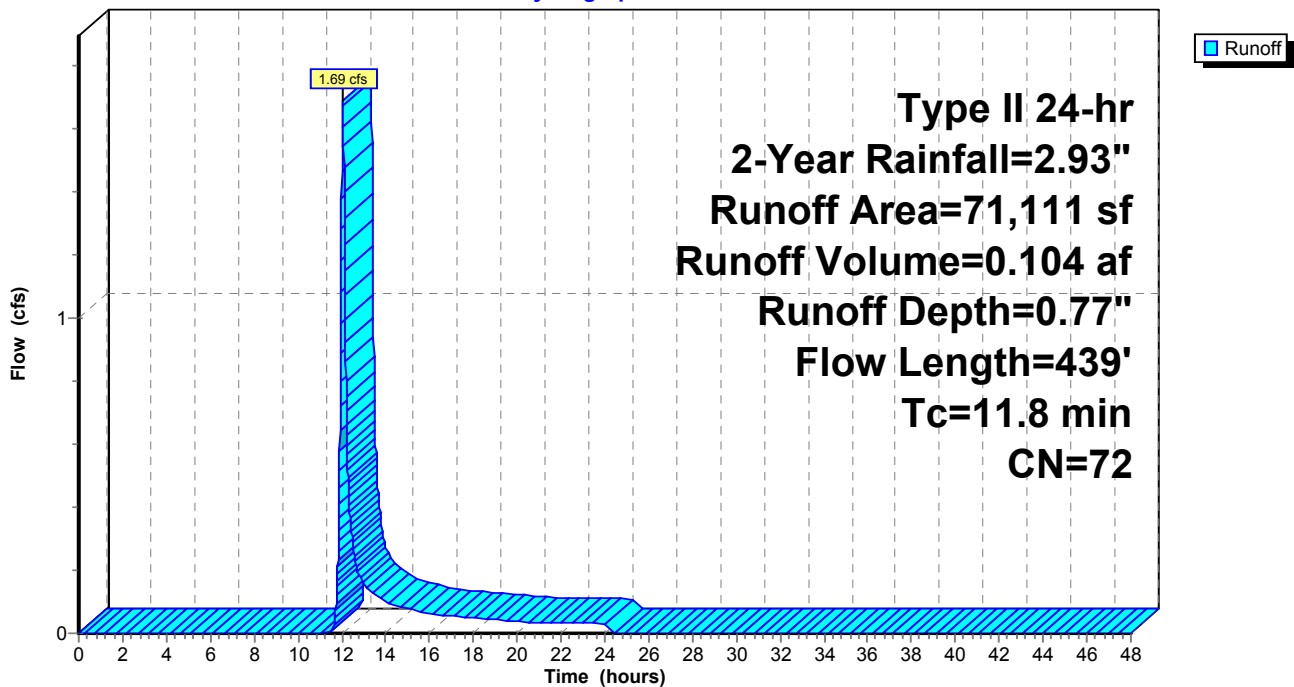
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 2-Year Rainfall=2.93"

Area (sf)	CN	Description
* 1,953	98	Paved Road, HSG C
* 68,478	71	Meadow, Fair, HSG C
680	70	Woods, Good, HSG C
71,111	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.85		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
7.8	89	0.0790	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
3.8	339	0.0440	1.47		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.8	439	Total			

Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Hydrograph



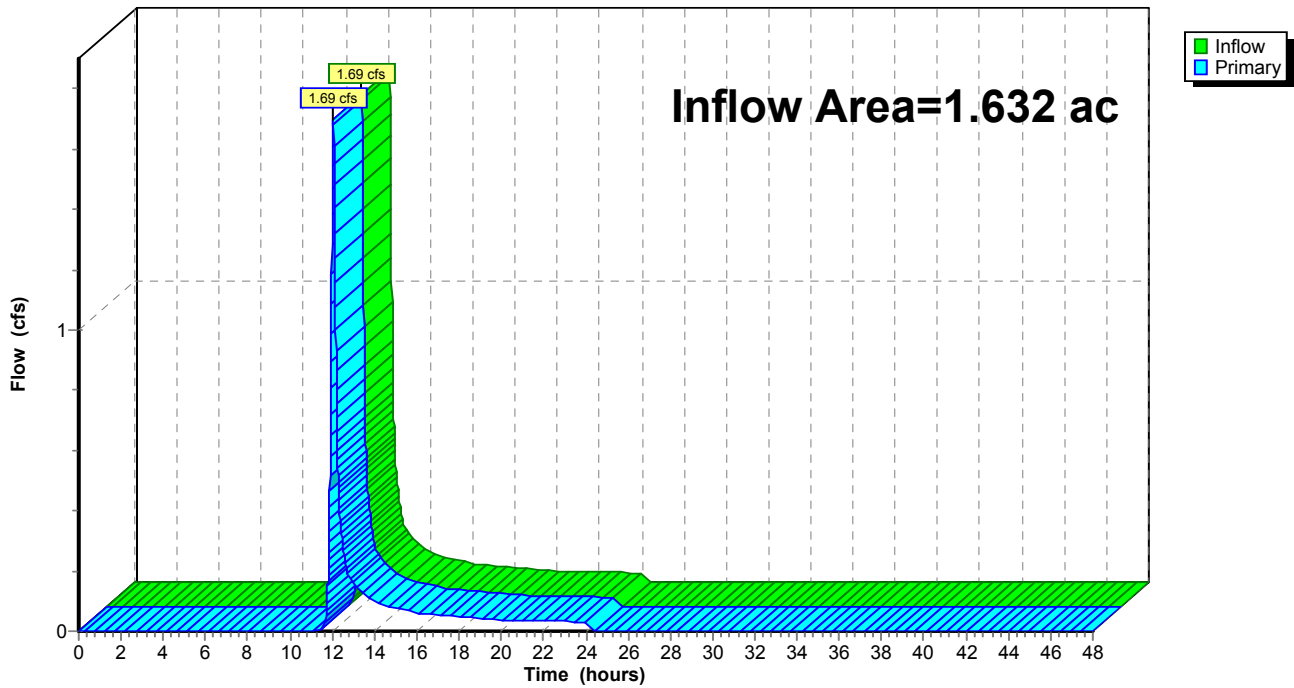
Summary for Link 2L: Existing Conditions

Inflow Area = 1.632 ac, Inflow Depth = 0.77" for 2-Year event
Inflow = 1.69 cfs @ 12.05 hrs, Volume= 0.104 af
Primary = 1.69 cfs @ 12.05 hrs, Volume= 0.104 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: Existing Conditions

Hydrograph



Summary for Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Runoff = 2.78 cfs @ 12.05 hrs, Volume= 0.164 af, Depth= 1.21"

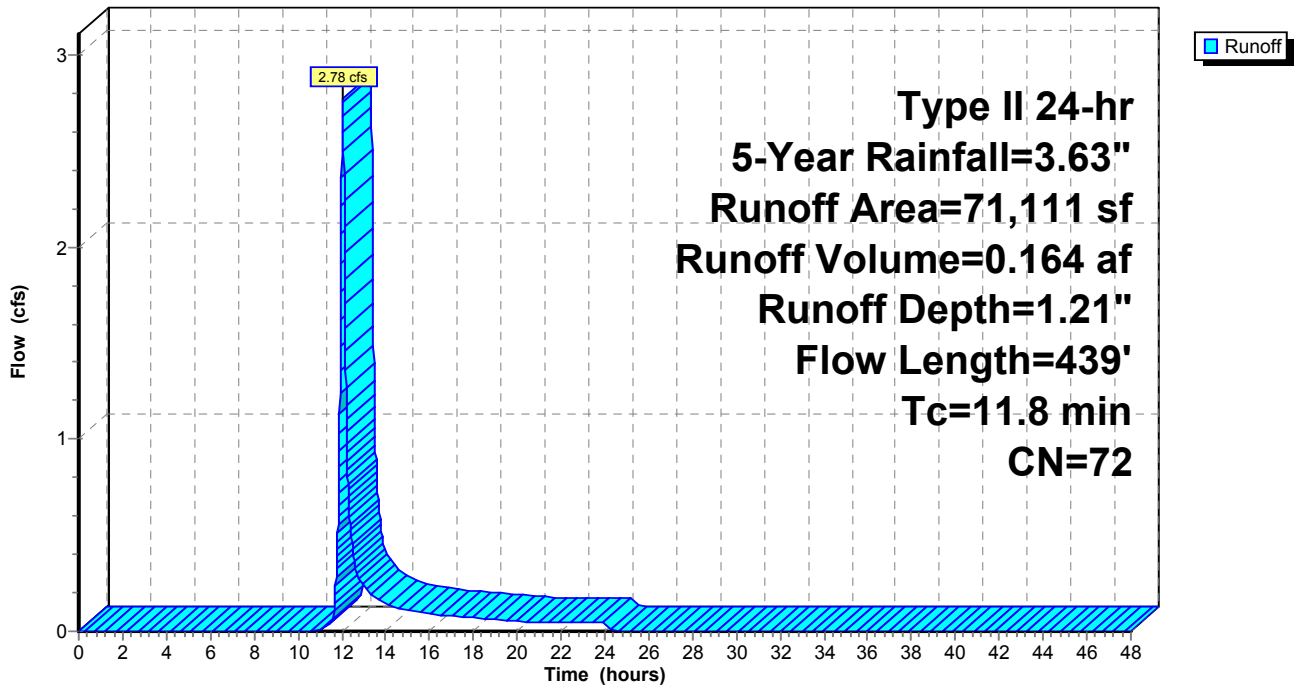
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 5-Year Rainfall=3.63"

Area (sf)	CN	Description
* 1,953	98	Paved Road, HSG C
* 68,478	71	Meadow, Fair, HSG C
680	70	Woods, Good, HSG C
71,111	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.85		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
7.8	89	0.0790	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
3.8	339	0.0440	1.47		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.8	439	Total			

Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Hydrograph



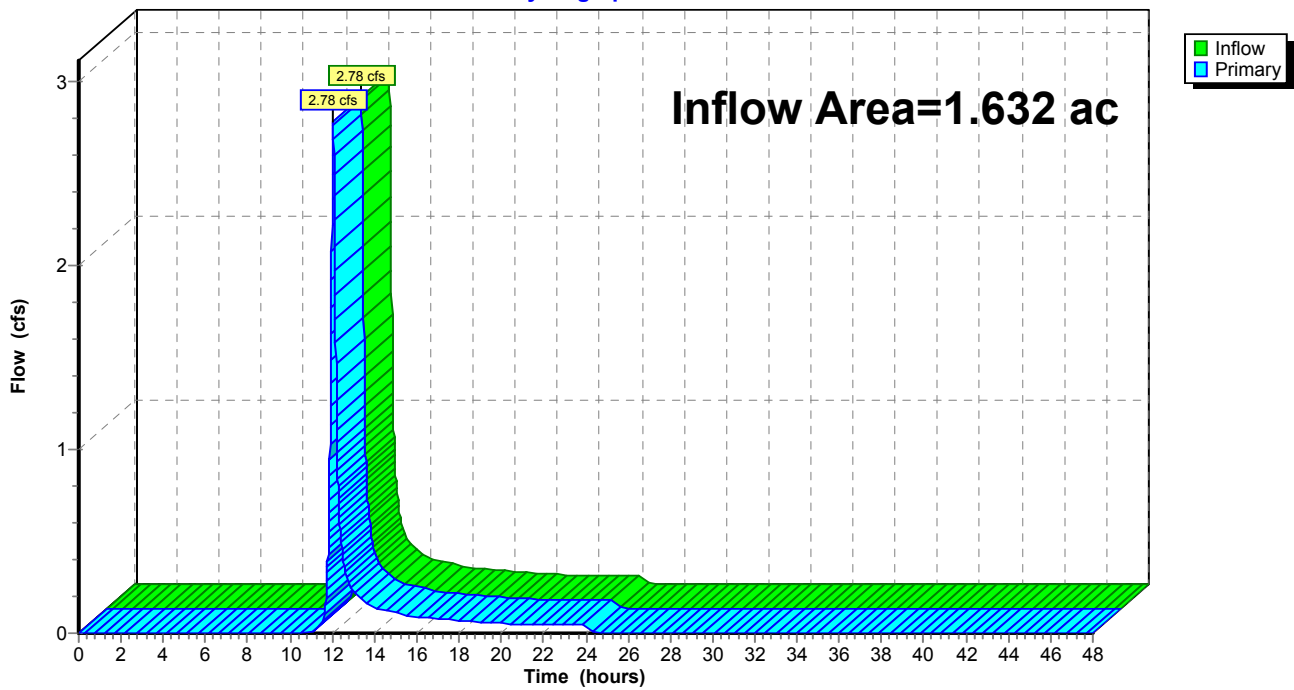
Summary for Link 2L: Existing Conditions

Inflow Area = 1.632 ac, Inflow Depth = 1.21" for 5-Year event
Inflow = 2.78 cfs @ 12.05 hrs, Volume= 0.164 af
Primary = 2.78 cfs @ 12.05 hrs, Volume= 0.164 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: Existing Conditions

Hydrograph



Summary for Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Runoff = 3.83 cfs @ 12.04 hrs, Volume= 0.223 af, Depth= 1.64"

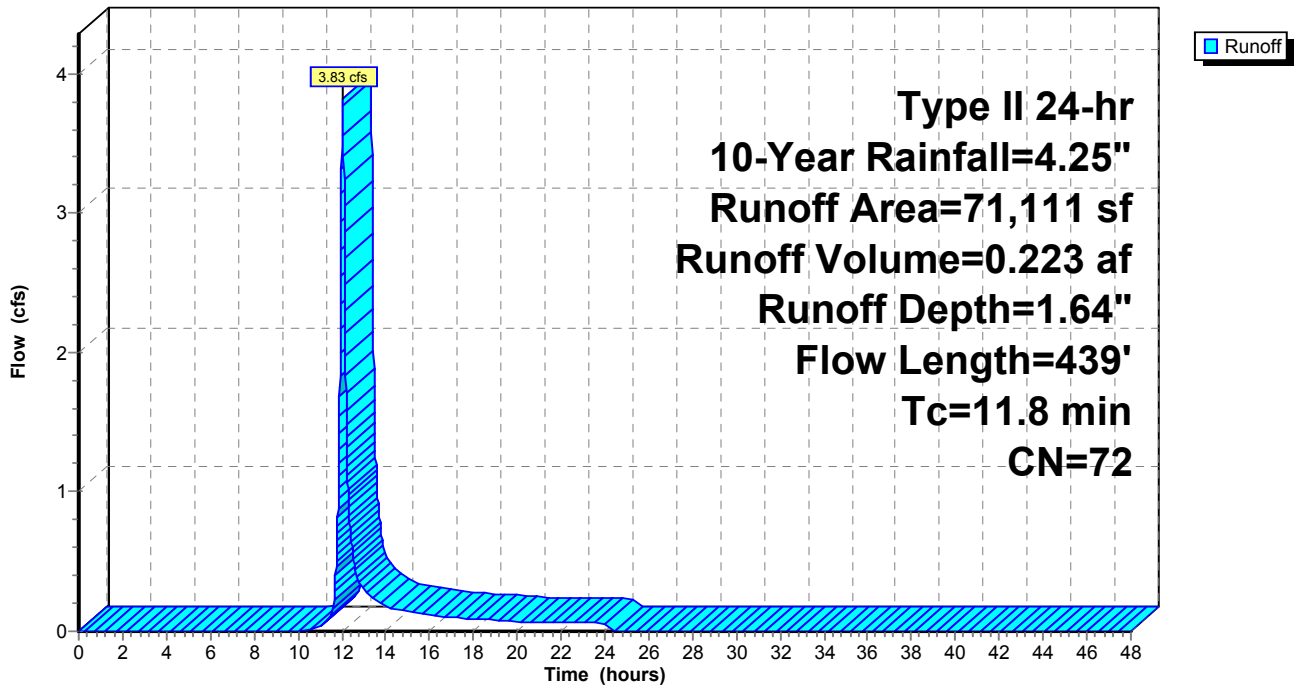
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 10-Year Rainfall=4.25"

Area (sf)	CN	Description
* 1,953	98	Paved Road, HSG C
* 68,478	71	Meadow, Fair, HSG C
680	70	Woods, Good, HSG C
71,111	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.85		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
7.8	89	0.0790	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
3.8	339	0.0440	1.47		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.8	439	Total			

Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Hydrograph



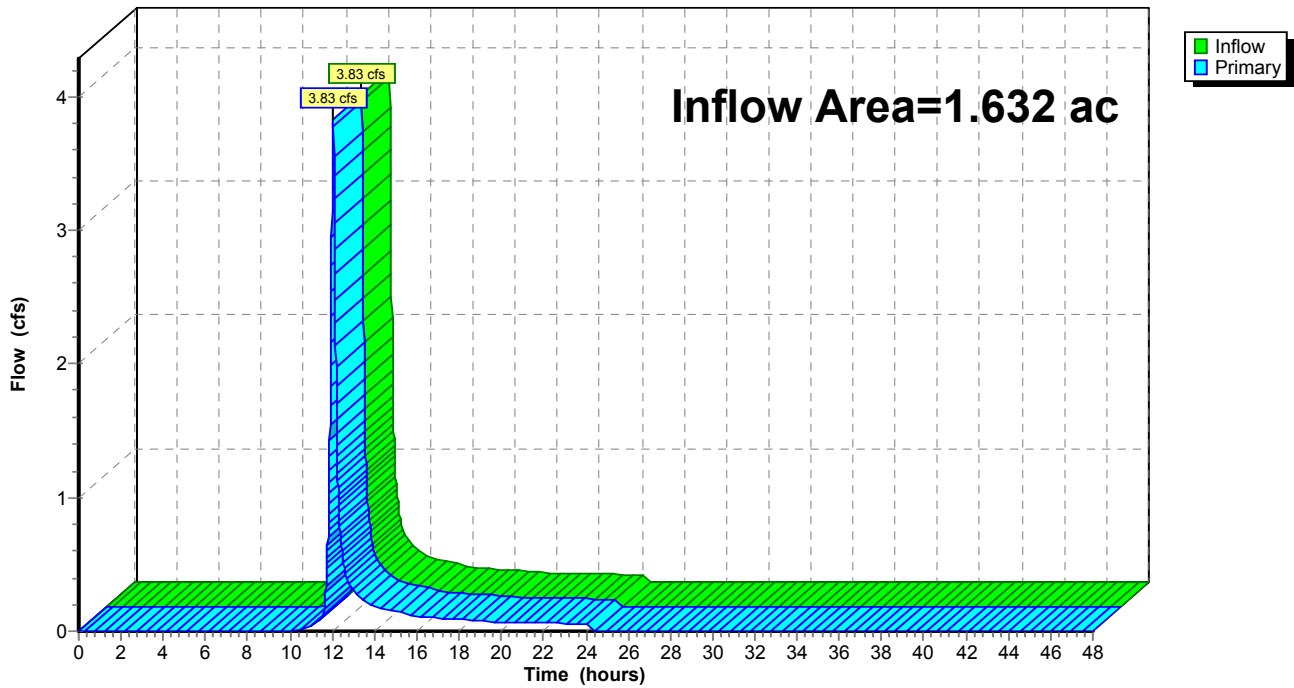
Summary for Link 2L: Existing Conditions

Inflow Area = 1.632 ac, Inflow Depth = 1.64" for 10-Year event
Inflow = 3.83 cfs @ 12.04 hrs, Volume= 0.223 af
Primary = 3.83 cfs @ 12.04 hrs, Volume= 0.223 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: Existing Conditions

Hydrograph



Summary for Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Runoff = 5.60 cfs @ 12.04 hrs, Volume= 0.323 af, Depth= 2.38"

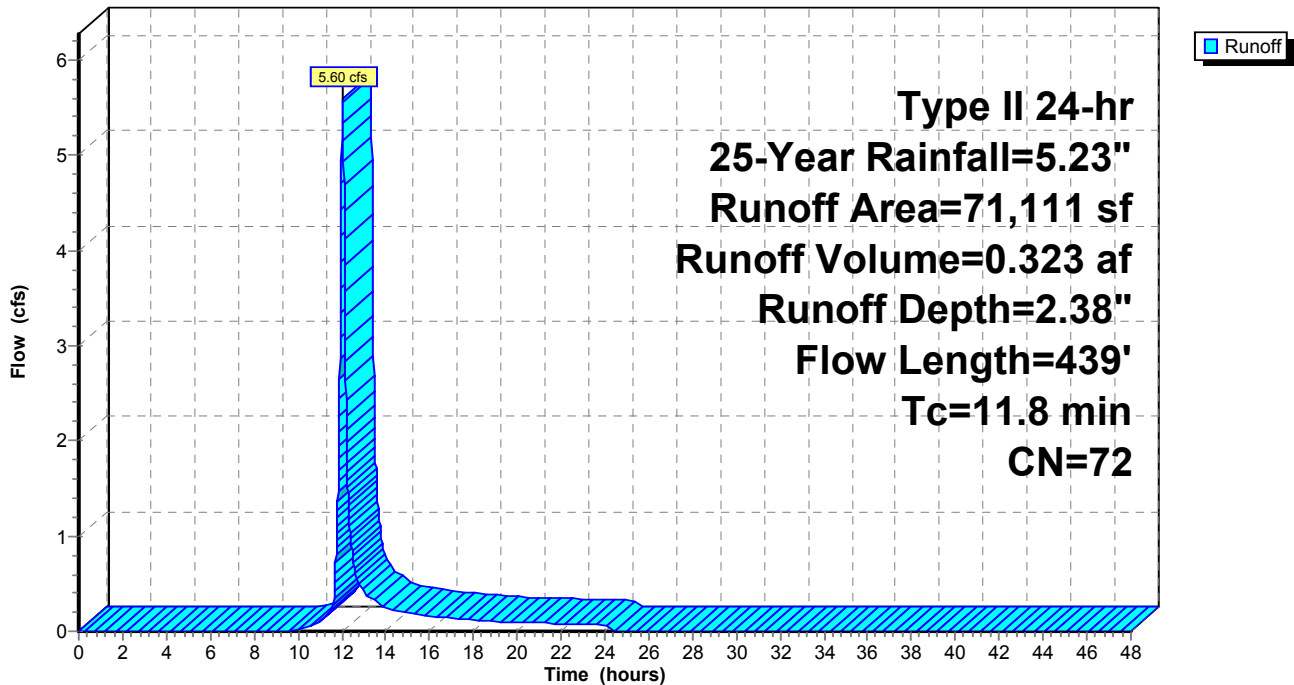
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 25-Year Rainfall=5.23"

Area (sf)	CN	Description
* 1,953	98	Paved Road, HSG C
* 68,478	71	Meadow, Fair, HSG C
680	70	Woods, Good, HSG C
71,111	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.85		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
7.8	89	0.0790	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
3.8	339	0.0440	1.47		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.8	439	Total			

Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Hydrograph



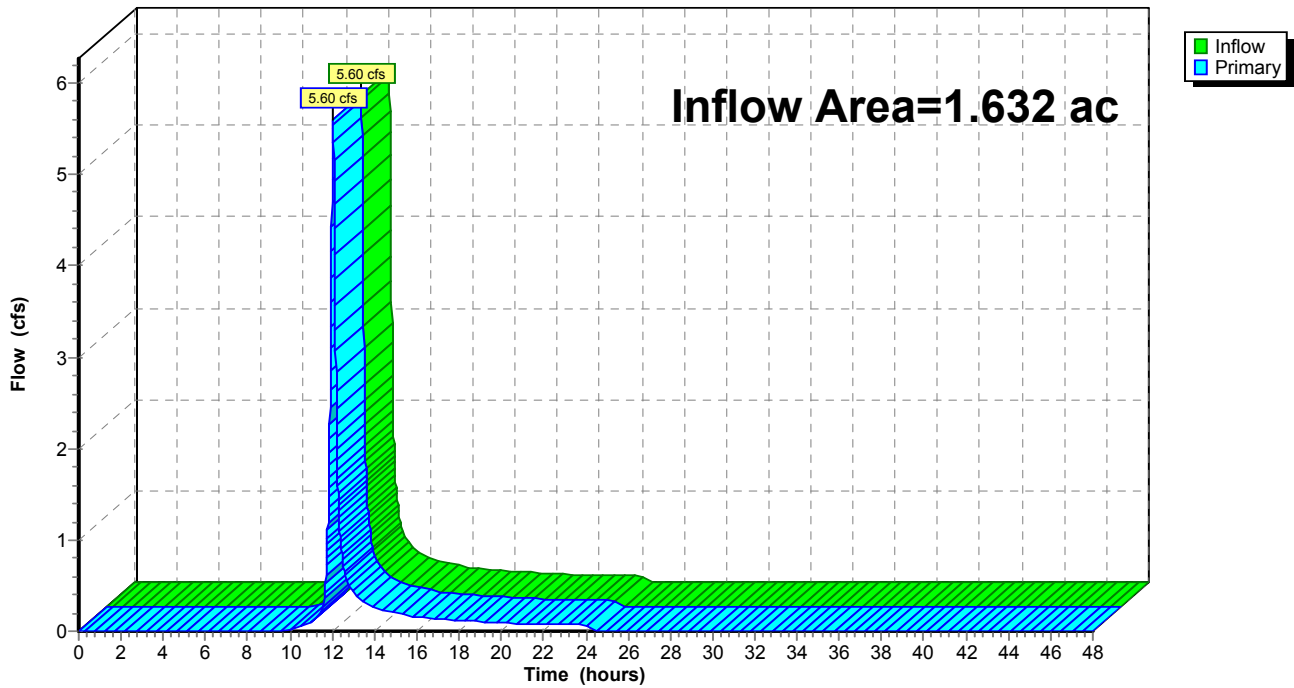
Summary for Link 2L: Existing Conditions

Inflow Area = 1.632 ac, Inflow Depth = 2.38" for 25-Year event
Inflow = 5.60 cfs @ 12.04 hrs, Volume= 0.323 af
Primary = 5.60 cfs @ 12.04 hrs, Volume= 0.323 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: Existing Conditions

Hydrograph



Summary for Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Runoff = 7.31 cfs @ 12.04 hrs, Volume= 0.422 af, Depth= 3.10"

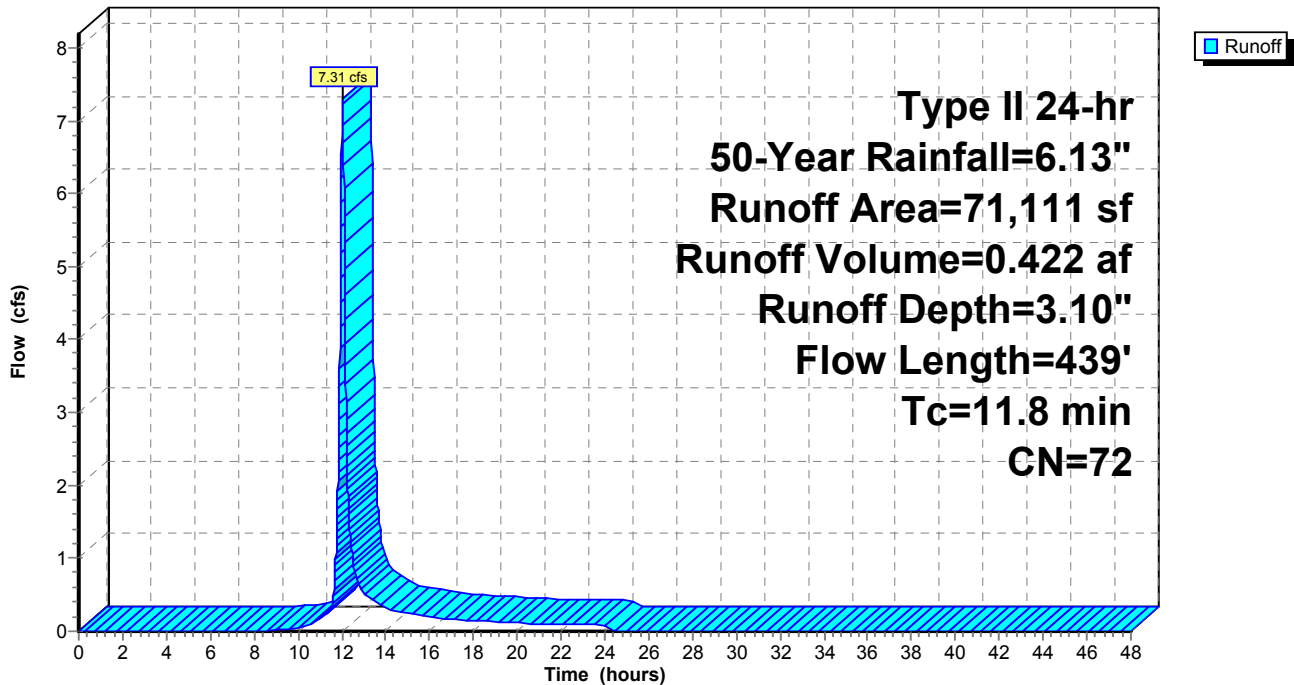
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 50-Year Rainfall=6.13"

Area (sf)	CN	Description
* 1,953	98	Paved Road, HSG C
* 68,478	71	Meadow, Fair, HSG C
680	70	Woods, Good, HSG C
71,111	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.85		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
7.8	89	0.0790	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
3.8	339	0.0440	1.47		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.8	439	Total			

Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Hydrograph



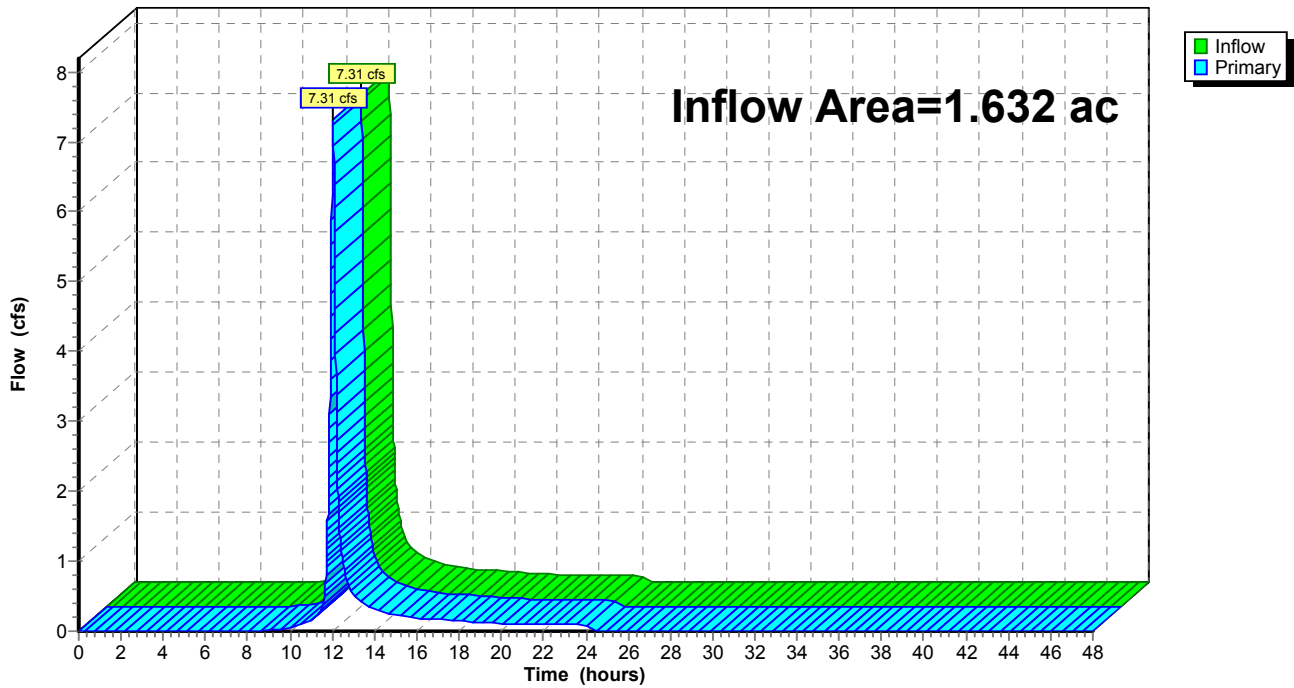
Summary for Link 2L: Existing Conditions

Inflow Area = 1.632 ac, Inflow Depth = 3.10" for 50-Year event
Inflow = 7.31 cfs @ 12.04 hrs, Volume= 0.422 af
Primary = 7.31 cfs @ 12.04 hrs, Volume= 0.422 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: Existing Conditions

Hydrograph



Summary for Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Runoff = 9.41 cfs @ 12.04 hrs, Volume= 0.544 af, Depth= 4.00"

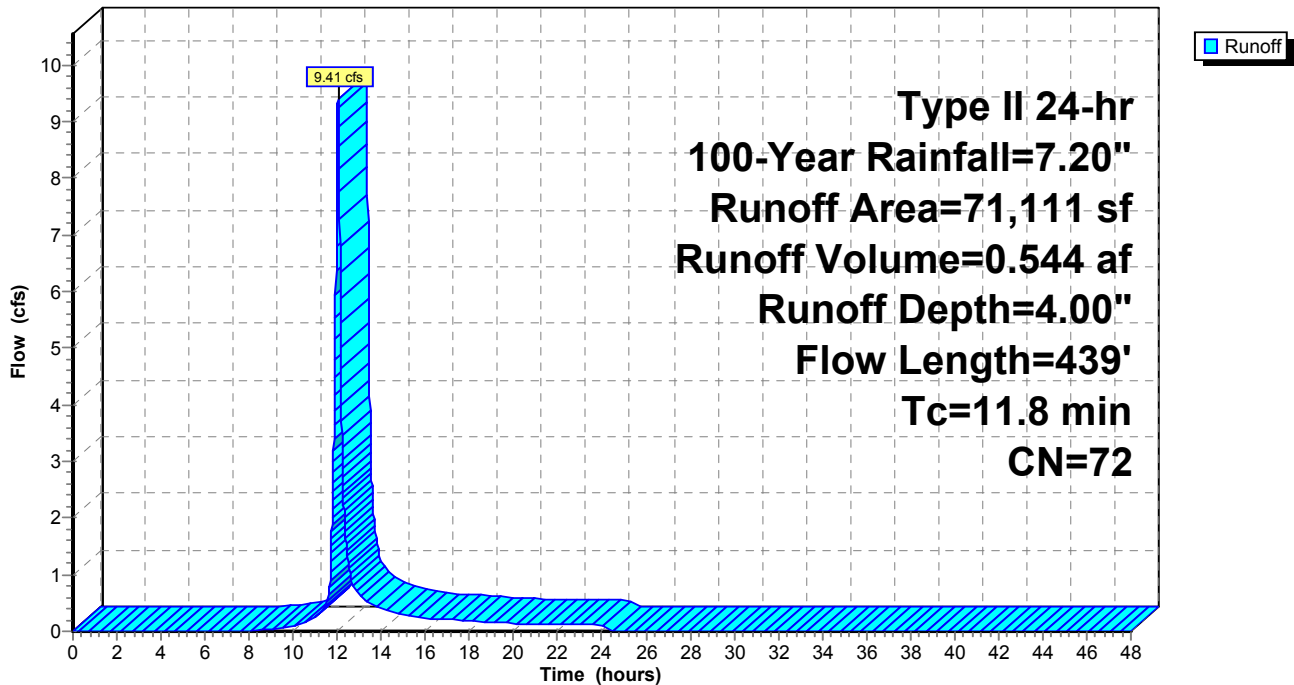
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 100-Year Rainfall=7.20"

	Area (sf)	CN	Description
*	1,953	98	Paved Road, HSG C
*	68,478	71	Meadow, Fair, HSG C
	680	70	Woods, Good, HSG C
	71,111	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	11	0.0200	0.85		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
7.8	89	0.0790	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
3.8	339	0.0440	1.47		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
11.8	439	Total			

Subcatchment 1S: DA OVERALL PRE-DEVELOPMENT

Hydrograph



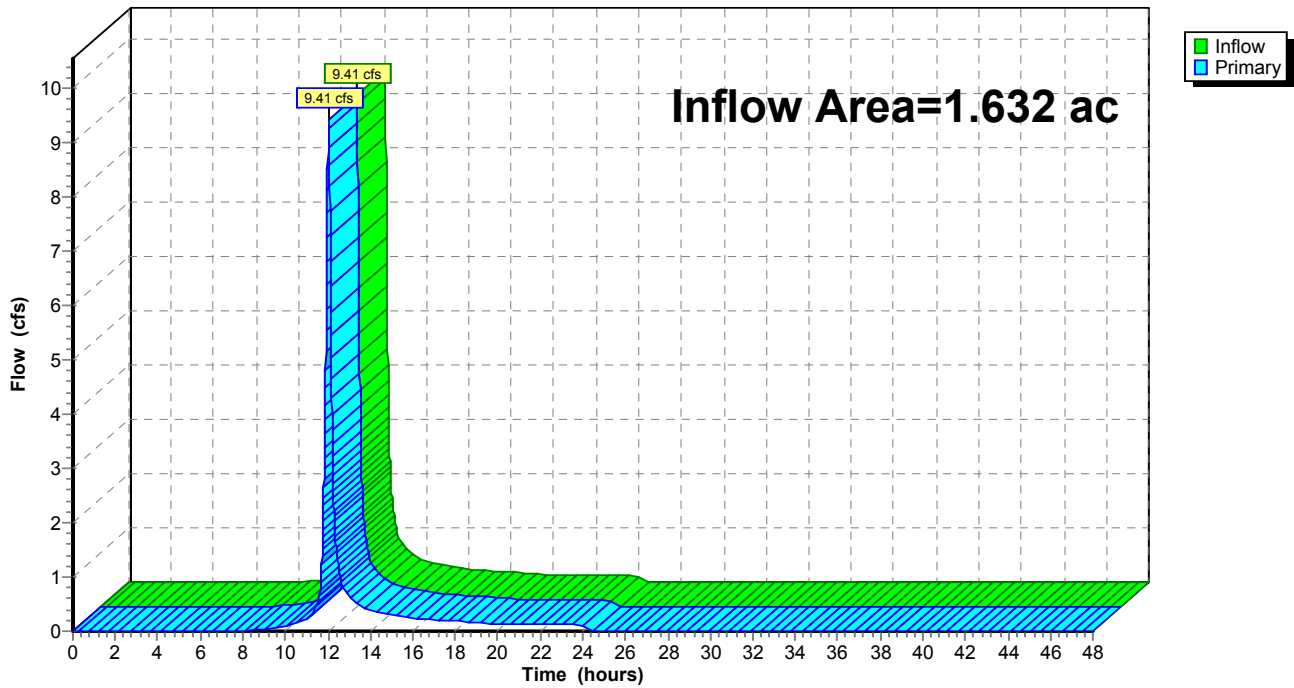
Summary for Link 2L: Existing Conditions

Inflow Area = 1.632 ac, Inflow Depth = 4.00" for 100-Year event
Inflow = 9.41 cfs @ 12.04 hrs, Volume= 0.544 af
Primary = 9.41 cfs @ 12.04 hrs, Volume= 0.544 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

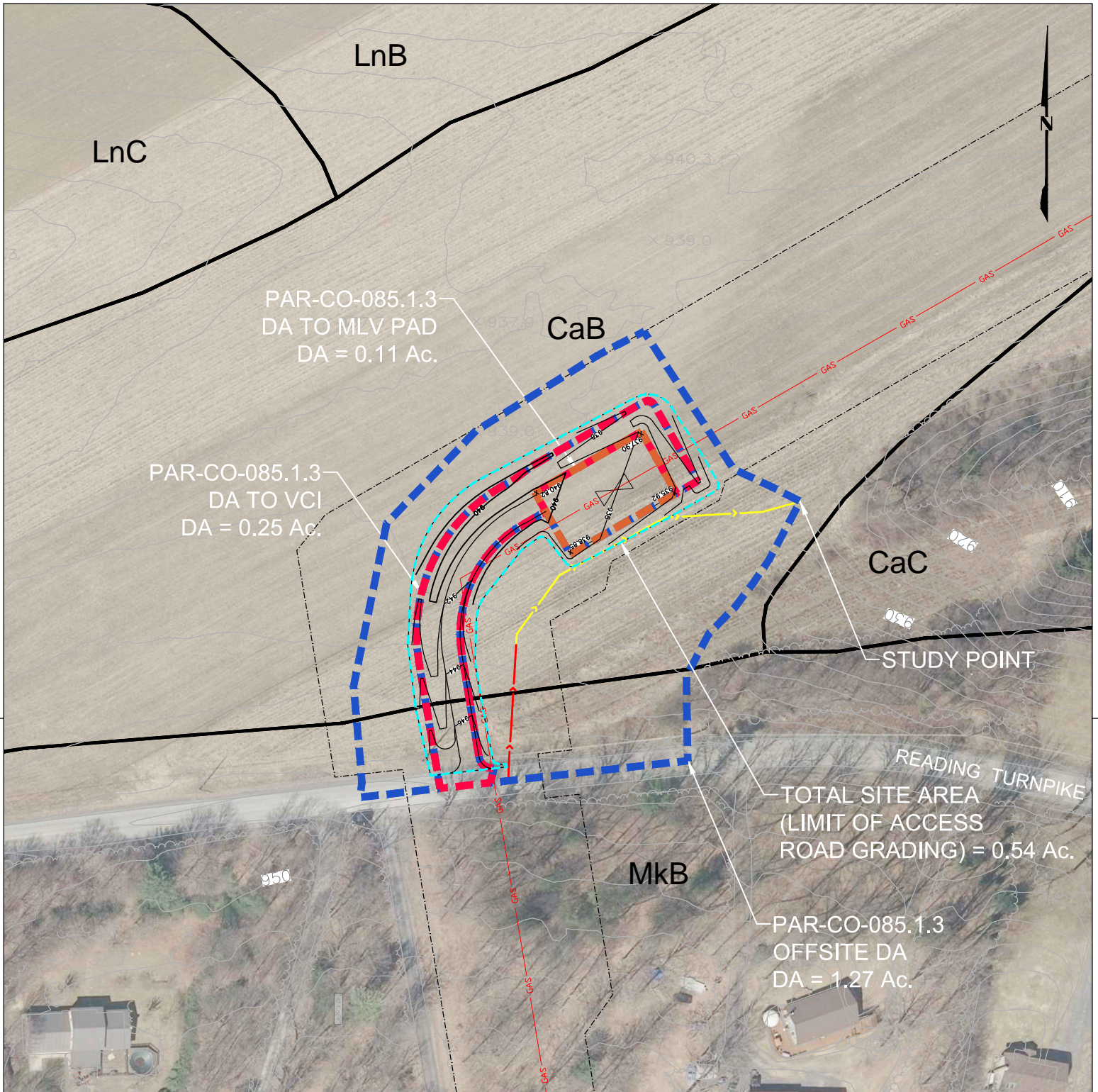
Link 2L: Existing Conditions

Hydrograph



N.4 Post Development Calculations

- a. Post Development Drainage Area Map
- b. 1-year Rainfall Event
- c. 2-Year Rainfall Event
- d. 5-Year Rainfall Event
- e. 10-Year Rainfall Event
- f. 25-Year Rainfall Event
- g. 50-year Rainfall Event
- h. 100-Year Rainfall Event



POST-DEVELOPMENT DRAINAGE AREA MAP

LEGEND

TIME OF CONCENTRATION-SHEET FLOW	
TIME OF CONCENTRATION-SHALLOW CONCENTRATED FLOW	
DRAINAGE AREA	
PROPOSED GAS PIPELINE	
TOTAL SITE AREA	



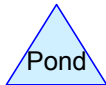
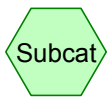
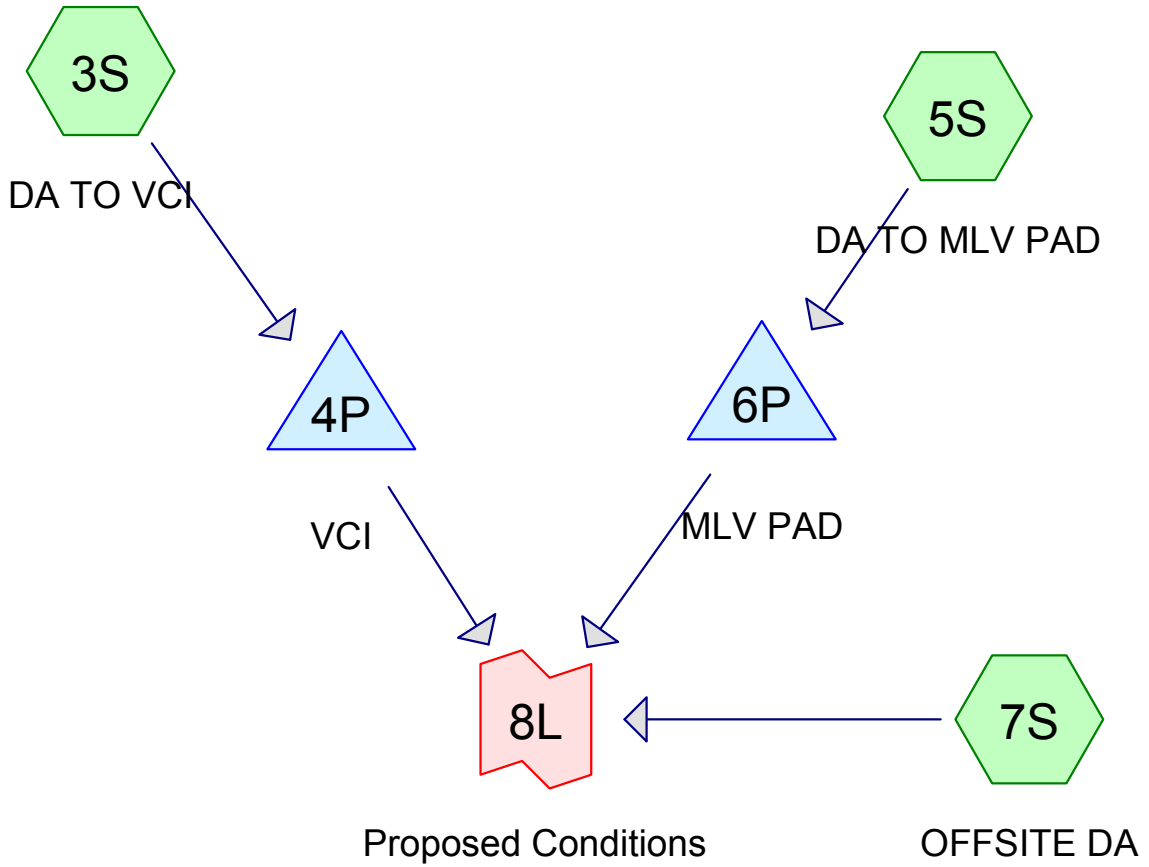
ISSUED FOR PERMITTING

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING

**ATLANTIC SUNRISE PROJECT -
CENTRAL PENN LINE SOUTH**
PROPOSED 42" NATURAL GAS PIPELINE
ACCESS ROAD DRAINAGE AREA MAP
AR-CO-085.1.3 POST
RALPHO TOWNSHIP
NORTHUMBERLAND COUNTY, PENNSYLVANIA



NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.	DRAWN BY: OLC	DATE: 01/19/17	ISSUED FOR BID:	SCALE: 1" = 100'
							CHECKED BY: SMK	DATE: 01/19/17	ISSUED FOR CONSTRUCTION:	
							APPROVED BY: SMK	DATE: 01/19/17	DRAWING NUMBER:	AR-CO-085.1.3 POST
							WO:			



AR-CO-085-1-3

Prepared by BL Companies

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Page 2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.107	98	Crushed Stone Pad, HSG C (5S)
0.074	89	Gravel roads, HSG C (3S)
1.380	71	Meadow Fair, HSG C (3S, 7S)
0.009	98	Paved road, HSG C (3S)
0.047	98	Paved roads, HSG C (7S)
0.016	70	Woods, Good, HSG C (7S)

Summary for Subcatchment 3S: DA TO VCI

Runoff = 0.32 cfs @ 11.97 hrs, Volume= 0.015 af, Depth= 0.70"

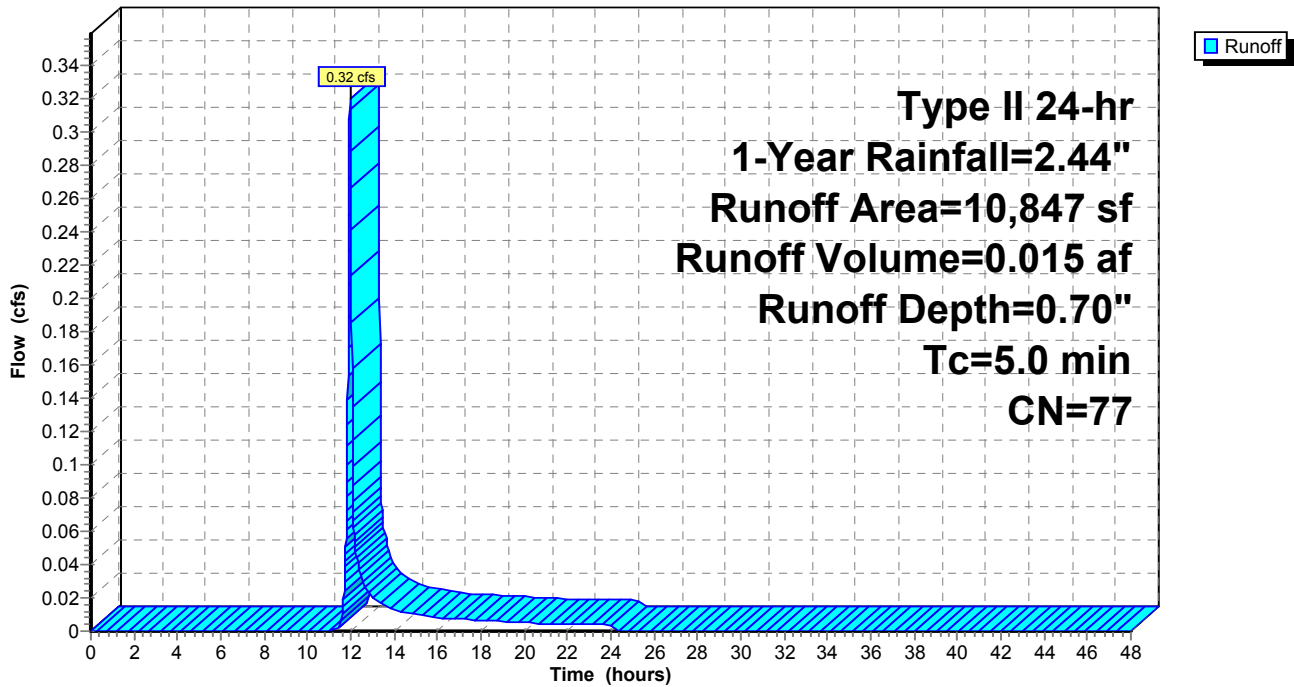
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 1-Year Rainfall=2.44"

	Area (sf)	CN	Description
*	399	98	Paved road, HSG C
	3,202	89	Gravel roads, HSG C
*	7,246	71	Meadow Fair, HSG C
	10,847	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 3S: DA TO VCI

Hydrograph



Summary for Pond 4P: VCI

Inflow Area = 0.249 ac, Inflow Depth = 0.70" for 1-Year event
 Inflow = 0.32 cfs @ 11.97 hrs, Volume= 0.015 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 933.38' @ 24.29 hrs Surf.Area= 0 sf Storage= 635 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	933.00'	2,527 cf	Custom Stage Data Listed below

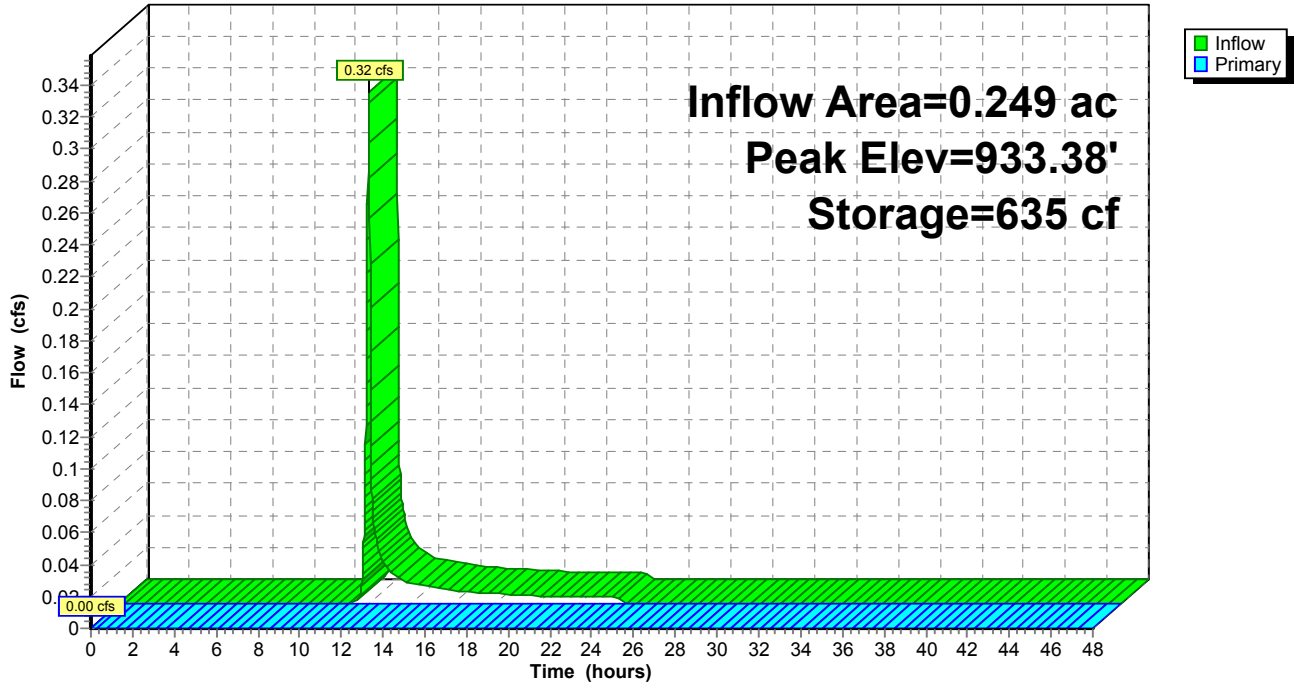
Elevation (feet)	Cum.Store (cubic-feet)
933.00	0
933.50	842
934.00	1,684
934.50	2,526
935.00	2,527

Device	Routing	Invert	Outlet Devices
#1	Primary	934.50'	14.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=933.00' (Free Discharge)
 ↑1=**Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 4P: VCI

Hydrograph



Summary for Subcatchment 5S: DA TO MLV PAD

Runoff = 0.38 cfs @ 11.96 hrs, Volume= 0.020 af, Depth= 2.21"

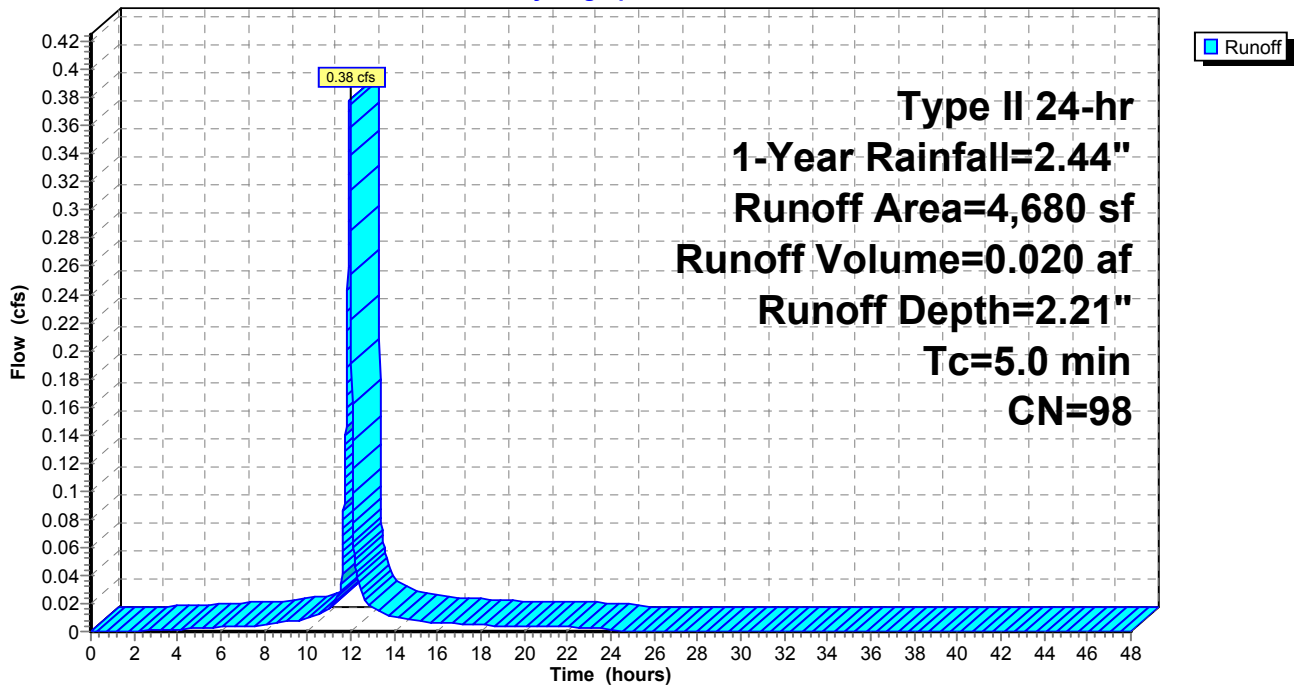
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 1-Year Rainfall=2.44"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 4,680	98	Crushed Stone Pad, HSG C
* 0	98	Paved roads , HSG C
* 0	71	Meadow Fair, HSG C
4,680	98	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 5S: DA TO MLV PAD

Hydrograph



Summary for Pond 6P: MLV PAD

Inflow Area = 0.107 ac, Inflow Depth = 2.21" for 1-Year event
 Inflow = 0.38 cfs @ 11.96 hrs, Volume= 0.020 af
 Outflow = 0.25 cfs @ 12.02 hrs, Volume= 0.010 af, Atten= 34%, Lag= 4.0 min
 Primary = 0.25 cfs @ 12.02 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 935.47' @ 12.02 hrs Surf.Area= 1,692 sf Storage= 474 cf

Plug-Flow detention time= 252.9 min calculated for 0.010 af (49% of inflow)
 Center-of-Mass det. time= 129.3 min (887.1 - 757.8)

Volume	Invert	Avail.Storage	Storage Description
#1	933.42'	497 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 1,243 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
933.42	0	0	0
933.50	3	0	0
934.00	136	35	35
934.50	471	152	187
935.00	1,009	370	557
935.42	1,617	551	1,108
935.50	1,745	134	1,243

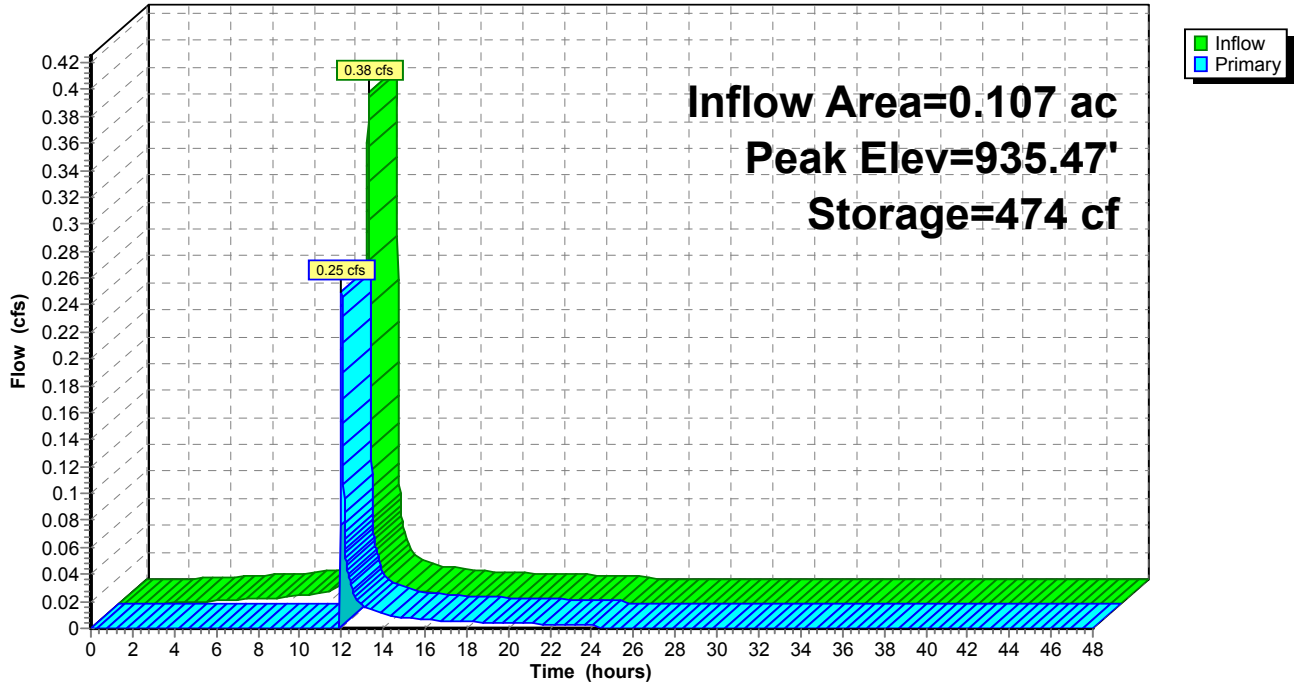
Device	Routing	Invert	Outlet Devices
#1	Primary	935.42'	10.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.24 cfs @ 12.02 hrs HW=935.47' (Free Discharge)

↑1=**Broad-Crested Rectangular Weir**(Weir Controls 0.24 cfs @ 0.53 fps)

Pond 6P: MLV PAD

Hydrograph



Summary for Subcatchment 7S: OFFSITE DA

Runoff = 0.78 cfs @ 12.06 hrs, Volume= 0.053 af, Depth= 0.50"

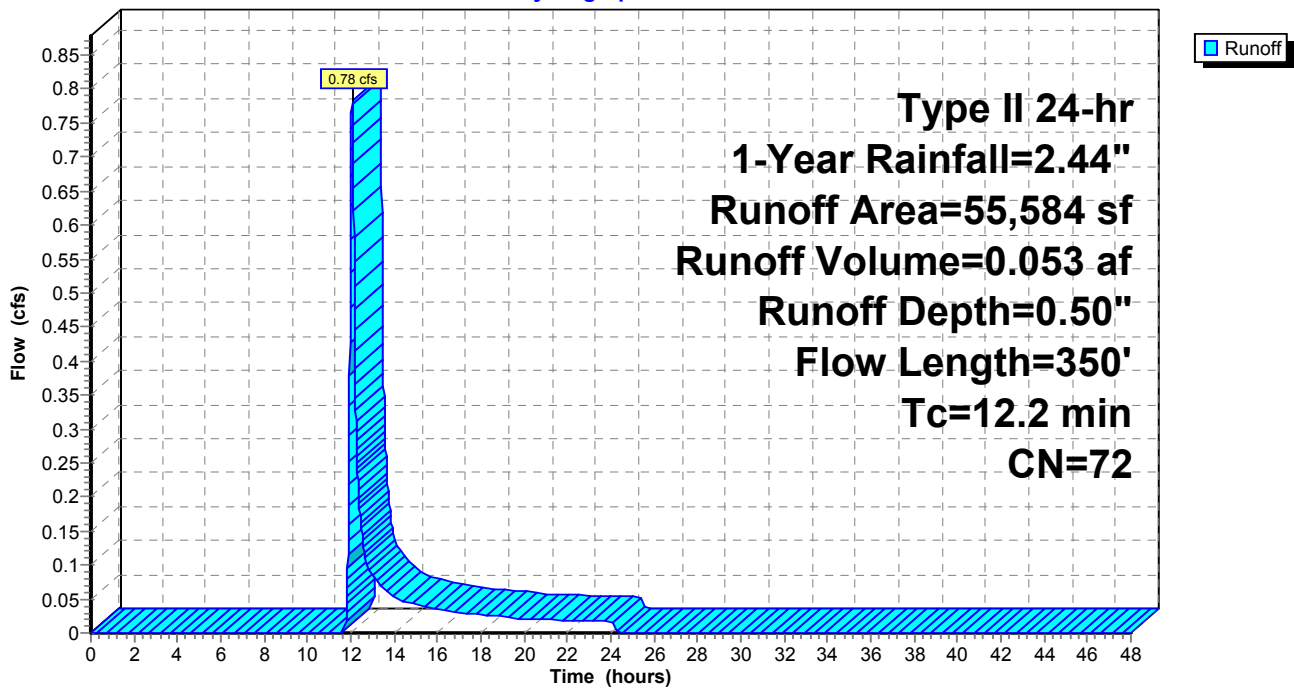
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 1-Year Rainfall=2.44"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 0	98	Crushed Stone Pad, HSG C
* 2,042	98	Paved roads, HSG C
* 52,862	71	Meadow Fair, HSG C
680	70	Woods, Good, HSG C
55,584	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0200	0.83		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
9.4	90	0.0520	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
2.6	250	0.0520	1.60		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
12.2	350	Total			

Subcatchment 7S: OFFSITE DA

Hydrograph



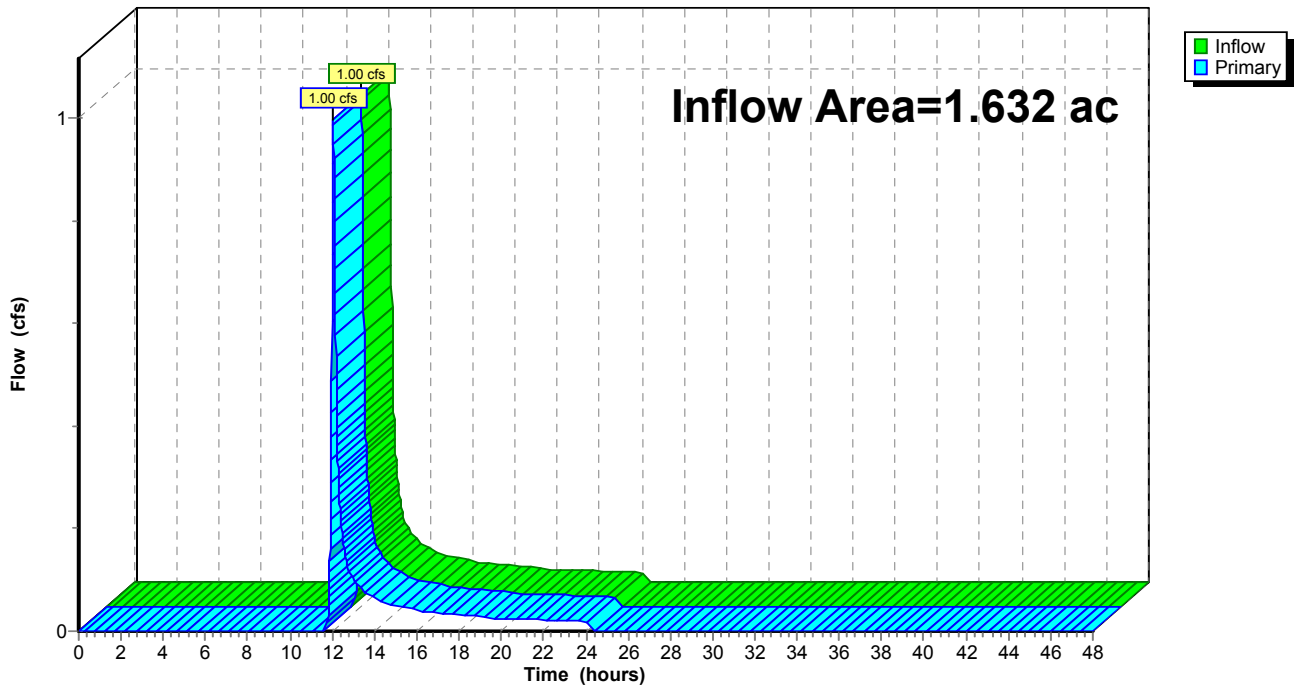
Summary for Link 8L: Proposed Conditions

Inflow Area = 1.632 ac, Inflow Depth = 0.46" for 1-Year event
Inflow = 1.00 cfs @ 12.04 hrs, Volume= 0.063 af
Primary = 1.00 cfs @ 12.04 hrs, Volume= 0.063 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 8L: Proposed Conditions

Hydrograph



Summary for Subcatchment 3S: DA TO VCI

Runoff = 0.47 cfs @ 11.97 hrs, Volume= 0.021 af, Depth= 1.02"

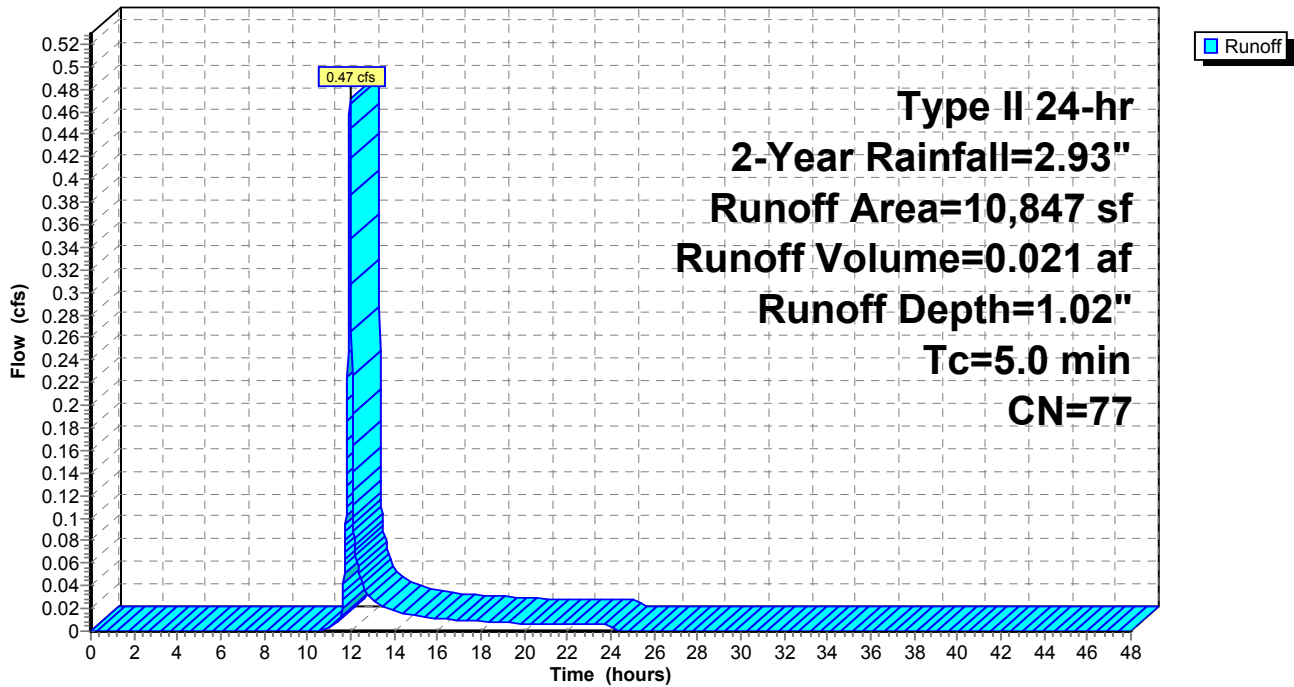
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 2-Year Rainfall=2.93"

	Area (sf)	CN	Description
*	399	98	Paved road, HSG C
	3,202	89	Gravel roads, HSG C
*	7,246	71	Meadow Fair, HSG C
	10,847	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 3S: DA TO VCI

Hydrograph



Summary for Pond 4P: VCI

Inflow Area = 0.249 ac, Inflow Depth = 1.02" for 2-Year event
 Inflow = 0.47 cfs @ 11.97 hrs, Volume= 0.021 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 933.55' @ 24.29 hrs Surf.Area= 0 sf Storage= 925 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	933.00'	2,527 cf	Custom Stage Data Listed below

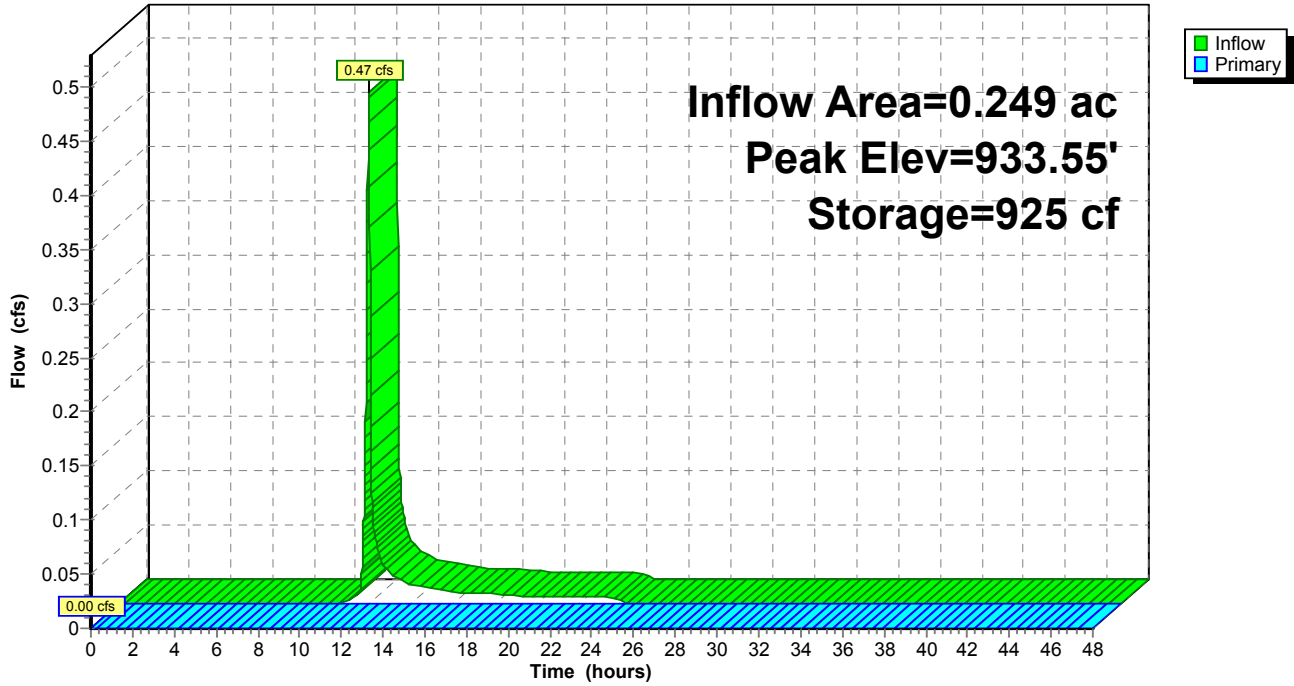
Elevation (feet)	Cum.Store (cubic-feet)
933.00	0
933.50	842
934.00	1,684
934.50	2,526
935.00	2,527

Device	Routing	Invert	Outlet Devices
#1	Primary	934.50'	14.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=933.00' (Free Discharge)
 ↑1=**Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 4P: VCI

Hydrograph



Summary for Subcatchment 5S: DA TO MLV PAD

Runoff = 0.46 cfs @ 11.96 hrs, Volume= 0.024 af, Depth= 2.70"

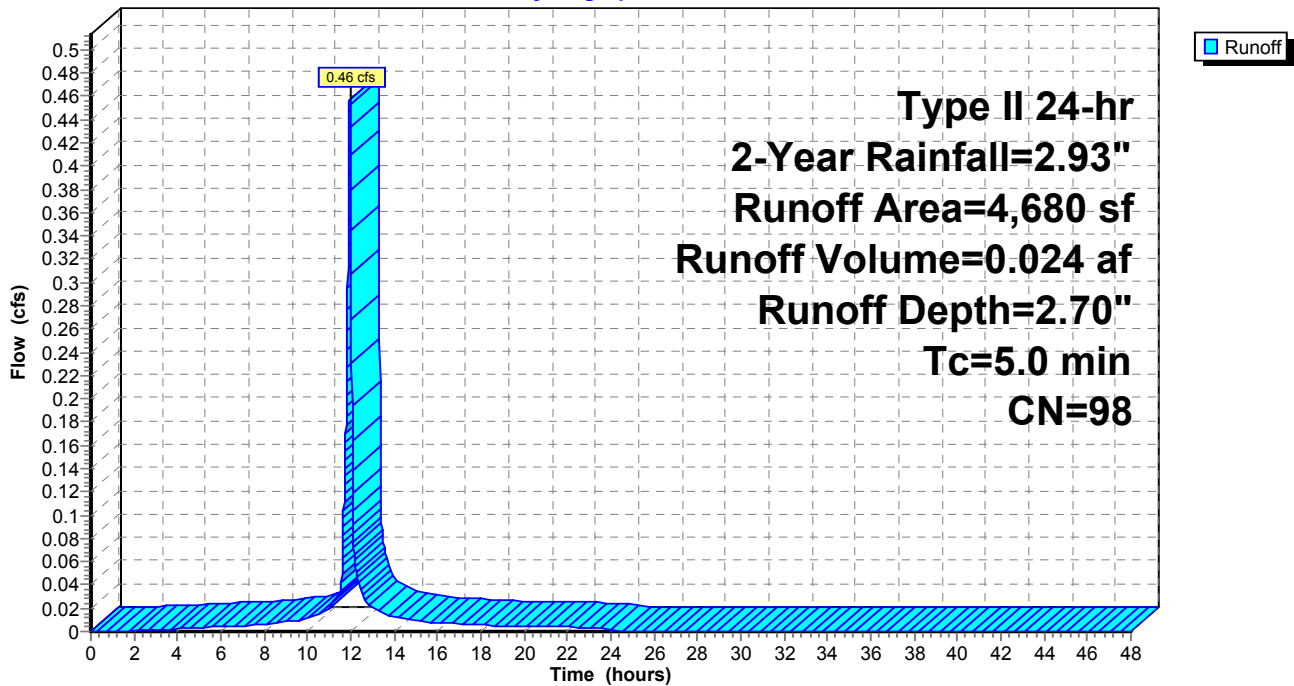
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 2-Year Rainfall=2.93"

	Area (sf)	CN	Description
	0	89	Gravel roads, HSG C
*	4,680	98	Crushed Stone Pad, HSG C
*	0	98	Paved roads , HSG C
*	0	71	Meadow Fair, HSG C
	4,680	98	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 5S: DA TO MLV PAD

Hydrograph



Summary for Pond 6P: MLV PAD

Inflow Area = 0.107 ac, Inflow Depth = 2.70" for 2-Year event
 Inflow = 0.46 cfs @ 11.96 hrs, Volume= 0.024 af
 Outflow = 0.43 cfs @ 11.98 hrs, Volume= 0.014 af, Atten= 6%, Lag= 1.6 min
 Primary = 0.43 cfs @ 11.98 hrs, Volume= 0.014 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 935.49' @ 11.98 hrs Surf.Area= 1,725 sf Storage= 488 cf

Plug-Flow detention time= 215.9 min calculated for 0.014 af (58% of inflow)
 Center-of-Mass det. time= 104.4 min (857.9 - 753.5)

Volume	Invert	Avail.Storage	Storage Description
#1	933.42'	497 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 1,243 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
933.42	0	0	0
933.50	3	0	0
934.00	136	35	35
934.50	471	152	187
935.00	1,009	370	557
935.42	1,617	551	1,108
935.50	1,745	134	1,243

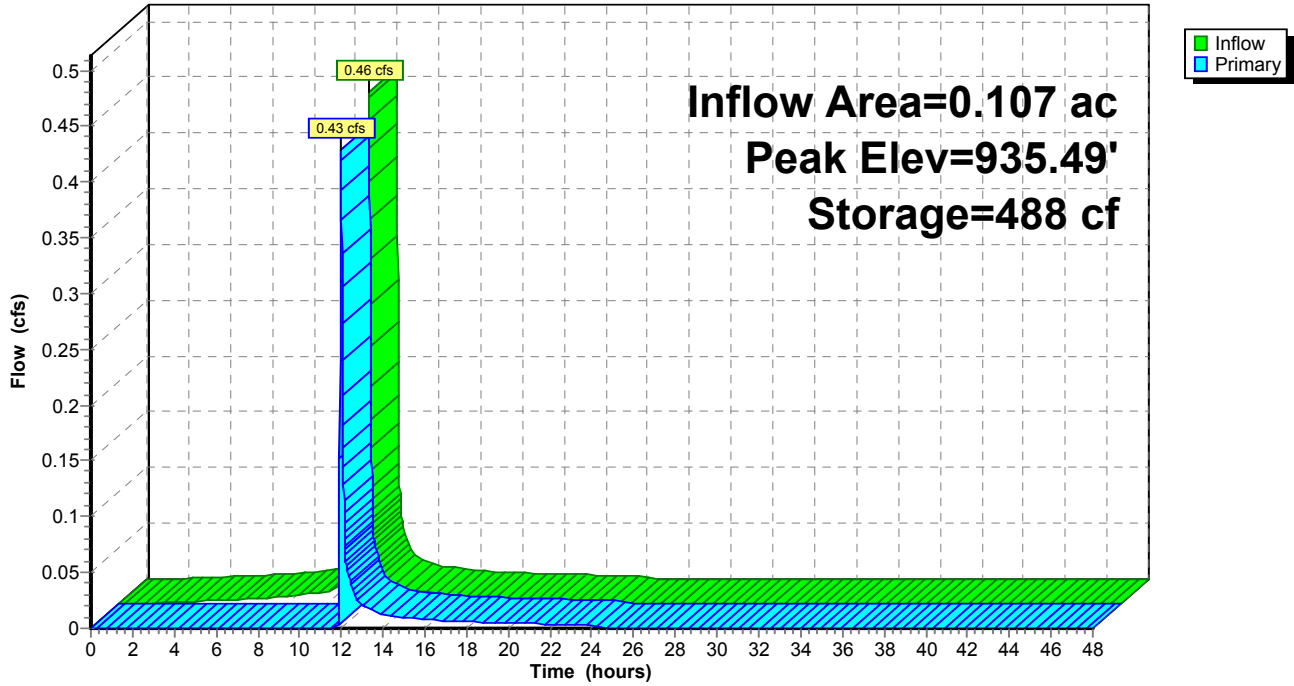
Device	Routing	Invert	Outlet Devices
#1	Primary	935.42'	10.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.42 cfs @ 11.98 hrs HW=935.49' (Free Discharge)

↑1=**Broad-Crested Rectangular Weir** (Weir Controls 0.42 cfs @ 0.63 fps)

Pond 6P: MLV PAD

Hydrograph



Summary for Subcatchment 7S: OFFSITE DA

Runoff = 1.30 cfs @ 12.05 hrs, Volume= 0.082 af, Depth= 0.77"

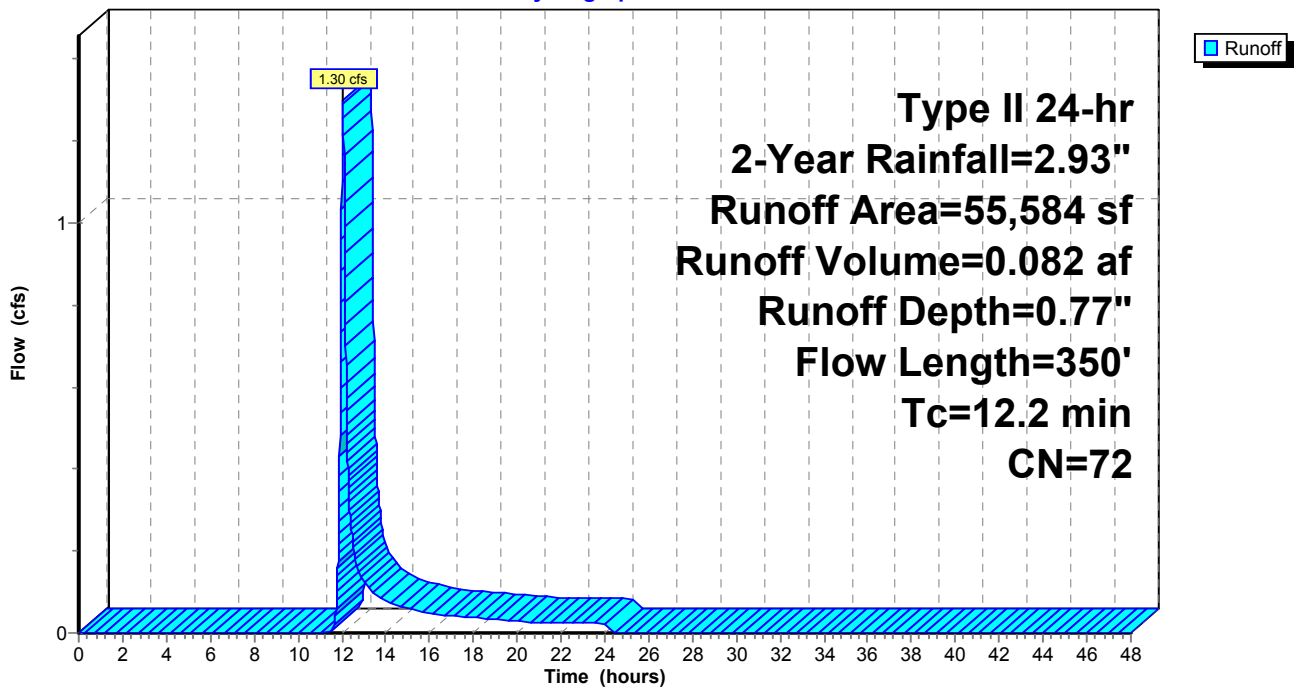
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 2-Year Rainfall=2.93"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 0	98	Crushed Stone Pad, HSG C
* 2,042	98	Paved roads, HSG C
* 52,862	71	Meadow Fair, HSG C
680	70	Woods, Good, HSG C
55,584	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0200	0.83		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
9.4	90	0.0520	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
2.6	250	0.0520	1.60		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
12.2	350	Total			

Subcatchment 7S: OFFSITE DA

Hydrograph



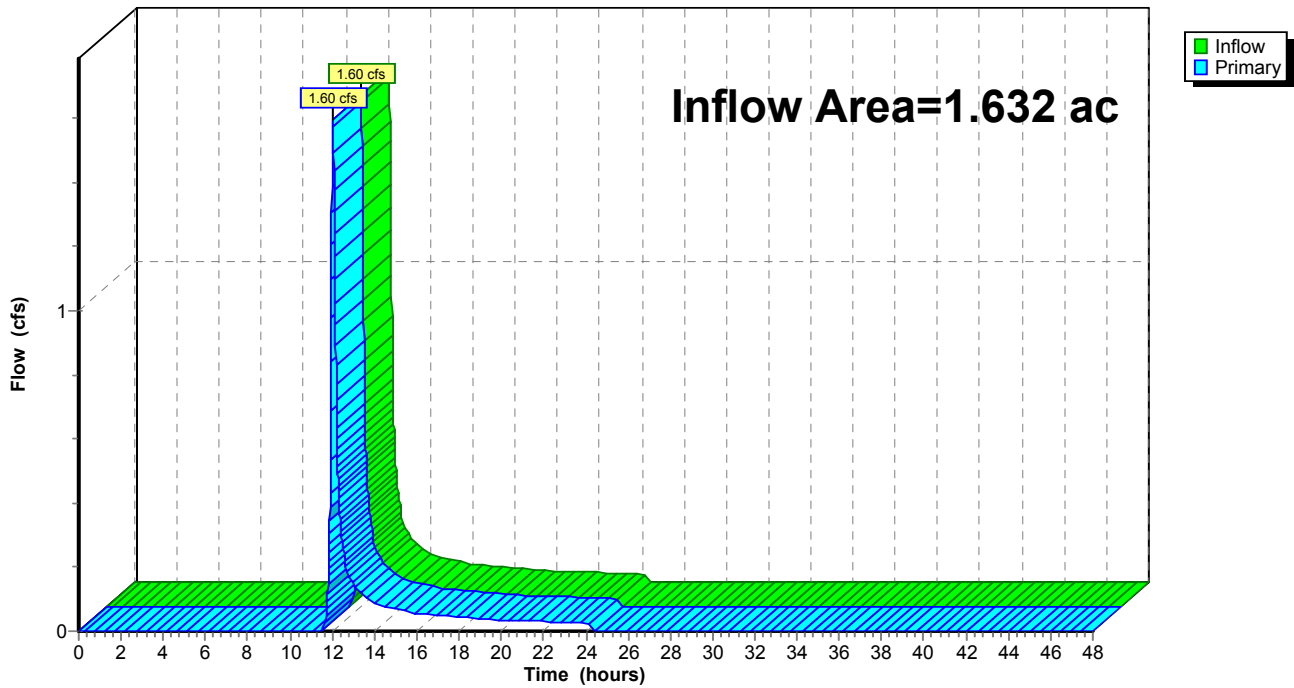
Summary for Link 8L: Proposed Conditions

Inflow Area = 1.632 ac, Inflow Depth = 0.70" for 2-Year event
Inflow = 1.60 cfs @ 12.03 hrs, Volume= 0.096 af
Primary = 1.60 cfs @ 12.03 hrs, Volume= 0.096 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 8L: Proposed Conditions

Hydrograph



Summary for Subcatchment 3S: DA TO VCI

Runoff = 0.71 cfs @ 11.96 hrs, Volume= 0.032 af, Depth= 1.53"

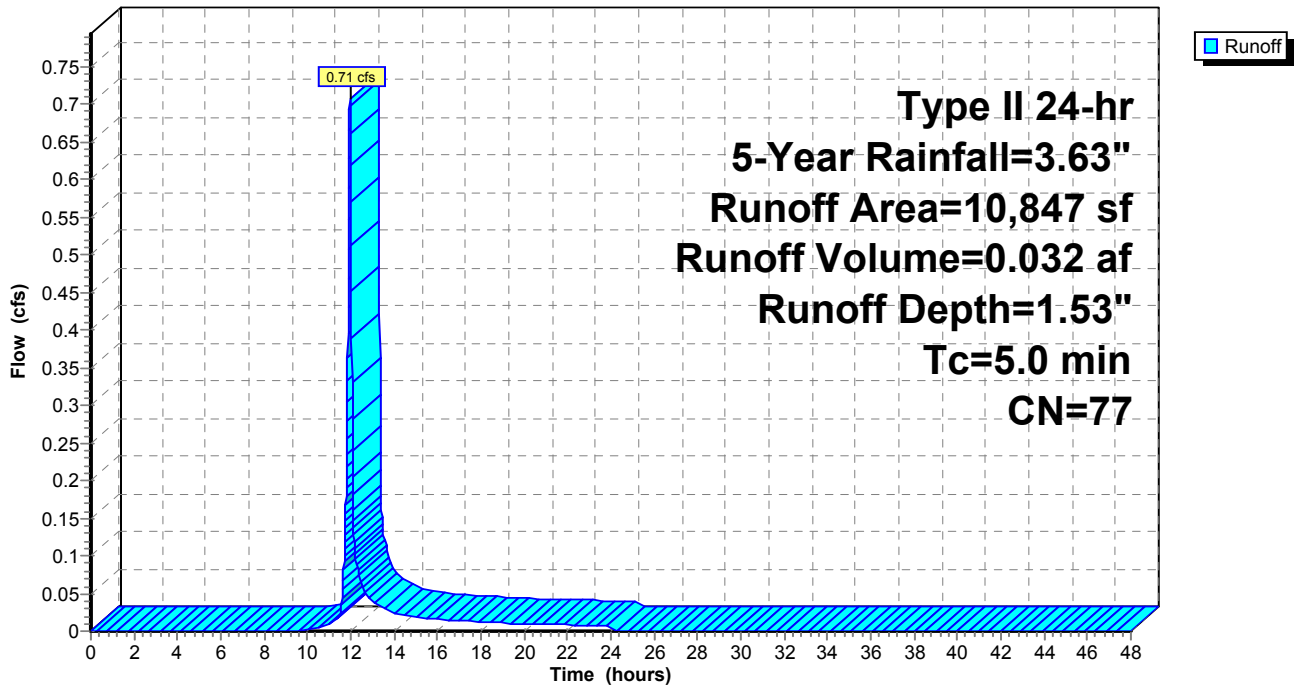
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 5-Year Rainfall=3.63"

	Area (sf)	CN	Description
*	399	98	Paved road, HSG C
	3,202	89	Gravel roads, HSG C
*	7,246	71	Meadow Fair, HSG C
	10,847	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 3S: DA TO VCI

Hydrograph



Summary for Pond 4P: VCI

Inflow Area = 0.249 ac, Inflow Depth = 1.53" for 5-Year event
 Inflow = 0.71 cfs @ 11.96 hrs, Volume= 0.032 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 933.82' @ 24.29 hrs Surf.Area= 0 sf Storage= 1,381 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	933.00'	2,527 cf	Custom Stage Data Listed below

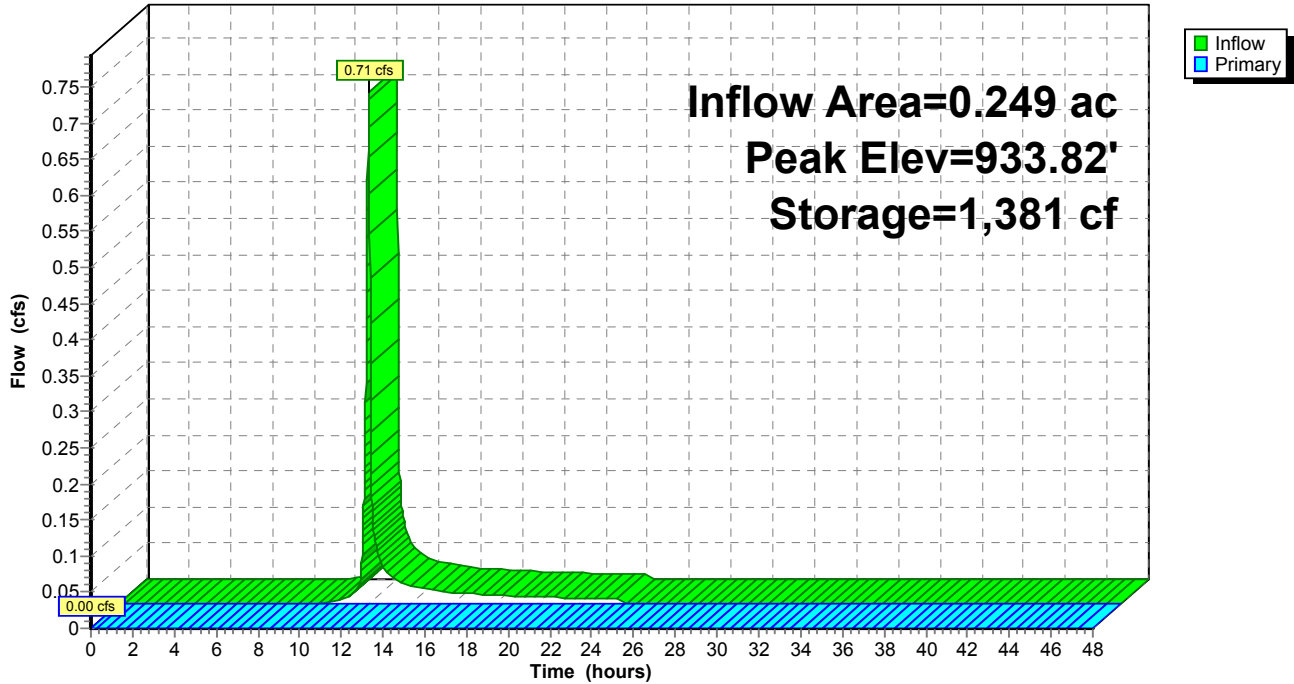
Elevation (feet)	Cum.Store (cubic-feet)
933.00	0
933.50	842
934.00	1,684
934.50	2,526
935.00	2,527

Device	Routing	Invert	Outlet Devices
#1	Primary	934.50'	14.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=933.00' (Free Discharge)
 ↑1=**Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 4P: VCI

Hydrograph



Summary for Subcatchment 5S: DA TO MLV PAD

Runoff = 0.57 cfs @ 11.96 hrs, Volume= 0.030 af, Depth= 3.40"

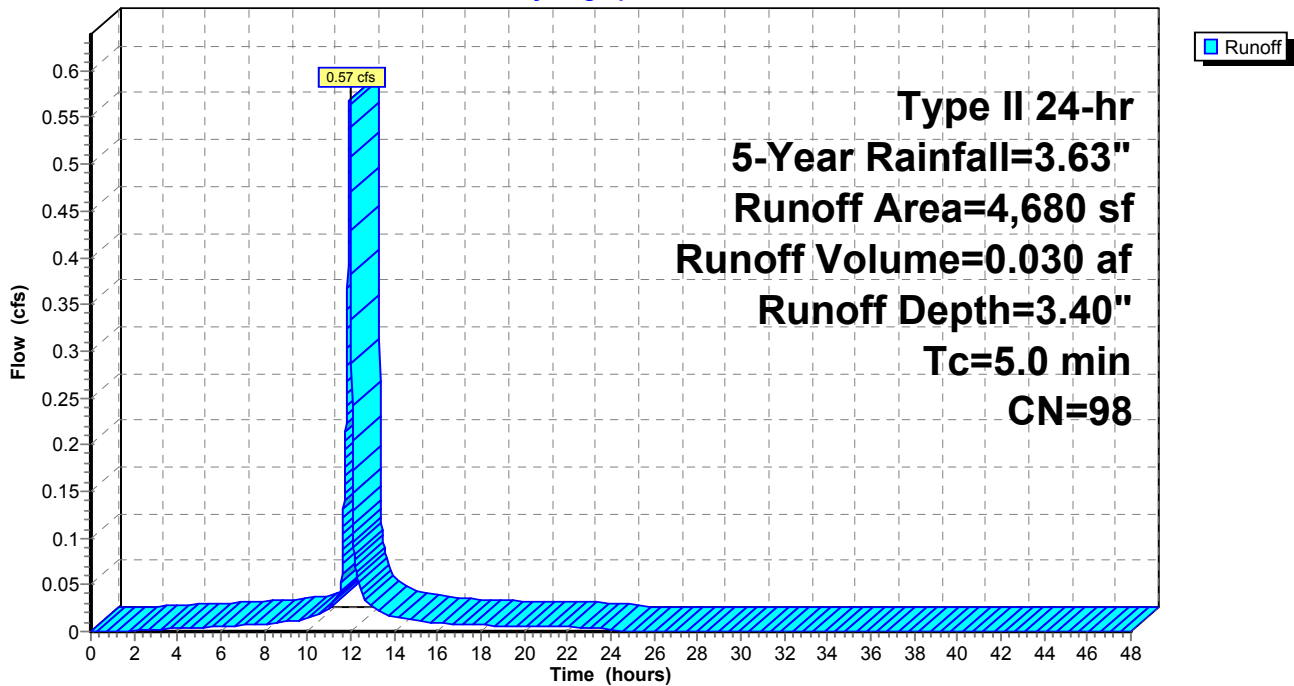
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 5-Year Rainfall=3.63"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 4,680	98	Crushed Stone Pad, HSG C
* 0	98	Paved roads , HSG C
* 0	71	Meadow Fair, HSG C
4,680	98	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 5S: DA TO MLV PAD

Hydrograph



Summary for Pond 6P: MLV PAD

Inflow Area = 0.107 ac, Inflow Depth = 3.40" for 5-Year event
 Inflow = 0.57 cfs @ 11.96 hrs, Volume= 0.030 af
 Outflow = 0.57 cfs @ 11.97 hrs, Volume= 0.020 af, Atten= 1%, Lag= 0.9 min
 Primary = 0.57 cfs @ 11.97 hrs, Volume= 0.020 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 935.50' @ 11.97 hrs Surf.Area= 1,745 sf Storage= 497 cf

Plug-Flow detention time= 189.6 min calculated for 0.020 af (67% of inflow)
 Center-of-Mass det. time= 88.3 min (837.3 - 748.9)

Volume	Invert	Avail.Storage	Storage Description
#1	933.42'	497 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 1,243 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
933.42	0	0	0
933.50	3	0	0
934.00	136	35	35
934.50	471	152	187
935.00	1,009	370	557
935.42	1,617	551	1,108
935.50	1,745	134	1,243

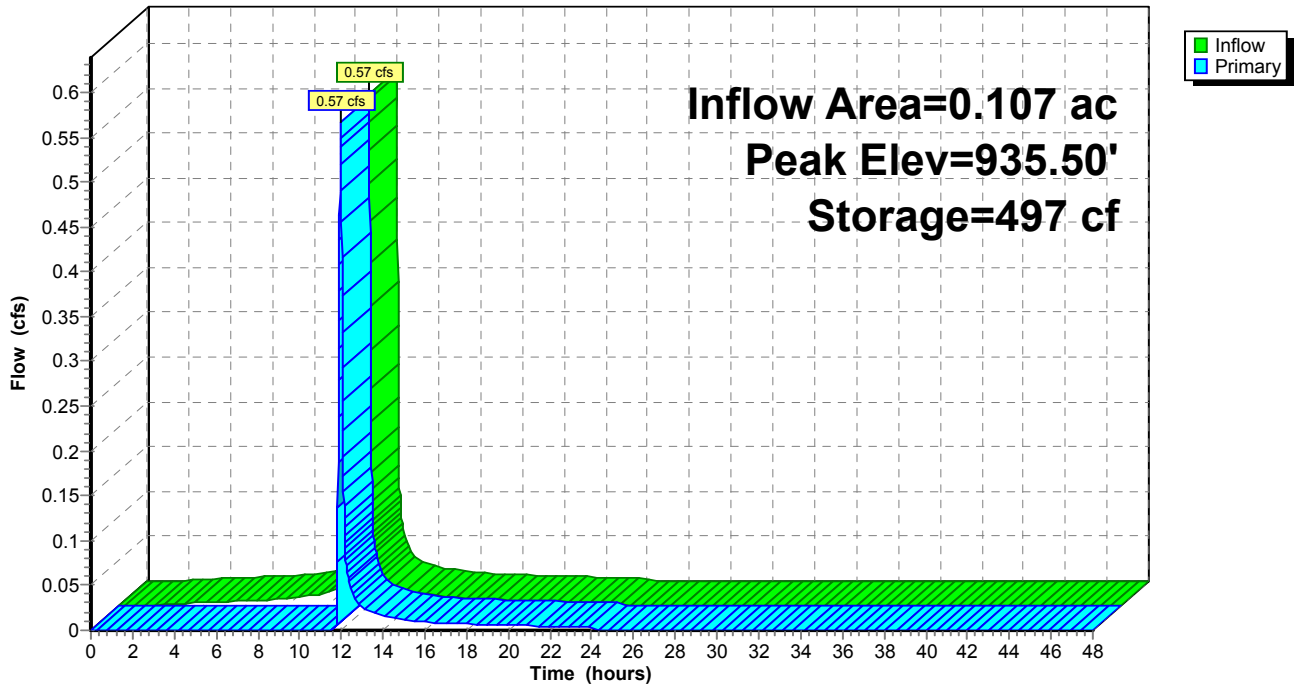
Device	Routing	Invert	Outlet Devices
#1	Primary	935.42'	10.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.57 cfs @ 11.97 hrs HW=935.50' (Free Discharge)

↑1=**Broad-Crested Rectangular Weir** (Weir Controls 0.57 cfs @ 0.70 fps)

Pond 6P: MLV PAD

Hydrograph



Summary for Subcatchment 7S: OFFSITE DA

Runoff = 2.14 cfs @ 12.05 hrs, Volume= 0.128 af, Depth= 1.21"

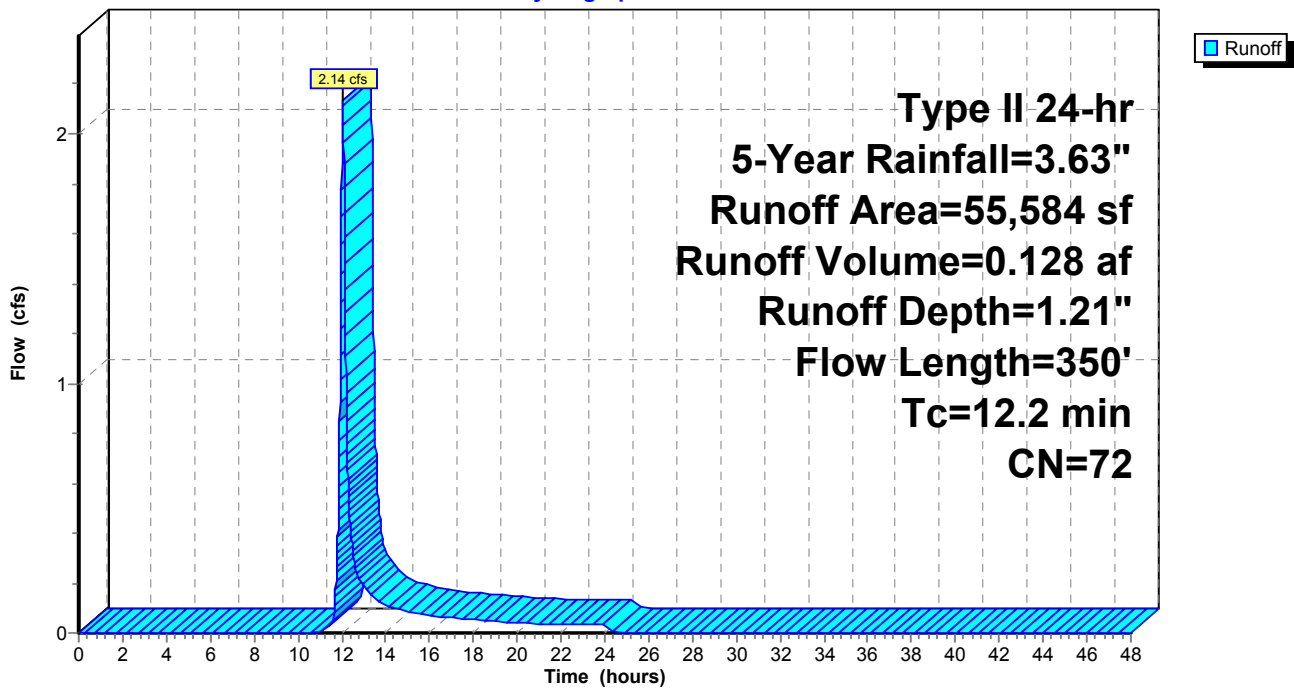
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 5-Year Rainfall=3.63"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 0	98	Crushed Stone Pad, HSG C
* 2,042	98	Paved roads, HSG C
* 52,862	71	Meadow Fair, HSG C
680	70	Woods, Good, HSG C
55,584	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0200	0.83		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
9.4	90	0.0520	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
2.6	250	0.0520	1.60		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
12.2	350	Total			

Subcatchment 7S: OFFSITE DA

Hydrograph



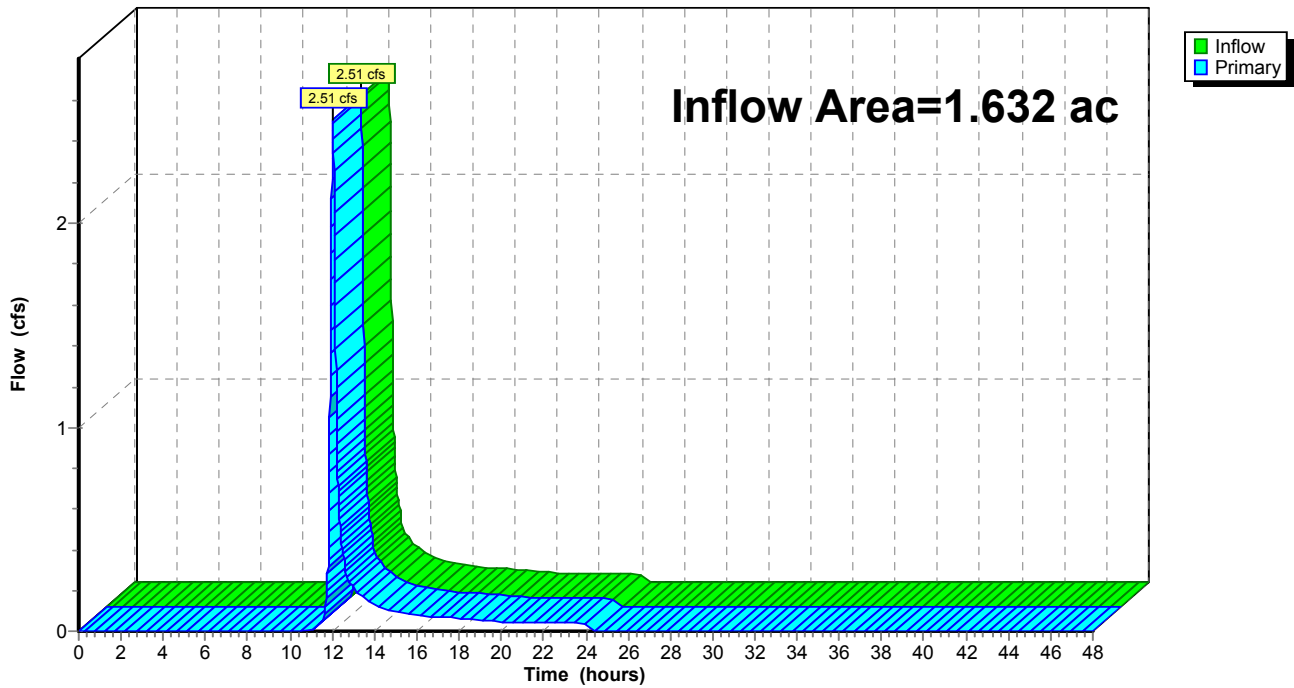
Summary for Link 8L: Proposed Conditions

Inflow Area = 1.632 ac, Inflow Depth = 1.09" for 5-Year event
Inflow = 2.51 cfs @ 12.03 hrs, Volume= 0.149 af
Primary = 2.51 cfs @ 12.03 hrs, Volume= 0.149 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 8L: Proposed Conditions

Hydrograph



Summary for Subcatchment 3S: DA TO VCI

Runoff = 0.93 cfs @ 11.96 hrs, Volume= 0.042 af, Depth= 2.01"

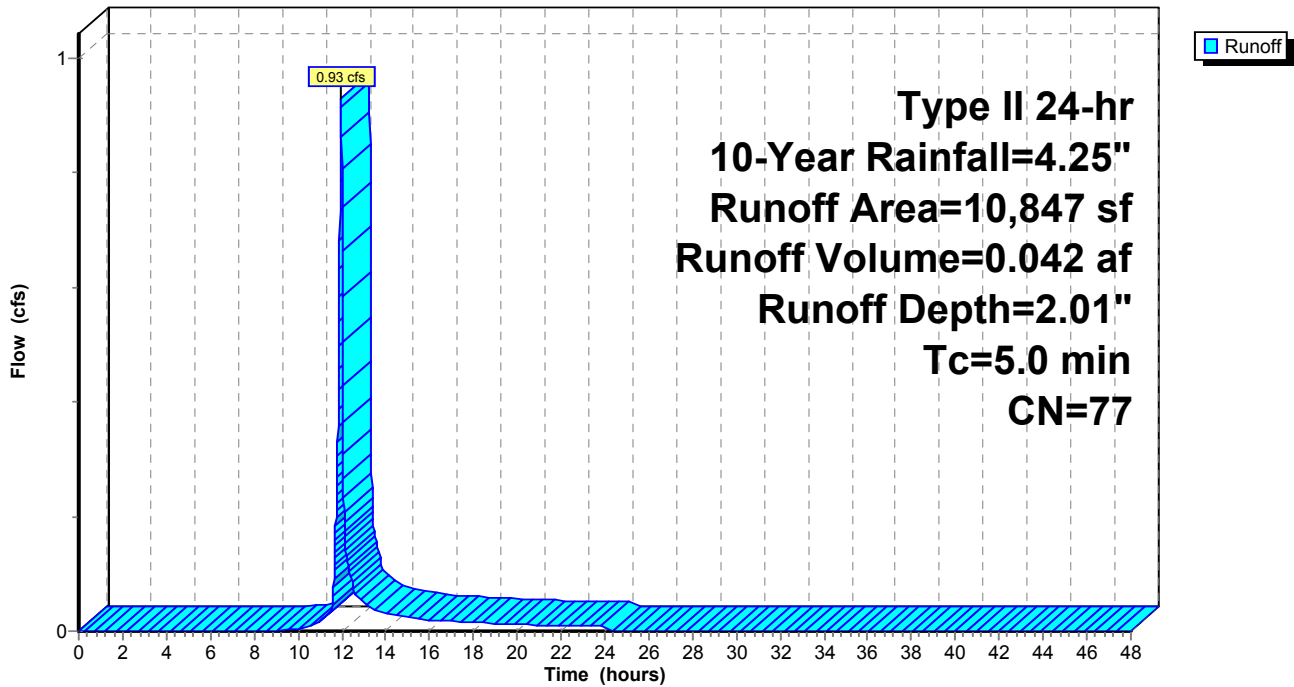
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 10-Year Rainfall=4.25"

	Area (sf)	CN	Description
*	399	98	Paved road, HSG C
	3,202	89	Gravel roads, HSG C
*	7,246	71	Meadow Fair, HSG C
	10,847	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 3S: DA TO VCI

Hydrograph



Summary for Pond 4P: VCI

Inflow Area = 0.249 ac, Inflow Depth = 2.01" for 10-Year event
 Inflow = 0.93 cfs @ 11.96 hrs, Volume= 0.042 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 934.08' @ 24.29 hrs Surf.Area= 0 sf Storage= 1,816 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	933.00'	2,527 cf	Custom Stage Data Listed below

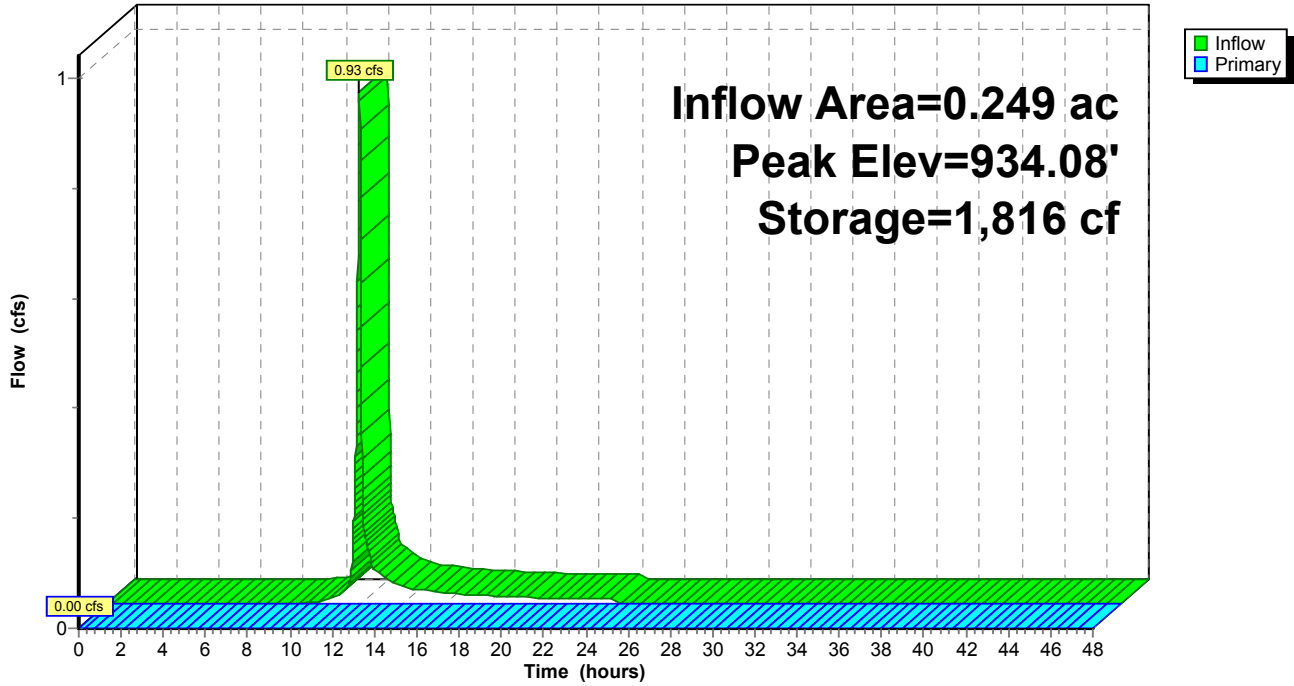
Elevation (feet)	Cum.Store (cubic-feet)
933.00	0
933.50	842
934.00	1,684
934.50	2,526
935.00	2,527

Device	Routing	Invert	Outlet Devices
#1	Primary	934.50'	14.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=933.00' (Free Discharge)
 ↑1=**Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 4P: VCI

Hydrograph



Summary for Subcatchment 5S: DA TO MLV PAD

Runoff = 0.67 cfs @ 11.96 hrs, Volume= 0.036 af, Depth= 4.01"

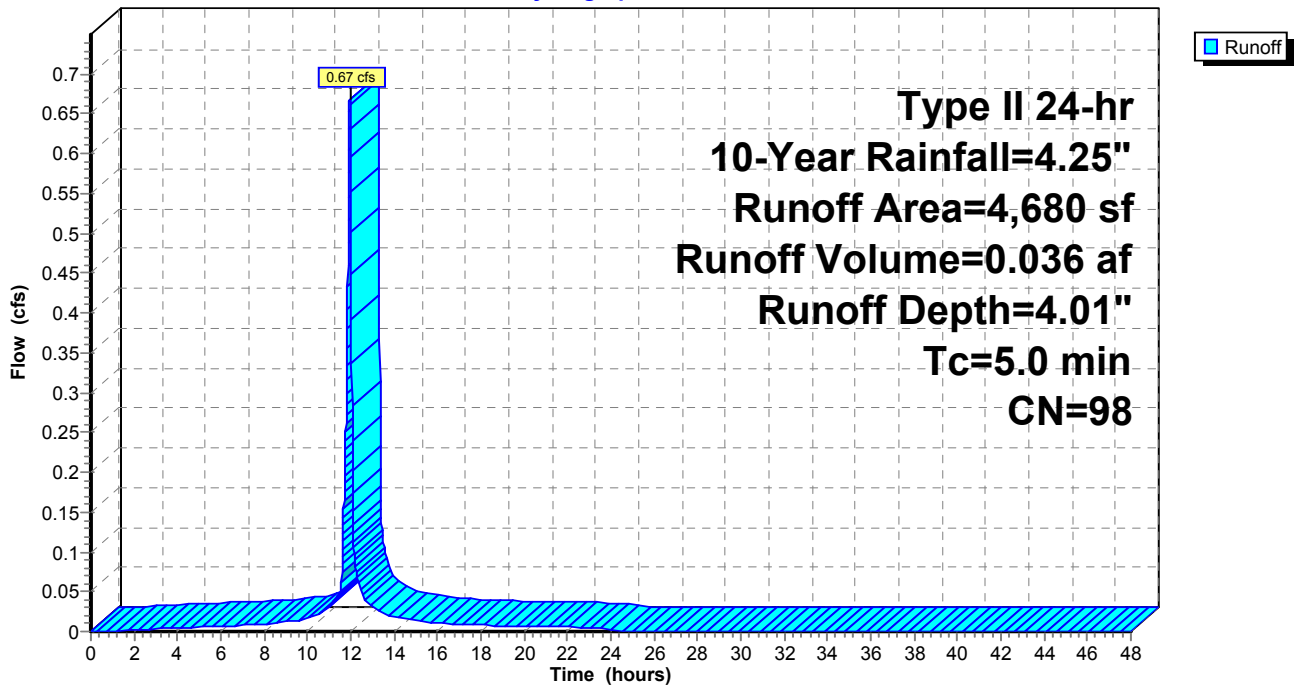
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 10-Year Rainfall=4.25"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 4,680	98	Crushed Stone Pad, HSG C
* 0	98	Paved roads , HSG C
* 0	71	Meadow Fair, HSG C
4,680	98	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 5S: DA TO MLV PAD

Hydrograph



Summary for Pond 6P: MLV PAD

Inflow Area = 0.107 ac, Inflow Depth = 4.01" for 10-Year event
 Inflow = 0.67 cfs @ 11.96 hrs, Volume= 0.036 af
 Outflow = 0.65 cfs @ 11.96 hrs, Volume= 0.026 af, Atten= 3%, Lag= 0.0 min
 Primary = 0.65 cfs @ 11.96 hrs, Volume= 0.026 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 935.51' @ 11.96 hrs Surf.Area= 1,745 sf Storage= 497 cf

Plug-Flow detention time= 176.8 min calculated for 0.026 af (71% of inflow)
 Center-of-Mass det. time= 81.5 min (827.4 - 745.9)

Volume	Invert	Avail.Storage	Storage Description
#1	933.42'	497 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 1,243 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
933.42	0	0	0
933.50	3	0	0
934.00	136	35	35
934.50	471	152	187
935.00	1,009	370	557
935.42	1,617	551	1,108
935.50	1,745	134	1,243

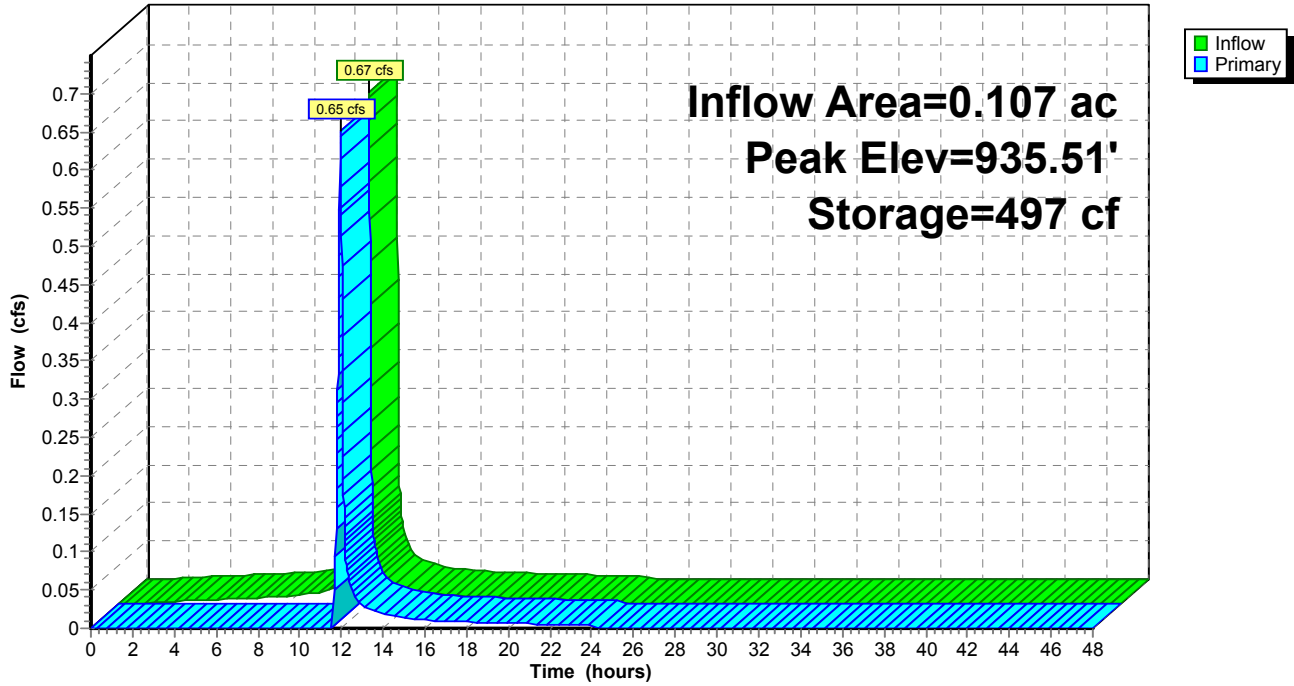
Device	Routing	Invert	Outlet Devices
#1	Primary	935.42'	10.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.65 cfs @ 11.96 hrs HW=935.51' (Free Discharge)

↑1=**Broad-Crested Rectangular Weir** (Weir Controls 0.65 cfs @ 0.73 fps)

Pond 6P: MLV PAD

Hydrograph



Summary for Subcatchment 7S: OFFSITE DA

Runoff = 2.95 cfs @ 12.05 hrs, Volume= 0.174 af, Depth= 1.64"

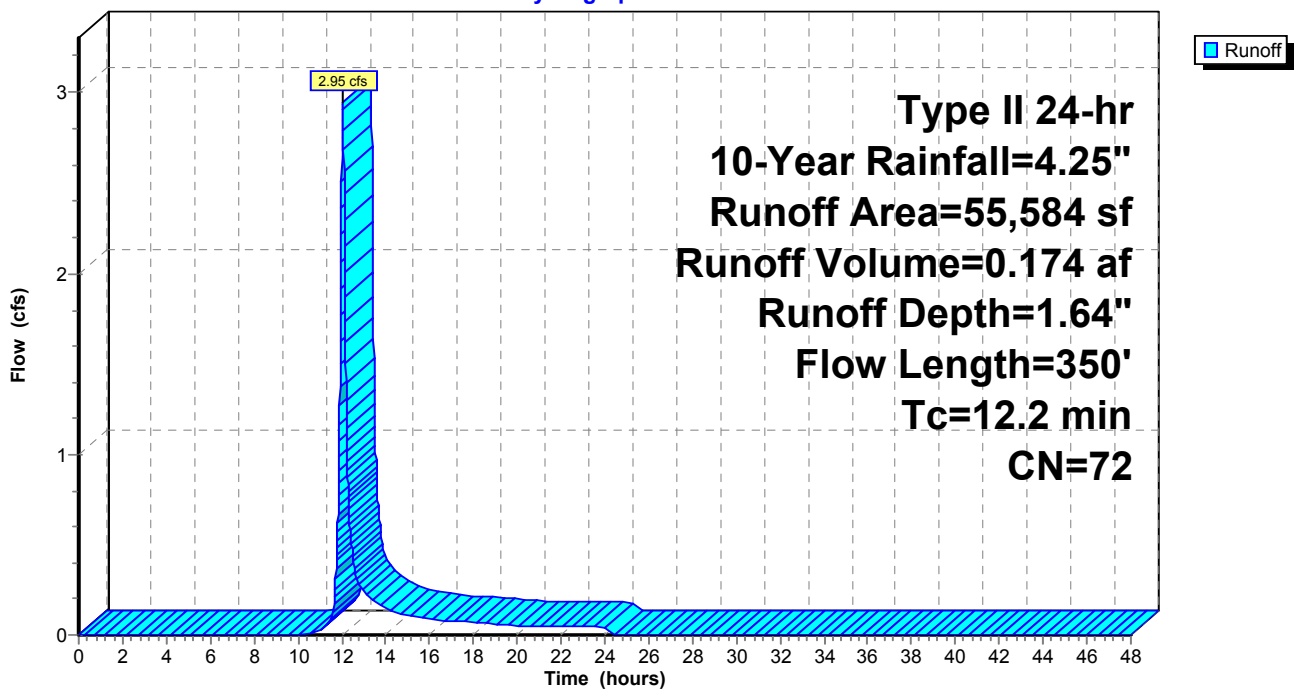
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 10-Year Rainfall=4.25"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 0	98	Crushed Stone Pad, HSG C
* 2,042	98	Paved roads, HSG C
* 52,862	71	Meadow Fair, HSG C
680	70	Woods, Good, HSG C
55,584	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0200	0.83		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
9.4	90	0.0520	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
2.6	250	0.0520	1.60		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
12.2	350	Total			

Subcatchment 7S: OFFSITE DA

Hydrograph



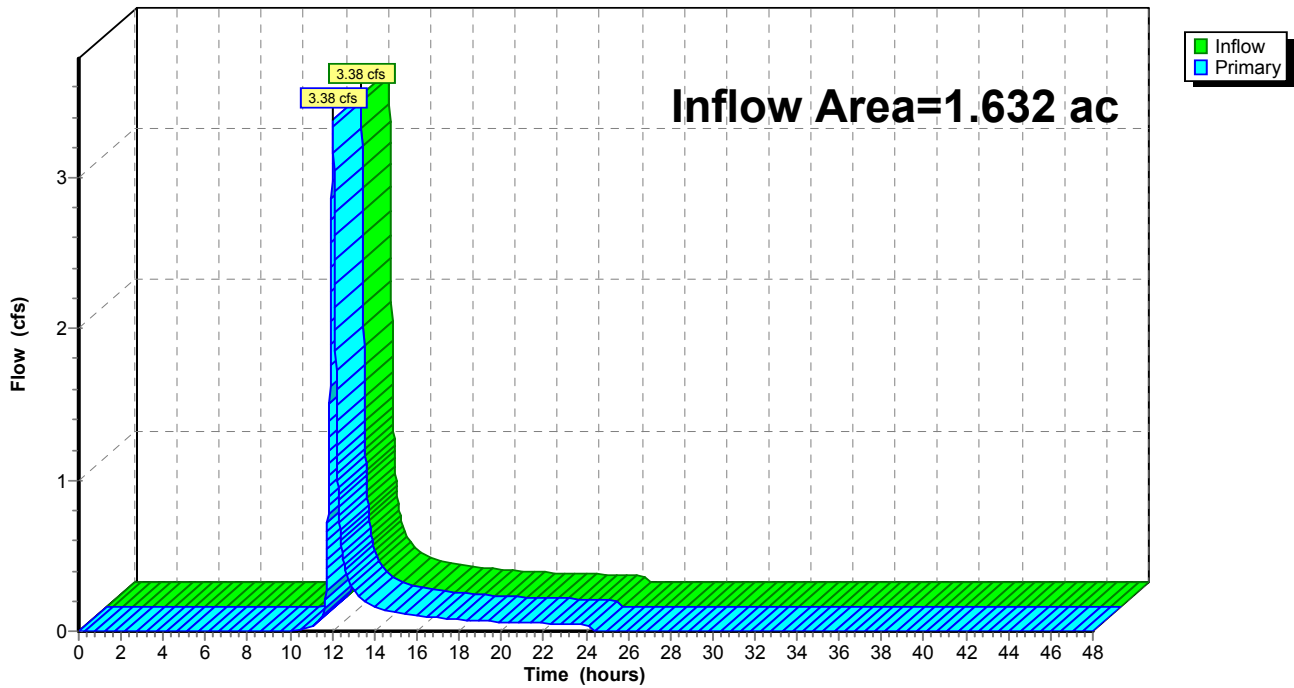
Summary for Link 8L: Proposed Conditions

Inflow Area = 1.632 ac, Inflow Depth = 1.47" for 10-Year event
Inflow = 3.38 cfs @ 12.03 hrs, Volume= 0.200 af
Primary = 3.38 cfs @ 12.03 hrs, Volume= 0.200 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 8L: Proposed Conditions

Hydrograph



Summary for Subcatchment 3S: DA TO VCI

Runoff = 1.29 cfs @ 11.96 hrs, Volume= 0.058 af, Depth= 2.82"

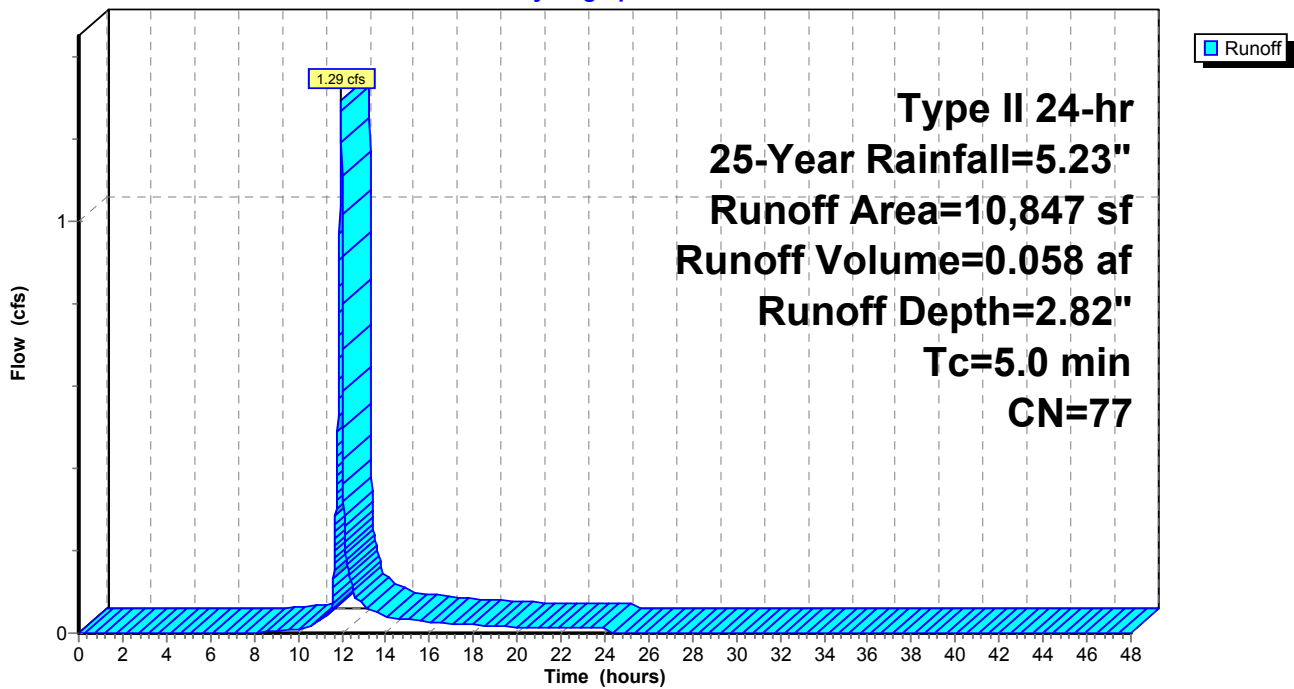
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 25-Year Rainfall=5.23"

Area (sf)	CN	Description
* 399	98	Paved road, HSG C
3,202	89	Gravel roads, HSG C
* 7,246	71	Meadow Fair, HSG C
10,847	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 3S: DA TO VCI

Hydrograph



Summary for Pond 4P: VCI

Inflow Area = 0.249 ac, Inflow Depth = 2.82" for 25-Year event
 Inflow = 1.29 cfs @ 11.96 hrs, Volume= 0.058 af
 Outflow = 0.01 cfs @ 23.94 hrs, Volume= 0.000 af, Atten= 99%, Lag= 718.6 min
 Primary = 0.01 cfs @ 23.94 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 934.50' @ 23.94 hrs Surf.Area= 0 sf Storage= 2,526 cf

Plug-Flow detention time= 888.8 min calculated for 0.000 af (1% of inflow)
 Center-of-Mass det. time= 608.4 min (1,432.0 - 823.6)

Volume	Invert	Avail.Storage	Storage Description
#1	933.00'	2,527 cf	Custom Stage Data Listed below

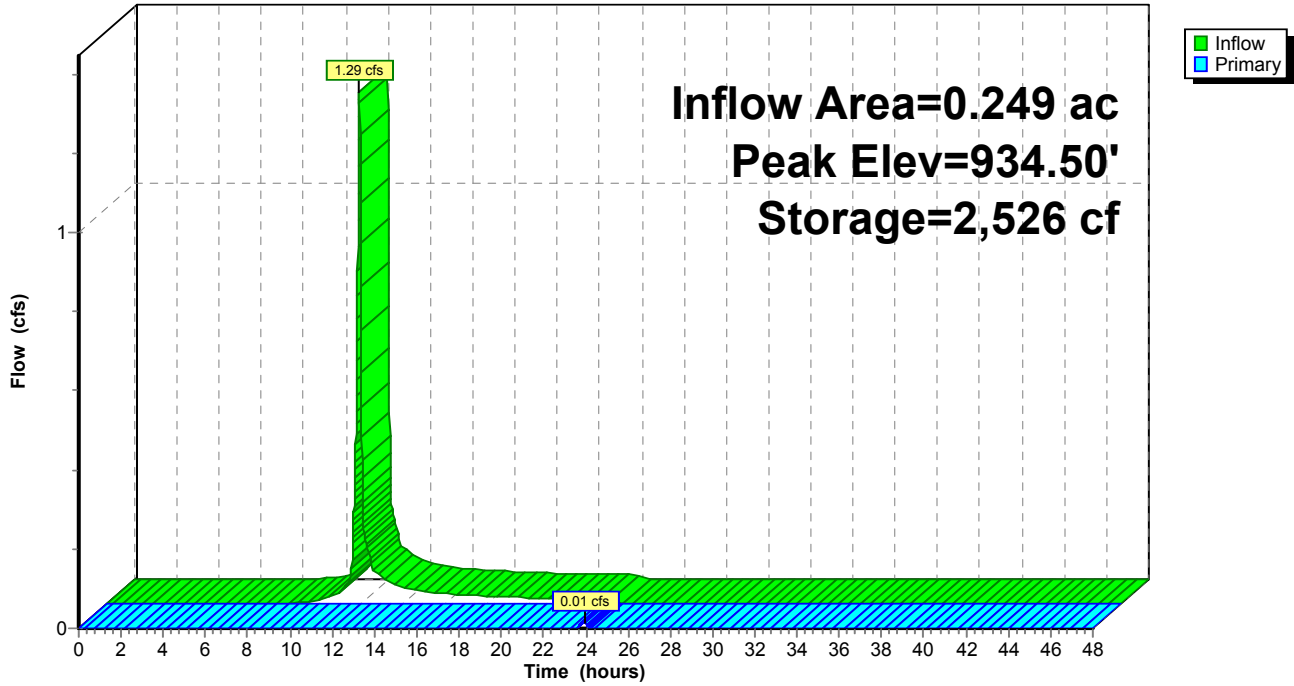
Elevation (feet)	Cum.Store (cubic-feet)
933.00	0
933.50	842
934.00	1,684
934.50	2,526
935.00	2,527

Device	Routing	Invert	Outlet Devices
#1	Primary	934.50'	14.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 23.94 hrs HW=934.50' (Free Discharge)
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 0.00 cfs @ 0.12 fps)

Pond 4P: VCI

Hydrograph



Summary for Subcatchment 5S: DA TO MLV PAD

Runoff = 0.83 cfs @ 11.96 hrs, Volume= 0.045 af, Depth= 4.99"

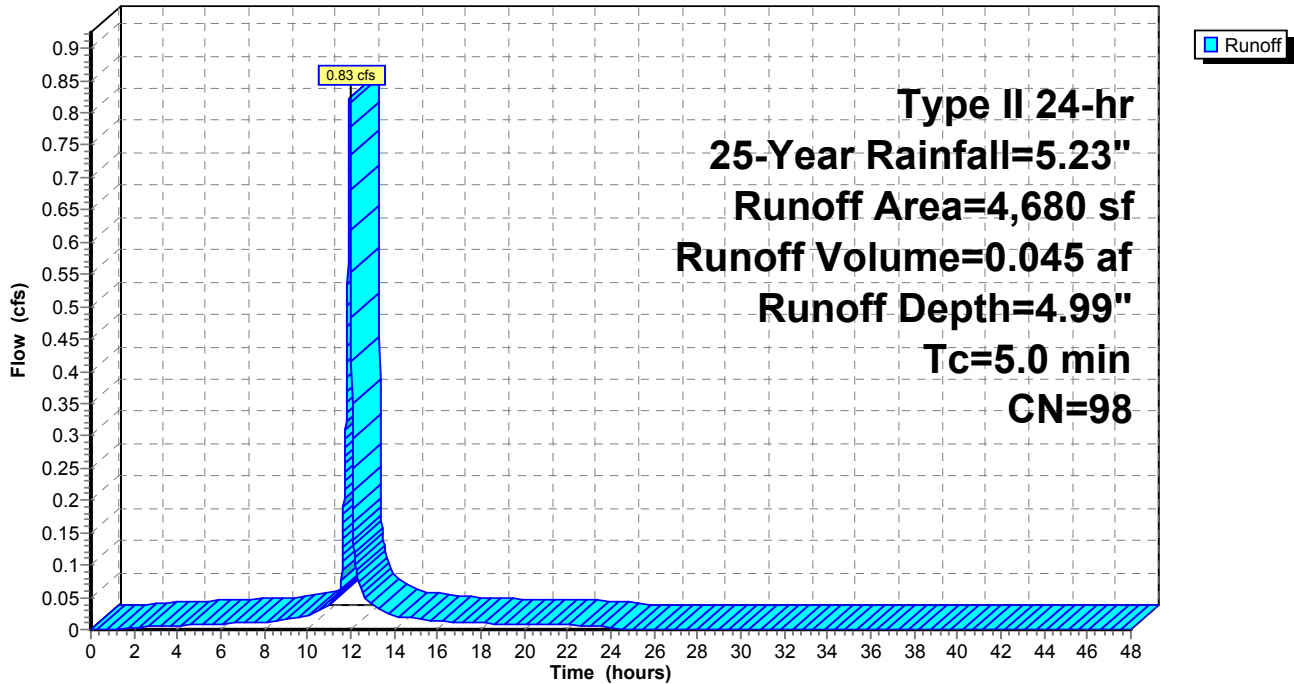
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 25-Year Rainfall=5.23"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 4,680	98	Crushed Stone Pad, HSG C
* 0	98	Paved roads , HSG C
* 0	71	Meadow Fair, HSG C
4,680	98	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 5S: DA TO MLV PAD

Hydrograph



Summary for Pond 6P: MLV PAD

Inflow Area = 0.107 ac, Inflow Depth = 4.99" for 25-Year event
 Inflow = 0.83 cfs @ 11.96 hrs, Volume= 0.045 af
 Outflow = 0.88 cfs @ 11.96 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.88 cfs @ 11.96 hrs, Volume= 0.035 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 935.53' @ 11.96 hrs Surf.Area= 1,745 sf Storage= 497 cf

Plug-Flow detention time= 156.6 min calculated for 0.035 af (79% of inflow)
 Center-of-Mass det. time= 72.4 min (814.7 - 742.2)

Volume	Invert	Avail.Storage	Storage Description
#1	933.42'	497 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 1,243 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
933.42	0	0	0
933.50	3	0	0
934.00	136	35	35
934.50	471	152	187
935.00	1,009	370	557
935.42	1,617	551	1,108
935.50	1,745	134	1,243

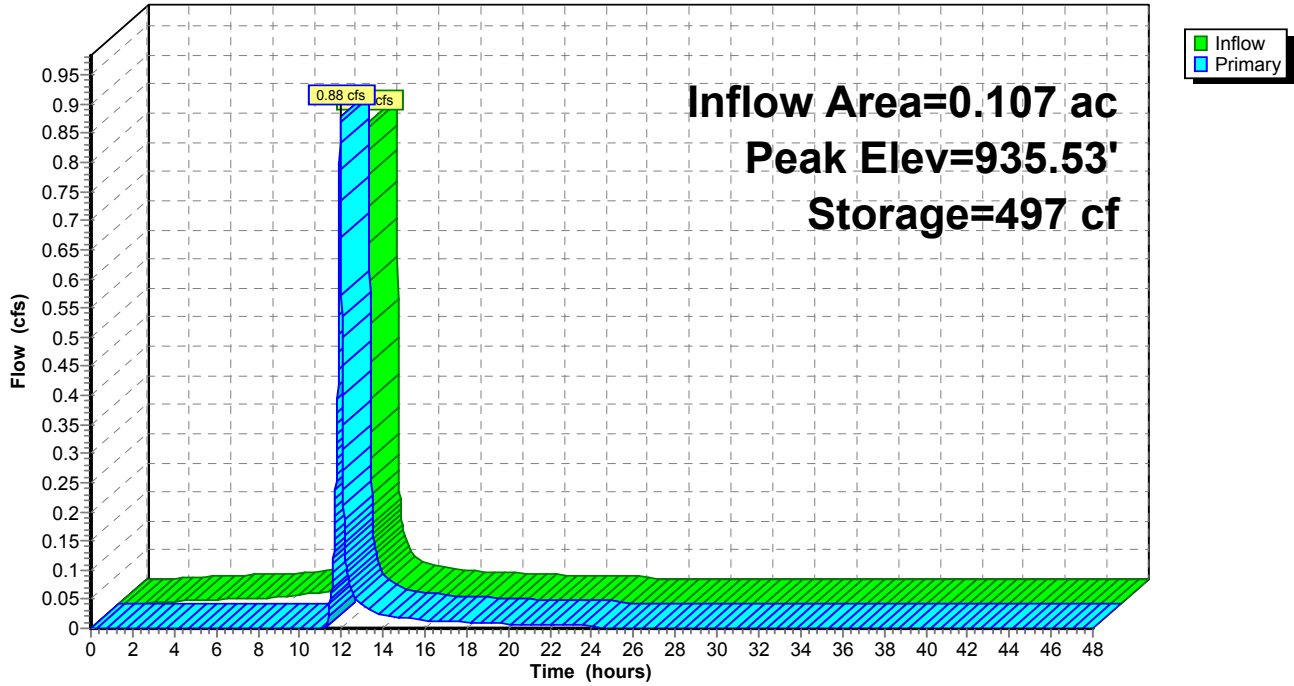
Device	Routing	Invert	Outlet Devices
#1	Primary	935.42'	10.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.87 cfs @ 11.96 hrs HW=935.53' (Free Discharge)

↑1=**Broad-Crested Rectangular Weir** (Weir Controls 0.87 cfs @ 0.80 fps)

Pond 6P: MLV PAD

Hydrograph



Summary for Subcatchment 7S: OFFSITE DA

Runoff = 4.32 cfs @ 12.05 hrs, Volume= 0.253 af, Depth= 2.38"

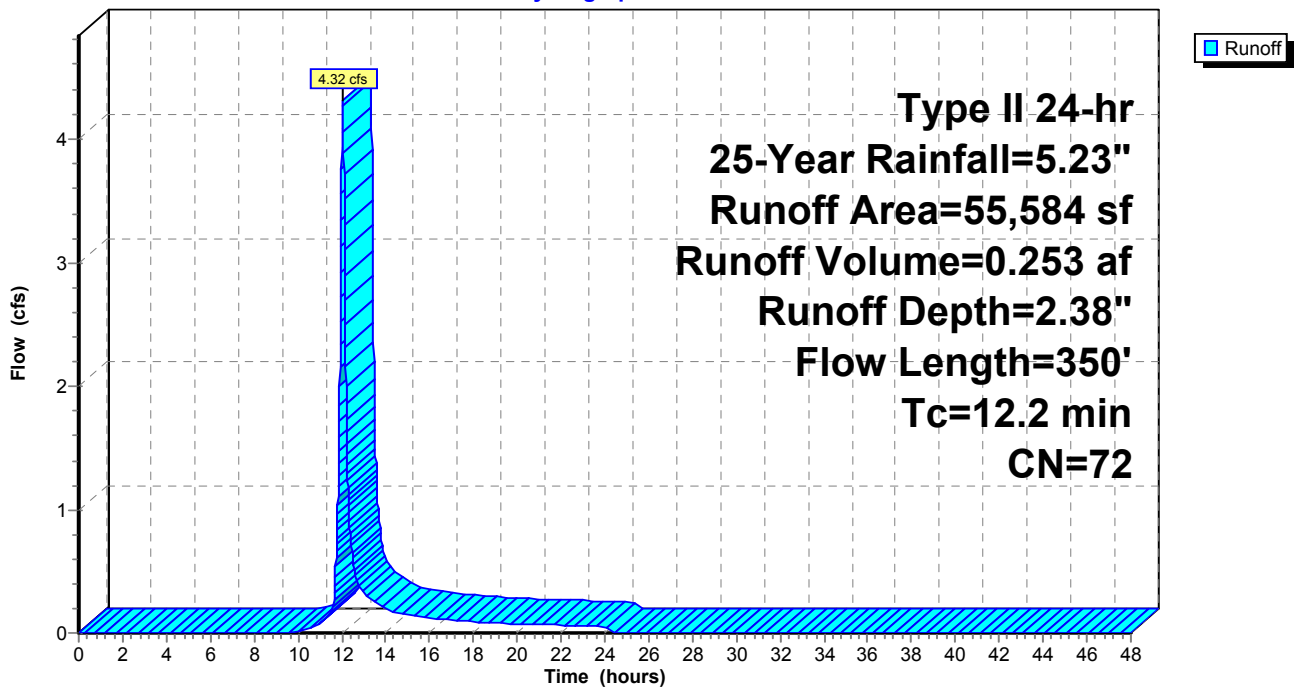
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 25-Year Rainfall=5.23"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 0	98	Crushed Stone Pad, HSG C
* 2,042	98	Paved roads, HSG C
* 52,862	71	Meadow Fair, HSG C
680	70	Woods, Good, HSG C
55,584	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0200	0.83		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
9.4	90	0.0520	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
2.6	250	0.0520	1.60		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
12.2	350	Total			

Subcatchment 7S: OFFSITE DA

Hydrograph



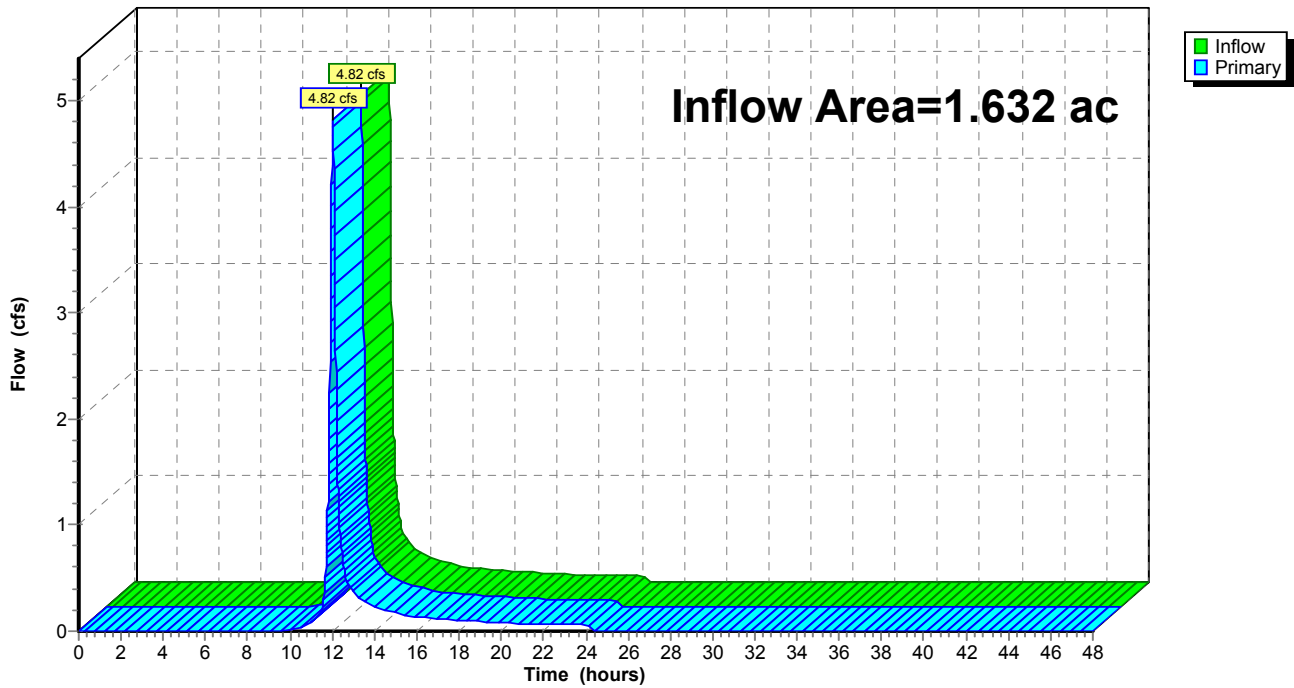
Summary for Link 8L: Proposed Conditions

Inflow Area = 1.632 ac, Inflow Depth = 2.12" for 25-Year event
Inflow = 4.82 cfs @ 12.04 hrs, Volume= 0.288 af
Primary = 4.82 cfs @ 12.04 hrs, Volume= 0.288 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 8L: Proposed Conditions

Hydrograph



Summary for Subcatchment 3S: DA TO VCI

Runoff = 1.64 cfs @ 11.96 hrs, Volume= 0.075 af, Depth= 3.59"

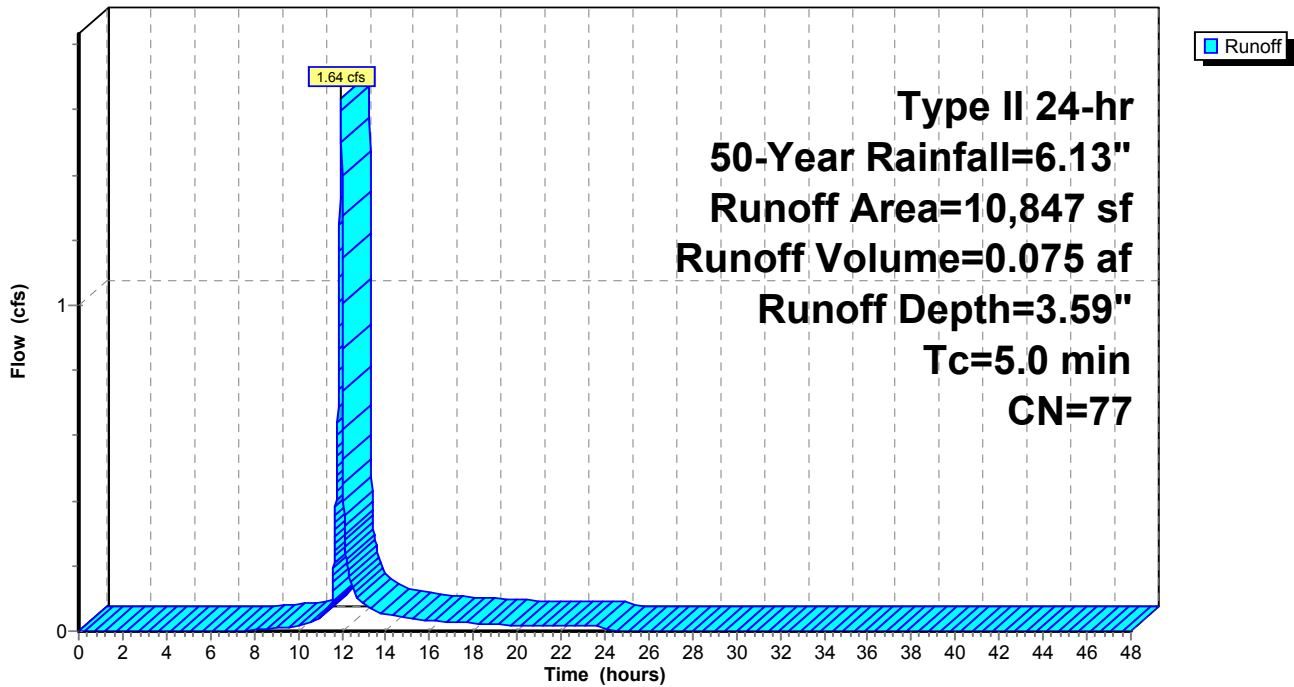
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=6.13"

	Area (sf)	CN	Description
*	399	98	Paved road, HSG C
	3,202	89	Gravel roads, HSG C
*	7,246	71	Meadow Fair, HSG C
	10,847	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 3S: DA TO VCI

Hydrograph



Summary for Pond 4P: VCI

Inflow Area = 0.249 ac, Inflow Depth = 3.59" for 50-Year event
 Inflow = 1.64 cfs @ 11.96 hrs, Volume= 0.075 af
 Outflow = 0.04 cfs @ 15.06 hrs, Volume= 0.017 af, Atten= 98%, Lag= 186.0 min
 Primary = 0.04 cfs @ 15.06 hrs, Volume= 0.017 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 934.51' @ 15.06 hrs Surf.Area= 0 sf Storage= 2,526 cf

Plug-Flow detention time= 446.0 min calculated for 0.017 af (22% of inflow)
 Center-of-Mass det. time= 307.7 min (1,124.3 - 816.7)

Volume	Invert	Avail.Storage	Storage Description
#1	933.00'	2,527 cf	Custom Stage Data Listed below

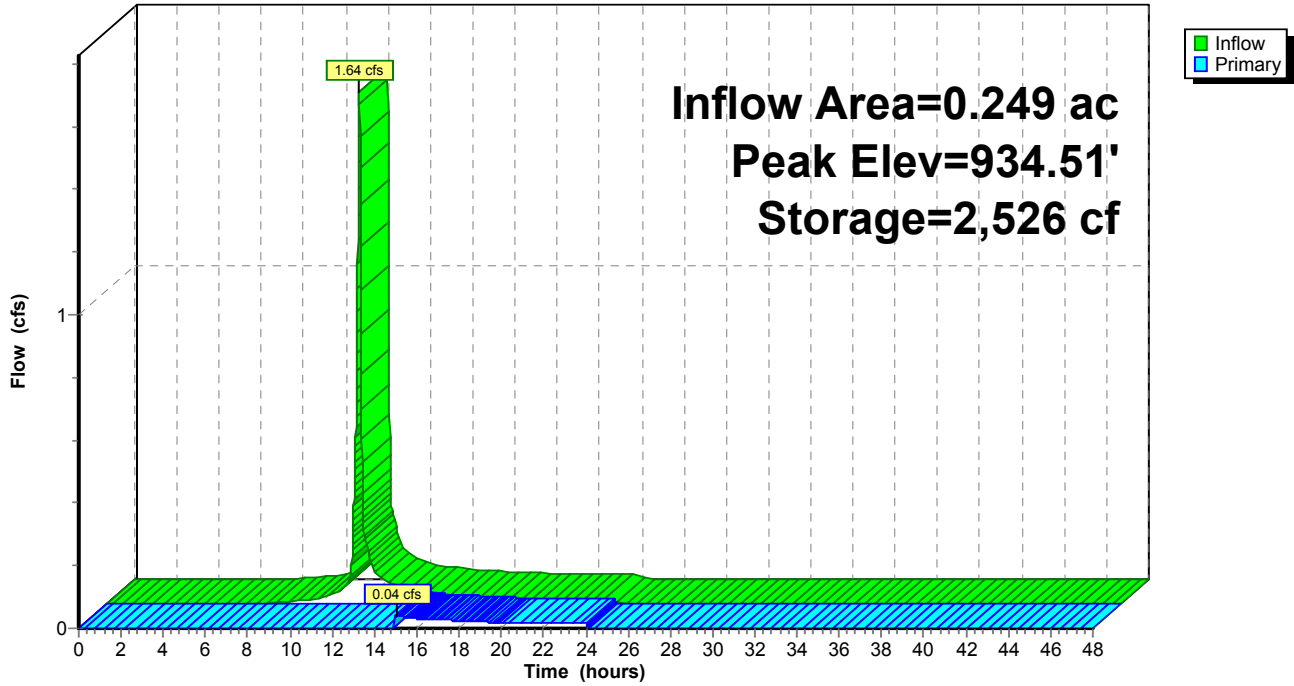
Elevation (feet)	Cum.Store (cubic-feet)
933.00	0
933.50	842
934.00	1,684
934.50	2,526
935.00	2,527

Device	Routing	Invert	Outlet Devices
#1	Primary	934.50'	14.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.02 cfs @ 15.06 hrs HW=934.51' (Free Discharge)
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 0.02 cfs @ 0.22 fps)

Pond 4P: VCI

Hydrograph



Summary for Subcatchment 5S: DA TO MLV PAD

Runoff = 0.97 cfs @ 11.96 hrs, Volume= 0.053 af, Depth= 5.89"

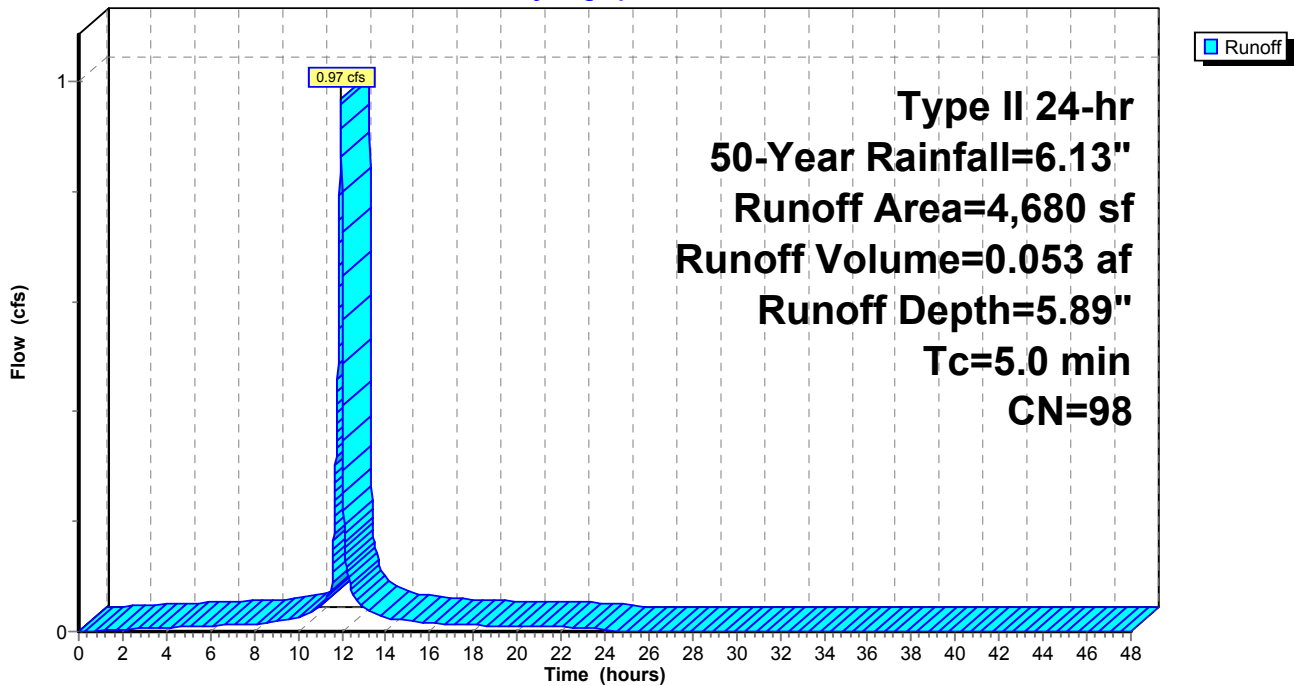
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 50-Year Rainfall=6.13"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 4,680	98	Crushed Stone Pad, HSG C
* 0	98	Paved roads , HSG C
* 0	71	Meadow Fair, HSG C
4,680	98	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 5S: DA TO MLV PAD

Hydrograph



Summary for Pond 6P: MLV PAD

Inflow Area = 0.107 ac, Inflow Depth = 5.89" for 50-Year event
 Inflow = 0.97 cfs @ 11.96 hrs, Volume= 0.053 af
 Outflow = 0.94 cfs @ 11.96 hrs, Volume= 0.042 af, Atten= 3%, Lag= 0.0 min
 Primary = 0.94 cfs @ 11.96 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 935.53' @ 11.96 hrs Surf.Area= 1,745 sf Storage= 497 cf

Plug-Flow detention time= 151.6 min calculated for 0.042 af (80% of inflow)
 Center-of-Mass det. time= 70.1 min (809.9 - 739.7)

Volume	Invert	Avail.Storage	Storage Description
#1	933.42'	497 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 1,243 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
933.42	0	0	0
933.50	3	0	0
934.00	136	35	35
934.50	471	152	187
935.00	1,009	370	557
935.42	1,617	551	1,108
935.50	1,745	134	1,243

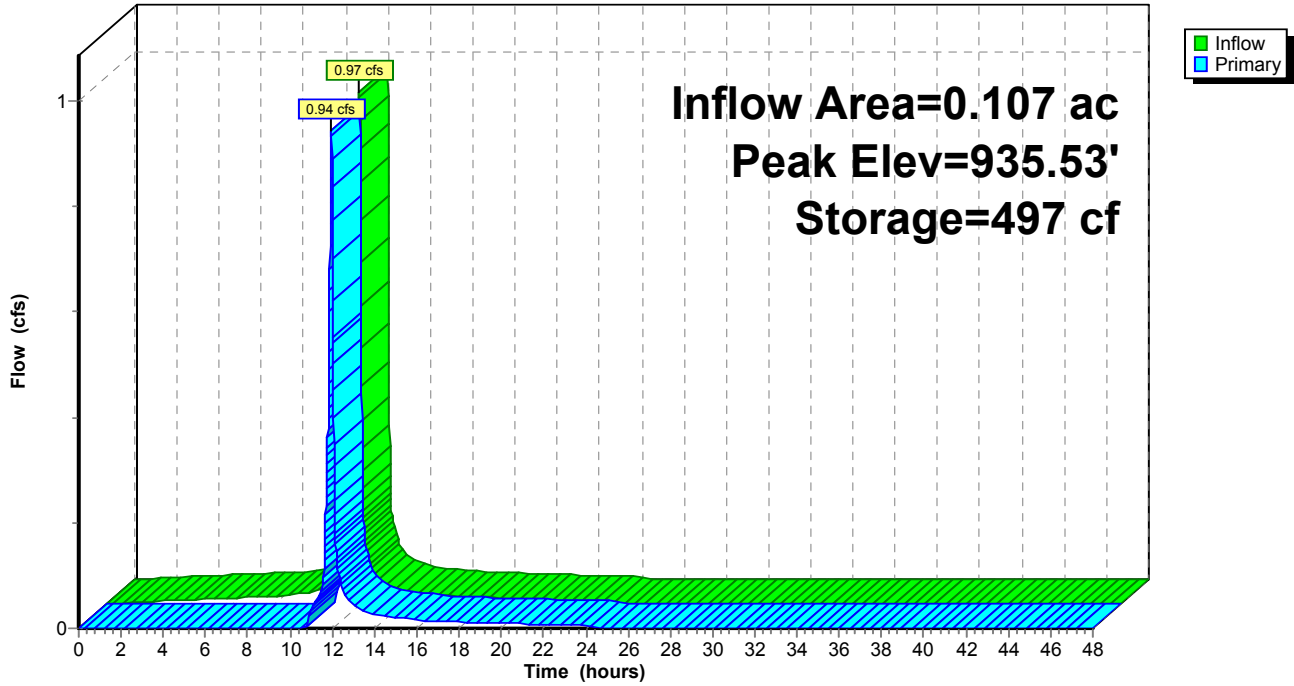
Device	Routing	Invert	Outlet Devices
#1	Primary	935.42'	10.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.94 cfs @ 11.96 hrs HW=935.53' (Free Discharge)

↑1=**Broad-Crested Rectangular Weir** (Weir Controls 0.94 cfs @ 0.82 fps)

Pond 6P: MLV PAD

Hydrograph



Summary for Subcatchment 7S: OFFSITE DA

Runoff = 5.64 cfs @ 12.04 hrs, Volume= 0.330 af, Depth= 3.10"

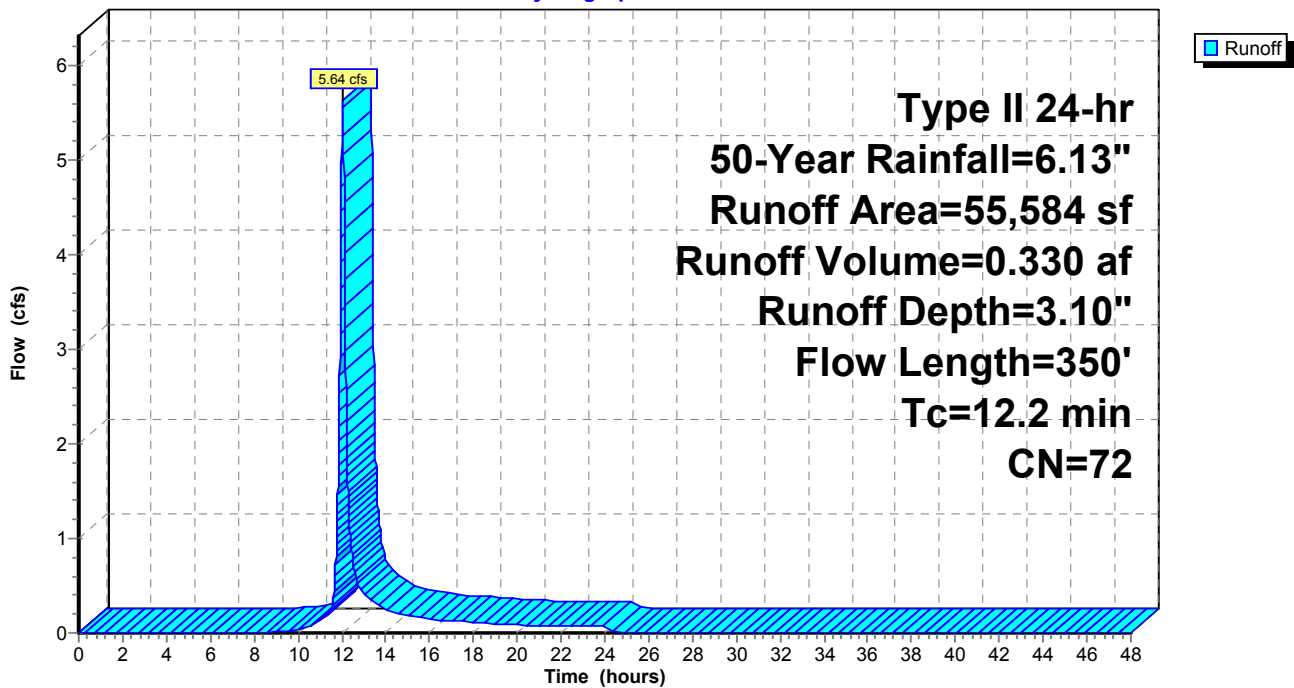
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 50-Year Rainfall=6.13"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 0	98	Crushed Stone Pad, HSG C
* 2,042	98	Paved roads, HSG C
* 52,862	71	Meadow Fair, HSG C
680	70	Woods, Good, HSG C
55,584	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0200	0.83		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
9.4	90	0.0520	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
2.6	250	0.0520	1.60		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
12.2	350	Total			

Subcatchment 7S: OFFSITE DA

Hydrograph



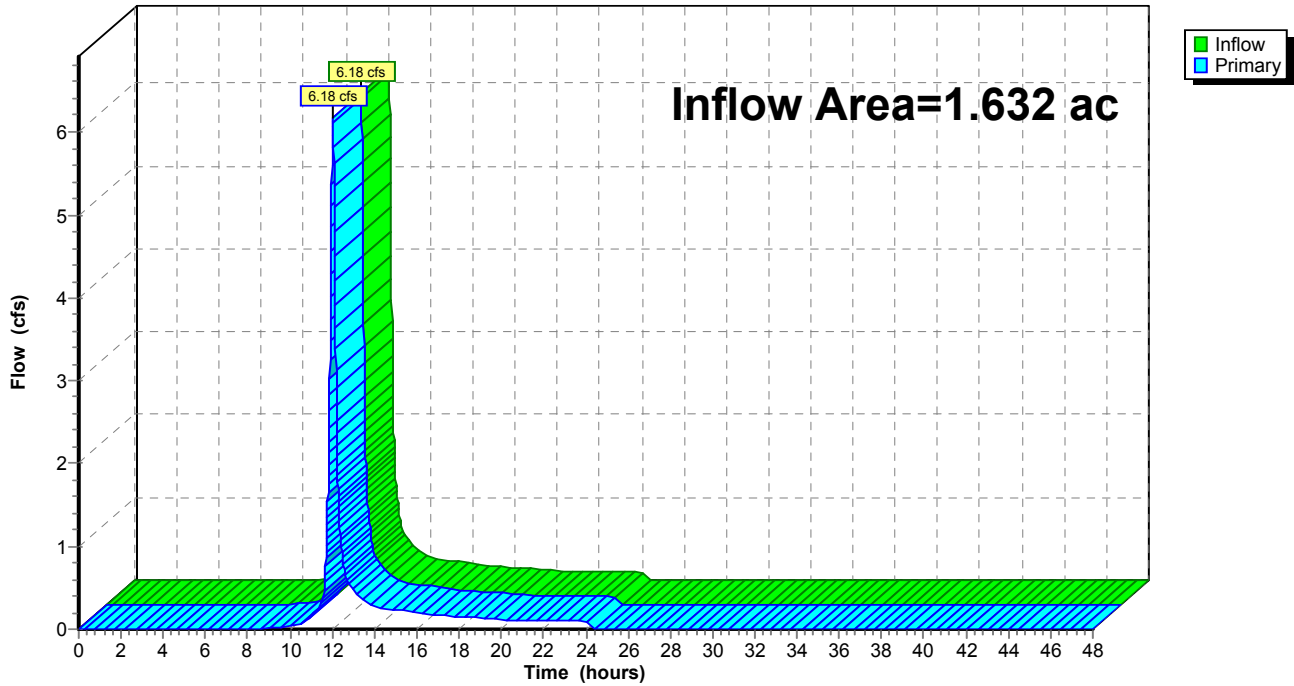
Summary for Link 8L: Proposed Conditions

Inflow Area = 1.632 ac, Inflow Depth = 2.86" for 50-Year event
Inflow = 6.18 cfs @ 12.04 hrs, Volume= 0.388 af
Primary = 6.18 cfs @ 12.04 hrs, Volume= 0.388 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 8L: Proposed Conditions

Hydrograph



Summary for Subcatchment 3S: DA TO VCI

Runoff = 2.05 cfs @ 11.96 hrs, Volume= 0.094 af, Depth= 4.55"

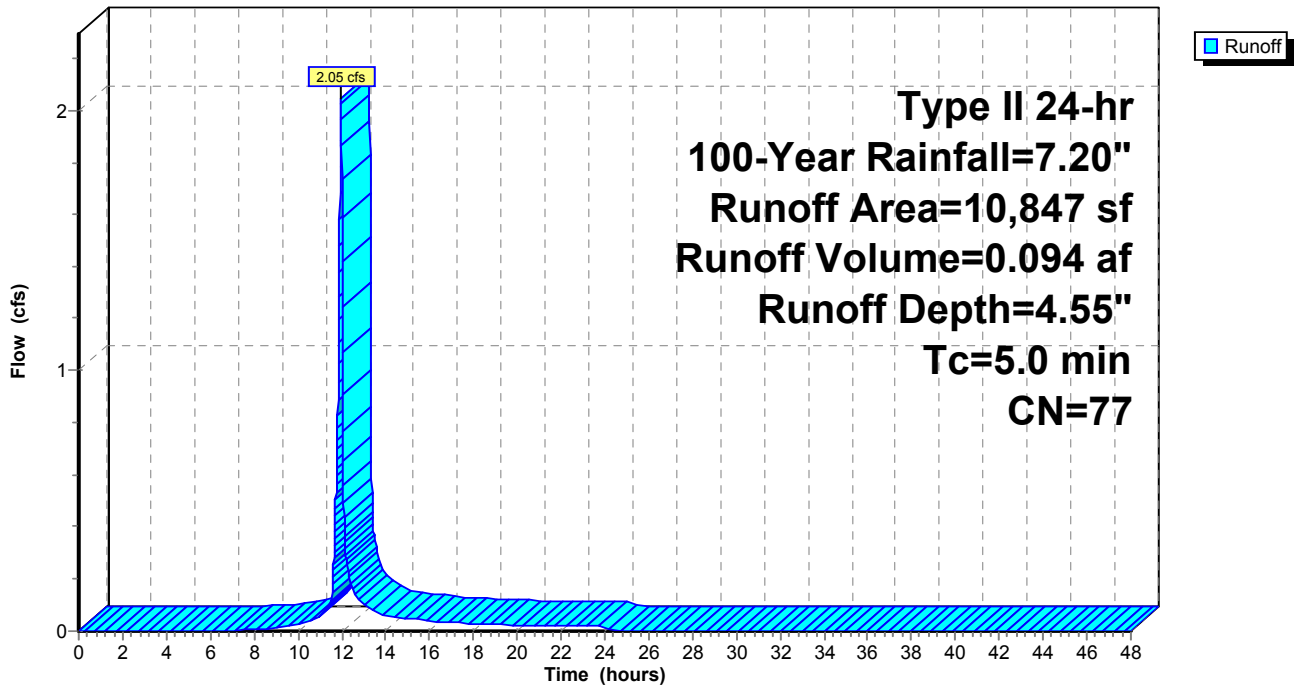
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Year Rainfall=7.20"

	Area (sf)	CN	Description
*	399	98	Paved road, HSG C
	3,202	89	Gravel roads, HSG C
*	7,246	71	Meadow Fair, HSG C
	10,847	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 3S: DA TO VCI

Hydrograph



Summary for Pond 4P: VCI

Inflow Area = 0.249 ac, Inflow Depth = 4.55" for 100-Year event
 Inflow = 2.05 cfs @ 11.96 hrs, Volume= 0.094 af
 Outflow = 0.18 cfs @ 12.46 hrs, Volume= 0.036 af, Atten= 91%, Lag= 30.0 min
 Primary = 0.18 cfs @ 12.46 hrs, Volume= 0.036 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 934.53' @ 12.46 hrs Surf.Area= 0 sf Storage= 2,526 cf

Plug-Flow detention time= 293.7 min calculated for 0.036 af (39% of inflow)
 Center-of-Mass det. time= 171.8 min (981.7 - 810.0)

Volume	Invert	Avail.Storage	Storage Description
#1	933.00'	2,527 cf	Custom Stage Data Listed below

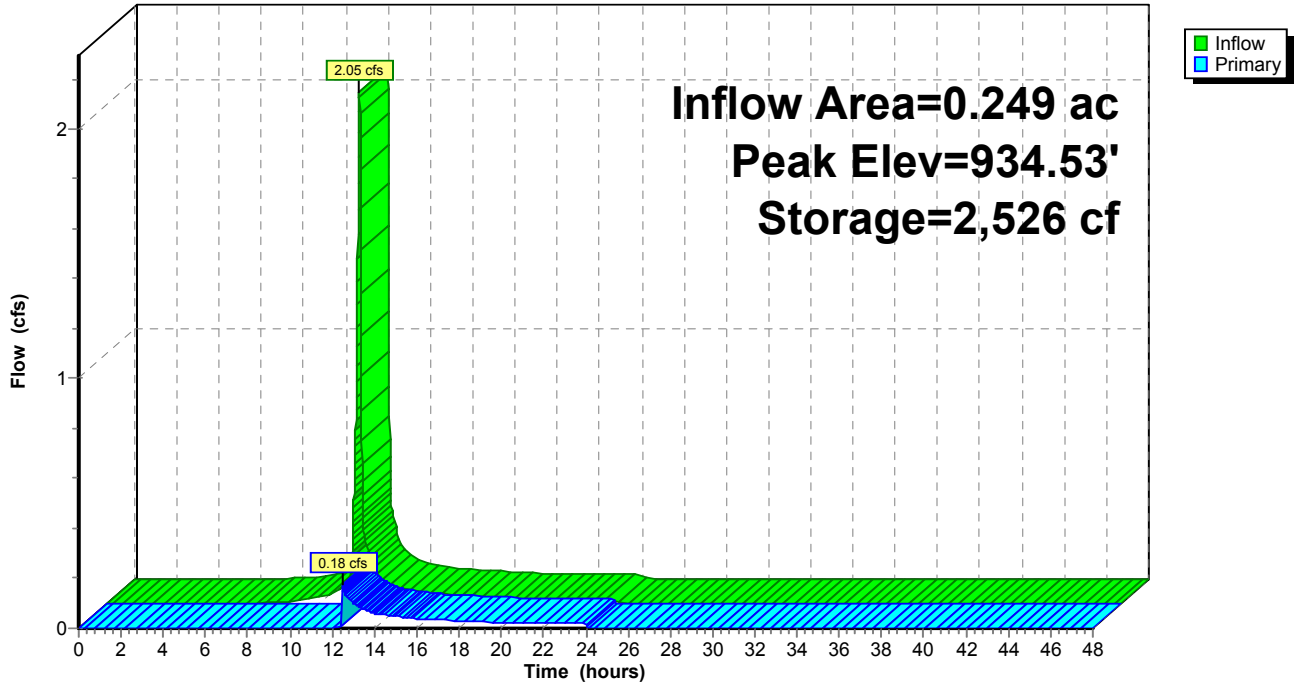
Elevation (feet)	Cum.Store (cubic-feet)
933.00	0
933.50	842
934.00	1,684
934.50	2,526
935.00	2,527

Device	Routing	Invert	Outlet Devices
#1	Primary	934.50'	14.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.17 cfs @ 12.46 hrs HW=934.53' (Free Discharge)
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 0.17 cfs @ 0.42 fps)

Pond 4P: VCI

Hydrograph



Summary for Subcatchment 5S: DA TO MLV PAD

Runoff = 1.14 cfs @ 11.96 hrs, Volume= 0.062 af, Depth= 6.96"

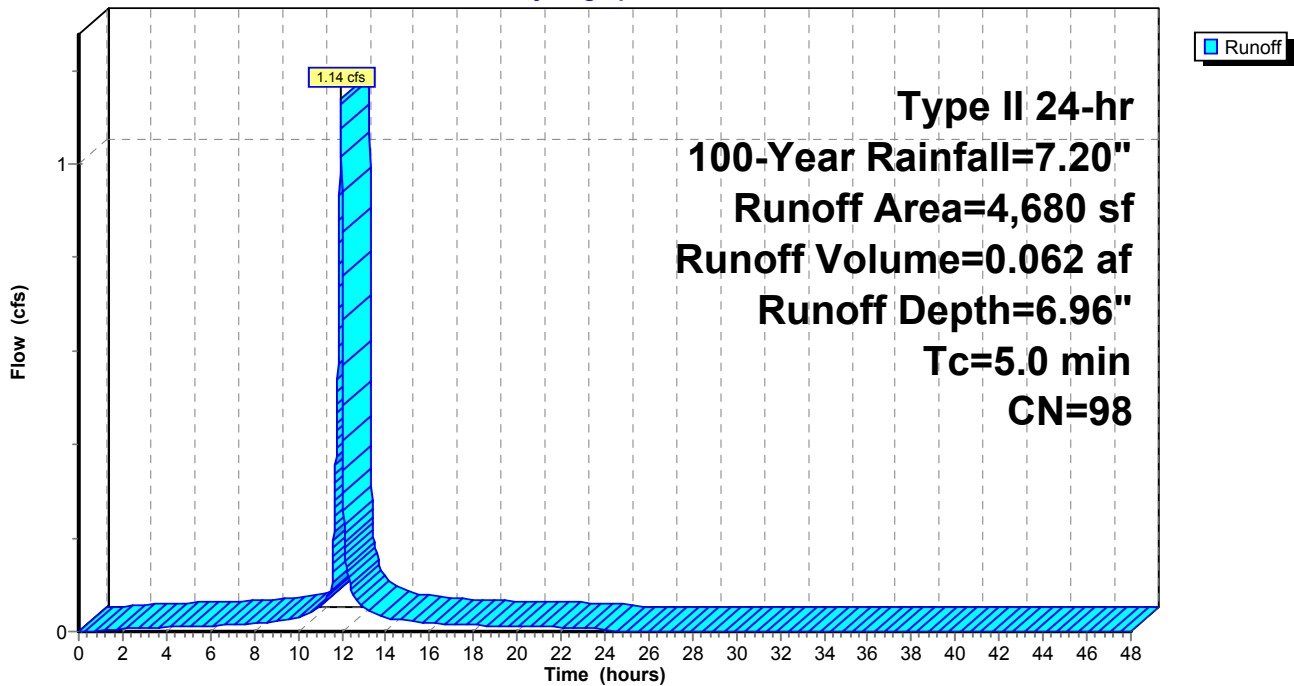
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 100-Year Rainfall=7.20"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 4,680	98	Crushed Stone Pad, HSG C
* 0	98	Paved roads , HSG C
* 0	71	Meadow Fair, HSG C
4,680	98	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, Min. Tc

Subcatchment 5S: DA TO MLV PAD

Hydrograph



Summary for Pond 6P: MLV PAD

Inflow Area = 0.107 ac, Inflow Depth = 6.96" for 100-Year event
 Inflow = 1.14 cfs @ 11.96 hrs, Volume= 0.062 af
 Outflow = 1.12 cfs @ 11.96 hrs, Volume= 0.052 af, Atten= 2%, Lag= 0.0 min
 Primary = 1.12 cfs @ 11.96 hrs, Volume= 0.052 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 935.55' @ 11.96 hrs Surf.Area= 1,745 sf Storage= 497 cf

Plug-Flow detention time= 139.7 min calculated for 0.052 af (83% of inflow)
 Center-of-Mass det. time= 65.2 min (802.7 - 737.4)

Volume	Invert	Avail.Storage	Storage Description
#1	933.42'	497 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 1,243 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
933.42	0	0	0
933.50	3	0	0
934.00	136	35	35
934.50	471	152	187
935.00	1,009	370	557
935.42	1,617	551	1,108
935.50	1,745	134	1,243

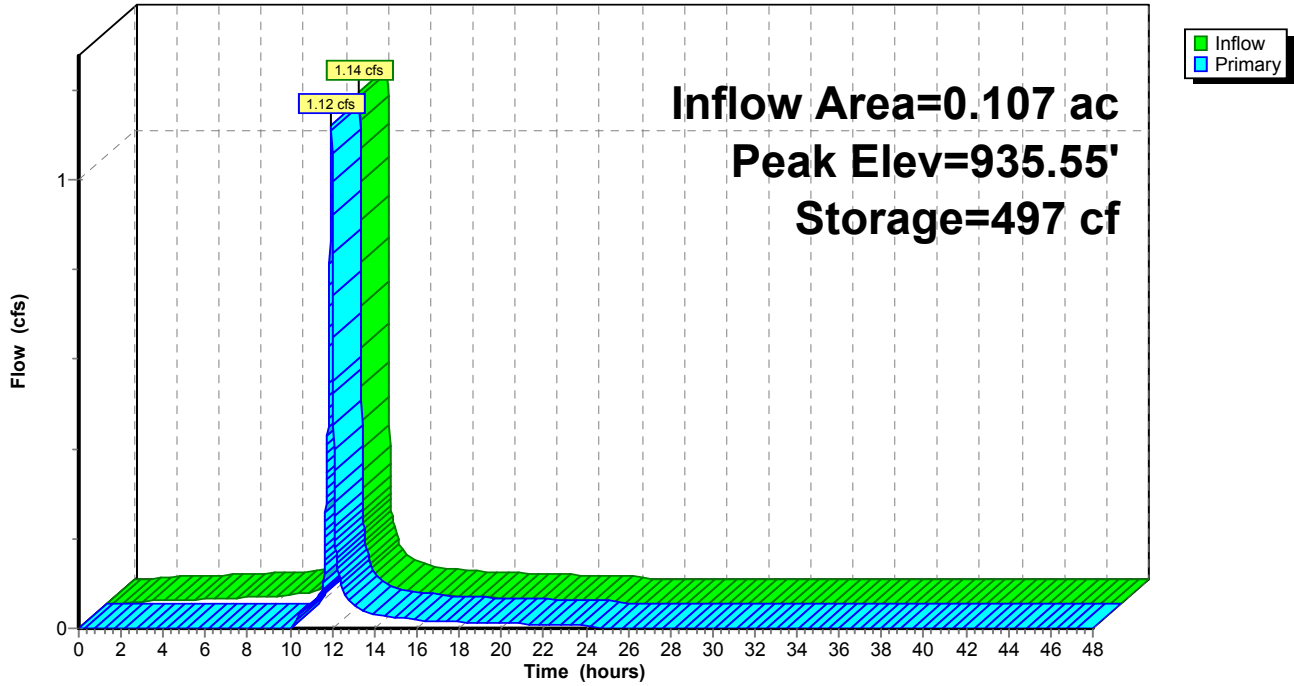
Device	Routing	Invert	Outlet Devices
#1	Primary	935.42'	10.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=1.12 cfs @ 11.96 hrs HW=935.55' (Free Discharge)

↑1=**Broad-Crested Rectangular Weir**(Weir Controls 1.12 cfs @ 0.87 fps)

Pond 6P: MLV PAD

Hydrograph



Summary for Subcatchment 7S: OFFSITE DA

Runoff = 7.26 cfs @ 12.04 hrs, Volume= 0.425 af, Depth= 4.00"

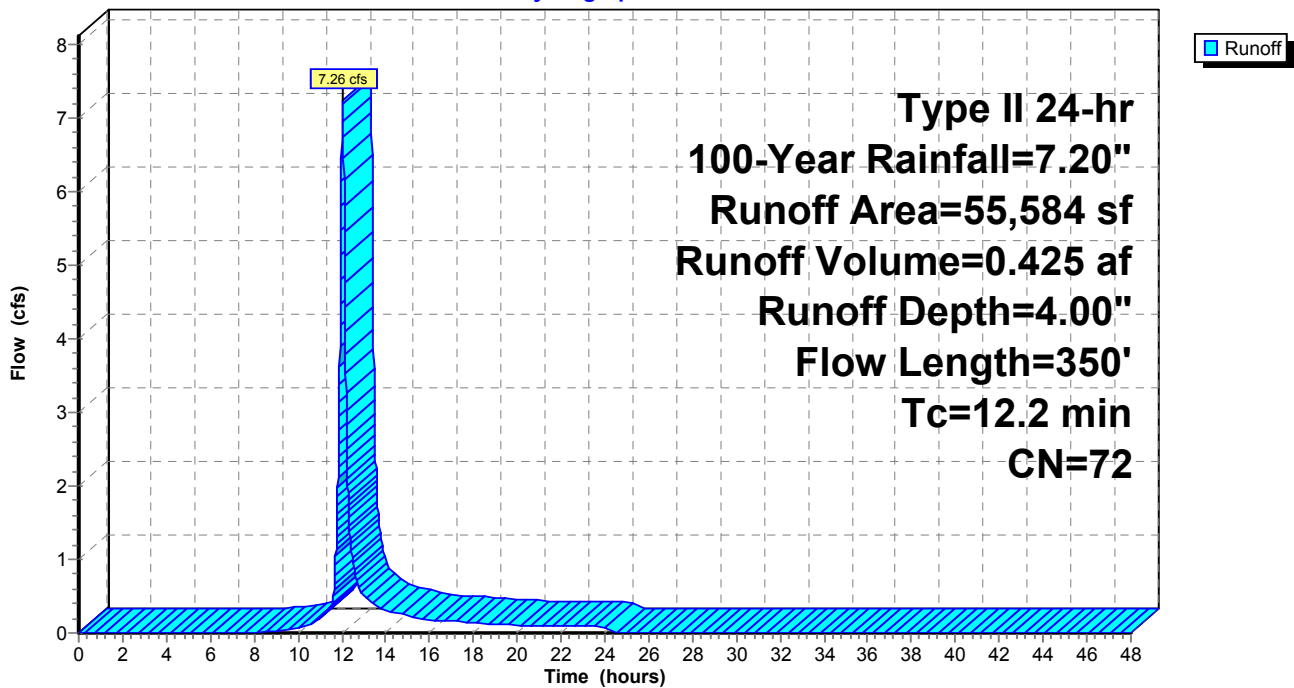
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
 Type II 24-hr 100-Year Rainfall=7.20"

Area (sf)	CN	Description
0	89	Gravel roads, HSG C
* 0	98	Crushed Stone Pad, HSG C
* 2,042	98	Paved roads, HSG C
* 52,862	71	Meadow Fair, HSG C
680	70	Woods, Good, HSG C
55,584	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	10	0.0200	0.83		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.93"
9.4	90	0.0520	0.16		Sheet Flow, Grass: Dense n= 0.240 P2= 2.93"
2.6	250	0.0520	1.60		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
12.2	350	Total			

Subcatchment 7S: OFFSITE DA

Hydrograph



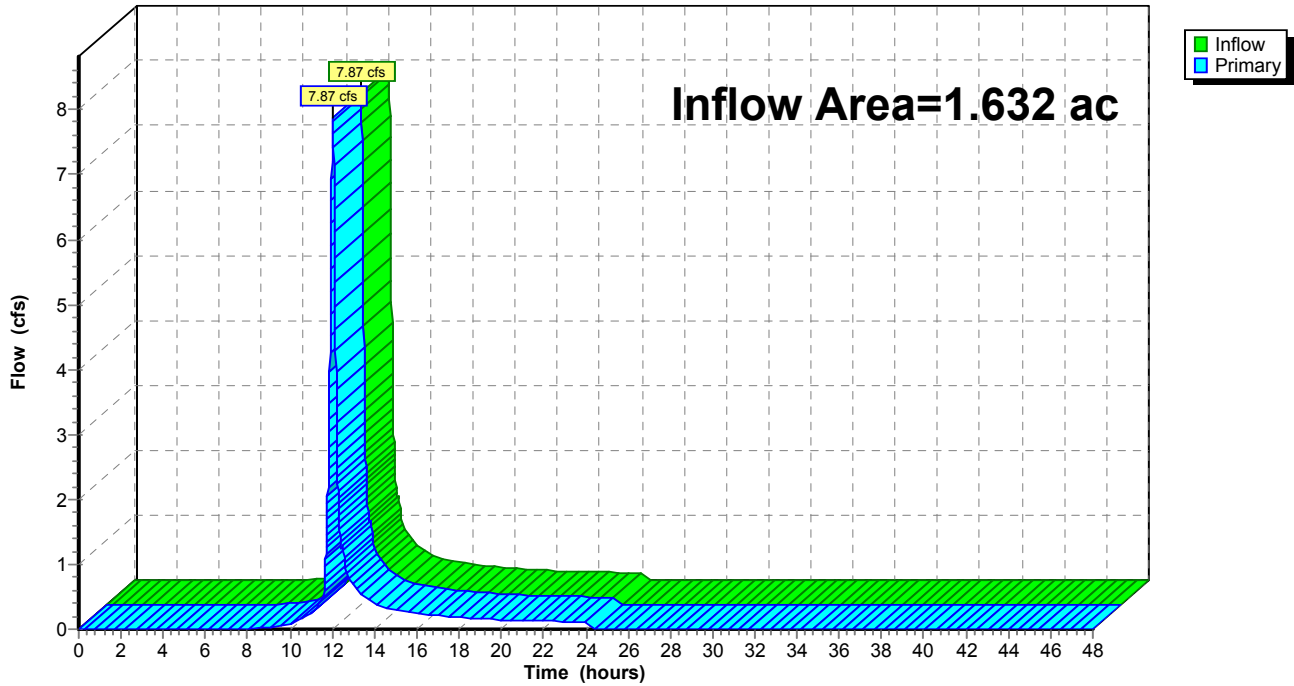
Summary for Link 8L: Proposed Conditions

Inflow Area = 1.632 ac, Inflow Depth = 3.78" for 100-Year event
Inflow = 7.87 cfs @ 12.03 hrs, Volume= 0.514 af
Primary = 7.87 cfs @ 12.03 hrs, Volume= 0.514 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 8L: Proposed Conditions

Hydrograph



N.5 Conveyance Calculations

- a. E&S Worksheet 11
- b. NAG Swale Lining Analysis
- c. Figure 9.3-Riprap Apron Design

E&S WORKSHEET # 11
Channel Design Data

PROJECT NAME: Atlantic Sunrise _____
 LOCATION: AR-CO-085.1.3 Vegetated Channel for Infiltration (VCI) _____
 PREPARED BY: JMS **REVISED BY: JMS** DATE: 9/28/15 **REV 10/18/16**
 CHECKED BY: BJP **CHECKED BY: SK** DATE: 9/28/15 **REV 10/18/16**

CHANNEL OR CHANNEL SECTION	AR-CO-085.1.3 VCI	AR-CO-085.1.3 VCI
TEMPORARY OR PERMANENT? (T OR P)	P	P
DESIGN STORM (2, 5, OR 10 YR)	10	10
ACRES (AC)	0.25	0.25
MULTIPLIER ¹ (1.6, 2.25, or 2.75) ¹	-	-
Q _r (REQUIRED CAPACITY) (CFS)	0.93	0.93
Q (CALCULATED AT FLOW DEPTH d) (CFS)	0.96	0.94
PROTECTIVE LINING ²	SC250	SC250 REINFORCED VEGETATION
n (MANNING'S COEFFICIENT) ²	0.04	0.249
V _a (ALLOWABLE VELOCITY) (FPS)	N/A	N/A
V (CALCULATED AT FLOW DEPTH d) (FPS)	1.80	0.55
τ _a (MAX ALLOWABLE SHEAR STRESS) (LB/FT ²)	2.50	8.00
τ _d (CALC'D SHEAR STRESS AT FLOW DEPTH d) (LB/FT ²)	0.34	1.00
CHANNEL BOTTOM WIDTH (FT)	5	5
CHANNEL SIDE SLOPES (H:V)	3	3
D (TOTAL DEPTH) (FT)	2.0	2.0
CHANNEL TOP WIDTH @ D (FT)	17	17
d (CALCULATED FLOW DEPTH) (FT)	0.10	0.29
CHANNEL TOP WIDTH @ FLOW DEPTH d (FT)	5.60	6.74
BOTTOM WIDTH: FLOW DEPTH RATIO (12:1 MAX)	50.00	17.24
d50 STONE SIZE (IN)	N/A	N/A
A (CROSS-SECTIONAL AREA) (SQ. FT.)	0.53	1.70
R (HYDRAULIC RADIUS)	0.09	0.25
S (BED SLOPE) ³ (FT/FT)	0.055	0.055
S _c (CRITICAL SLOPE) (FT/FT)	0.052	1.455
.7S _c (FT/FT)	0.036	1.018
1.3S _c (FT/FT)	0.067	1.891
STABLE FLOW? (Y/N)	N	Y
FREEBOARD BASED ON UNSTABLE FLOW (FT)	0.01	0.0
FREEBOARD BASED ON STABLE FLOW (FT)	0.50	0.5
MINIMUM REQUIRED FREEBOARD ⁴ (FT)	0.50	0.5
DESIGN METHOD FOR PROTECTIVE LINING ⁵ PERMISSIBLE VELOCITY (V) OR SHEAR STRESS (S)	S	S

EQUIVALENT PIPE CALCULATION:

Q n s (ft/ft) D (ft.) D (in) Round up to:
 0.96 0.013 0.055 0.443 5.316 **12" pipe**

$$D = ((Q*n)/(S^{1/2}*Pi*0.1478))^{3/8}$$

Pipe Equivalence Calculation for Sizing Rip Rap Apron:
 Use Manning's Equation
 $Q = (1.49/n)*A*(R^{2/3})*S^{1/2}$

Q = Flow Rate from Worksheet 11 (cfs)
 n = Manning's Constant for Smooth Plastic Pipe = 0.013 (unitless)
 A = Area of Pipe (ft) = 0.25 * Pi * D²
 D = Diameter of Pipe (ft)
 R = Hydraulic Radius = A / P = (0.25 * Pi * D²) / (Pi * D) = 0.25 * D
 P = Perimeter of Pipe (ft) = Pi * D
 S = Slope of channel from Worksheet 11 (ft/ft)

Solve Manning's Equation for Diameter of Pipe:
 $Q = (1.49/n)*A*(R^{2/3})*S^{1/2}$
 $Q = (1.49/n)*(0.25*Pi*D^2)*((0.25*D)^{2/3})*S^{1/2}$
 $Q*n*/(1.49*S^{1/2}) = (0.25*Pi*D^2)*((0.25*D)^{2/3})$
 $Q*n*/(1.49*S^{1/2})*0.25*(0.25^{2/3}) = (Pi*D^2)*(D^{2/3})$
 $Q*n*/(S^{1/2}*Pi*0.1478) = [D^2]^{3/8}$
 $Q*n*/(S^{1/2}*Pi*0.1478) = [D^2]^{3/8}$
 $(Q*n*/(S^{1/2}*Pi*0.1478))^{3/8} = D$

Multiply by 12 to convert feet to inches:
 $D = ((Q*n)/(S^{1/2}*Pi*0.1478))^{3/8} * 12$

- Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.
- Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
- Slopes may not be averaged.
- Minimum Freeboard is 0.5 ft. or 1/4 Total Channel Depth, whichever is greater
- Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.



Tensar International Corporation
 5401 St. Wendel-Cynthiana Road
 Poseyville, Indiana 47633
 Tel. 800.772.2040
 Fax 812.867.0247
 www.nagreen.com

**Erosion Control Materials Design Software
 Version 5.0**

**Project Name: ASR Access Roads
 Project Number: 63544
 Channel Name: PAR-CO-085.1.3-VCI**

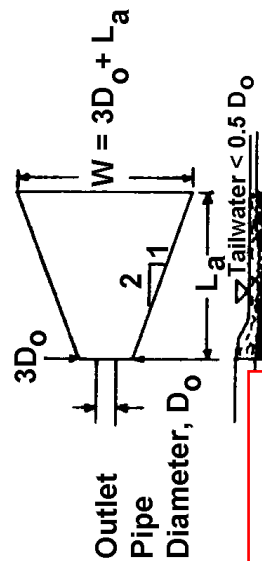
Discharge	0.93
Peak Flow Period	24
Channel Slope	0.055
Channel Bottom Width	5
Left Side Slope	3
Right Side Slope	3
Low Flow Liner	
Retardance Class	C
Vegetation Type	Mix (Sod & Bunch)
Vegetation Density	Good 75-95%
Soil Type	Silt Loam

SC250 - Class C - Mix (Sod & Bunch) - Good 75-95%

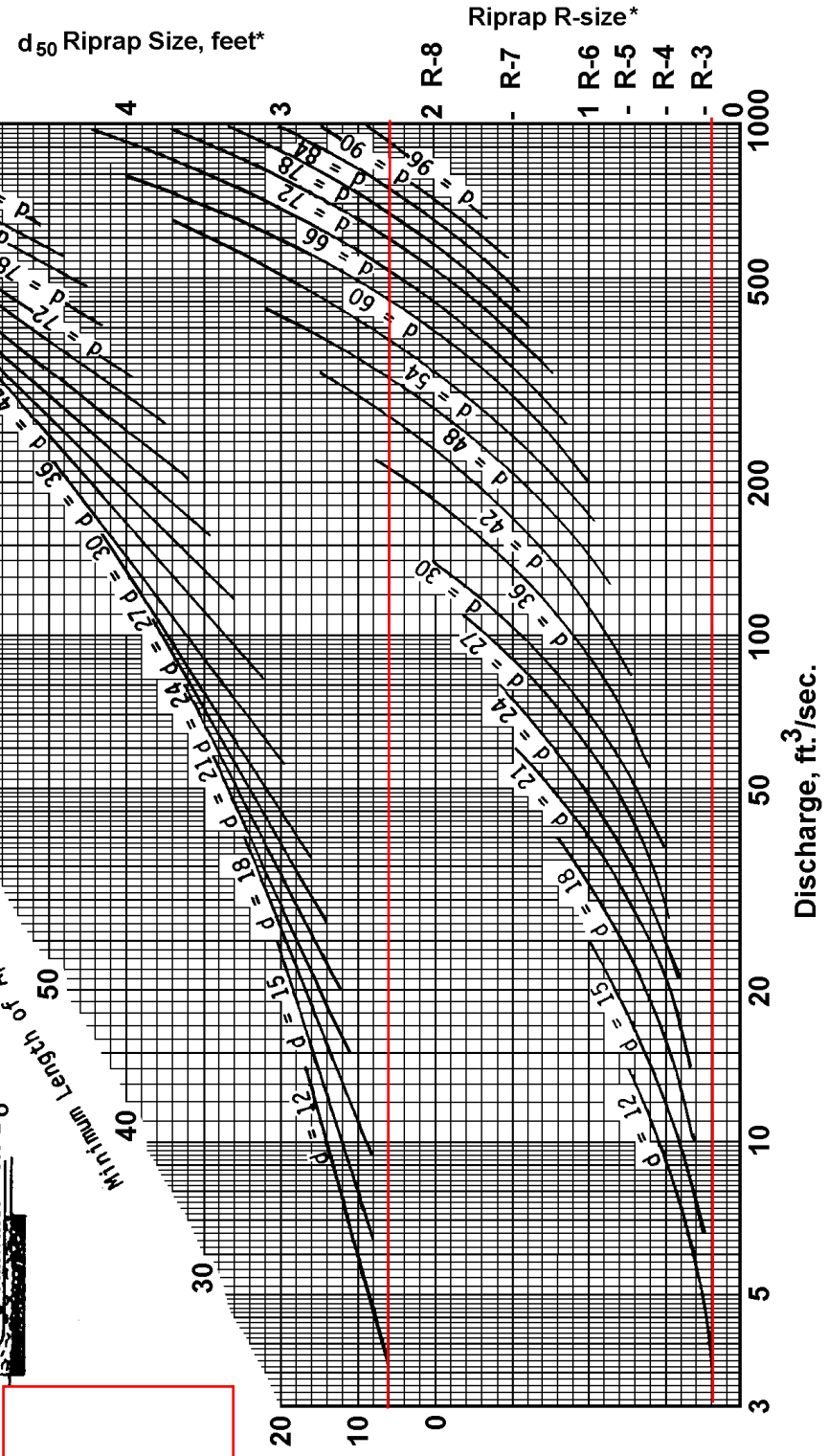
Phase	Reach	Discharge	Velocity	Normal Depth	Mannings N	Permissible Shear Stress	Calculated Shear Stress	Safety Factor	Remarks	Staple Pattern
SC250 Unvegetated	Straight	0.93 cfs	1.79 ft/s	0.1 ft	0.04	2.5 lbs/ft ²	0.34 lbs/ft ²	7.4	STABLE	E
SC250 Reinforced Vegetation	Straight	0.93 cfs	0.55 ft/s	0.29 ft	0.249	8 lbs/ft ²	0.99 lbs/ft ²	8.1	STABLE	E
Underlying Substrate	Straight	0.93 cfs	0.55 ft/s	0.29 ft	--	0.8 lbs/ft ²	0.006 lbs/ft ²	125.66	STABLE	--

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)



Adapted from USDA - NRCS



$D_o=1'$ **
 $3D_o=3'$ **
 $L_a=6'$ **
 $W=9'$ **
 $R_t=9'$ **
Riprap R-Size=R-3**

NOTE

- Check Velocity
- Riprap R-Size: R-3
- Maximum Velocity from Table 6.6 of E&S Manual: 6.5 ft/s
- Velocity of Runoff in Channel (larger velocity value from either Worksheet #11 or HydroCAD): 1.80 ft/s
- Velocity of Runoff in Channel less than Maximum? Yes

* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.
 **DIMENSIONS BASED ON MINIMUM SIZING CRITERIA FROM CHART FOR 12" EQUIVALENT PIPE DISCHARGE.

N.6 PCSM BMP Calculations

- a. Check Dam Volume Calculations

ATLANTIC SUNRISE NATURAL GAS PIPELINE PROJECT
(ACCESS ROAD) VEGETATED CHANNEL CHECKDAM VOLUME
ATLANTIC SUNRISE NATURAL GAS PIPELINE PROJECT
PAR CO-085.1.3-Vegetated Channel for Infiltration
(ACCESS ROAD) CHECKDAM VOLUME

AR-SC-063 - VEGETATED CHANNEL FOR INFILTRATION

10/18/2016

TOTAL REACH VOLUME = 2526 CF Width (W_b): 5 FT. Depth (H): 1.5 FT.

VEGETATED CHANNEL PAR-CO-085.1.3

ROAD STA 0+40 to 1+39

Input data

S = 0.030 ft/ft
H = 1.5 ft
WB = 5
z1 = 3
z2 = 3

Output data

$L_{storage}$ = 50 ft
WT = 14 ft
WT + WB = 19 ft
V = 356 cf
 $L_{spacing}$ = 56 ft
No. of Check Dams = 3
Subreach Volume = 1069 CF

VEGETATED CHANNEL PAR-CO-085.1.3

ROAD STA 1+39 to 2+73

Input data

S = 0.010 ft/ft
H = 1.5 ft
WB = 5
z1 = 3
z2 = 3

Output data

$L_{storage}$ = 150 ft
WT = 14 ft
WT + WB = 19 ft
V = 1069 cf
 $L_{spacing}$ = 156 ft
No. of Check Dams = 1
Subreach Volume = 1069 CF

VEGETATED CHANNEL PAR-CO-085.1.3

ROAD STA 2+73 to 3+40

Input data

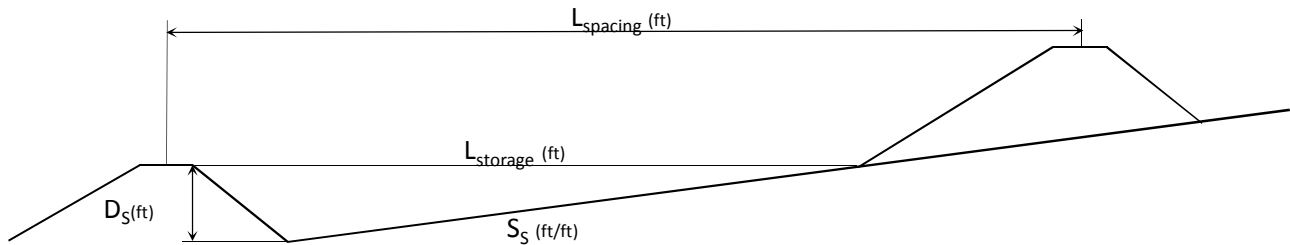
S = 0.055 ft/ft
H = 1.5 ft
WB = 5
z1 = 3
z2 = 3

Output data

$L_{storage}$ = 27 ft
WT = 14 ft
WT + WB = 19 ft
V = 194 cf
 $L_{spacing}$ = 33 ft
No. of Check Dams = 2
Subreach Volume = 389 CF

EARTHEN CHECK DAM INFILTRATION VOLUME AND SPACING

Per the Pennsylvania Stormwater BMP Manual (pg 94), the minimum spacing ($L_{spacing}$) of check dams is determined by the length of the storage volume ($L_{storage}$) and the length to the check dam center line. The length of the storage volume is calculated by dividing the height of the rock filter (D_S) by the slope of the channel (S_S):



$$L_{storage} = D_S / S_S$$

Where: $L_{storage}$ = Storage Length

S_S = Channel slope

D_S = Height of the check dam

$$L_{spacing} = L_{storage} + [(D_S + 1) / (-S_S + 0.5)]$$

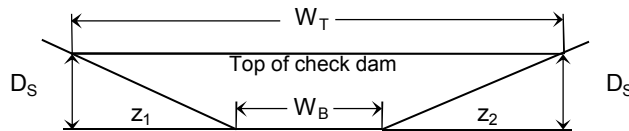
Where: $L_{spacing}$ = Check Dam Spacing

$L_{storage}$ = Storage Length

S_S = Channel slope

D_S = Height of the check dam

The volume of runoff that will be stored upstream of a check dam is dependent on the height of the check dam, the slope of the upstream channel and the dimensions of the upstream channel. The storage volume (V_S) can be calculated with:



$$V_S = 0.25 \times L_{storage} \times D_S \times (W_T + W_B)$$

Where:

$L_{storage}$ = Storage Length

D_S = Height of check dam

W_T = check dam top width

W_B = check dam bottom width

The check dam top width (W_T) is given by:

$$W_T = W_B + z_1 + z_2$$

Where: W_B = check dam bottom width

z_1 = side slope

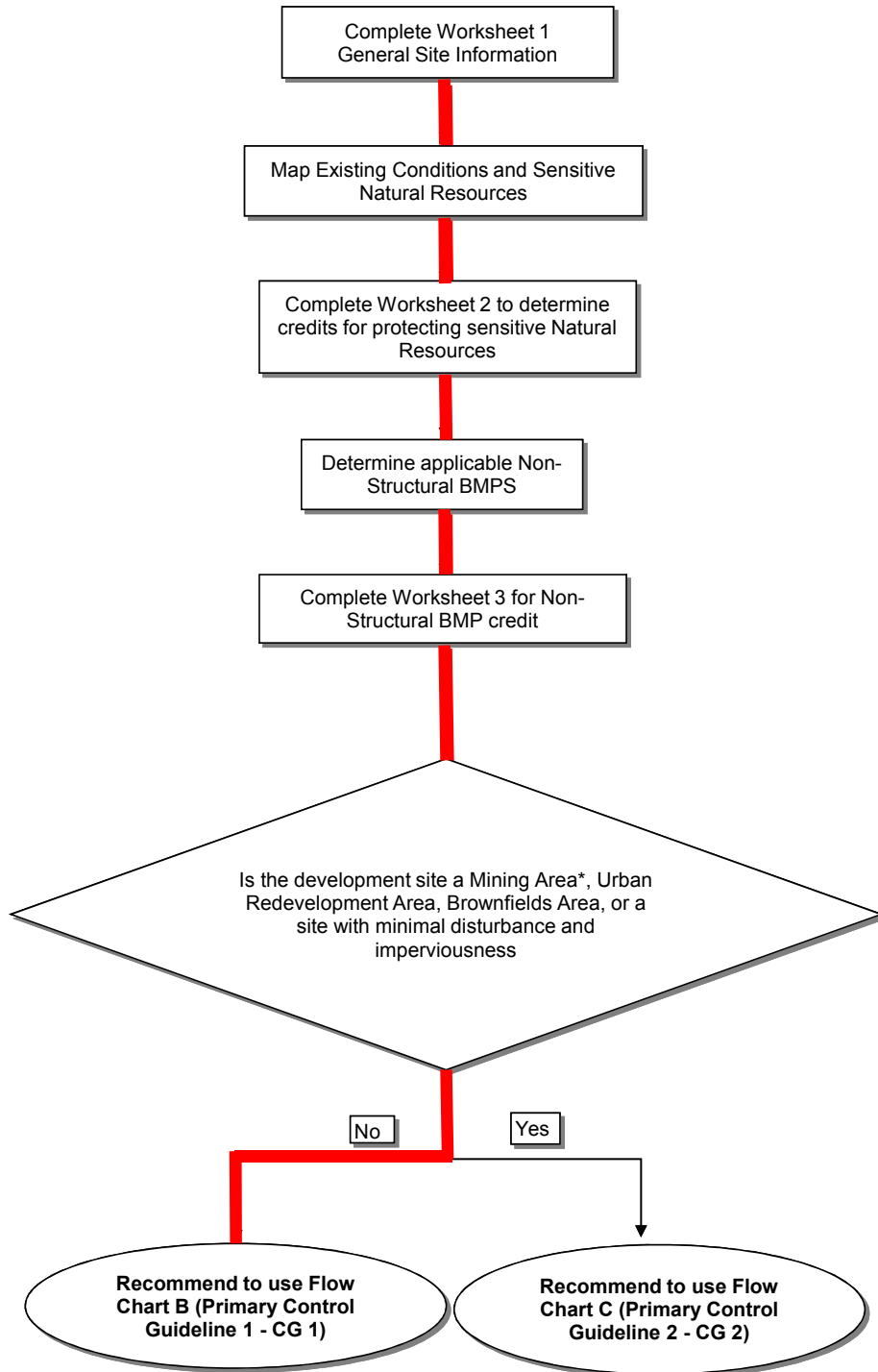
z_2 = side slope

N.7 Water Quality Worksheets

- a. Flow Chart A – Stormwater Calculation Process
- b. Worksheet 1. General Site Information
- c. Worksheet 2. Sensitive Natural Resources
- d. Worksheet 3. Nonstructural BMP Credits
- e. Flow Chart B – Control Guideline 1 Process
- f. Worksheet 4. Change in Runoff Volume for 2-Yr Storm Event
- g. Worksheet 5. Structural BMP Volume Credits
- h. Worksheet 10. Water Quality Compliance for Nitrate
- i. Worksheet 11. BMPs for Pollution Prevention*
- j. Worksheet 12. Water Quality Analysis of Pollutant Loading
from All Disturbed Areas*
- k. Worksheet 13. Pollutant Reduction Through BMP Applications*

FLOW CHART A

Stormwater Calculation Process



Worksheet 1. General Site Information

INSTRUCTIONS: Fill out Worksheet 1 for each watershed

Date: 28-Feb-16

Project Name: Atlantic Sunrise Pipeline AR-CO-085.1.3

Municipality: Ralpho Township

County: Northumberland

Total Area (acres): 0.54

Major River Basin: Susquehanna River

<http://www.dep.state.pa.us/dep/depupdate/watermgt/wc/default.htm#newtopics>

Watershed: Mahanoy - Shamokin Creeks

Sub-Basin: Lower Central Susquehanna

Nearest Surface Water(s) to Receive Runoff: UNT to Miller Run

Chapter 93 - Designated Water Use: CWF, MF

<http://www.pacode.com/secure/data/025/chapter93/chap93toc.html>

Impaired according to Chapter 303(d) List? Yes

<http://www.dep.state.pa.us/dep/deputate/watermgt/wqp/wqstandards/303d-Report.htm> No

List Causes of Impairment: _____

Is project subject to, or part of:

Municipal Separate Storm Sewer System (MS4) Requirements? Yes

No

<http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/GeneralPermits/default.htm>

Existing or planned drinking water supply? Yes

No

If yes, distance from proposed discharge (miles): _____

Approved Act 167 Plan? Yes

No

http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/Approved_1.html

Existing River Conservation Plan? Yes

No

<http://www.dcnr.state.pa.us/brc/rivers/riversconservation/planningprojects/>

Worksheet 2. Sensitive Natural Resources

INSTRUCTIONS:

1. Provide Sensitive Resources Map according to non-structural BMP 5.4.1 in Chapter 5. This map should identify wetlands, woodlands, natural drainage ways, steep slopes, and other sensitive natural areas.

2. Summarize the existing extent of each sensitive resource in the Existing Sensitive Resources Table (below, using Acres). If none present, insert 0.

3. Summarize Total Protected Area as defined under BMPs in Chapter 5.

4. Do not count any area twice. For example, an area that is both a floodplain and a wetland may only be considered once.

EXISTING NATURAL SENSITIVE RESOURCE	MAPPED? yes/no/n/a	TOTAL AREA (Ac.)	PROTECTED AREA (Ac.)
Waterbodies	N/A	0.00	0.00
Floodplains	N/A	0.00	0.00
Riparian Areas	N/A	0.00	0.00
Wetlands	N/A	0.00	0.00
Woodlands	N/A	0.00	0.00
Natural Drainage Ways	N/A	0.00	0.00
Steep Slopes, 15% - 25%	N/A	0.00	0.00
Steep Slopes, over 25%	N/A	0.00	0.00
Other:	N/A	0.00	0.00
Other:	N/A	0.00	0.00
TOTAL EXISTING:		0.00	0.00

Worksheet 3. Nonstructural BMP Credits

PROTECTED AREA

1.1 Area of Protected Sensitive/Special Value Features (see WS 2)	<u> - </u> Ac.
1.2 Area of Riparian Forest Buffer Protection	<u> - </u> Ac.
3.1 Area of Minimum Disturbance/Reduced Grading	<u> 0.00 </u> Ac.
TOTAL	<u> 0.00 </u> Ac.

Site Area	minus	Protected Area	=	Stormwater Management Area
<u> 0.54 </u>	-	<u> 0.00 </u>	=	<u> 0.54 </u>
		<i>This is the area that requires stormwater management</i>		

VOLUME CREDITS

3.1 Minimum Soil Compaction

Lawn	<u> </u> ft ²	x 1/4" x 1/12	=	<u> </u> - ft ³
Meadow	<u> </u> ft ²	x 1/3" x 1/12	=	<u> </u> - ft ³

3.3 Protect Existing Trees

For Trees within 100 feet of impervious area:

Tree Canopy	<u> </u> ft ²	x 1/2" x 1/12	=	<u> </u> - ft ³
-------------	-----------------------------------	---------------	---	-------------------------------------

For Trees within 20 feet of impervious area:

Tree Canopy	<u> </u>	x 1/12	=	<u> </u> - ft ³
-------------	-------------------	--------	---	-------------------------------------

5.1 Disconnect Roof Leaders to Vegetated Areas

For Runoff directed to areas protected under 5.8.1 and 5.8.2

Roof Area	<u> </u> ft ²	x 1/12	=	<u> </u> - ft ³
-----------	-----------------------------------	--------	---	-------------------------------------

For all other disconnected roof areas

Roof Area	<u> </u> ft ²	x 1/4" x 1/12	=	<u> </u> - ft ³
-----------	-----------------------------------	---------------	---	-------------------------------------

5.2 Disconnect Non-Roof impervious to Vegetated Areas

For Runoff directed to areas protected under 5.8.1 and 5.8.2

Impervious Area	<u> </u> ft ²	x 1/3" x 1/12	=	<u> </u> - ft ³
-----------------	-----------------------------------	---------------	---	-------------------------------------

For all other disconnected roof areas

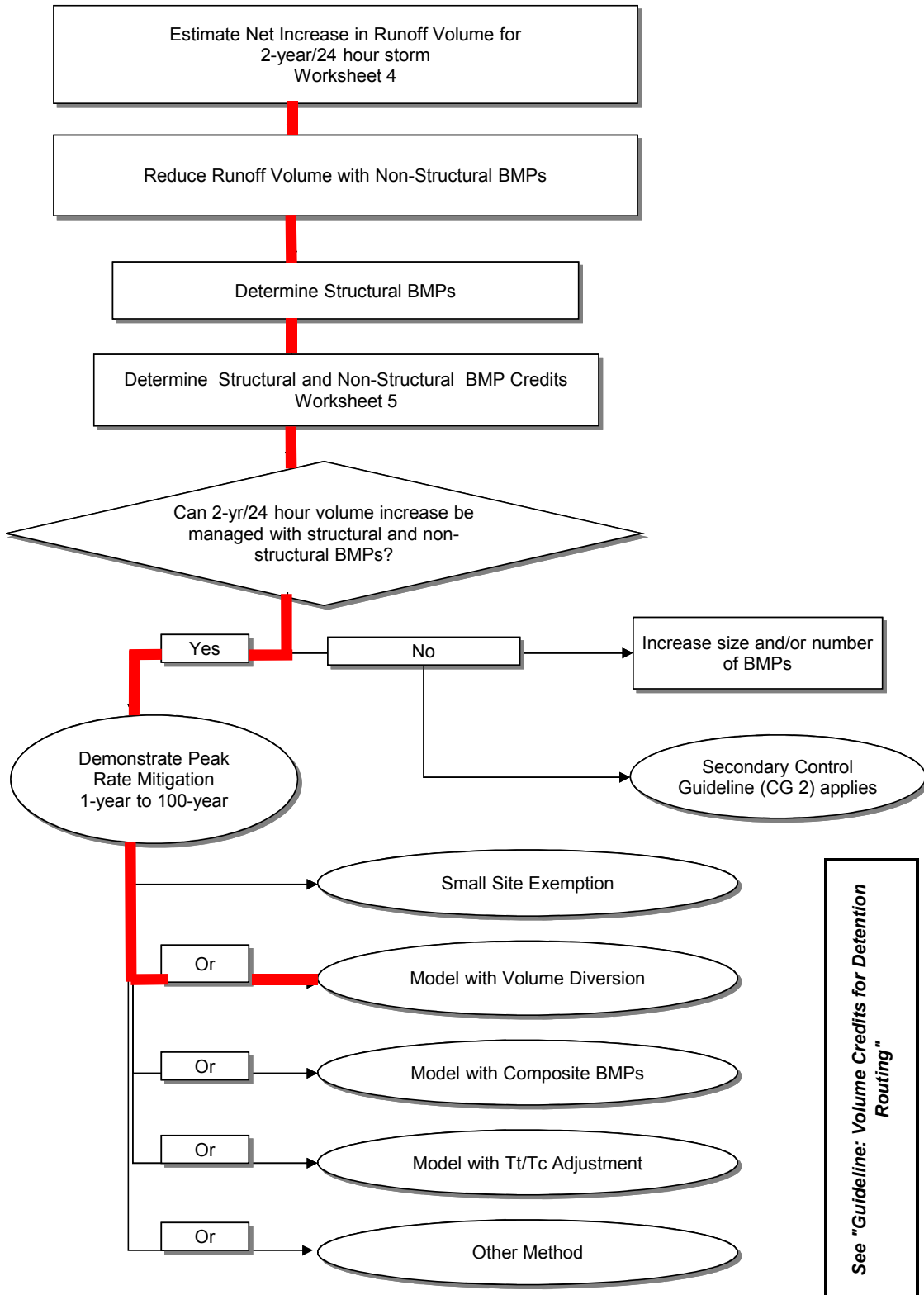
Impervious Area	<u> </u> ft ²	x 1/4" x 1/12	=	<u> </u> - ft ³
-----------------	-----------------------------------	---------------	---	-------------------------------------

TOTAL NON-STRUCTURAL VOLUME CREDIT* - ft³

** For use on Worksheet 5*

FLOW CHART B

Control Guideline 1 Process



WORKSHEET 4 . CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT

PROJECT: Atlantic Sunrise Pipeline AR-CO-085.1.3
DA: 1.42 acres
2-Year Rainfall: 2.93 in

Total Site Area: 0.54 acres
Protected Site Area: 0.00 acres
Managed Area: 0.54 acres

NOTE: The total area for Worksheet 4 is equal to the Total Site Area (Limit of Grading) show on the drainage area maps.

Existing Conditions:

Cover Type/ Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff ¹ (in)	Runoff Volume ² (ft ³)
Impervious	C	-	-	98	0.20	0.04	2.70	-
Meadow	C	23,522	0.54	71	4.08	0.82	0.72	1,412
Woods	C	-	-	70	4.29	0.86	0.68	-
Gravel	C	-	-	89	1.24	0.25	1.84	-
TOTAL:		23,522	0.54					1,412

Developed Conditions:

Cover Type/ Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff ¹ (in)	Runoff Volume ² (ft ³)
Impervious	C	-	-	98	0.20	0.04	2.70	-
Meadow	C	15,640	0.36	71	4.08	0.82	0.72	939
Woods	C	-	-	70	4.29	0.86	0.68	-
Gravel	C	7,882	0.18	89	1.24	0.25	1.84	1,206
TOTAL:		23,522	0.54					2,145

2-Year Volume Increase (ft³)	733
--	------------

2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume

1. Runoff (in) = $Q = (P - 0.2S)^2 / (P + 0.8S)$ where

P = 2-Year Rainfall (in)

S = $(1000 / CN) - 10$

2. Runoff Volume (CF) = Q x Area x 1/12

Q = Runoff (in)

Area = Land use area (sq. ft.)

Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI. The use of a weighted CN value for volume calculations is not acceptable.

WORKSHEET 5. STRUCTURAL BMP VOLUME CREDITS

PROJECT: Atlantic Sunrise Pipeline AR-CO-085.1.3
SUB-BASIN: Upper Central Susquehanna River

Required Control Volume (ft³) - from Worksheet 4: 733
Non-structural Volume Credit (ft³) - from Worksheet 3: - 0

Structural Volume Reqmt (ft³) 733
(Required Control Volume minus Non-structural Credit)

Proposed BMP	Area (ft ²)	Volume Reduction Permanently Removed (ft ³)
6.4.1 Porous Pavement		
6.4.2 Infiltration Basin		
6.4.3 Infiltration Bed		
6.4.4 Infiltration Trench		
6.4.5 Rain Garden/Bioretenion		
6.4.6 Dry Well / Seepage Pit		
6.4.7 Constructed Filter		
6.4.8 Vegetated Swale		
6.4.9 Vegetated Filter Strip		
6.4.10 Berm		
6.5.1 Vegetated Roof		
6.5.2 Capture and Re-use		
6.6.1 Constructed Wetlands		
6.6.2 Wet Pond / Retention Basin		
6.7.1 Riparian Buffer/Riparian Buffer Restoration		
6.7.2 Landscape Restoration / Reforestation		
6.7.3 Soil Amendment		
6.8.1 Level Spreader		
6.8.2 Special Storage Areas		
<i>Other</i> Check Dams in Vegetated Swales		925
Storage in 24" stone MLV pad		488

Total Structural Volume (ft³): 1,413
Structural Volume Requirement (ft³): 733

DIFFERENCE 680

WORKSHEET 10. WATER QUALITY COMPLIANCE FOR NITRATE

Does the site design incorporate the following BMPs to address nitrate pollution? A summary "yes" rating is achieved if at least 2 Primary BMPs for nitrate are provided across the site or 4 secondary BMPs for nitrate are provided across the site (or the

PRIMARY BMPs FOR NITRATE:

	YES	NO
NS BMP 5.4.2 - Protect / Conserve / Enhance Riparian Buffers	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.5.4 - Cluster Uses at Each Site	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.6.1 - Minimize Total Disturbed Area	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.9.1 - Street Sweeping / Vacuuming	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.1 - Riparian Buffer Restoration	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.2 - Landscape Restoration	<input type="checkbox"/>	<input checked="" type="checkbox"/>

SECONDARY BMPs FOR NITRATE:

NS BMP 5.4.1 - Protect Sensitive / Special Value Features	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.4.3 - Protect / Utilize Natural Drainage Features	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.6.2 - Minimize Soil Compaction	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.4.5 - Rain Garden / Bioretention	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.4.8 - Vegetated Swale	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.4.9 - Vegetated Filter Strip	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.6.1 - Constructed Wetland	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.1 - Riparian Buffer Restoration	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.2 - Landscape Restoration	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.3 - Soils Amendment/Restoration	<input type="checkbox"/>	<input checked="" type="checkbox"/>

WORKSHEET 11. BMPs FOR POLLUTION PREVENTION

Does the site design incorporate the following BMPs to address nitrate pollution? A summary "yes" rating is achieved if at least 2 BMPs are provided across the site. "Provided across the site" is taken to mean that the specifications for that BMP set forward in Chapters 5 and 6 are satisfied.

BMPs FOR POLLUTANT PREVENTION:

	YES	NO
NS BMP 5.4.1 - Protect Sensitive / Special Value Features	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.4.2 - Protect / Conserve / Enhance Riparian Buffers	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.4.3 - Protect / Utilize Natural Flow Pathways in Overall	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.5.1 - Cluster Uses at Each Site; Build on the Smallest Area	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.6.1 - Minimize Total Disturbed Area - Grading	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.6.2 - Minimize Soil Compaction in Disturbed Areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.7.1 - Reduce Street Imperviousness	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.7.2 - Reduce Parking Imperviousness	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.8.1 - Rooftop Disconnection	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.8.2 - Disconnection from Storm Sewers	<input type="checkbox"/>	<input checked="" type="checkbox"/>
NS BMP 5.9.1 - Street Sweeping	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.1 - Riparian Buffer Restoration	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.2 - Landscape Restoration	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Structural BMP 6.7.3 - Soils Amendment and Restoration	<input type="checkbox"/>	<input checked="" type="checkbox"/>

WORKSHEET 12. WATER QUALITY ANALYSIS OF POLLUTANT LOADING FROM ALL DISTURBED AREAS

TOTAL SITE AREA (AC)	0.54
TOTAL DISTURBED AREA (AC)	0.54
DISTURBED AREA CONTROLLED BY BMPs (AC)	0.43

NOTE: Worksheet 12 calculates the pollutant loading for the actual disturbed area shown as the "Total Site Area (Limit of Grading)" on the drainage area maps.

TOTAL DISTURBED AREAS:

	LAND COVER CLASSIFICATION	POLLUTANT				POLLUTANT LOAD		
		TSS EMC (mg/l)	TP EMC (mg/l)	Nitrate-Nitrite EMC (mg/l as N)	COVER (Acres)	RUNOFF VOLUME (Acre-Feet)	TSS** (LBS)	TP** (LBS)
Pervious Surfaces	Forest	39	0.15	0.17	0.00	0.00	0.00	0.00
	Meadow	47	0.19	0.3	0.54	0.03	4.09	0.02
	Fertilized Planting Area	55	1.34	0.73	0.00	0.00	0.00	0.00
	Native Planting Area	55	0.40	0.33	0.00	0.00	0.00	0.00
	Lawn, Low-Input	180	0.40	0.44	0.00	0.00	0.00	0.00
	Lawn, High-Input	180	2.22	1.46	0.00	0.00	0.00	0.00
	Golf Course Fairway/Green	305	1.07	1.84	0.00	0.00	0.00	0.00
	Grassed Athletic Field	200	1.07	1.01	0.00	0.00	0.00	0.00
Impervious Surfaces	Rooftop	21	0.13	0.32	0.00	0.00	0.00	0.00
	High Traffic Street / Highway	261	0.40	0.83	0.00	0.00	0.00	0.00
	Medium Traffic Street	113	0.33	0.58	0.00	0.00	0.00	0.00
	Low Traffic / Residential Street	86	0.36	0.47	0.00	0.00	0.00	0.00
	Res. Driveway, Play Courts, etc.	60	0.46	0.47	0.00	0.00	0.00	0.00
	High Traffic Parking Lot	120	0.39	0.60	0.00	0.00	0.00	0.00
	Low Traffic Parking Lot	58	0.15	0.39	0.00	0.00	0.00	0.00
TOTAL LOAD						4.09	0.02	0.03
REQUIRED REDUCTION (%)						85%	85%	50%
REQUIRED REDUCTION (LBS)						3.47	0.01	0.01

* Pollutant Load = [EMC, mg/l] X [Volume, Acre-Feet] X [2.7, Unit Conversion]

** TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

WORKSHEET 13 - POLLUTANT REDUCTION THROUGH BMP APPLICATIONS*

* FILL THIS WORKSHEET OUT FOR EACH BMP TYPE WITH DIFFERENT POLLUTANT REMOVAL EFFICIENCIES. SUM POLLUTANT REDUCTION ACHIEVED FOR ALL BMP TYPES ON FINAL SHEET.

BMP TYPE: Vegetated Channel for Infiltration

DISTURBED AREA CONTROLLED BY THIS BMP TYPE (AC)	0.25
---	------

NOTE: Worksheet 13 calculates the pollutant reduction based on the drainage area to each BMP. As shown on the drainage area maps, the total drainage areas are larger than the "Total Site Area (Limit of Grading)".

DISTURBED AREAS CONTROLLED BY THIS BMP TYPE:

	LAND COVER CLASSIFICATION	POLLUTANT			COVER (Acres)	RUNOFF VOLUME (AF)	POLLUTANT LOAD**		
		TSS EMC (mg/l)	TP EMC (mg/l)	Nitrate-Nitrite EMC (mg/l as N)			TSS*** (LBS)	TP*** (LBS)	NO3 (LBS)
Pervious Surfaces	Forest	39	0.15	0.17	0.00	0.00	0.00	0.00	0.00
	Meadow	47	0.19	0.30	0.17	0.01	1.27	0.01	0.01
	Fertilized Planting Area	55	1.34	0.73	0.00	0.00	0.00	0.00	0.00
	Native Planting Area	55	0.40	0.33	0.00	0.00	0.00	0.00	0.00
	Lawn, Low-Input	180	0.40	0.44	0.00	0.00	0.00	0.00	0.00
	Lawn, High-Input	180	2.22	1.46	0.00	0.00	0.00	0.00	0.00
	Golf Course Fairway/Green	305	1.07	1.84	0.00	0.00	0.00	0.00	0.00
	Grassed Athletic Field	200	1.07	1.01	0.00	0.00	0.00	0.00	0.00
Impervious Surfaces	Rooftop	21	0.13	0.32	0.00	0.00	0.00	0.00	0.00
	High Traffic Street / Highway	261	0.40	0.83	0.00	0.00	0.00	0.00	0.00
	Medium Traffic Street	113	0.33	0.58	0.01	0.00	0.43	0.00	0.00
	Low Traffic / Residential Street	86	0.36	0.47	0.00	0.00	0.00	0.00	0.00
	Res. Driveway, Play Courts, etc.	60	0.46	0.47	0.00	0.00	0.00	0.00	0.00
	High Traffic Parking Lot	120	0.39	0.60	0.00	0.00	0.00	0.00	0.00
	Low Traffic Parking Lot	58	0.15	0.39	0.07	0.01	1.76	0.00	0.01
TOTAL LOAD TO THIS BMP TYPE							3.46	0.01	0.02
POLLUTANT REMOVAL EFFICIENCIES FROM TABLE A-4 (%)							85%	85%	30%
POLLUTANT REDUCTION ACHIEVED BY THIS BMP TYPE (LBS)							2.94	0.01	0.01
POLLUTANT REDUCTION ACHIEVED BY ALL BMP TYPES (LBS)							2.94	0.01	0.01
REQUIRED REDUCTION FROM WS12 (LBS)							3.47	0.01	0.01

Remaining Reduction

TSS*** (LBS)	TP*** (LBS)	NO3 (LBS)
0.54	0.00	0.01

** Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]
 *** TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

WORKSHEET 13 - POLLUTANT REDUCTION THROUGH BMP APPLICATIONS*

* FILL THIS WORKSHEET OUT FOR EACH BMP TYPE WITH DIFFERENT POLLUTANT REMOVAL EFFICIENCIES. SUM POLLUTANT REDUCTION ACHIEVED FOR ALL BMP TYPES ON FINAL SHEET.

BMP TYPE: Storage in 24" MLV Pad

DISTURBED AREA CONTROLLED BY THIS BMP TYPE (AC)	0.11
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NOTE: Worksheet 13 calculates the pollutant reduction based on the drainage area to each BMP. As shown on the drainage area maps, the total drainage areas are larger than the "Total Site Area (Limit of Grading)".

DISTURBED AREAS CONTROLLED BY THIS BMP TYPE:

	LAND COVER CLASSIFICATION	POLLUTANT			COVER (Acres)	RUNOFF VOLUME (AF)	POLLUTANT LOAD**		
		TSS EMC (mg/l)	TP EMC (mg/l)	Nitrate-Nitrite EMC (mg/l as N)			TSS*** (LBS)	TP*** (LBS)	NO3 (LBS)
Pervious Surfaces	Forest	39	0.15	0.17	0.00	0.00	0.00	0.00	0.00
	Meadow	47	0.19	0.30	0.00	0.00	0.00	0.00	0.00
	Fertilized Planting Area	55	1.34	0.73	0.00	0.00	0.00	0.00	0.00
	Native Planting Area	55	0.40	0.33	0.00	0.00	0.00	0.00	0.00
	Lawn, Low-Input	180	0.40	0.44	0.00	0.00	0.00	0.00	0.00
	Lawn, High-Input	180	2.22	1.46	0.00	0.00	0.00	0.00	0.00
	Golf Course Fairway/Green	305	1.07	1.84	0.00	0.00	0.00	0.00	0.00
	Grassed Athletic Field	200	1.07	1.01	0.00	0.00	0.00	0.00	0.00
Impervious Surfaces	Rooftop	21	0.13	0.32	0.00	0.00	0.00	0.00	0.00
	High Traffic Street / Highway	261	0.40	0.83	0.00	0.00	0.00	0.00	0.00
	Medium Traffic Street	113	0.33	0.58	0.00	0.00	0.00	0.00	0.00
	Low Traffic / Residential Street	86	0.36	0.47	0.00	0.00	0.00	0.00	0.00
	Res. Driveway, Play Courts, etc.	60	0.46	0.47	0.00	0.00	0.00	0.00	0.00
	High Traffic Parking Lot	120	0.39	0.60	0.00	0.00	0.00	0.00	0.00
	Low Traffic Parking Lot	58	0.15	0.39	0.11	0.02	2.58	0.01	0.02
TOTAL LOAD TO THIS BMP TYPE							2.58	0.01	0.02
POLLUTANT REMOVAL EFFICIENCIES FROM TABLE A-4 (%)							85%	85%	30%
POLLUTANT REDUCTION ACHIEVED BY THIS BMP TYPE (LBS)							2.19	0.01	0.01
POLLUTANT REDUCTION ACHIEVED BY ALL BMP TYPES (LBS)							5.13	0.01	0.01
REQUIRED REDUCTION FROM WS12 (LBS)							3.47	0.01	0.01

Remaining Reduction

TSS*** (LBS)	TP*** (LBS)	NO3 (LBS)
-1.65	0.00	0.00

** Pollutant Load = [EMC, mg/l] X [Volume, AF] X [2.7, Unit Conversion]

*** TSS and TP calculations only required for projects not meeting CG1/CG2 or not controlling less than 90% of the disturbed area

N.8 Infiltration Information

- a. Field Observation Report

Infiltration Rate Summary – AR-CO-085.1.3

Infiltration Test Pit Location	Field Measured Infiltration Rates		
Pit #1 (Channel)	7.613	in/hr	
Pit #2 (Channel)	2.719	in/hr	
Pit #3 (Channel)	4.313	in/hr	
Pit #4 (MLV Pad)	2.344	in/hr	
Pit #5 (MLV Pad)	8.813	in/hr	
Pit #6 (MLV Pad)	8.625	in/hr	

MLV Pad Infiltration Calculations Summary		
Average Measured Infiltration Rate for MLV Pad	6.59	in/hr
Factor of Safety	2.00	
Design Infiltration Rate	3.30	in/hr
Dewatering Time for top 6 inches of MLV Pad	1.82	hours
Depth of AASHTO #57 Section of MLV Pad	18	inches
Dewatering Time for AASHTO #57 Section of MLV Pad	5.46	hours
Total Dewatering Time for MLV Pad	7.28	hours

Check Dam Infiltration Calculations Summary		
Average Measured Infiltration Rate for Swale	4.88	in/hr
Factor of Safety	2.00	
Design Infiltration Rate	2.44	in/hr
Height of Check Dam	12	inches
Dewatering Time for Detained Water in Swale	4.92	hours

****A factor of safety of 2 is the minimal safety factor for design purposes per page 19 of 21 of "Protocol 1, Site Evaluation and Soil Infiltration Testing, included as Appendix C of the Pennsylvania Stormwater BMP Manual.***



Field Observation Report

Project Number: 14C4909 - A
Project Name: Atlantic Sunrise Project – AR-CO-085.1.3
Date of Field Visit: October 19, 2015
Weather Conditions: Sunny Temperature: Approx. 34-50°F
Prepared By: Krystal Bealing, APSS and Joseph Kempf

Copies of Report Have Been Sent To: Client Contractor Other

Client:
Transcontinental Gas Pipe Line
Company, LLC
2800 Post Oak Blvd
Houston, TX 77251

Contractor:
BL Companies
4242 Carlisle Pike, Suite 260
Camp Hill, PA 17011

Six soil pits were excavated by backhoe and described by an Associate Professional Soil Scientist (APSS) to varying depths utilizing the U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) *Field Book for Describing and Sampling Soils, Version 3.0* and *Keys to Soil Taxonomy, Twelfth Edition, 2014*. According to the Web Soil Survey, soils within the area of the pits are described by the USDA-NRCS as Calvin-Klinesville shaly silt loams, 3-8% slopes and Meckesville silt loam, 3-8% slopes.

Test Pit #1, located at N40° 50' 04.62", W76° 31' 02.92", was observed to have four horizons, with a restrictive soil horizon due to bedrock components observed at 30 inches, and bedrock at 40 inches.

Test Pit #2, located at N40° 50' 05.56", W76° 31' 02.92", was observed to have five horizons, with a fragipan observed at 22 inches, and a restrictive soil horizon due to bedrock components observed at 51 inches.

Test Pit #3, located at N40° 50' 06.36", W76° 31' 02.18", was observed to have four horizons, with a fragipan observed at 15 inches, and a restrictive soil horizon due to bedrock components observed at 17 inches.

Field Observation Report

Test Pit #4, located at N40° 50' 06.42", W76° 31' 01.32", was observed to have four horizons, with a fragipan observed at 24 inches and a restrictive soil horizon due to bedrock components observed at 32 inches.

Test Pit #5 located at N40° 50' 06.09", W76° 31' 01.53", was observed to have three horizons, with a restrictive soil horizon due to bedrock components observed at 31 inches.

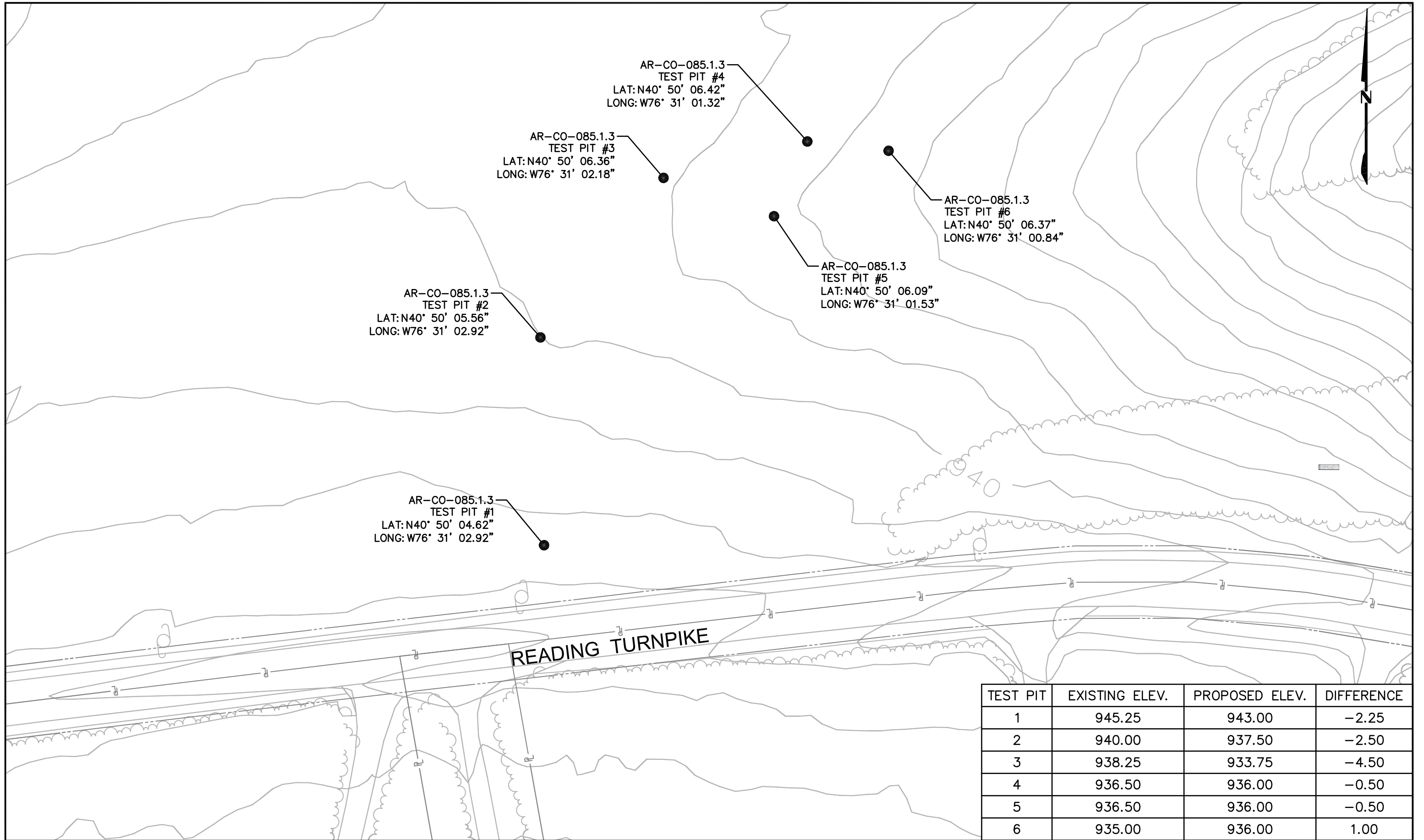
Test Pit #6 located at N40° 50' 06.37", W76° 31' 00.84", was observed to have four horizons, with a restrictive soil horizon due to bedrock components observed at 36 inches.

Additionally, infiltration tests using the double ring infiltrometer method were conducted at each pit location, at depths ranging from the surface (0 inches) to 12 inches below surface. The elevations of the proposed improvements and the existing ground are provided on the infiltration testing location map. If the difference between the existing and proposed elevations is greater than zero, infiltration was performed at the existing elevation. If the difference between the existing and proposed elevation is between 0 and -5.00 feet, infiltration was conducted at the proposed elevation, or at two feet above the observed limiting layer, whichever was more shallow. If the difference between the existing and proposed elevations is greater than -5.00, infiltration was placed at 5 feet (60 inches) below the existing elevation to adhere to Occupational Safety and Health Administration (OSHA) standards for trenching and excavation safety.

Infiltration testing was conducted within a level testing area at all test pit locations using the double ring infiltrometer method. An infiltrometer containing a 12-inch outer ring and a 6-inch inner ring was driven into the soil a minimum of two inches. Both rings were filled with water to the rim at 30 minute intervals for one hour. If the drop in water level, measured within the center ring, during the last 30 minutes of the presoak is 2 inches or more, measurements are taken in 10-minute intervals. If the water level drop is less than 2 inches, measurements are taken in 30-minute intervals. After each measurement, the rings were refilled to the rim. Each measurement was taken at a fixed reference point. Measurements were taken until the rate of drop stabilized, or eight measurements were taken. A stabilized rate of drop is considered a difference of 0.25-inch or less between the highest and lowest measurements of four consecutive readings. An average of the stabilized rate (i.e., the last four measurements) or the average of eight total measurements if the rate of drop did not stabilize, expressed in inches per hour, represents the infiltration rate. Testing was completed at 6 inches below the surface at Test Pit #1 and Test Pit #5, at 12 inches below the surface at Test Pit #6, and at the surface for Test Pits #2, #3, and #4.

The infiltration rate at Test Pit #1 was observed to be 7.613 inches per hour.
The infiltration rate at Test Pit #2 was observed to be 2.719 inches per hour.
The infiltration rate at Test Pit #3 was observed to be 4.313 inches per hour.
The infiltration rate at Test Pit #4 was observed to be 2.344 inches per hour.
The infiltration rate at Test Pit #5 was observed to be 8.813 inches per hour.
The infiltration rate at Test Pit #5 was observed to be 8.625 inches per hour.

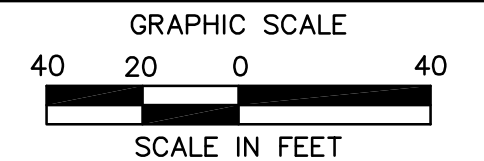
The soil profile descriptions, infiltration worksheet, photographs, infiltration testing location map, and USDA-NRCS Soil Survey information are attached.



TEST PIT	EXISTING ELEV.	PROPOSED ELEV.	DIFFERENCE
1	945.25	943.00	-2.25
2	940.00	937.50	-2.50
3	938.25	933.75	-4.50
4	936.50	936.00	-0.50
5	936.50	936.00	-0.50
6	935.00	936.00	1.00

LANDOWNER: HOAGLAND

AR-CO-085.1.3 INFILTRATION TESTING LOCATIONS



Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-CO-085.1.3

Test Pit # 1

Name Joe Kempf and Krystal Bealing, APSS

Date October 19, 2015

Weather 34-50°F; Sunny

Equipment Mini Excavator

Elevation 945.25 AMSL

Soil Type Meckesville silt loam, 3-8% slopes

Geology Buddys Run Member of Catskill Formation

Landscape Position/Slope Sideslope bench, 0-3%

Land Use Agriculture

Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
Ap	0	8	Sil	-	5YR 3/3	-	Roots present; Weak, Granular	-	-	Very Friable
Bw	8	30	Sil	35-60% Channery	2.5YR 4/3	-	Moderate Subangular Blocky	-	-	Friable
Cr	30	40	Sil	60-90% Channery	2.5YR 4/3	-	Massive	40	-	Firm Limiting Layer - Restrictive Soil Horizon due to bedrock components
R	40	48+	-	-	-	-	-	-	-	Observed excavator limit

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-CO-085.1.3

Test Pit # 2

Name Joe Kempf and Krystal Bealing, APSS

Date October 19, 2015

Weather 34-50°F; Sunny

Equipment Mini Excavator

Elevation 940 AMSL

Soil Type Calvin-Klinesville shaly silt loams, 3-8% slopes

Geology Buddys Run Member of Catskill Formation

Landscape Position/Slope Sideslope bench, 0-3%

Land Use Agriculture

Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
Ap	0	8	SiL	-	5YR 3/3	-	Roots present; Weak, Granular	-	-	Very Friable
Bw	8	22	SiL	15-35% Channery	2.5YR 4/3	-	Moderate, Subangular Blocky	-	-	Friable
Bx	22	31	SiL	35-60% Channery	2.5YR 4/3	-	Weak, Subangular Blocky	-	-	Firm Limiting Layer - Fragipan
C	31	51	SL	15-35% Channery	2.5YR 3/4	-	Massive	-	-	Friable
Cr	51	60+	SL	60-90% Channery	2.5YR 3/4	-	Massive	35	-	Firm Limiting Layer - Restrictive Soil Horizon due to bedrock components

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-CO-085.1.3

Test Pit # 3

Name Joe Kempf and Krystal Bealing, APSS

Date October 19, 2015

Weather 34-50°F; Sunny

Equipment Mini Excavator

Elevation 938.25 AMSL

Soil Type Calvin-Klinesville shaly silt loams, 3-8% slopes

Geology Buddys Run Member of Catskill Formation

Landscape Position/Slope Sideslope bench, 0-3%

Land Use Agriculture

Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
Ap	0	10	Sil	-	5YR 3/3	-	Roots present; Moderate, Granular	-	-	Friable
Bw	10	15	Sil	-	2.5YR 4/3	-	Moderate, Subangular Blocky	-	-	Friable
Bx	15	35	Sil	-	2.5YR 4/4	5% 5YR 4/6	Weak, Subangular Blocky	-	-	Firm Limiting Layer - Fragipan
Cr	35	55+	Sil	60-90% Channery	2.5YR 4/4	-	Massive	-	-	Friable Limiting Layer - Restrictive Soil Horizon due to bedrock components

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-CO-085.1.3

Test Pit # 4

Name Joe Kempf and Krystal Bealing, APSS

Date October 19, 2015

Weather 34-50°F; Sunny

Equipment Mini Excavator

Elevation 936.5 AMSL

Soil Type Calvin-Klinesville shaly silt loams, 3-8% slopes

Geology Buddys Run Member of Catskill Formation

Landscape Position/Slope Sideslope bench, 0-3%

Land Use Agriculture

Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
Ap	0	10	Sil	-	5YR 3/3	-	Roots present; Weak, Granular	-	-	Friable
Bw	10	24	Sil	-	2.5YR 4/3	-	Roots present; Moderate, Subangular Blocky	-	-	Friable
Bx	24	32	Sil	15-35% Channery	2.5YR 4/4	-	Weak, Subangular Blocky	-	-	Very Firm Limiting Layer - Fragipan
Cr	32	48+	Sil	60-90% Channery	2.5YR 4/4	-	Massive	-	-	Friable Limiting Layer - Restrictive Soil Horizon due to bedrock components

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-CO-085.1.3
 Test Pit # 5
 Name Joe Kempf and Krystal Bealing, APSS
 Date October 19, 2015
 Weather 34-50°F; Sunny
 Equipment Mini Excavator

Elevation 936.5 AMSL
 Soil Type Calvin-Klinesville shaly silt loams, 3-8% slopes
 Geology Buddys Run Member of Catskill Formation
 Landscape Position/Slope Sideslope bench, 0-3%
 Land Use Agriculture
 Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
Ap	0	10	Sil	-	5YR 3/3	-	Roots present; Weak, Granular	-	-	Very Friable
Bw	10	31	Sil	35-60% Channery	2.5YR 3/4	-	Moderate, Subangular Blocky	-	-	Friable
Cr	31	53+	Sil	60-90% Channery	2.5YR 4/3	-	Massive	-	-	Firm Limiting Layer - Restrictive Soil Horizon due to bedrock components

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project - AR-CO-085.1.3

Test Pit # 6

Name Joe Kempf and Krystal Bealing, APSS

Date October 19, 2015

Weather 34-50°F; Sunny

Equipment Mini Excavator

Elevation 935 AMSL

Soil Type Calvin-Klivesville shaly silt loams, 3-8% slopes

Geology Buddys Run Member of Catskill Formation

Landscape Position/Slope Sideslope bench, 0-3%

Land Use Agriculture

Additional Comments

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Maxtrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
Ap	0	10	SiL	-	5YR 3/3	-	Roots present; Moderate, Granular	-	-	Friable
Bw1	10	23	SiL	-	2.5YR 3/4	-	Roots present; Moderate, Subangular Blocky	-	-	Friable
Bw2	23	36	SiL	35-60% Channery	2.5YR 3/4	-	Moderate Subangular Blocky	-	-	Friable
Cr	36	48+	SiL	60-90% Channery	2.5YR 4/4	-	Massive	-	-	Very Friable Limiting Layer - Restrictive Soil Horizon due to bedrock components

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

ATLANTIC SUNRISE PROJECT - AR-CO-085.1.3

SOIL INFILTRATION WORKSHEET - DOUBLE RING INFILTROMETER METHOD

Hole Number	Drop >2 inches after 30 minute presoak? ¹	Reading Interval (minutes)	Reading 1 (Inches of Drop)	Reading 2 (Inches of Drop)	Reading 3 (Inches of Drop)	Reading 4 (Inches of Drop)	Reading 5 (Inches of Drop)	Reading 6 (Inches of Drop)	Reading 7 (Inches of Drop)	Reading 8 (Inches of Drop)	Average Stabilized Reading ² (Inches of Drop)	Infiltration Rate ³ (in/hr)	Comments
1	Yes	10	2.000	1.500	1.750	0.200	1.625				1.269	7.613	34-50°F, sunny. Test done at 6 inches below the surface.
2	Yes	10	0.500	0.375	0.500	0.438					0.453	2.719	34-50°F, sunny. Test done at the surface.
3	Yes	10	0.875	0.688	0.688	0.625					0.719	4.313	34-50°F, sunny. Test done at the surface.
4	Yes	10	0.313	0.500	0.375	0.375					0.391	2.344	34-50°F, sunny. Test done at the surface.
5	Yes	10	1.500	1.500	1.625	1.250					1.469	8.813	34-50°F, sunny. Test done at 6 inches below the surface.
6	Yes	10	1.063	1.500	1.625	1.250	1.375				1.438	8.625	34-50°F, sunny. Test done at 12 inches below the surface.

¹Inches of drop greater than 2 inches after the 30 minute presoak? Yes, use 10 minute interval; No, use 30 minute interval.

²Calculated as the average of the last four stabilized (less than 0.25-inch difference overall) readings, or an overall average in the case of eight total readings.

³Calculated as the average stabilized reading x 2 for 30 minute intervals; x 6 for 10 minute intervals.



View of Pit #1.



View of Pit #2.



View of Pit #3.



View of Pit #4.



View of Pit #5.



View of Pit #6.

Northumberland County, Pennsylvania

CaB—Calvin-Klinesville shaly silt loams, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 13hs

Elevation: 300 to 1,600 feet

Mean annual precipitation: 36 to 50 inches

Mean annual air temperature: 45 to 57 degrees F

Frost-free period: 120 to 217 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Calvin and similar soils: 50 percent

Klinesville and similar soils: 30 percent

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Calvin

Setting

Landform: Hillslopes

Landform position (three-dimensional): Side slope, crest

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Residuum weathered from siltstone

Typical profile

H1 - 0 to 8 inches: channery silt loam

H2 - 8 to 25 inches: very channery silt loam

H3 - 25 to 30 inches: very channery silt loam

R - 30 to 34 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: 20 to 40 inches to lithic bedrock

Natural drainage class: Well drained

Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2e

Hydrologic Soil Group: B

Description of Klinesville

Setting

Landform: Valleys, ridges
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from siltstone

Typical profile

H1 - 0 to 7 inches: channery silt loam
H2 - 7 to 11 inches: very channery silt loam
H3 - 11 to 15 inches: very channery silt loam
R - 15 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D

Minor Components

Leck kill

Percent of map unit: 10 percent

Berks

Percent of map unit: 5 percent

Weikert

Percent of map unit: 5 percent

Data Source Information

Soil Survey Area: Northumberland County, Pennsylvania
Survey Area Data: Version 6, Sep 22, 2014

Northumberland County, Pennsylvania

MkB—Meckesville silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 13k6
Elevation: 400 to 2,800 feet
Mean annual precipitation: 34 to 48 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 120 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Meckesville and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Meckesville

Setting

Landform: Mountain valleys, mountain slopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Lower third of mountainflank
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Sandstone, siltstone and shale colluvium derived from sedimentary rock

Typical profile

H1 - 0 to 4 inches: silt loam
H2 - 4 to 36 inches: silt loam
H3 - 36 to 60 inches: gravelly silty clay loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 25 to 48 inches to fragipan
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat):
Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 28 to 48 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C

Minor Components

Calvin

Percent of map unit: 5 percent

Albrights

Percent of map unit: 5 percent

Leck kill

Percent of map unit: 5 percent

Data Source Information

Soil Survey Area: Northumberland County, Pennsylvania
Survey Area Data: Version 6, Sep 22, 2014

N.9 Off-Site Discharge Analysis

- a. Adequacy of Off-Site Discharge

ACCESS ROAD: AR-CO-085.1.3- Adequacy of Off-Site Discharge

AR-CO-085.1.3 is a proposed permanent access road (PAR) located in Ralpho Township, Northumberland County, Pennsylvania. The intent of this PAR is to provide permanent maintenance and operational access to the proposed Main Line Valve 10 (CS-MLV-10) located on the proposed 42" Central Penn Line South Pipeline. The road begins at Reading Turnpike and terminates at the MLV site at approximate mile post M-0167 MP 0.0. The PAR is approximately 230 feet long and has an elevation change of approximately 12 feet and is located on an existing pasture.



Reading Turnpike looking northeast toward MLV site location

A vegetated channel is proposed on the west side of the access road to intercept the access road runoff and infiltrate the runoff into the ground. The vegetated channel will have check dams to detain runoff for infiltration.

Additional runoff detention is proposed within the MLV pad. The pad is 90 feet by 52 feet and constructed of 6" of AASHTO #8 stone on 24" AASHTO #57 stone. The 24" deep bottom layer will detain and infiltrate stormwater from the MLV pad.

Downhill of the MLV pad and vegetated channel, the runoff flows southeast to the convergence point with the existing flow path, approximately 90 feet east of the MLV site. The runoff follows the pre-construction flow path to an unnamed tributary to Miller Run, approximately 1380 feet east of the MLV site.

The MLV pad and vegetated channels are designed to reduce the overall disturbance to the maximum extent practicable. The proposed detention is designed so the post-construction stormwater peak rate of runoff is less than or equal to the pre-construction stormwater peak rate of runoff. Pre- and post-construction drainage area maps and model results are provided in Appendix N.3 and N.4, respectively. The pre- and post-construction peak rate of runoff and the discharge velocity for the design storm events are summarized below:

Pre- vs. Post-construction Peak Rate of Flow Summary			
Stormwater discharge rate for the design frequency storm (cfs)	Pre-construction	Post-construction	Net Change
1) 1-Year/24-Hour	1.02	1.00	(0.02)
2) 2-Year/24-Hour	1.69	1.60	(0.09)
3) 5-Year/24-Hour	2.78	2.51	(0.27)
4) 10-Year/24-Hour	3.83	3.38	(0.45)
5) 25-Year/24-Hour	5.60	4.82	(0.78)
6) 50-Year/24-Hour	7.31	6.18	(1.13)
7) 100-Year/24-Hour	9.41	7.87	(1.54)

Pre- and Post-construction Discharge Velocity	MLV Pad (fps)	Vegetated Channel (fps)
1) 1-Year/24-Hour	0.53	0.00
2) 2-Year/24-Hour	0.63	0.00
3) 5-Year/24-Hour	0.70	0.00
4) 10-Year/24-Hour	0.73	0.00
5) 25-Year/24-Hour	0.80	0.12
6) 50-Year/24-Hour	0.82	0.22
7) 100-Year/24-Hour	0.87	0.42

The MLV pad and vegetated channel discharge to agricultural land that is considered mulch for design purposes. Based on Table G.1. Allowable Velocities for Downslope Covers for Channeled Flows in the Pennsylvania DEP Erosion and Sediment Pollution Control Program Manual, the maximum allowable velocity for mulch ground cover is 1-2 fps. The discharge velocity from the MLV pad and vegetated channel is less than 1 fps for all design storm events. Therefore, no erosion is anticipated in the agricultural land downhill of the MLV pad and vegetated channel.

After being conveyed through one of the these stormwater PCSM BMP's above

The flow path from the MLV site crosses the following soil types:

- CaB – Calvin-Klinesville shaly silt loams, 3 to 8 percent slopes.
- CaC – Calvin-Klinesville shaly silt loams, 8 to 15 percent slopes.
- WkE – Weikert and Klinesville shaly silt loams, steep.

The PADEP E&S Manual defines erosion resistant soils as soils having an erodibility “K” factor less than or equal to 0.37. The K factor for the soil types, according to the National Resources Conservation Service (NRCS) website <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>, crossed by the flow path are summarized below:

- CaB – 0.28
- CaC – 0.28
- WkE – 0.17

All soils crossed by the flow path are considered erosion resistant soils.

There is no change between pre- and post-construction stormwater volume, rate of runoff or velocity downstream of the MLV pad and vegetated channel due to the provided detention. The soils crossed by the runoff are considered to be erosion resistant. Therefore, there are no downstream off-site impacts due to installing the proposed improvements.

Down Slope Property Owners:

- Lynn L. Hoagland & Carol C. Hoagland (PA-NO-024.100)

N.10 Storage Volume Analysis

a. Storage Volume Analysis

ACCESS ROAD: CO-085.1.3 – Storage Volume Analysis

Stormwater detention is provided behind the check dams in the vegetated channel and in the void space between the AASHTO #57 stone at the MLV pad. The void space between the 6" AASHTO #8 stone at the surface of the pad is excluded from the storage volume calculations. The required storage volume is calculated through an iterative process of increasing the storage volume in the HydroCAD model until the post-construction stormwater runoff rate is less than or equal to the pre-construction runoff rate for the 1, 2, 5, 10, 25, 50 and 100 year 24-hour storm events.

Vegetated channel storage is created by installing check dams along the channel. The "Earthen Check Dam Infiltration Volume and Spacing" exhibit provided in Appendix N.6 illustrates how the storage volume behind each check dam is calculated. The number of check dams required is dependent on the channel cross-sectional dimensions, slope of channel, and required storage volume.

The storage volume of the MLV pad is dependent on the slope of the MLV pad. If the pad were graded at 0% in all directions, the storage volume would be equal to the area of the pad multiplied by the depth. However, due to site topography, a 0% grade would result in large quantities of earth movement, fill at the infiltration interface, or cut too close to the ground water table. Instead, the pad is designed to minimize these terrain impacts by mimicking the existing contours as close as possible. The actual storage volume is calculated based on the elevation of the low point of the pad (minus the 6" AASHTO #8 cover), since that is the highest elevation runoff can be stored without overtopping the AASHTO #57 stone.

Due to the complexity of the MLV pad geometry, AutoCAD Civil 3D was used to determine the storage volume. Surfaces representing the bottom of the pad and water surface elevation were built at 0.5 feet intervals and combined into a TIN volume surface. An earthwork analysis was run on the TIN volume surface to determine the total volume between surfaces. This storage volume was reduced by 60% to determine the available storage volume between the AASHTO #57 stone, estimated to be 40% voids.

The maximum available storage volume within the voids of the AASHTO #57 layer of the MLV pad is 497 cubic feet. This volume is required to attenuate the anticipated flow for the 100-year, 24-hour design storm event. However, the design storage volume for the 2-year, 24-hour storm event is 488 cubic feet as calculated in the post-development HydroCAD model. The 2-year, 24-hour storm event storage volume is used in the calculations in Worksheet 5 provided in Appendix N.7.

The detained stormwater will infiltrate the ground. The dewatering time for the stormwater detained behind the check dams and in the void space of the MLV pad is provided at the beginning of Appendix N.8, Infiltration Information.

N.11 Sediment Barrier Table

a. E&S Worksheet #1

