WETLANDS TECHNICAL APPENDIX

Appendix C-1	Wetland Delineation Report for LIT:
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	• Vernal Pool Characterization and Valuation Form from April 14, 2014
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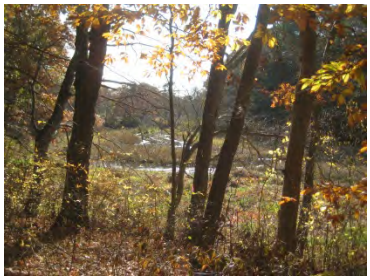
Appendix C-1
Wetlands Delineation Report for LIT:

Wetlands and Waterways Delineation Report of the Mashpee Wampanoag Tribe, Fee-to-Trust Acquisition and Casino Project, Taunton, Massachusetts



Wetlands and Waterways Delineation Report for Land-Into-Trust (LIT) Project Site

For the Mashpee Wampanoag Tribe, Fee-to-Trust Acquisition and Casino Project
Taunton, Massachusetts

NAE File No. 2012-01239

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Epsilon ASSOCIATES INC.

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WETLAND DELINEATION REPORT

1.0 Introduction

This wetland delineation report has been prepared for the Mashpee Wampanoag Tribe (the Tribe), a federally recognized tribe. The Tribe is proposing that land be taken-into-trust (LIT) in the City of Taunton, Massachusetts by the U.S. Department of Interior Bureau of Indian Affairs (BIA) to establish the Tribe's reservation. The lands in Taunton would be used to meet the Tribe's economic needs through construction of a destination resort casino and ancillary facilities. The resort casino is referred to herein as "First Light". The LIT land comprises approximately 151 acres located within and adjacent to the Liberty & Union Industrial Park (LUIP). This land is referred to as the "Project Site" within this report. The LUIP is a commercial/industrial development park created in 2003 and is currently operated by the private, non-profit Taunton Development Corporation (TDC) for the purpose of generating economic development in the City of Taunton.

The Project Site is generally bounded to the north by Middleborough Avenue, which is residential; to the east by Stevens Street, which is residential and commercial; to the south by Route 140; and to the west by Route 24 and the Cotley River/Barstows Pond system (See Attachment A, Figure 1). The site is accessed via Stevens Street off of Route 140, Exit 11. O'Connell Way, off of Stevens Street, provides access to the interior of the site. The Project Site is transected by an east-west railroad track; as such the Project Site is described herein by proximity and location relative to the railroad tracks (e.g. north and south parcels). This report describes the limits of wetlands[1] and other waters of the United States (U.S.)[2] delineated by Epsilon Associates, Inc. (Epsilon) within the Project Site during the months of September and October 2012.

The proposed project also involves a traffic mitigation component that proposes improvements to the Route 24 and Route 140 interchange including construction of a new slip ramp to connect Route 24 Southbound directly to Route 140 Northbound, modifications to existing ramps, and widening of Route 140 in order to fix a current bottleneck. Wetlands and other waters of the US within the traffic mitigation study area were delineated by AECOM during the months of January, February and March 2014. Collectively the AECOM and Epsilon reports have been provided to the Regulatory Division

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[1] Wetlands means "those area that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." 33 C.F.R. § 328.3(b).

[2] "Waters of the U.S." is broadly defined in the federal regulations that implement the Clean Water Act. It includes tidal waters, rivers, streams, lakes, ponds and wetlands. 33 C.F.R. § 328.3(a).

of the U.S. Army Corps of Engineers; New England District (USACE) as part of the USACE's review of the Final Environmental Impact (FEIS) Statement entitled "Mashpee Wampanoag Tribe, Fee-to-Trust Acquisition and Casino Project".

This report is organized as follows: Section 1 provides a brief overview of the project; Section 2 provides a description of the site and its general environmental setting; Section 3 describes data review and the wetland delineation methodology employed by Epsilon; Section 4 describes wetland characteristics and surface waterbodies within the site including a detailed discussion of field delineated wetlands; Section 5 contains a general regulatory analysis regarding jurisdiction under federal wetlands regulations.

Three attachments provide supporting material for this report: Attachment A includes a series of graphics depicting the limits of delineated wetlands and other waters of the U.S., existing topographic, hydrologic, and soil conditions, major watersheds, and mapped floodplain areas. USACE wetland determination data forms are provided in Attachment B while representative site photographs are provided in Attachment C. A vernal pool assessment technical memorandum prepared by Oxbow Associates, Inc. and an USACE vernal pool evaluation is provided in Attachment D.

2.0 Environmental Setting

2.1 Project Site Description

The approximately 151-acre Project Site is located in East Taunton, Massachusetts in Bristol County (41° 52′ 21.99″ N, 71° 02′ 56.86″ W). Approximately 30 percent of the area south of the railroad tracks within the Project Site is currently developed with roadways, parking areas, and buildings. The majority of the land use is forested, undeveloped land. As previously described, the Project Site is generally bounded to the north by Middleborough Avenue, which is residential; to the east by Stevens Street, which is residential and commercial; to the south by Route 140, and to the west by Route 24. Both Routes 140 and 24 are limited access highways; the highway corridor is located a minimum of approximately 30 feet west of the Project Site.

2.2 Site Topography, Watershed and Floodplain Information

The Project Site is located in the Narragansett Basin watershed (8-digit Hydrologic Unit Code 01090004) and the Taunton River sub-basin (see Attachment A, Figure 5). According to the Taunton and Assonet 7.5-minute USGS Topographic Quadrangle maps, elevations within the Project Site range from approximately 6 feet to 18 feet NAVD88 (see Attachment A, Figure 1). Topography generally slopes in a westerly direction across the majority of the Project Site from Stevens Street toward the Cotley River. The extreme western portion of the site slopes eastward toward the Cotley River.

The Cotley River flows for approximately 1.2 miles in the western portion of the Project Site to Barstows Pond at the northernmost extent of the Project Site. The river flows in a westerly direction along the southern portion of the Project Site roughly parallel to Route 140 before turning northward parallel to Route 24. The Cotley River flows through a culvert beneath the existing railroad tracks and eventually into Barstows Pond located to the north and within the Project Site. The Cotley River flows offsite through a culvert beneath Hart Street and ultimately into the Taunton River located approximately 2,000 feet northeast of the site. The Cotley River exhibits some undercutting along its banks, which represents the steepest slopes within the Project Site. The Cotley River is identified as perennial on the USGS quadrangle. Several smaller unnamed intermittent streams flow into it within the Project Site and the channel is directed through multiple manmade structures (i.e., culvert, railroad bridge). The channel becomes undefined where it transitions to a large scrub-shrub and emergent wetland located south of the railroad tracks and again north of the railroad where it enters Barstows Pond.

According to the current Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), a portion of the Project Site along the Cotley River is located in a Zone A, within which no base flood elevations have been established (see Attachment A, Figure 2). Project engineers have calculated the base flood elevation for the 100-year storm event as ranging between 24 feet NGVD and 37 feet NGVD south of the railroad tracks. North of the railroad tracks, the 100-year floodplain is projected to be approximately 17 feet NGVD assuming the dam at Barstows Pond is removed (as is currently proposed by others unrelated to this Project (see Attachment A, Figure 2).

2.3 Plant Communities

The Project Site, located north of the railroad tracks is primarily comprised of a mix of upland, wetland and riparian communities. This contains an early successional field and upland forest; these features are bounded to the west by the Cotley River and Barstows Pond system. Land located south of the railroad tracks is also comprised of upland, wetland and riparian communities. This land is largely managed or developed as part of the LUIP. There are undeveloped fields and deciduous forested uplands and deciduous forested wetlands associated with the Cotley River system.

The Cotley River and the adjoining riparian habitat is a primary habitat feature on the Project Site. The riparian corridor immediately adjacent to the river is almost entirely forested within the Project Site, dominated by red maple (*Acer rubrum*), white pine (*Pinus strobus*) and black tupelo (*Nyssa sylvatica*) interspersed with swamp white oak (*Quercus bicolor*), American elm (*Ulmus americana*) and upland oaks (*Quercus* spp.) and hickories (*Carya* spp.) exhibiting morphological adaptations to wet conditions. The understory is varied, generally dominated by sweet pepperbush (*Clethra alnifolia*), highbush blueberry

(*Vaccinium corymbosum*), viburnums (*Viburnum* spp.), dogwoods (*Cornus* spp.), multiflora rose (*Rosa multiflora*), greenbriar (*Smilax rotundifolia*), poison ivy (*Toxicodendron radicans*) and hydrophyte fern species.

The forested uplands contain a variety of deciduous tree species including oaks, red maples, birches (*Betula* spp.) and white pine. The understory and ground cover are composed of a variety of shrub and herb species including but not limited to honeysuckle (*Lonicera* spp.), multiflora rose, poison ivy, greenbriar, low bush blueberry (*Vaccinium angustifolium*), Canada mayflower (*Maianthemum canadense*), oriental bittersweet (*Celastrus orbiculatus*) and hay-scented fern (*Dennstaedtia punctilobula*).

2.4 Soils

The Soil Map Units mapped by United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) within and proximate to the Project Site are depicted on Figure 4 in Attachment A. A summary of the predominant soil associations within the Project Site and their important characteristics is provided below.

Table 2-1 Description of soils within the Project Site

Map Unit	Map Unit Name	General Soil Description	Drainage Classification	Hydric Soil
AmA	Amostown fine sandy loam (0-5% slope)	Very deep soils formed in glacial outwash fine gravel can be found up to 10%.	Moderately well drained	No
Bd	Birdsall silt loam (0-3% slope)	Deep soils, formed in water laid deposits of silt and fine sands	Very poorly drained	Yes
HfA	Hinckley sandy loam ()-3% slope)	Very deep soils formed by glaciofluvial deposits with from 5 to 50% gravels.	Excessively well drained	No
HfC	Hinckley sandy loam (8-15% slope)	Very deep soils formed by glaciofluvial deposits with from 5 to 50% gravels.	Excessively well drained	No
MeB	Merrimac fine sandy loam (3-8% slope)	Very deep soils formed in glacial outwash. Rock fragments can range from 10 to 50%.	Somewhat excessively drained	No
Ng	Ninigret fine sandy loam (0-3% slope)	Very deep stratified glacial outwash (fine loamy over sand/gravel)	Moderately well drained	No
Pg	Pits-Udorthents complex	Soils dominated by man-manipulated soils and gravel/sand mining operations.	Well drained	No
Ra	Raynham silt loam (0-3% slope)	Very deep silty glaciolacustrine deposits	Poorly drained	Yes
RdA	Ridgebury fine sandy loam (0-3% slope)	Very deep till derived in granite, gneiss, or schist rock. Rock fragments can range from 5 to 25%, stone sized fragments less than 1%, moderately slow infiltration	Somewhat poorly drained to poorly drained	Yes
ReA	Ridgebury fine sandy loam (0-3% slope), extremely stony	Very deep till derived in granite, gneiss, or schist rock. Rock fragments can range from 5 to 25%,stone sized fragments between 3-15%, moderately slow infiltration	Somewhat poorly drained to poorly drained	Yes

Table 2-1 Description of soils within the Project Site (continued)

Map Unit	Map Unit Name	General Soil Description	Drainage Classification	Hydric Soil
ReB	Ridgebury fine sandy loam (3-8% slope), extremely stony	Very deep till derived in granite, gneiss, or schist rock. Rock fragments can range from 5 to 25%, stone sized fragments between 3-15%, moderately slow infiltration	Somewhat poorly drained to poorly drained	Yes
Sb	Scarboro mucky loamy fine sand (0-3% slope)	Very deep sandy glaciofluvial deposits dominated by organic material.	Very poorly drained	Yes
UnA	Unadilla very fine sandy loam (0-3% slope)	Very deep, silty lacustrine deposits found on terraces	Well drained	No
WnA	Windsor loamy sand (0-3% slope)	Very deep sandy outwash deposits with up to 10% gravel	Excessively well drained	No
WrA	Woodbridge fine sandy loam (0-3% slope)	Soils moderately deep to densic contact formed in lodgment till can have up to 34% rock fragments.	Moderately well drained	No
WrB	Woodbridge fine sandy loam (3-8% slope)	Soils moderately deep to densic contact formed in lodgment till can have up to 34% rock fragments.	Moderately well drained	No
WsB	Woodbridge fine sandy loam (3-8% slope), very stony	Soils moderately deep to densic contact formed in lodgment till can have up to 34% rock fragments. Stone sized fragments between 0.1 and 3%.	Moderately well drained	No
WtB	Woodbridge fine sandy loam (3-8% slope), extremely stony	Soils moderately deep to densic contact formed in lodgment till can have up to 34% rock fragments. Stone sized fragments between 3-15%.	Moderately well drained	No

2.5 Threatened and Endangered Animal and Plant Species

According to available U.S. Fish and Wildlife Service (USFWS) data there are no known federally-listed species or Endangered Species Act designated Critical Habitat within the vicinity of the Project Site.[3]

The Project Site is not within areas mapped as Priority Habitat of Rare Species or Estimated Habitat of Rare Wildlife by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) under the Massachusetts Endangered Species Act (MESA) and the Massachusetts Wetlands Protection Act, respectively (Natural Heritage Atlas, 2008). According to the current NHESP Atlas (NHESP, 2008), there are no known certified or potentially certifiable vernal pools located in the Project Site. There are a number of potentially certifiable vernal pools located north, east and south of the Project Site, as shown in Attachment A, Figure 3. Epsilon identified one wetland system (Wetland Series 7) located north of the railroad tracks on the Project Site that functions as vernal pool habitat based on the observed presence of spotted salamander *(Ambystoma maculatum)* and wood

[3] Source: http://ecos.fws.gov/ipac/wizard.

frog *(Lithobates sylvaticus)* egg masses, hydrologic characteristics, juxtaposition in the landscape and topography and plant community composition. This area has not been previously mapped by NHESP. See Figure 3 for additional detail and Attachment D, the Vernal Pool Assessment Memo prepared by Oxbow Associates and USACE Vernal Pool Evaluation prepared by Epsilon for additional detail.

3.0 Wetland Delineation Methodology

This section of the report describes the methods and materials used to conduct the wetland delineation work and field survey work. The wetland delineation work was conducted by professional wetland scientists and certified soil scientists from Epsilon.

3.1 Preliminary Data Review

Prior to performing fieldwork, background information was reviewed to assist in the initial identification of wetlands, surface waterbodies, and ephemeral waterbodies (e.g., vernal pools) within the Project Site. Information sources included color-infrared aerial photographs of the Project Site, USGS 7.5-Minute Series Topographic Quadrangle Maps, MassGIS™ data layers, National Wetlands Inventory (NWI) Maps, NRCS Soil Surveys, FEMA FIRMs, and several base map and environmental data layers distributed by MassGIS™. The delineation team also reviewed existing conditions plans and permit drawings depicting wetlands delineated by others on and adjacent to the Project Site over the past ten plus years.

The site plans, permit drawings, USGS topographic maps, the NWI and MassGIS™ wetlands data layer, NRCS soil maps, and the aerial photographs referenced above were used to indicate the possible presence of wetlands on the Project Site. The NWI and MassGIS™ wetland information can be particularly useful, showing different types of wetland environments and the potential presence of hydrologic connections between wetlands. It should be noted that NWI and MassGIS™ maps carry no federal jurisdictional value and serve only as general reference documents. The soil maps can indicate the potential presence of wetlands via soil classifications (e.g., somewhat poorly drained, poorly drained, and very poorly drained soils).

3.2 Field Delineation Methodology

During the months of September and October 2012, professional wetland scientists and certified soil scientists from Epsilon delineated wetlands and other waters of the U.S. on the Project Site. In accordance with 33 CFR 328.4 (Limits of Jurisdiction), the limits of Corps jurisdiction in non-tidal waters, in the absence of adjacent wetlands, extends to the ordinary

high water mark (OHWM).[4] Consistent with this definition, the edge of jurisdictional wetlands were delineated with pink flagging tape with the label "Wetland Delineation" and a flag series number (e.g., A-1). Where the OHWM of rivers and streams was not coincident with the edge of wetlands, the OHWM limit was delineated with blue flagging tape with the label "B" and a unique flag series number (e.g., B-1). Blue flagging tape was also used to identify the locations of transects and plots where Corps wetland determination forms were completed. The upland data point along each transect contained a "U" in the flag series whereas the wetland data point along the same transect contained a ""W" in the flag series. Wetland flags were located in the field by Registered Professional Land Surveyors using traditional survey methods. The survey data were incorporated onto the project drawings and maps.

Wetlands were delineated in accordance with the Corps *1987 Wetland Delineation Manual* and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region, Version 2.0 (January 2012).* These methods include field-testing for the presence of criteria that are typically found in wetlands. These criteria include wetland hydrology, a predominance of hydrophytic vegetation and hydric soils.

Vegetation cover types were classified into distinctive upland, wetland, and aquatic ecological communities. Water bodies and watercourses, including rivers, streams, and drainage ditches were characterized within the Project Site. Photographs were taken at select wetland areas representative of the Project Site. Data from the delineated wetlands including vegetation, soil characteristics, hydrology, photographic information, and sketches were recorded in a field notebook.

Soils, the first of three diagnostic characteristics of a wetland, were examined and evaluated both within and outside the wetland boundaries using a soil Dutch auger to a depth of approximately 20 inches. Soils were characterized throughout this depth. Soil colors were identified using a Munsell® Soil Color Chart (Munsell, 1998), and other characteristics such as soil texture and moisture were recorded. Hydric characteristics such as organic soil layers, reduced matrices, and redoximorphic features were noted when they occurred.

The Corps delineation manuals provide guidelines for determining the presence of wetland hydrology, the second of the three diagnostic characteristics of a wetland. In general, the criteria for wetland hydrology are met if the area is inundated or saturated at the soil surface during the growing season for a time sufficient to develop hydric soils and support hydrophytic vegetation. In some instances, other field characteristics specified in the manuals to identify wetland hydrology were also utilized. These characteristics included

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[4] According to 33 CFR 328.3(e) and Corps Regulatory Guidance Letters, an OHWM is a line on the shore established by the fluctuations of water and indicated by physical characteristics, or by other appropriate means that consider the characteristics of the surrounding areas.

water stained leaves, blowdowns, shallow roots and drainage patterns. Hydrologic characteristics as well as the depth of surface water, or depth to soil saturation, were recorded for each wetland area.

To determine the presence of hydrophytic vegetation, the third of the diagnostic wetland characteristics, the dominant plant species in each major vegetative stratum (e.g., tree, shrub/sapling, herbaceous, and woody vine) were identified and recorded for each wetland area using the Corps Standard Dominance Test procedure. Each plant was then assigned a wetland indicator status (e.g., obligate, facultative, etc) from the Corps *2012 National Wetland Plant List* (NWPL). A prevalence of dominant species (i.e., greater than 50%) that are facultative, facultative wetland, and obligate wetland indicates the presence of hydrophytic vegetation.

4.0 Wetland Characteristics

4.1 Wetland Classifications

Delineated wetlands and other waters of the U.S. were categorized to a subsystem or class level according to the USFWS *Classification of Wetlands and Deepwater Habitats of the United States* (the Cowardin Approach).[5] The USFWS System broadly defines wetland types by hydrology and vegetative cover. Wetlands are categorized within a classification hierarchy of Systems, Subsystems, and Classes. Systems, the highest level of the classification hierarchy, include Marine, Estuarine, Riverine, Lacustrine, and Palustrine. Marine and Estuarine Systems each have two Subsystems - Subtidal and Intertidal; the Riverine System has four Subsystems - Tidal, Lower Perennial, Upper Perennial, and Intermittent; the Lacustrine has two - Littoral and Limnetic; and the Palustrine has no Subsystems.

Within the Subsystems, Classes are based on substrate material and flooding regime, or on vegetative life form. The same Classes may appear under one or more of the Systems or Subsystems. Six Classes are based on substrate and flooding regime: (1) Rock Bottom with a substrate of bedrock, boulders, or stones; (2) Unconsolidated Bottom with a substrate of cobbles, gravel, sand, mud, or organic material; (3) Rocky Shore with the same substrates as Rock Bottom; (4) Unconsolidated Shore with the same substrates as Unconsolidated Bottom; (5) Streambed with any of the substrates; and (6) Reef with a substrate composed of the living and dead remains of invertebrates (corals, mollusks, or worms). The bottom Classes, (1) and (2) above, are flooded all or most of the time and the shore Classes, (3) and (4), are exposed most of the time. The Class Streambed is restricted to channels of intermittent streams and tidal channels that are dewatered at low tide. The life form of the dominant vegetation defines the five Classes based on vegetative form: (1) Aquatic Bed,

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[5] Cowardin, L. et al. (1979). Classification of Wetlands and Deepwater Habitats of the United States, United States Fish and Wildlife Service, Biological Services Program, Washington, D.C., FWS/OBS-79/31.

dominated by plants that grow principally on or below the surface of the water; (2) Moss-Lichen Wetland, dominated by mosses or lichens; (3) Emergent Wetland, dominated by emergent herbaceous angiosperms; (4) Scrub-Shrub Wetland, dominated by shrubs or small trees; and (5) Forested Wetland, dominated by large trees.

Using the Cowardin approach, the wetland systems identified within the Project Site include predominantly Riverine Lower Perennial Unconsolidated Bottom (UB), Riverine Intermittent Streambed and Palustrine Forested Wetlands (PFO). Palustrine Scrub-Shrub Wetlands (PSS), Palustrine Emergent Wetlands (PEM) and Lacustrine Littoral/Limnetic wetlands are also present to a lesser degree.

- **Riverine Lower Perennial UB (Cotley River)** includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean derived salts in excess of 0.5 percent. A channel is an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water. The Riverine System is bounded on the landward side by upland, by the channel bank (including natural and man-made levees), or by wetland dominated by trees, shrubs, persistent emergent vegetation, emergent mosses, or lichens. In Lower Perennial subsystems the gradient is low and water velocity is slow. There is no tidal influence, and some water flows throughout the year. The substrate consists mainly of sand and mud. Oxygen deficits may sometimes occur, the fauna is composed mostly of species that reach their maximum abundance in still water, and true planktonic organisms are common. The gradient is lower than that of the Upper Perennial Subsystem and the floodplain is well developed.

- **Riverine Intermittent Streambed (unnamed intermittent streams)** contains flowing water for only part of the year. When the water is not flowing, it may remain in isolated pools or surface water may be absent.

- **Lacustrine systems** are defined as wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses and lichens with greater than 30 percent aerial coverage; and (3) total area exceeds 8 hectares (20 acres). Subsystems consist of Littoral and Limnetic zones, i.e. zones characterized by varying plant growth and flood conditions.

- **PFO** is defined as woody vegetation that is six meters (20 feet) tall or taller covering 30 percent or more of the wetland area. They may occur in the Palustrine and Estuarine Systems and normally possess an overstory of trees, an understory of young trees or shrubs, and a herbaceous layer. Forested wetlands typically receive runoff from adjacent areas, have poorly drained soils and may be inundated for

extended periods during the growing season. These areas may have several inches to a foot of water in the wet seasons while completely drying out in the summer months.

- **PSS** wetlands are dominated by woody vegetation (i.e. young trees, shrubs) less than six meters (20 feet) tall covering 30 percent or more of the wetland area. Scrub-shrub wetlands occur mostly in landscape depressions where inundation is typically seasonal. These areas may have several inches to several feet of water in the wet seasons while completely drying out in the summer months. PSS wetlands are frequently found in conjunction with an emergent wetland area or on the fringe of a forested wetland. Scrub-shrub wetlands may represent a successional stage leading to a forested wetland, or they may be relatively stable communities.

- **PEM** class wetlands are characterized by an open structure and the presence of erect, rooted, herbaceous hydrophytes with few or no woody plant species present. This vegetation, often dominated by perennial grasses, sedges and rushes, is present for the majority of the growing season in most years. PEM wetlands commonly occur in landscape depressions where water from slope or field drainage collects, and at the margins of inundated pond and river wetland systems. The soils typically consist of a layer of well-decomposed organic muck overlying mineral material. Emergent wetlands are known by many names including marsh and wet meadow.

There are a variety of regional specific plant communities within these classes of wetlands. These plant communities provide different functions and values to the surrounding landscape. A general functional assessment of the wetlands within the Project Site is provided under separate cover within the FEIS.

4.2 Detailed Description of Delineated Wetlands

The wetland community types identified within the Project Site are described in detail below. For the purposes of this report the wetland systems described herein are presumed to be waters of the U.S. subject to jurisdiction under Section 404 of the U.S. Clean Water Act (see Section 5.0 for additional detail). Refer to Figure 3 – Delineated Waters of the United States provided in Attachment A for the location and extent of each wetland flag series. Representative USACE wetland determination data forms are provided in Attachment B. Site photographs of each delineated wetland are provided in Attachment C.

A summary of the delineated waters of the U.S. within the Project Site and their important characteristics is provided below. The subsequent sections provide more specific information on the delineated waters of the U.S.

Table 4-1 Summary of delineated waters of the U.S. within the Project Site

Wetland Series ID	Flag Series	Cowardin Classification	Dominant Vegetation	Wetland Acreage (acres)
1	O1-O17	PEM	Cattail (*Typha spp.*), beggar-ticks (*Bidens spp.*), soft rush (*Juncus effusus*), spike rush (*Eleocharis spp.*) & lurid sedge (*Carex lurida*)	**0.2**
2	**Wetland:** A1-A101, A147-A205, A300-A393, A400-A436, A500-A517, A600-A637, A700-713, A800-A807, A1000-A1033, A1110-A1116, F1-F41, F100-F105, F200-F211, F300-F320, F3a-F3k, M1-M65, AA1-AA13, AC1-AC20, R1-R8, FP1-FP3 & FX1-FX11 **Cotley River:** B1-B99, B200-B222 & B300-B355 **Streams:** E1-E6, G1-G15 & G100-G113, B8-B30	R2 (Cotley River), R4, PFO, PSS	Red maple, yellow birch (*Betula alleghaniensis*), American elm, ironwood (*Carpinus caroliniana*), viburnums, sweet pepperbush, sensitive fern (*Onoclea sensibilis*) & cinnamon fern (*Osmunda cinnamomea*)	**29.8**
3	**Wetland:** D100-D114 & D300-D374 **Stream:** D1-D9	R4, PFO, PSS, PEM	Red maple, swamp white oak, white pine red oak, ironwood, viburnums, spicebush (*Lindera benzoin*) & marsh fern (*Thelypteris palustris*)	**11.1**
4	**Wetland:** H700-H770 **Cotley River:** H1-H80, H300-H303, H400-H404, H500-H503 & H600-H605.	R2 (Cotley River), L1 (Barstows Pond), PFO,PEM	Red maple, viburnums, sweet pepperbush, cattail, tussock sedge (*Carex stricta*) & rice cutgrass (*Leersia oryzoides*)	**3.3**
5	N1-N21	PFO	Red maple, white pine, winterberry (*Ilex verticillata*), highbush blueberry & viburnums	**0.2**
6	J1-J15	PFO	Red maple, white pine, winterberry, highbush blueberry & viburnums	**0.2**
7	I1-I20	PSS	Buttonbush (*Cephalanthus occidentalis)*, silky dogwood (*Cornus amomum*), highbush blueberry, winterberry & viburnums	**0.2**
8	K1-K8	PFO	Winterberry, highbush blueberry & viburnums	**0.04**
9	L1-L7	PEM	Cattail	**0.01**

4.2.1 Wetland 1

Wetland 1 is delineated by flags O1 through O17. It is located in the west central portion of the Project Site, south of the railroad tracks and west of a newly constructed warehouse facility. This somewhat isolated wetland occurs in a shallow topographic depression dominated by cattail, beggar-ticks, soft rush, spike rush and lurid sedge. This feature is part previous mitigation plans for prior development and Epsilon understands that it was created primarily for compensatory flood storage mitigation. This feature is approximately 0.2 acres.

4.2.2 Wetland 2

Wetland 2 is delineated by flags A1 through A101, A147 through A205, A300 through A393, A400 through A436, A500 through A517, A600 through A637, A700 through 713, A800 through A807, A1000 through A1033, A1110 through A1116, F1 through F41, F100 through F105, F200 through F211, F300 through F320, F3a through F3k, M1 through M65, AA1 through AA13, AC1 through AC20, R1 through R8, FP1 through FP3 and FX1 through FX11. Wetland 2 is located along the western extent of the Project Site, south of the railroad tracks and is part of the Cotley River system. The Cotley River is identified within this wetland system by flags B1 through B99, B200 through B222 and B300 through B355. Wetland 2 consists of a predominately forested wetland containing smaller sections of scrub-shrub wetlands. Wetland 2 is also fed by three intermittent streams; one located along the northern extent of this system, another located along the western portion of the system that conveys water from a culvert below Route 24, and a third stream conveying water from the LUIP stormwater system. These streams are flags E1 through E6, G1 through G15 and G100 through G113, and a portion of the B-flag series.

The wetland is a mix of PFO, PSS, R2 (Riverine Lower Perennial UB) and R4 (Riverine Intermittent Streambed) cover types. The delineated portion of this wetland within the Project Site covers approximately 29.8 acres. The stream enters the Project Site via a culvert under Stevens Street and Route 140. The topography is gently sloping in a northerly direction and toward the Cotley River/Barstows Pond wetland complex (defined herein as Wetland 4). There is generally an abrupt transition at the wetland-upland interface. Marked exceptions include discrete portions of the wetland that extend upslope into groundwater seep areas. Hydrologic input is derived from upstream watersheds and drainage areas, groundwater discharge, surface runoff and precipitation.

Dominant vegetation within the wetland includes red maple, yellow birch, American elm, ironwood, viburnums, sweet pepperbush in the tree and sapling/shrub strata. The herb stratum includes sensitive fern and cinnamon fern.

The majority of Wetland 2 is mapped by NRCS as Birdsail silt loam and Raynham silt loam, which are designated hydric soils. Based on visual observations the soils in the delineated wetland are generally consistent with these Soil Map Units, consisting of very poorly drained hydric soils and redoximorphic features (i.e. concentrations and depletions).

4.2.3 Wetland 3

Wetland 3 is delineated by flags D1 through D9, D100 through D114, D300 through D374. Wetland 3 is located along the eastern extent of the Project Site south of the railroad tracks. This wetland is generally topographically flat to gently sloping and is contiguous to two intermittent streams that generally flow west and into Wetland 2/Cotley River system via culverts under O'Connell Way. The intermittent streams are identified by the D1 through D9 flag series and via aerial photography as the northern intermittent stream is not located within the Project Site. The eastern edge of this wetland was also not delineated and the wetland continues outside the Project Site. The eastern portion of Wetland 3 is dominated by forested wetlands while the western portion of this wetland is generally scrub-shrub or emergent.

The wetland is a mix of PFO, PSS, PEM and R4 cover types. The delineated portion of this wetland within the Project Site covers approximately 11.1 acres. Hydrologic input is derived from groundwater discharge, surface runoff and precipitation.

Dominant vegetation within the wetland includes red maple, swamp white oak, white pine red oak, ironwood, viburnums and spicebush in the tree and sapling/shrub strata. The herb stratum includes marsh fern.

The majority of Wetland 3 is mapped by NRCS as Scarboro mucky loamy fine sand, which is a designated hydric soil. Based on visual observations the soils in the delineated wetland are generally consistent with this Soil Map Unit, although less poorly drained in portions, consists of mucky modified surface horizons and/or redoximorphic features.

4.2.4 Wetland 4

Wetland 4 is delineated by flags H700 through H770. Wetland 4 is located along the western extent of the Project Site north of the railroad tracks and is part of the Cotley River system. The Cotley River is identified within this wetland system by flags H1 through H80, H300 through H303, H400 through H404, H500 through H503 and B600 through H605. Wetland 4 consists of predominately lacustrine and riverine features with narrow bands of forested and emergent wetlands. Wetland 4 is a continuation of Wetland 2 as the Cotley River flows onto the northern Project Site via a railroad culvert. This wetland has been manipulated by human activity and the majority of this feature is an impoundment resulting from Barstows Pond Dam, located at immediately south of Hart Street at the northernmost

extent of the Project Site. The southern portion of this system contains a riverine portion of the Cotley River that is bounded within the primary floodplain by rice cutgrass dominated PEM.

The wetland is a mix of PFO, PEM, L1 (Lacustrine) and R2 cover types. The delineated portion of this wetland within the Project Site covers approximately 3.3 acres. The topography is gently sloping to the north. The Cotley River flows north, offsite via the Hart Street culvert and ultimately into the Taunton River. Hydrologic input is derived from upstream watersheds and drainage areas, groundwater discharge, surface runoff and precipitation.

Dominant vegetation within the wetland includes red maple, viburnums and sweet pepperbush in the tree and sapling/shrub strata. The herb stratum includes cattail, tussock sedge and rice cutgrass.

The majority of Wetland 4 was mapped by NRCS as open water. The limited wetland component of Wetland 4 consists of very poorly drained hydric soils with mucky surface textures and/or redoximorphic features.

4.2.5 Wetland 5

Wetland 5 is delineated by flags N1 through N21. Wetland 5 is located north of the railroad tracks, in the south-central portion of the Project Site. This somewhat isolated pocket wetland occurs in a shallow topographic depression located within an upland forest. This PFO wetland is dominated by red maple, white pine, winterberry, highbush blueberry and viburnum in the tree and sapling/shrub strata. This wetland is approximately 0.2 acres.

Hydrologic input is limited to groundwater discharge, surface runoff and precipitation. There is evidence of periodic standing water (water stains/ marks on trees). Wetland 5 is mapped by NRCS as Windsor loamy sand, which is an excessively drained soil and not designated as hydric. Based on visual observations the soils in this delineated wetland are wetter than mapped and exhibit redoximorphic features.

4.2.6 Wetland 6

Wetland 6 is delineated by flags J1 through J15. Wetland 6 is also located north of the railroad tracks, in the south-central portion of the Project Site, immediately south of Wetland 5. This somewhat isolated pocket wetland occurs in a shallow topographic depression located within an upland forest. This PFO wetland is also dominated by red maple, white pine, winterberry, highbush blueberry and viburnum in the tree and sapling/shrub strata, yet at a lesser density than Wetland 5. This wetland is approximately 0.2 acres.

Hydrologic input is also limited to groundwater discharge, surface runoff and precipitation. There is minor evidence of periodic standing water (water stains/ marks on trees). Wetland

6 is mapped by NRCS as Windsor loamy sand, which is an excessively drained soil and not designated as hydric. Based on visual observations the soils in this delineated wetland are wetter than mapped and exhibit redoximorphic features.

4.2.7 Wetland 7

Wetland 7 is delineated by flags I1 through I20. Wetland 7 is located north of the railroad tracks, in the central portion of the Project Site. This somewhat isolated pocket wetland occurs in a topographic depression located within an upland forest. This PSS wetland is dominated by buttonbush, with standing water throughout for long periods during the year. Peripheral portions of the wetland include silky dogwood, highbush blueberry, winterberry and viburnum in the shrub strata. This wetland is approximately 0.2 acres.

Hydrologic input is limited to groundwater discharge, surface runoff and precipitation. There is evidence of periodic standing water (water stains/ marks on trees and water stained leaves). Wetland 7 is mapped by NRCS as Hinckley sandy loam, which is an excessively drained soil and not designated as hydric. Based on visual observations the soils in the delineated wetland are wetter than mapped and exhibit mucky modified surface textures and/or redoximorphic features.

Based on site specific observations this wetland functions as a vernal pool, in April 2012 and 2014, Epsilon observed spotted salamander egg masses, wood frog egg masses and fairy shrimp (*Branchinecta lynchi*). This wetland also exhibits classic vernal pool hydrologic characteristics and topographic features. This area has not been previously mapped by NHESP, however Epsilon utilized NHESP methodology to confirm such. Epsilon completed vernal pool assessments as a result of the April 2012 and 2014 visits, information is included in Attachment D. Attachment D also includes the Vernal Pool Assessment Memo prepared by Oxbow Associates as a result of the April 2014 visit.

4.2.8 Wetland 8

Wetland 8 is delineated by flags K1 through K8. Wetland 8 is also located north of the railroad tracks, in the northwest corner of the Project Site. This somewhat isolated pocket wetland occurs in a shallow topographic depression located within an upland forest. This PFO wetland is sparsely vegetated with winterberry, highbush blueberry and viburnum shrub strata. A white pine overstory shades this wetland. This wetland is approximately 0.04 acres.

Hydrologic input is also limited to groundwater discharge, surface runoff and precipitation. There is minor evidence of periodic standing water (water stains). Wetland 8 is mapped by NRCS as Hinckley sandy loam, which is an excessively drained soil and not designated as hydric. Based on visual observations the soils in this delineated wetland are wetter than mapped and exhibit redoximorphic features.

4.2.9 Wetland 9

Wetland 9 is delineated by flags L1 through L7. Wetland 9 is located south of the railroad tracks and immediately west of Wetland 3. This somewhat isolated pocket wetland occurs in a shallow topographic depression located within an upland field and is dominated by cattail. This wetland is approximately 0.01 acres.

Hydrologic input is also limited to surface runoff and precipitation, a standing water periodically ponds over the rock or dense gravels that underlie this area. Wetland 9 is mapped by NRCS as Unadilla very fine sandy loam, which is well drained soil and not designated as hydric. Based on visual observations the soils in this delineated wetland are wetter than mapped and exhibit redoximorphic features.

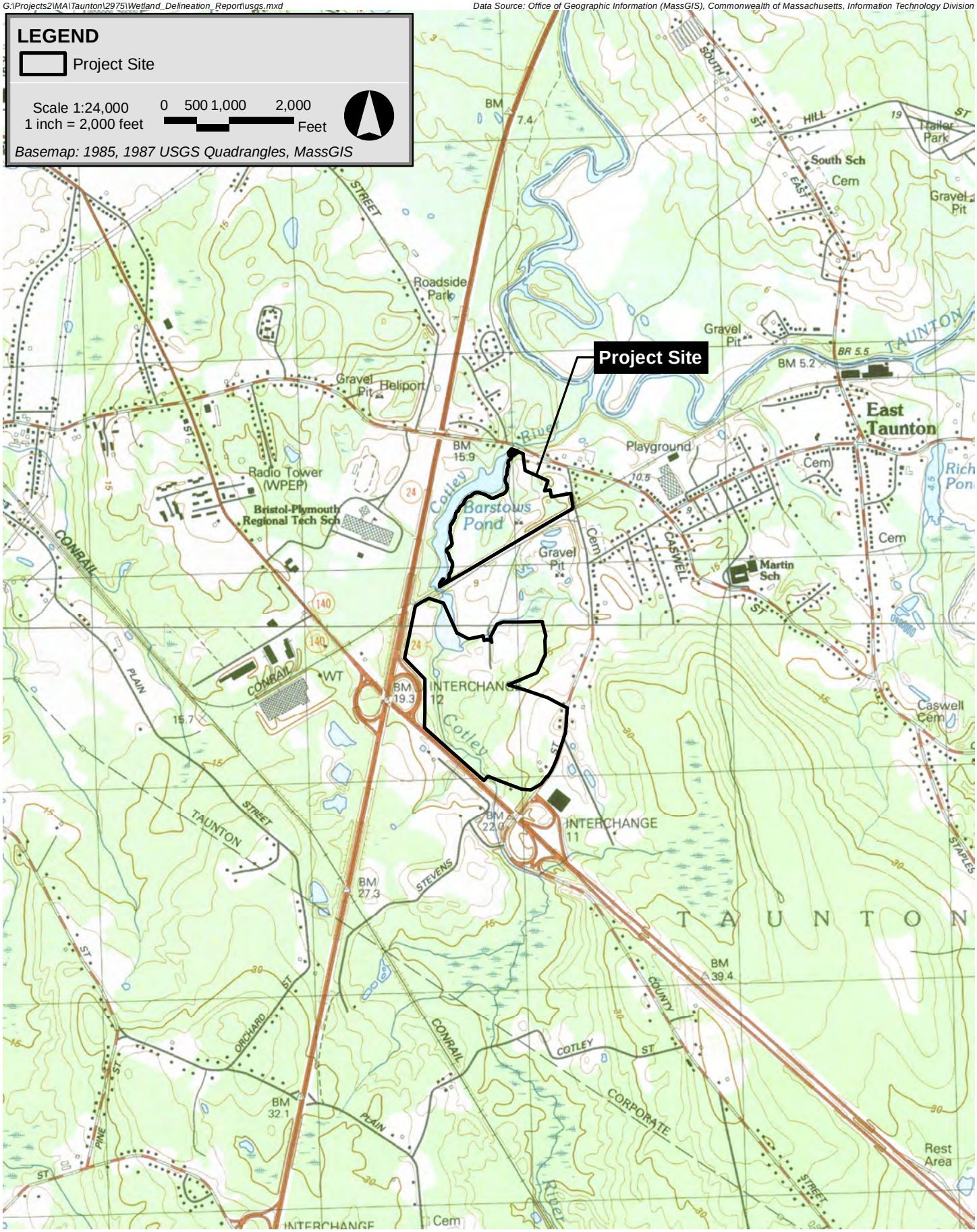
5.0 Conclusion

As described above, on September and October 2012, wetland and soil scientists from Epsilon delineated wetlands within the Project Site. Epsilon delineated approximately 45.05 acres of wetlands within the wetland delineation boundary. Wetland systems identified within the Project Site include predominantly Riverine Lower Perennial and Intermittent Streams and Palustrine Forested Wetlands, with Palustrine Scrub-Shrub Wetlands, Palustrine Emergent Wetlands, Riverine Intermittent and Lacustrine Littoral/Limnetic wetlands also present to a lesser degree. For the purposes of this delineation report all of the wetland systems delineated within the Project Site are presumed to be waters of the U.S. subject to jurisdiction under Section 404 of the U.S. Clean Water Act.

Attachment A

Figures

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Project First Light Taunton Massachusetts

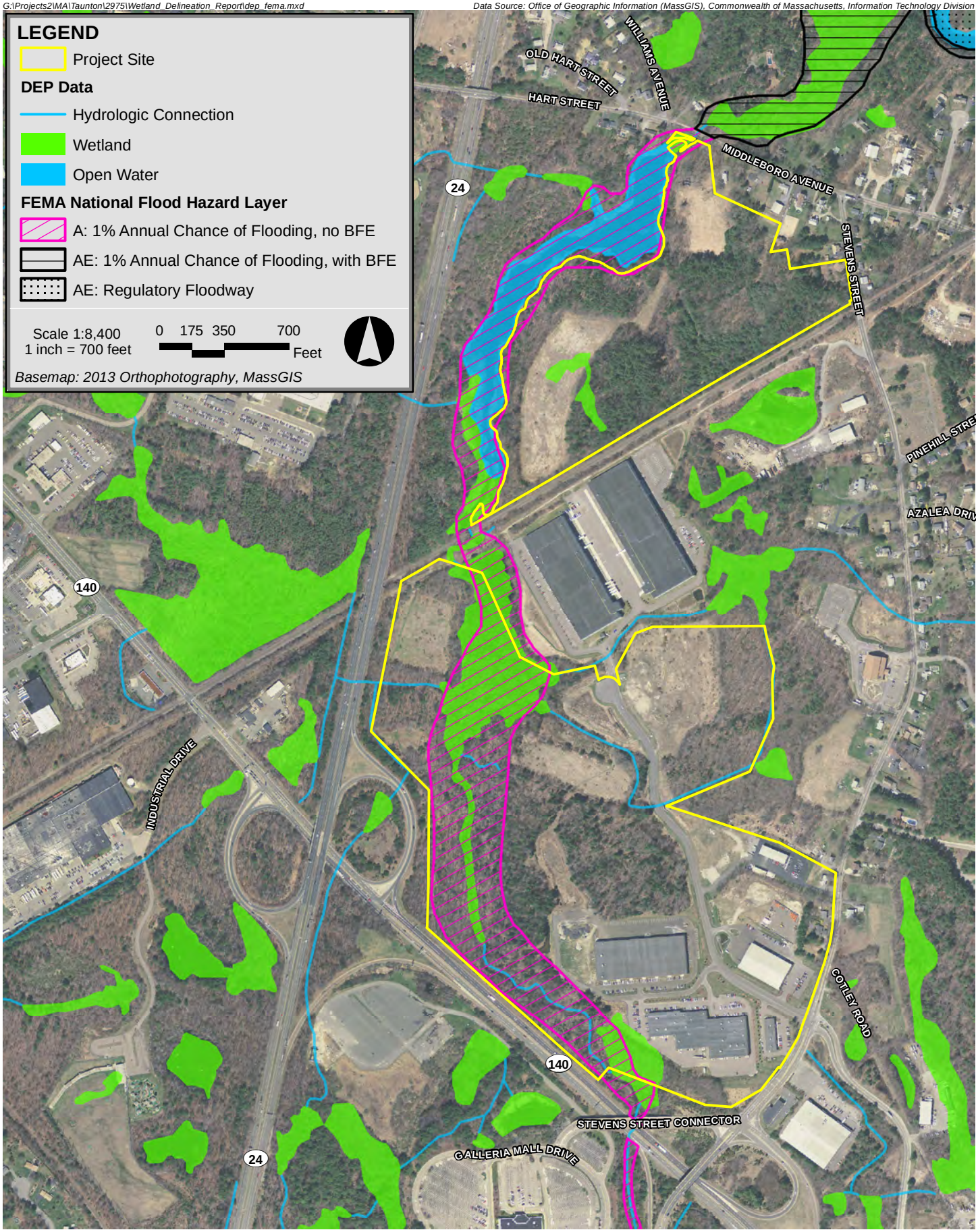
Epsilon Associates Inc.

Figure 1

USGS Locus

G:\Projects2\MA\Taunton\2975\Wetland_Delineation_Report\dep_fema.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Project First Light Taunton Massachusetts

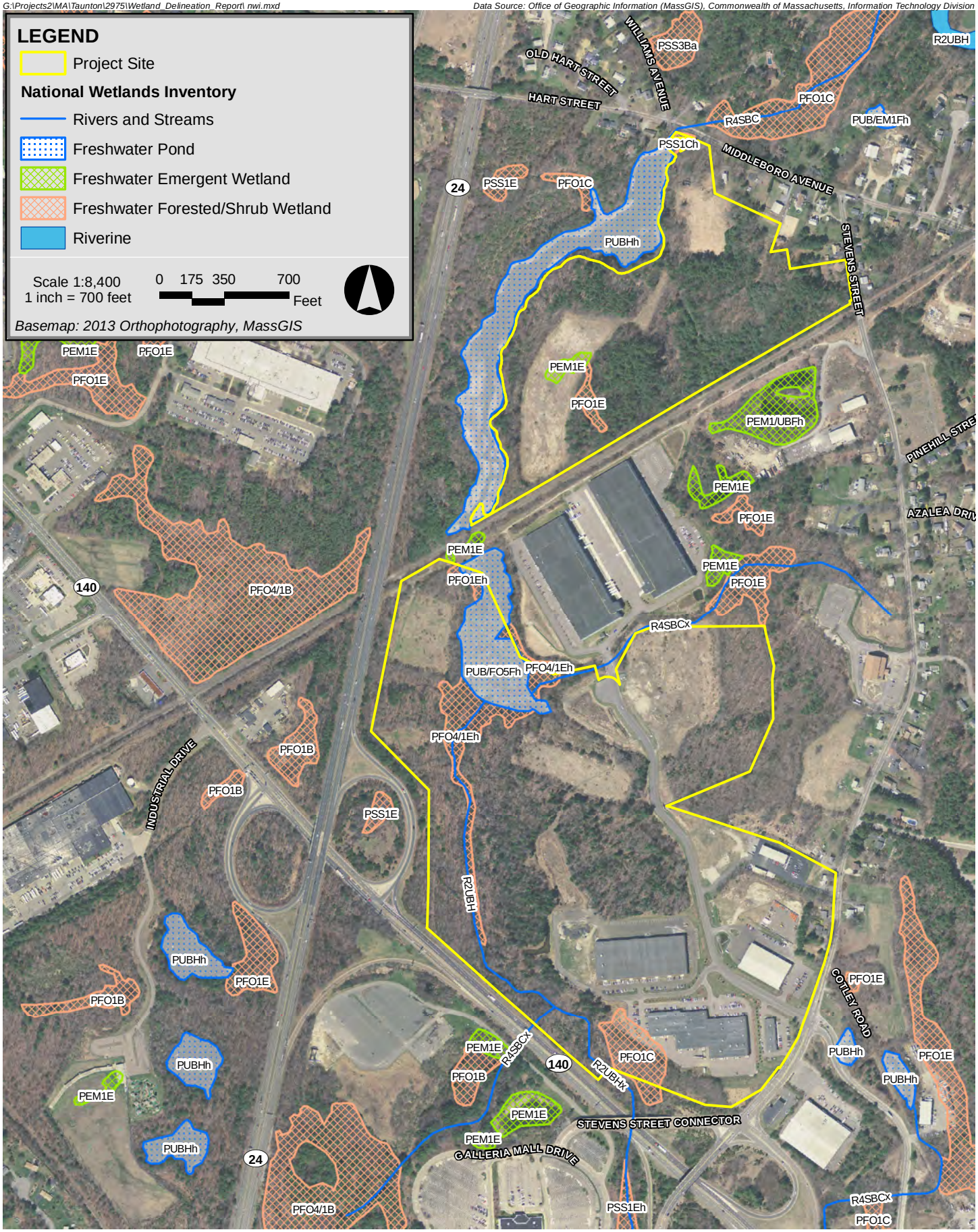
Epsilon ASSOCIATES INC.

Figure 2a

DEP Wetlands and FEMA Flood Zones

G:\Projects2\MA\Taunton\2975\Wetland_Delineation_Report\ nwi.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



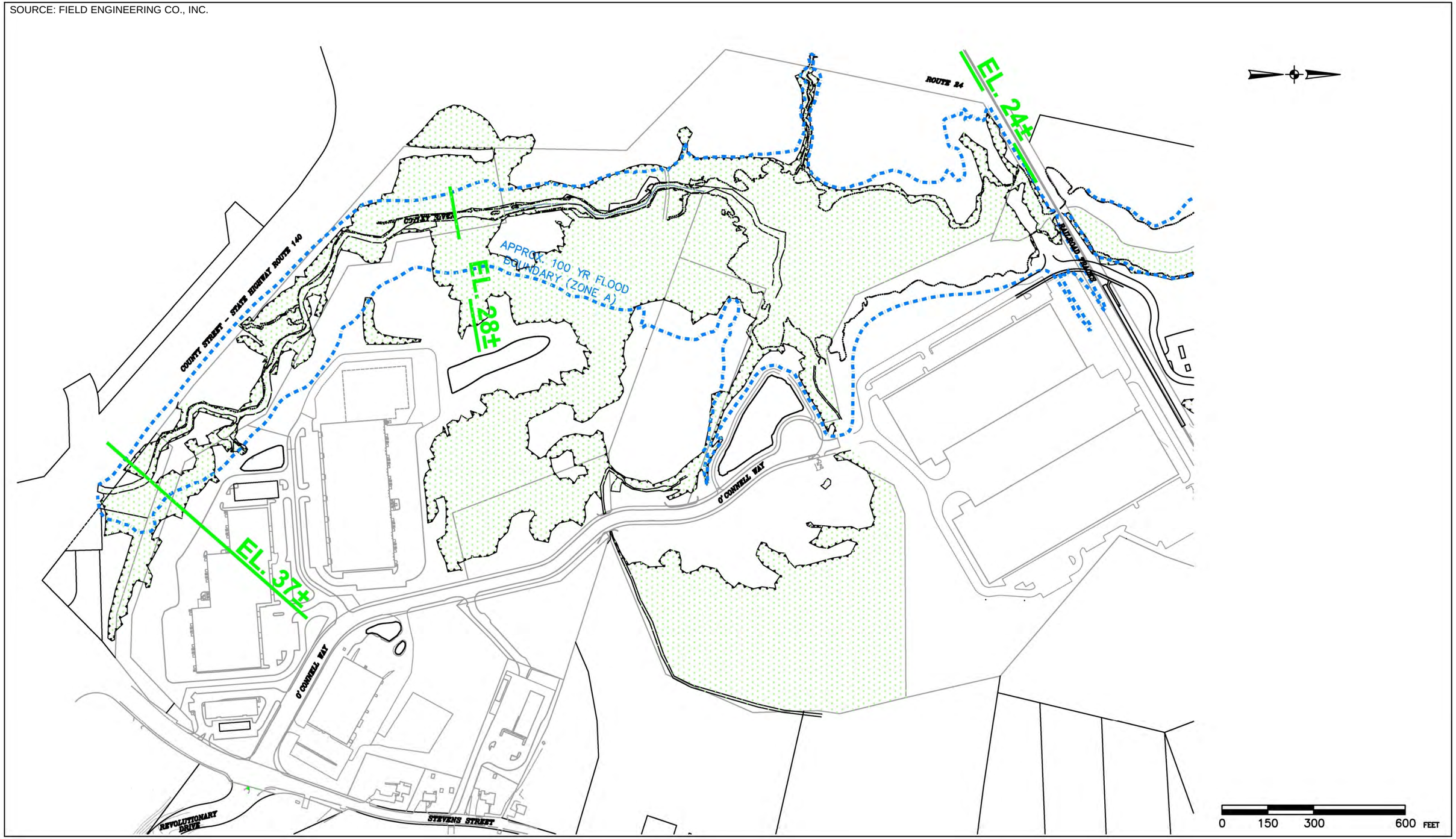
Project First Light **Taunton Massachusetts**

Epsilon Associates Inc.

Figure 2b

National Wetlands Inventory

SOURCE: FIELD ENGINEERING CO., INC.



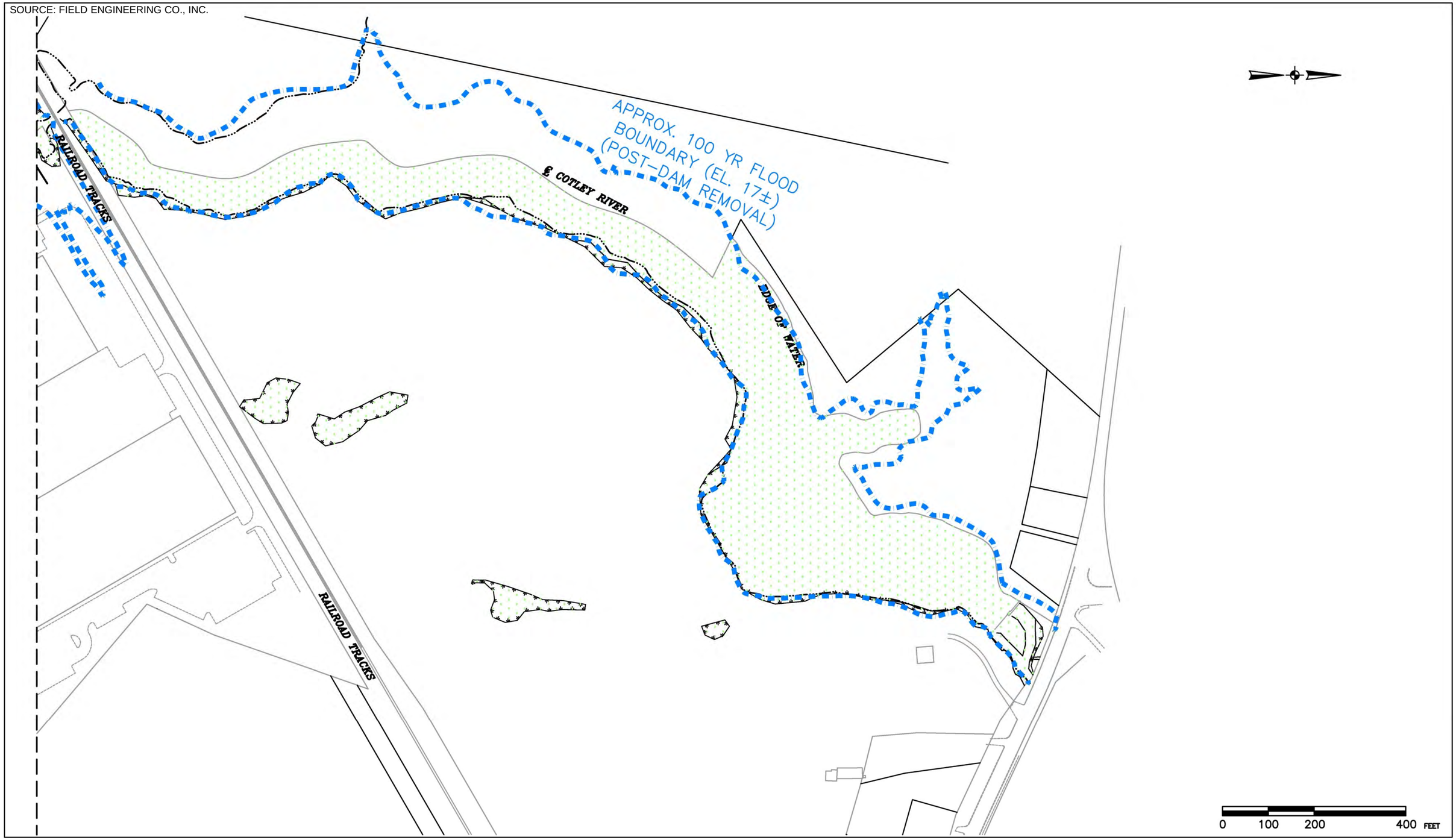
Project First Light Taunton Massachusetts

Epsilon ASSOCIATES INC.

Figure 2c

100 Year Floodplain Elevations (South of Railroad Tracks)

SOURCE: FIELD ENGINEERING CO., INC.



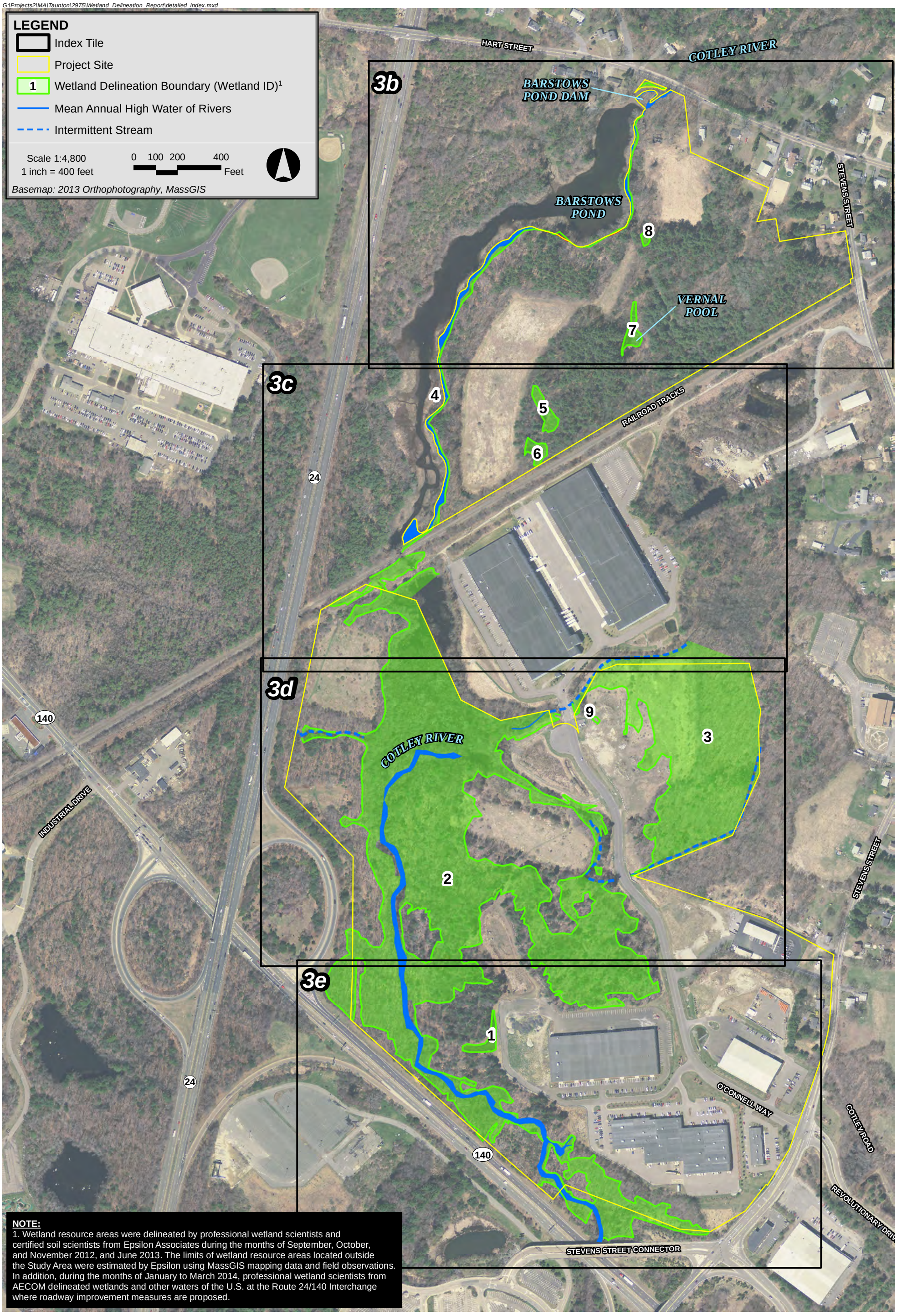
Project First Light **Taunton Massachusetts**

Epsilon ASSOCIATES INC.

Figure 2d

100 Year Floodplain Elevations (North of Railroad Tracks)

G:\Projects2\MA\Taunton\2975\Wetland_Delineation_Report\detailed_index.mxd



NOTE:
1. Wetland resource areas were delineated by professional wetland scientists and certified soil scientists from Epsilon Associates during the months of September, October, and November 2012, and June 2013. The limits of wetland resource areas located outside the Study Area were estimated by Epsilon using MassGIS mapping data and field observations. In addition, during the months of January to March 2014, professional wetland scientists from AECOM delineated wetlands and other waters of the U.S. at the Route 24/140 Interchange where roadway improvement measures are proposed.

Project First Light **Taunton Massachusetts**

Epsilon ASSOCIATES INC.

Figure 3a - Index Map

Delineated Waters of the U.S. (Wetland Series 1 through 9)

G:\Projects2\MA\Taunton\2975\Wetland_Delineation_Report\detailed_3b.mxd

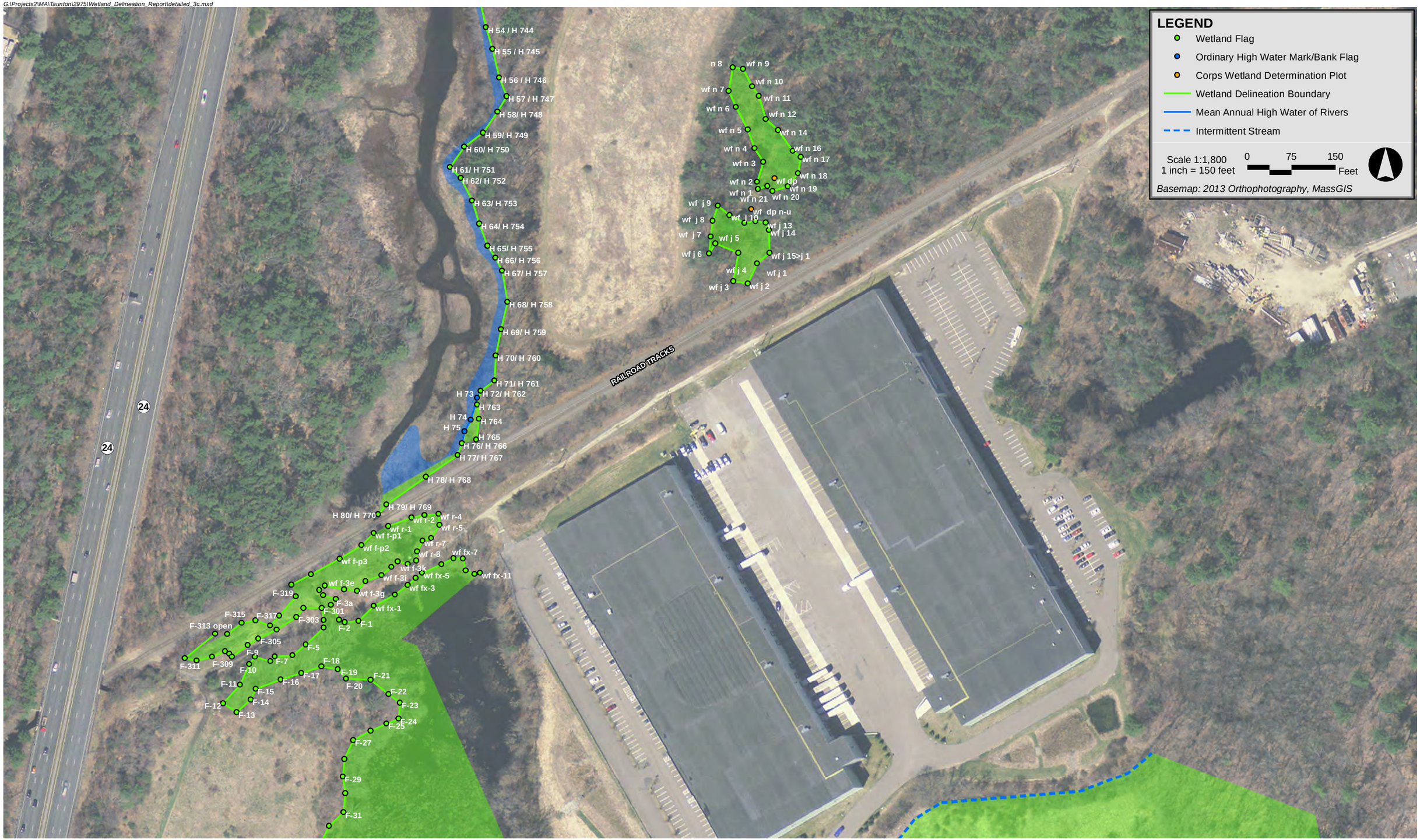
Project First Light **Taunton Massachusetts**

Epsilon Associates Inc.

Figure 3b

Delineated Waters of the U.S. (Wetland Series 1 through 9)

G:\Projects2\MA\Taunton\2975\Wetland_Delineation_Report\detailed_3c.mxd



Project First Light **Taunton Massachusetts**

Epsilon ASSOCIATES INC.

Figure 3c

Delineated Waters of the U.S. (Wetland Series 1 through 9)

G:\Projects2\MA\Taunton\2975\Wetland_Delineation_Report\detailed_3d.mxd

Project First Light **Taunton Massachusetts**

Epsilon ASSOCIATES INC.

Figure 3d

Delineated Waters of the U.S. (Wetland Series 1 through 9)

G:\Projects2\MA\Taunton\2975\Wetland_Delineation_Report\detailed_3e.mxd

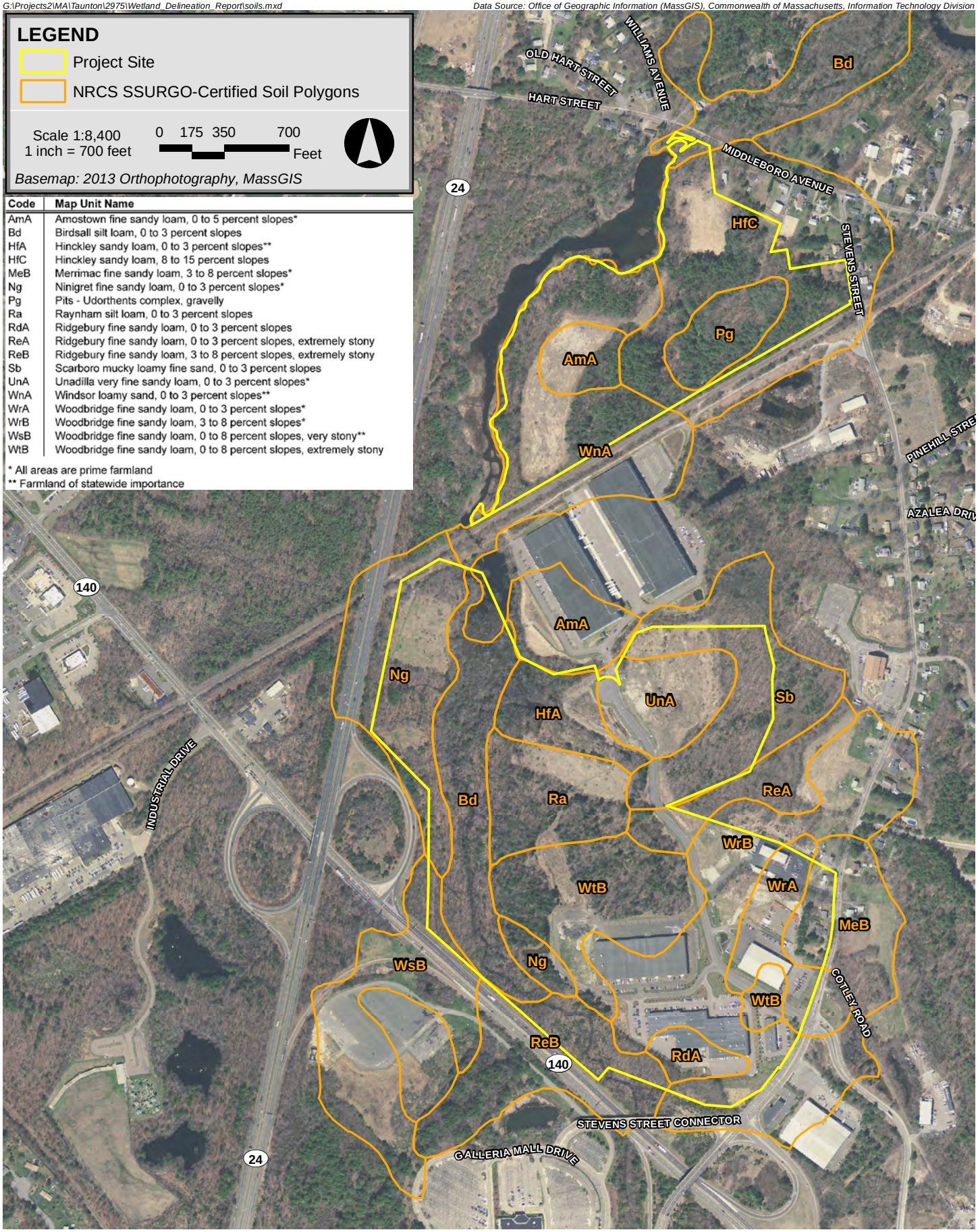
Project First Light **Taunton Massachusetts**

Epsilon ASSOCIATES INC.

Figure 3e

Delineated Waters of the U.S. (Wetland Series 1 through 9)

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Code	Map Unit Name
AmA	Amostown fine sandy loam, 0 to 5 percent slopes*
Bd	Birdsall silt loam, 0 to 3 percent slopes
HfA	Hinckley sandy loam, 0 to 3 percent slopes**
HfC	Hinckley sandy loam, 8 to 15 percent slopes
MeB	Merrimac fine sandy loam, 3 to 8 percent slopes*
Ng	Ninigret fine sandy loam, 0 to 3 percent slopes*
Pg	Pits - Udorthents complex, gravelly
Ra	Raynham silt loam, 0 to 3 percent slopes
RdA	Ridgebury fine sandy loam, 0 to 3 percent slopes
ReA	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony
ReB	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony
Sb	Scarboro mucky loamy fine sand, 0 to 3 percent slopes
UnA	Unadilla very fine sandy loam, 0 to 3 percent slopes*
WnA	Windsor loamy sand, 0 to 3 percent slopes**
WrA	Woodbridge fine sandy loam, 0 to 3 percent slopes*
WrB	Woodbridge fine sandy loam, 3 to 8 percent slopes*
WsB	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony**
WtB	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony

* All areas are prime farmland
** Farmland of statewide importance

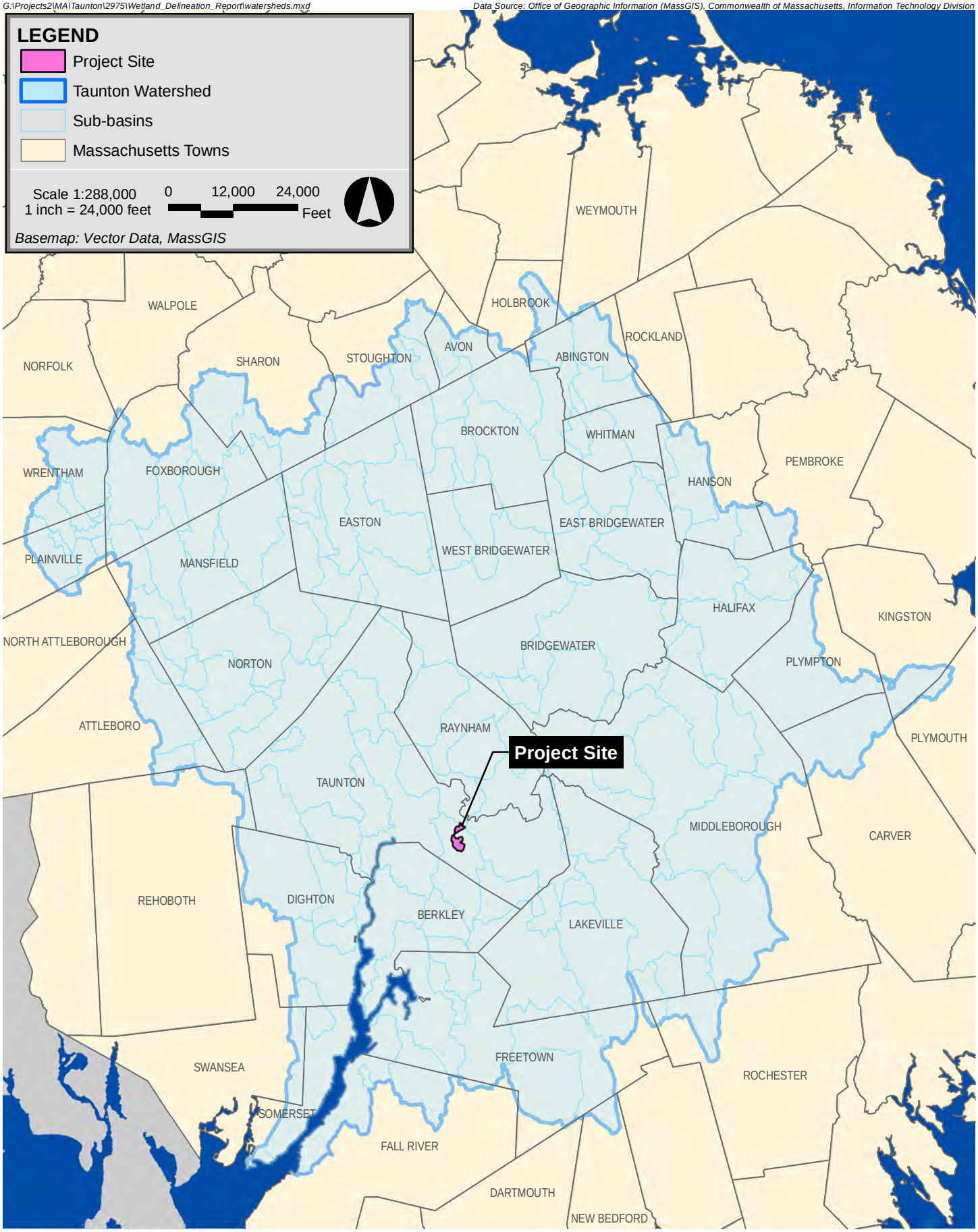
Project First Light Taunton Massachusetts

Epsilon Associates Inc.

Figure 4
NRCS SSURGO-Certified Soils

G:\Projects2\MA\Taunton\2975\Wetland_Delineation_Report\watersheds.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Project First Light Taunton Massachusetts

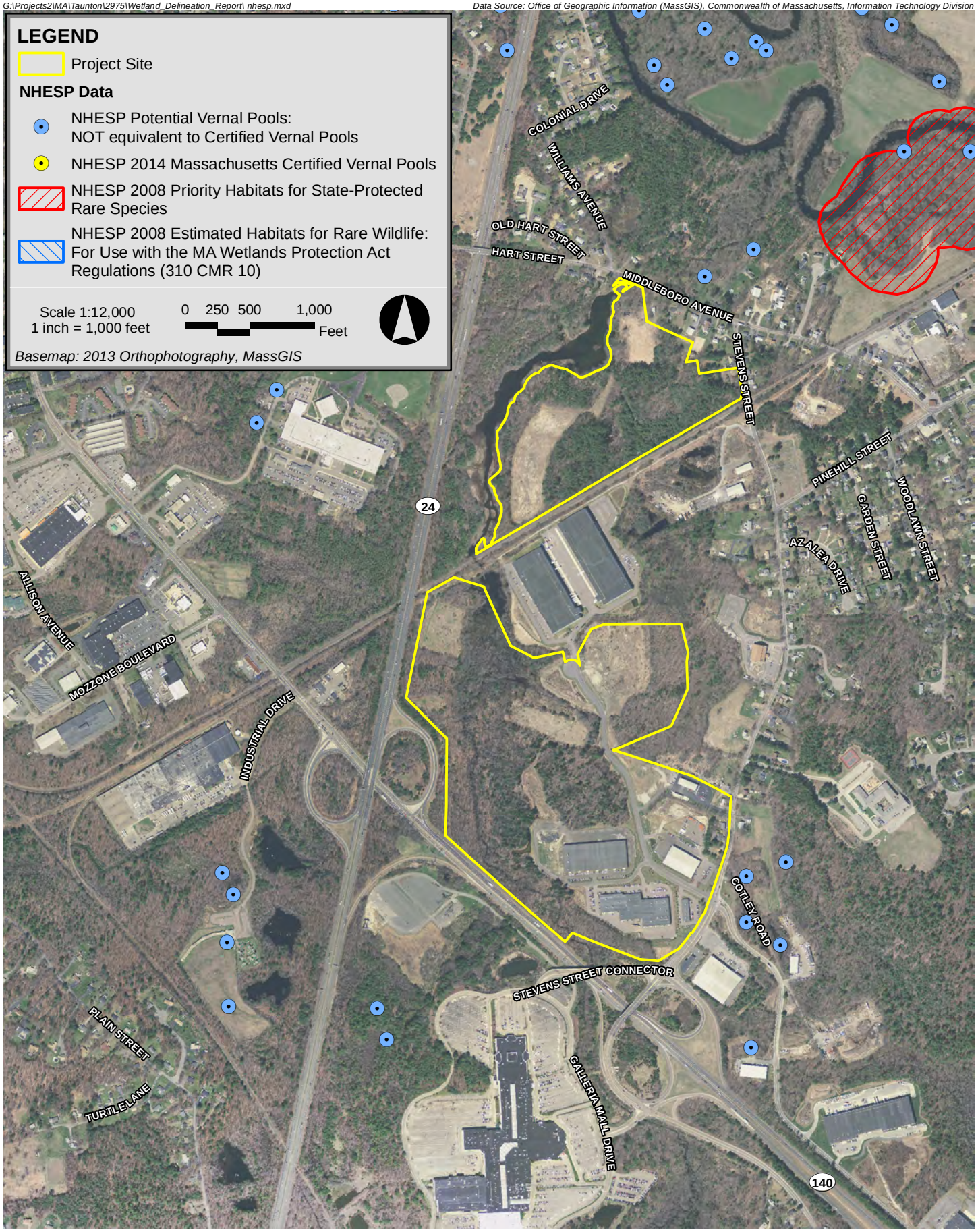
Epsilon ASSOCIATES INC.

Figure 5

Taunton Watershed and Sub-basins

G:\Projects2\MA\Taunton\2975\Wetland_Delineation_Report\ nhesp.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



Project First Light **Taunton Massachusetts**

Epsilon Associates Inc.

Figure 6

Natural Heritage and Endangered Species Program

Attachment B

U.S. Army Corps of Engineers Wetland Determination Data Forms

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: First Light (LIT parcel) City/County: Taunton, Bristol Sampling Date: 9/6/2012

Applicant/Owner: Mashpee Wampanoag Tribe State: MA Sampling Point: 2-UPL

Investigator(s): J. Fennell, A. Atwell Section, Township, Range: n/a

Landform (hillslope, terrace, etc.): slight slope Local relief (concave, convex, none): convex Slope (%): 4

Subregion (LRR or MLRA): R Lat: 41 52'14.72" N Long: 71 03' 04.39" W Datum: WGS 84

Soil Map Unit Name: 245A - Hinckley Sandy Loam NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes Yes No _____ (If no, explain in Remarks.)

Are Vegetation NO, Soil NO, or Hydrology NO significantly disturbed? Are "Normal Circumstances" present? Yes Yes No _____

Are Vegetation NO, Soil NO, or Hydrology NO naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** X
Hydric Soil Present?	Yes _____	No X	If yes, optional Wetland Site ID: _____
Wetland Hydrology Present?	Yes X	No _____	

Remarks: (Explain alternative procedures here or in a separate report.)

Forested upland fringe bordering managed uplands, a stormwater pond berm, and paved road embankments. Upland may receive some overland flow from nearby embankments. Although wetland hydrology was evident at the time of survey, hydrophytic vegetation and hydric soils were absent. Data point UPL-2 is located adjacent to wetland flag AC-14.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No X	Depth (inches): _____
Water Table Present?	Yes X	No _____	Depth (inches): 11
Saturation Present? (includes capillary fringe)	Yes X	No _____	Depth (inches): 0

Wetland Hydrology Present? **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: 2-UPL

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Pinus strobus	45	Y	FACU
2. Acer rubrum	30	Y	FAC
3. Quercus rubra	20	N	FACU
4. Betula populifolia	15	N	FAC
5.			
6.			
7.			
	110 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Nyssa sylvatica	25	Y	FAC
2. Viburnum dentatum	20	Y	FAC
3. Pinus strobus	20	Y	FACU
4. Hamamelis virginiana	5	N	FACU
5. Ilex verticillata	5	N	FACW
6.			
7. Quercus rubra	5	N	FACU
	80 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Dennstaedtia punctilobula	45	Y	UPL
2. Aralia nudicalis	7	N	FACU
3. Mitchella repens	3	N	FACU
4. Dendrolycopodium obscurum	15	Y	FACU
5. Hamamelis virginiana	Trace	N	FACU
6. Thelypteris noveboracensis**	Trace	N	FAC**
7. Lindera benzoin	Trace	N	FACW
8.			
9.			
10.			
11.			
12.			
	70 = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 43% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

**Thelypteris noveboracensis, nor synonyms of this species (New York Fern) were found within the Northcentral-Northeast Region-NWPL Final Draft Ratings. Epsilon used the previous rating from REED, 1988 and looked up the indicator status for region 2, this indicator status is FAC.

SOIL

Sampling Point: 2-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-1"	10 YR 2/1	100						mucky mod sandy loam
1-6"	10 YR 3/2	50					Fine Sandy Loam	Mixed matrix, not redox
	10 YR 2/2	50						
6-9"	10 YR 3/2	100					Fine sandy loam	
9-20+"	10 YR 4/3	100					C. sandy loam	(coarse)

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

Representative view of data plot UPL-2.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: First Light (LIT parcel) City/County: Taunton, Bristol Sampling Date: 9/6/2012

Applicant/Owner: Mashpee Wampanoag Tribe State: MA Sampling Point: 2-WET

Investigator(s): J. Fennell, A. Atwell Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): Hummocky Slope (%): 1-2%

Subregion (LRR or MLRA): R Lat: 41 52' 15.33" N Long: 71 03' 05.06" W Datum: WGS 84

Soil Map Unit Name: 245A - Hinckley Sandy Loam NWI classification: PFO

Are climatic / hydrologic conditions on the site typical for this time of year? Yes Yes No ____ (If no, explain in Remarks.)

Are Vegetation NO, Soil NO, or Hydrology NO significantly disturbed? Are "Normal Circumstances" present? Yes Yes No ____

Are Vegetation NO, Soil NO, or Hydrology NO naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area within a Wetland?** **Yes** X **No** ____
Hydric Soil Present?	Yes X	No ____	If yes, optional Wetland Site ID: Wetland Flag Series A
Wetland Hydrology Present?	Yes X	No ____	

Remarks: (Explain alternative procedures here or in a separate report.)

Wetland is part of large wetland and stream complex associated with the Cotley River; wetland is characterized by hummocks, with several ATV trails running through area. Data point is located near Wetland Flag AC-15.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- X Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X	No ____	Depth (inches): 2"
Water Table Present?	Yes X	No ____	Depth (inches): 0"
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 0"

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

The presence of muck indicates long term saturation within this system. Primary indicators of hydrology were observed.

VEGETATION – Use scientific names of plants.

Sampling Point: 2-WET

Tree Stratum (Plot size: 30' Radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	30	Y	FAC
2. Pinus strobus	20	Y	FACU
3. Carpinus carolinia	20	Y	FAC
4.			
5.			
6.			
7.			
	70 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15' Radius)			
1. Clethra alnifolia	40	Y	FACW
2. Carpinus carolinia	30	Y	FAC
3. Pinus strobus	10	N	FACU
4. Acer rubrum	5	N	FAC
5. Ilex verticillata	1	N	FACW
6.			
7.			
	86 = Total Cover		

Herb Stratum (Plot size: 5' Radius)			
1.			
2. Osmunda cinnamomea	10	Y	FACW
3. Aralia nudacalis	5	Y	FACU
4. Quercus rubra	1	N	FAC
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	16 = Total Cover		

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 71% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

The presence of hydrophytic vegetation was confirmed using the dominance test.

SOIL

Sampling Point: 2-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-1"	10 YR 2/1	100					Muck	
1-6"	10 YR 4/1	98	10 YR 5/2	2	C	M	Fine Sandy Loam	
6-16"	2.5 Y 5/2	95	2.5 Y 5/3	5	C	M	Loamy Sand	
16-20"	5 Y 6/1	92	2.5 Y 6/3	8	C	M	Loamy VF Sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ____

Remarks:

Representative view of data plot WET-2.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: First Light (LIT parcel) City/County: Taunton, Bristol Sampling Date: 9/6/12

Applicant/Owner: Mashpee Wampanoag Tribe State: MA Sampling Point: UPL-3

Investigator(s): J. Fennell, A. Atwell Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): NONE Slope (%): 2

Subregion (LRR or MLRA): R Lat: 41 52'27.91"N Long: 71 02'54.33" W Datum: WGS 84

Soil Map Unit Name: Unadilla very fine sandy loam, 0-3% slopes NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation NO, Soil NO, or Hydrology NO significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation NO, Soil NO, or Hydrology NO naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** X
Hydric Soil Present?	Yes X	No _____	If yes, optional Wetland Site ID: _____
Wetland Hydrology Present?	Yes _____	No X	

Remarks: (Explain alternative procedures here or in a separate report.)

This data plot is located within a field that is likely managed (mowed). Data point UPL-3 is located adjacent to wetland flag D-334.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No X	Depth (inches): _____
Water Table Present?	Yes _____	No X	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes X	No _____	Depth (inches): 18

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: UPL-3

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Rosa multiflora	5	Y	FACU
2.			
3.			
4.			
5.			
6.			
7.			
	5 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Festuca rubra	40	Y	FACU
2. Secale cereale	40	Y	UPL
3. Plantago major	10	N	FACU
4. Galium mollugo	8	N	UPL
5. Dactylis glomerata	5	N	FACU
6. Rosa multiflora	10	N	FACU
7. Erechtities hieraciifolius	2	N	FACU
8.			
9.			
10.			
11.			
12.			
	115 = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ____ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

Non-dominant plants are also not hydrophytic.

SOIL

Sampling Point: UPL-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 4/3	100					loamy sand	
8-15	10YR 5/2	70					Gr. loamy sand	Two matrix colors (likely from mixing)
	10YR 7/2	30						
15-20	2.5Y 6/3	80	2.5Y 5/1	20	C	M	Gravelly sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ____

Remarks:

Representative view of UPL-3.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: First Light (LIT parcel) City/County: Taunton, Bristol Sampling Date: 9/6/12

Applicant/Owner: Mashpee Wampanoag Tribe State: MA Sampling Point: WET-3

Investigator(s): J. Fennell, A. Atwell Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): NONE Slope (%): 2

Subregion (LRR or MLRA): R Lat: 41 52' 29.10" N Long: 71 02' 53.27"W Datum: WGS 84

Soil Map Unit Name: Unadilla very fine sandy loam, 0-3% slopes NWI classification: PEM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation NO, Soil NO, or Hydrology NO significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation NO, Soil NO, or Hydrology NO naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area within a Wetland?** **Yes** X **No** ____
Hydric Soil Present?	Yes X	No ____	If yes, optional Wetland Site ID: D SERIES
Wetland Hydrology Present?	Yes X	No ____	

Remarks: (Explain alternative procedures here or in a separate report.)

Wetland system is located within a field, has likely been managed (mowed). Wetland D contains an area of previously created mitigation wetlands. The data plot is not located within the mitigation area. Data plot is located adjacent to wetland flag D-333.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes X	No ____	Depth (inches): 6
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 0

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: WET-3

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Acer rubrum	5	Y	FAC
2. Fraxinus pennsylvanica	Trace	N	FACW
3.			
4.			
5.			
6.			
7.			
	5 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Verbena hastata	60	Y	FACW
2. Juncus effusus	20	Y	FACW
3. Onoclea sensibilis	19	N	FACW
4. Eutrochium maculatum	17	N	OBL
5. Phalaris arundinacea	10	N	FACW
6. Acer rubrum	2	N	FAC
7. Lythrum salicaria	7	N	OBL
8. Carex lurida	5	N	OBL
9. Solidago gigantea	5	N	FACW
10.			
11.			
12.			
	145 = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

Non-dominant plants are also predominantly hydrophytic.

SOIL

Sampling Point: WET-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12	2.5 Y 4/1	97	7.5 YR 5/4	3	C	PL	Fine sandy loam	
12-20+	10YR 5/1	98	10YR 5/6	2	C	M	Fine sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** _____

Remarks:

Representative view of WET-3.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: First Light (LIT parcel) City/County: Taunton, Bristol Sampling Date: 9/6/2012

Applicant/Owner: Mashpee Wampanoag Tribe State: MA Sampling Point: 5-UPL

Investigator(s): J. Fennell, A. Atwell Section, Township, Range: n/a

Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): None Slope (%): 1-2%

Subregion (LRR or MLRA): R Lat: 41 52'41.67" N Long: 71 02' 59.83" W Datum: WGS 84

Soil Map Unit Name: 255A - Windsor Sandy Loam NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes Yes No _____ (If no, explain in Remarks.)

Are Vegetation NO, Soil NO, or Hydrology NO significantly disturbed? Are "Normal Circumstances" present? Yes Yes No _____

Are Vegetation NO, Soil NO, or Hydrology NO naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** X
Hydric Soil Present?	Yes _____	No X	If yes, optional Wetland Site ID: _____
Wetland Hydrology Present?	Yes _____	No X	

Remarks: (Explain alternative procedures here or in a separate report.)

Forested area outside edge of wetland and located between Wetland N and Wetland J.
Slight topographical relief. Data point 5-UPL is located between wetland flags N-21 and J-10.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No X	Depth (inches): _____
Water Table Present?	Yes _____	No X	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes _____	No X	Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: 5-UPL

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Pinus strobus	65	Y	FACU
2. Acer rubrum	20	Y	FAC
3. Quercus rubra	10	N	FACU
4. Fagus grandifolia	5	N	FACU
5.			
6.			
7.			
	100	= Total Cover	

Sapling/Shrub Stratum (Plot size: 15')			
1. Pinus strobus	20	Y	FACU
2. Acer rubrum	40	Y	FAC
3. Ilex verticillata	20	Y	FACW
4. Virburnum dentatum	5	N	FAC
5.			
6.			
7.			
	85	= Total Cover	

Herb Stratum (Plot size: 5')			
1. Smilax rotundifolia	10	Y	FAC
2. Pinus strobus	5	Y	FACU
3. Osmunda regalis	2	N	OBL
4. Ilex verticillata	5	Y	FACW
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	22	= Total Cover	

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0	= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 8 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 63 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: 5-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-3"	10 YR 2/1	100					Fine Sandy Loam	
3-12"	10 YR 3/1	100					Fine Sandy Loam	
12-20"	10 YR 4/3	100					Gravelly Coarse Sandy l	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

No redoximorphic features are apparent within the soil.

Representative view of data plot UPL-5.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: First Light (LIT parcel) City/County: Taunton, Bristol Sampling Date: 9/6/2012

Applicant/Owner: Mashpee Wampanoag Tribe State: MA Sampling Point: 5-WET

Investigator(s): J. Fennell, A. Atwell Section, Township, Range: n/a

Landform (hillslope, terrace, etc.): Terrace Local relief (concave, convex, none): None Slope (%): 1-2%

Subregion (LRR or MLRA): R Lat: N 41 52' 41.67" Long: 71 02' 59.83" W Datum: WGS 84

Soil Map Unit Name: 255A - Windsor Sandy Loam NWI classification: PFO

Are climatic / hydrologic conditions on the site typical for this time of year? Yes Yes No ____ (If no, explain in Remarks.)

Are Vegetation NO, Soil NO, or Hydrology NO significantly disturbed? Are "Normal Circumstances" present? Yes Yes No ____

Are Vegetation NO, Soil NO, or Hydrology NO naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area within a Wetland?** **Yes** X **No** ____
Hydric Soil Present?	Yes X	No ____	If yes, optional Wetland Site ID: Wetland Flag Series N
Wetland Hydrology Present?	Yes X	No ____	

Remarks: (Explain alternative procedures here or in a separate report.)

Forested wetland with hummocky topography in some sections and sparsely vegetated portions. Hydrology may be partially impounded by railroad embankment to south. Data plot is located adjacent to wetland flag N-19.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- X Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- X Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes X	No ____	Depth (inches): 18"
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 6"

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Many tree species within wetland exhibit buttressed root systems.

VEGETATION – Use scientific names of plants.

Sampling Point: 5-WET

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	20	Y	FAC
2. Pinus strobus	15	Y	FACU
3. Quercus rubra	5	N	FACU
4. Nyssa sylvatica	5	N	FAC
5.			
6.			
7.			
	45 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Ilex verticillata	50	Y	FACW
2. Virburnum dentatum	15	N	FAC
3. Acer rubrum	5	N	FAC
4. Nyssa sylvatica	5	N	FAC
5. Vaccinium corymbosum	5	N	FACW
6.			
7.			
	80 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Osmunda regalis	25	Y	OBL
2. Osmunda cinnamomea	25	Y	FACW
3. Rubus hispidus	20	Y	FACW
4. Viburnum dentatum	2	N	FAC
5. Maiamthemum canadense	Trace	N	FACU
6. Pinus strobus	Trace	N	FACU
7. Quercus rubra	Trace	N	FACU
8.			
9.			
10.			
11.			
12.			
	72 = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 83.3 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: 5-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-1"	10 YR 2.5/1	100					mmsl	Ag1 (mucky modified fine sandy loam)
1-7"	10 YR 2.5/1	98	10YR 4/3	2	C	M	f sandy loam	Ag2
7-15"	10 YR 3/1	92.5	10 YR 6/3	1.5	C	M	f sandy loam	Ag3
			10 YR 4/2	6	C	M		
15-16"	10YR 2/2	100					crs sndy loam	Bw1
16-20"	10YR 4/3	90	10YR 5/4	10	C	M	CRS SNDY LOAM	Bw2

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- X Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** _____

Remarks:

Soils show evidence of episaturation.

Representative view of data plot WET-5.

Attachment C

Representative Photographs of Delineated Wetlands

View of Wetland 1.

View of Cotley River within Wetland 2.

View of Cotley River within Wetland 2.

View of representative PFO located within Wetland 2.

View of a representative PSS located within Wetland 2.

View of intermittent stream located within Wetland 2.

View of intermittent stream located within Wetland 2.

View of intermittent stream located within Wetland 2.

View of representative of PFO portion of Wetland 3.

View of representative PEM located within Wetland 3.

View of intermittent stream within Wetland 3.

View of intermittent stream located within Wetland 3.

View of Cotley River at Barstows Pond Dam, located within Wetland 4.

View of Barstows Pond located within Wetland 4.

View of Cotley River and PEM located within Wetland 4.

View of PFO wetland located within Wetland 4, this wetland fringes the PEM/ Cotley River portion of Wetland 4.

View of Wetland 5.

View of Wetland 6.

View of Wetland 7, a vernal pool.

View of egg masses within Wetland 7, observed in April 2014.

View of Wetland 8.

View of wetland 9.

Attachment D

Vernal Pool Assessment Memo and USACE Vernal Pool Evaluation

OXBOW ASSOCIATES, INC.

Wetlands Delineation and Permitting • Wildlife Studies • Herpetology • Vernal Pool Ecology

May 9, 2014

Mr. Michael Howard
Epsilon Associates, Inc.
3 Clock Tower Place, Suite 250
Maynard, MA 01754

Re: Vernal Pool Evaluation
Proposed First Light Casino Property
Taunton, MA

Dear Mr. Howard:

In response to your request, Oxbow Associates, Inc. (OA: specifically, S. Smyers) reviewed the above referenced site with you and Amanda Atwell on April 14, 2014. This site is located south of Hart Street, east of the Cotley River, and north of railroad tracks. The property is mix of forested uplands and wetlands with some fields and an existing gravel road.

The purpose for this site evaluation was to review the salamander egg masses within the seasonal pond located in the southern portion of the property. We used chest waders and a dip-net to conduct visual survey of egg masses within a portion of the pond. It is our understanding that one egg mass was questioned as possibly a blue-spotted salamander (*Ambystoma laterale*) during a site review from the Environmental Protection Agency (EPA).

Seasonal Pond Description

The subject property has a varying topography with small hills and depressions. The upland surrounding the subject pond includes moderately steep slopes within a forested upland vegetated with eastern white pine (*Pinus strobus*), oaks (*Quercus* spp.), and maples (*Acer* spp.). The pond is approximately 12-30 inches deep with a organic rich substrate with wetland shrubs including buttonbush (*Cephalanthus occidentalis*), highbush blueberry (*Vaccinium corymbosum*) arrowwood (*Viburnum recognitum*), northern manna grass (*Glyceria borealis*), and tussock sedge (*Carex stricta*) scattered throughout the basin. Invertebrates found using a dipnet include caddisflies (Limnephilidae) fairy shrimp (*Eubranchipus vernalis*), water striders (Gerridae), and ramshorn snails (Planorbidae).

P.O. Box 971 • Acton, Massachusetts 01720-0971
Telephone: 978.929.9058 • Facsimile: 978.635.1892 • E-mail: oxbow@oxbowassociates.com

The vegetation and invertebrate community is typical of seasonal ponds in southeastern Massachusetts. The number of egg masses of both spotted salamander (*Ambystoma maculatum*) and wood frogs (*Lithobates sylvatica*) indicate that this pond provides adequate hydrology so that many amphibians rely on this pond for breeding and larval development.

Egg Mass Characteristics

Ms. Atwell was successful in relocating the exact egg mass that was questioned by the staff of EPA. This egg mass was somewhat unusual in that it had an appendage of four eggs connected to the outer margin of the main mass. I photographed this egg mass from both sides and the appendage became detached during handling, but it was attached when I first observed the mass (see attached photos). I have seen thousands of egg masses throughout New England, mostly in Massachusetts, and there is considerable variability in shapes and sizes, but there are some characteristics that are commonly uniform within species of amphibians.

The following characteristics lead me to conclude that this egg mass, and the eggs attached were deposited by spotted salamander, NOT a blue-spotted salamander (or more accurately, *A. laterale X jeffersonianum*). 1. The consistency of the gelatinous matrix of both the mass and egg appendage is firm, not loose. 2. The semi-opaque coloration is uniform throughout the primary egg mass and the appendicular portion. 3. The number of eggs in the primary mass is much larger than blue-spotted salamanders. 4. The appendage of eggs was connected to the egg mass, not attached after the larger egg mass was deposited as evidenced by the size, consistency, development stage, and nature of the connective egg material. 5. Eggs of *A. laterale* X *jeffersonianum* group are characterized by a relatively narrow gap between the vitelline membrane and the outer margin of the egg compared to spotted salamander. The eggs examined all had a vitelline membrane consistent with the spotted salamander.

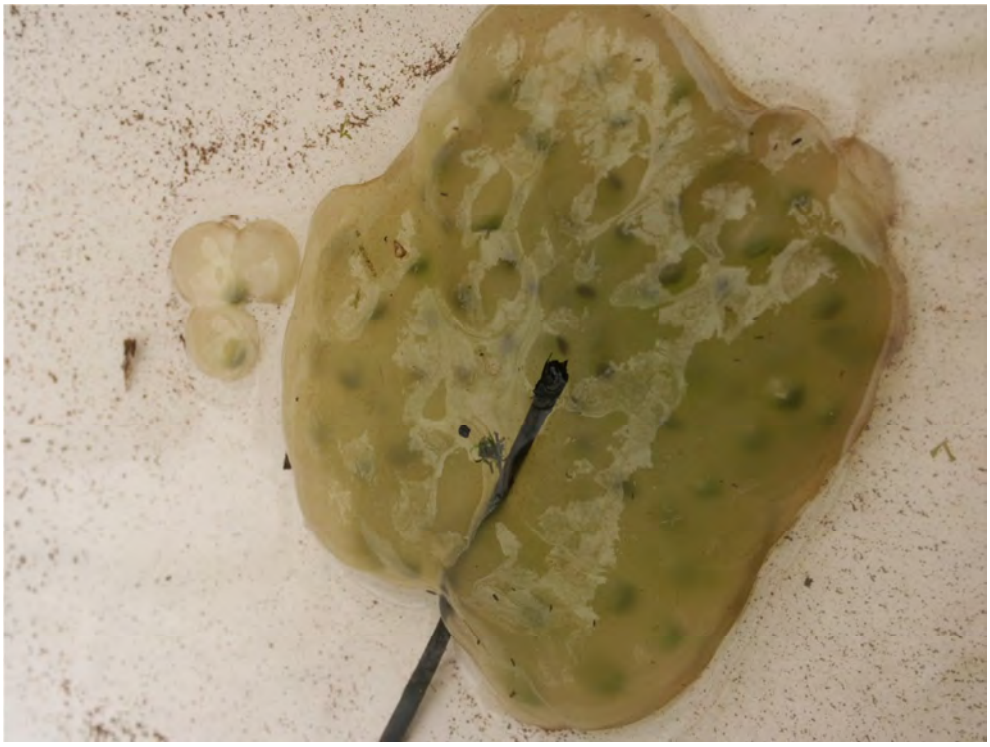
I also examined a minimum of 50 other egg masses to determine if there were any other eggs that could possibly be those of blue-spotted salamanders and I did not find any such eggs.

If you have any questions, please do not hesitate to contact us.

Sincerely,

Scott D. Smyers, M.S.
Senior Scientist
encs.

1. Egg mass of spotted salamander (from A. Atwell 4/9/14)



2. Opposite side of same egg mass with detached appendage

3. View of seasonal pond

4. Other spotted salamander egg masses within the same seasonal pond

US Army Corps of Engineers - New England District
DRAFT Vernal Pool Characterization Form

Project File # 2975 Project Name Project First Light Pool ID Wetland 7
Observer Amanda Atwell, Epsilon Assoc.; Scott Smyers, Oxbow Assoc. Phone or E-mail 978-897-7100
Landowner/Applicant Mashpee Wampanoag Tribe, Attn Cedric Cromwell Phone or E-mail 508-477-0208
Address 483 Great Road, South City Mashpee State MA Zip 02649
Location of vernal pool: City/State Taunton, Massachusetts
Survey date(s) April 10, 2014 with representatives from EPA and COE, April 14, 2014 with Oxbow Associates.
Longitude/Latitude (in decimal degrees) -71.048621W, 41.879459N

A. VERNAL POOL CHARACTERISTICS (fill in all information known):

1. Landscape setting (check all that apply):

[X] Upland depression (4 pts; if this is also in a floodplain, use 2 pts)
[ ] Pool part of wildlife corridor (4 pts)
[ ] Pool part of a pool complex (within 1000 feet of one or more other vernal pools) (NA)
[ ] Pool within larger wetland system (4 pts; if this is also in a floodplain, use 2 pts)
[ ] Other: _____ (variable pts)

2. Vernal pool condition:

Describe any recent modifications to the pool and associated landscape: Appears to have a spoil pile or soil stockpile associated with the southern edge, this area is covered with Japanese knotweed. Knotweed area appears to have increased since 2012

3. Parent material:

[X] Glacial fluvial ("outwash")
[ ] Loose till
[ ] Peat
[ ] Dense till
[ ] Alluvium
[ ] Coastal marine sediments

4. Aquatic resource type that best applies to this pool (choose dominant):

[ ] Forested wetland (4 pts)
[ ] Herbaceous wetland (4 pts)
[ ] Floodplain (overflow/oxbow) (3 pts)
[X] Shrub wetland (4 pts)
[ ] Open water (2 pts)
[ ] Other: _____ (variable points)
[ ] Peatland (acidic fen or bog) (4 pts)
[ ] Intermittent stream reach (2 pts)

5. Pool canopy cover (%): 60%, Upland forest overstory contributes to shading within the pool.

6. Predominant substrate:

[X] Mineral soil
[X] Organic matter (peat/muck) Depth 1.5 ft Sampling location (e.g., deepest zone, edge, etc.) Deepest zone (the edge is mineral, while the center of the pool is histic)

7. Pool size:

a. Approximate dimensions of pool (at maximum capacity; include units): Length 200 ft Width 75 ft
Area: 37,500 square feet

b. Maximum depth at deepest point at time of survey (include units): 24 inches

8. Hydrology:

a. Estimated hydroperiod (unless actual, observed hydroperiod value(s) is(are) known, use the presence of these example indicator species to best predict the expected hydroperiod of the pool):

[ ] Dries between early March and early July (e.g., *Thelypteris palustris, Carex stricta, Impatiens capensis, Ilex verticillata*) (6 pts)
[X] Dries between early July and early September (e.g., *Sagittaria latifolia, Scirpus cyperinus, Dulichium arund., Cephalanthus occ.*) (8 pts)
[ ] Dries between early September and early November (e.g., *Eleocharis palustris, Glyceria cana., Utricularia* spp., *Decodon vert.*) (8 pts)
[ ] Dries between early November and late December, or intermittently exposed (e.g., *Nuphar* spp., *Potamogeton* spp.) (2 pts)

b. Inlet/outlet (pick one):

[X] No inlet/outlet (8 pts)
[ ] Permanent inlet or outlet (channel with well-defined banks and permanent flow) (2 pts)
[ ] Temporary inlet/outlet (6 pts)

9. Water quality:

[ ] Clear
[ ] High turbidity
[X] High algae content
[X] Tannic

24 **TOTAL for Pool Characteristics (out of 28 max.)**

DRAFT

Pool ID Wetland 7

B. VERNAL POOL ENVELOPE (100 ft) AND CRITICAL HABITAT AREA (100-750 ft) CHARACTERISTICS (fill in all information known):

1. Landuse type and approximate percentage within the 100-ft vernal pool envelope:

[X] Forested 95 % (16 pts) [X] Open (e.g., meadow, agriculture, golf course) field 4 % (4 pts)

[ ] Shrub ____ % (10 pts) [ ] Developed ____ % (0 pts)

2. **Landuse type and approximate percentage within the 100 - 750-ft vernal pool critical terrestrial habitat:**

[X] Forested 50 % (16 pts) [X] Open (e.g., agriculture, golf course) 15 % (4 pts)

[X] Shrub 5 % (10 pts) [X] Developed 30 % (0 pts)

[X] Are there one or more barriers to vernal pool fauna movement within the envelope and/or critical terrestrial habitat? If so, check here and see directions for explanation of how to incorporate this information. There is a railroad track to the south.

Based on: [X] Field estimate [X] GIS [ ] Aerial photo estimate

24.5 **TOTAL for Pool Envelope and Critical Terrestrial Habitat Area (out of 32 max.)**

C. SPECIES PRESENT IN VERNAL POOL

INDICATOR SPECIES	DATE	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvaticus*)	4/14	15	Present
Spotted Salamander (*Ambystoma maculatum*)	4/14	around 100	
Blue-spotted Salamander (*Ambystoma laterale*)			
Jefferson's Salamander (*Ambystoma jeffersonianum*)			
Marbled Salamander (*Ambystoma opacum*)			
Fairy Shrimp (*Eubranchipus* spp.)	4/14	PRESENT/ABSENT	ABUNDANCE: at least 10
OTHER SPECIES	**DATE**	**PRESENCE/ABSENCE**	**FEW/COMMON/MANY**
Facultative Species (e.g., Spring Peeper (*Pseudacris crucifer*), Gray Tree Frog (*Hyla versicolor*), Caddisflies (Limnephilidae, Phryganeidae), American Toad (*Anaxyrus americanus*), Eastern Spadefoot Toad (*Scaphiopus holbrookii*), Fowler's Toad (*Anaxyrus fowleri*), Fingernail Clams (Sphaeriidae, Pisidiidae))(list):	4/14	Fingernail clams	common
Rare Species (list):			
Predator Species (e.g., Bullfrog/Green frog tadpoles, Fish) (list):			
Other species (e.g., Ducks, Turtles, etc.)(list):			

Presence of Indicator Species [X] Yes [ ] No

SUMMARY:

24 **TOTAL for Pool Characteristics** 24.5 **TOTAL for Pool Envelope and Critical Terrestrial Habitat Area**

Other comments (append photographs, additional notes, sketch of pool and surrounding landscape):

US Army Corps of Engineers - New England District
Vernal Pool Characterization Form

Project File # _____ Project Name First Light Pool ID Wetland 7 (flags I)
Observer Amanda Atwell, Jeremy Fennell, Epsilon Associates Phone or E-mail 978-897-7100
Landowner/Applicant Ap: Mashpee Wampanoag Tribe: Cedric Cromwell Phone or E-mail 508-477-0208
Address 483 Great Road, South City Mashpee State MA Zip 02649
Location of vernal pool: City/State Taunton, MA
Brief directions to pool _____
Survey date(s) VP identification 4/10/12, Delineated July, 2012, Reviewed 10/26/12
Longitude/Latitude (in decimal degrees) -71.048621W, 41.879459N
USGS Quad Taunton Plat # _____ Lot # _____

A. VERNAL POOL LANDSCAPE CHARACTERISTICS (fill in all information known):

1. Landscape setting (check all that apply):

- [x] Upland depression
- [ ] Floodplain depression
- [ ] Pool within larger wetland system
- [ ] Pool part of a pool complex (within 1000 feet of one or more other vernal pools)
- [ ] Pool part of wildlife corridor
- [ ] Other _____

2. Vernal pool origin:

- [x] Natural
- [ ] Natural, but Human Altered
- [ ] Anthropogenic
- [ ] Unknown

Describe any recent modifications to the pool and associated landscape: Appears to have a spoil pile or soil stock-pile associated with the southern edge, this area is covered with Japanese knotweed

3. Parent material:

- [x] Glacial fluvial ("outwash")
- [ ] Loose till
- [ ] Peat
- [ ] Dense till
- [ ] Alluvium

B. VERNAL POOL CHARACTERISTICS (fill in all information known):

1. Wetland type(s) that best apply to this pool:

- [ ] Forested wetland
- [ ] Herbaceous wetland
- [ ] Floodplain (overflow/oxbow)
- [x] Shrub wetland
- [ ] Open water
- [x] Other: Forest overstory contributes to shading within the pool.
- [ ] Peatland (acidic fen or bog)
- [x] Intermittent stream

2. Pool canopy cover (%) 60

3. Predominant substrate:

- [x] Mineral soil
- [x] Organic matter (peat/muck) Depth 1.5 ft (histic epipedon)

Organic matter sampling location (e.g., deepest zone, edge, etc.) Edge is mineral, center of pool is histic

4. Pool size:

a. Approximate dimensions of pool (at maximum capacity; include units): Length 200 feet Width 75 feet

b. Approximate area of pool (at maximum capacity): 37,500 square feet

c. Maximum depth at deepest point at time of survey (include units): 18 inches

5. Hydrology

a. Estimated hydroperiod (unless actual, observed hydroperiod value(s) is(are) known, use the example indicator species to best predict the expected hydroperiod of the pool):

- [ ] Dries between early March and early July (e.g., *Thelypteris palustris, Carex stricta, Impatiens capensis, Ilex verticillata*)
- [x] Dries between early July and early September (e.g., *Sagittaria latifolia, Scirpus cyperinus, Dulichium arundinaceum, Cephalanthus occ.*)
- [ ] Dries between early September and early November (e.g., *Eleocharis palustris, Glyceria canadensis, Utricularia* spp., *Decodon vert.*)
- [ ] Dries between early November and late December, or intermittently exposed (e.g., *Nuphar* spp., *Potamogeton* spp.)

b. Inlet/outlet (circle which in each instance): Pool ID Wetland 7

☒ No inlet/outlet ☐ Permanent inlet or outlet (channel with well-defined banks and permanent flow)

☐ Temporary inlet/outlet ☐ Other _____

C. VERNAL POOL ENVELOPE (100 ft) AND CRITICAL HABITAT AREA (100-750 ft) CHARACTERISTICS (fill in all information known):

1. Surrounding forest cover within 100 ft (30.5 m) (%) 95 **100-750 ft (230 m)** (%) 60

2. Landuse type and approximate percentage within the 100-ft vernal pool envelope:

☐ Forested wetland _____ % ☒ Agriculture field (4) %

☒ Forested upland 96 % ☐ Developed (<25% impervious surface) _____ %

☐ Shrub/herbaceous wetland _____ % ☐ Developed (>25% impervious surface) _____ %

☐ Shrub/herbaceous upland _____ % ☐ Other (please specify) _____ %

3. **Landuse type and approximate percentage within the 100 - 750-ft vernal pool critical terrestrial habitat:**

☒ Forested wetland 6 % ☐ Agriculture _____ %

☒ Forested upland 46 % ☒ Developed (<25% impervious surface) 16 %

☒ Shrub/herbaceous wetland 5 % ☒ Developed (>25% impervious surface) 12 %

☒ Shrub/herbaceous upland (field) 15 % ☐ Other (please specify) _____ %

Based on: ☒ Field estimate ☒ GIS

D. SPECIES PRESENT IN VERNAL POOL

Was the entire pool comprehensively surveyed for egg masses? ☐ Yes ☐ No

INDICATOR SPECIES	DATE	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvaticus*)	4/10	2	
Spotted Salamander (*Ambystoma maculatum*)	4/10	166	
Blue-spotted Salamander (*Ambystoma laterale*)			
Jefferson's Salamander (*Ambystoma jeffersonianum*)			
Marbled Salamander (*Ambystoma opacum*)			
Fairy Shrimp (*Eubranchipus* spp.)		**PRESENCE/ABSENCE/**	**ABUNDANCE:**
FACULTATIVE SPECIES	**DATE**	**PRESENCE/ABSENCE**	**FEW/COMMON/MANY**
Spring Peeper (*Pseudacris crucifer*)			
Gray Tree Frog (*Hyla versicolor*)			
American Toad (*Anaxyrus americanus*)			
Eastern Spadefoot Toad (*Scaphiopus holbrookii*)			
Fowler's Toad (*Anaxyrus fowleri*)			
Fingernail Clams (Sphaeriidae, Pisidiidae)			
Caddisflies (Limnephilidae, Phryganeidae)			
OTHER SPECIES	**DATE**	**PRESENCE/ABSENCE**	**FEW/COMMON/MANY**
Rare Species (list): _____			
Predator Species (e.g., Bullfrog/Green frog tadpoles, Fish) (list): _____			

Other comments (append photographs, additional notes, sketch of pool and surrounding landscape):

Also found large 1.5 to 2 inch unidentified tadpoles in pools. April 2012 was very dry, temperatures were high, many pools dried out this Spring prior to amphibian lifecycle completion.

US Army Corps of Engineers - New England District
Vernal Pool Valuation Score Form

Wetland 7

Project File # _____ Project Name First Light Pool ID (flags I)
Observer A. Atwell, J. Fennell, Epsilon Associates Phone or E-mail 978-897-7100
Survey date(s) VP identification 4/10/12, Delineated July 2012, Reviewed 10/26/12
Longitude/Latitude (in decimal degrees) -71.048621W, 41.879459N

Use data from Vernal Pool Characterization Form to fill out below.

A. VERNAL POOL CHARACTERISTICS (fill in all information known):

1. Landscape setting:

☒ 4 Upland depression ☐ 2 Floodplain depression ☐ 4 Pool within larger wetland system (if this is also in a floodplain , use 2)

2. Wetland type(s) that best apply to this pool:

☐ 4 Forested wetland
☒ 4 Shrub wetland
☐ 4 Peatland (acidic fen or bog)
☐ 4 Herbaceous wetland
☐ 2 Open water
☐ 2 Intermittent stream
☐ 3 Floodplain (overflow/oxbow)

3. Hydrology

a. Estimated hydroperiod range:

☐ 6 Dries between early March and early July
☒ 8 Dries between early July and early September
☐ 8 Dries between early September and early November
☐ 2 Dries between early November and late December, or intermittently exposed

b. Inlet/outlet (specify which):

☒ 8 No inlet/outlet
☐ 6 Temporary inlet/outlet
☐ 2 Permanent inlet or outlet (channel with well-defined banks and permanent flow)

24 **TOTAL for Pool Characteristics**

B. VERNAL POOL ENVELOPE (100 ft) AND CRITICAL HABITAT AREA (100-750 ft) CHARACTERISTICS (fill in all information known):

☒ 4 Are immediate surroundings and pool part of a wildlife corridor? Check box if yes.

1. Landuse type and approximate percentage within the 100-ft vernal pool envelope (value assumes 100% per type; if multiple types, use percentage of values for each type present):

☐ 16 Forested wetland _____%
☒ 16 Forested upland 96 %
☐ 10 Shrub/herbaceous wetland _____%
☒ 8 Shrub/herbaceous upland 4 %
☐ 2 Agriculture _____%
☐ 2 Developed (<25%) _____%
☐ 1 Developed (>25%) _____%
☐ Other (please specify) _____%

2. Landuse type and approximate percentage within the 100 - 750-ft vernal pool critical terrestrial habitat (value assumes 100% per type; if multiple types, use percentage of values for each type present):

☒ 16 Forested wetland 6 %
☒ 16 Forested upland 46 %
☒ 10 Shrub/herbaceous wetland 5 %
☒ 8 Shrub/herbaceous upland 15 %
☐ 2 Agriculture _____%
☒ 2 Developed (<25%) 16 %
☒ 1 Developed (>25%) 12 %
☐ Other (please specify) _____%

30.2 **TOTAL for Pool Envelope and Critical Habitat Area**

C. SPECIES PRESENT IN VERNAL POOL

☒ 16 Indicator species present (check all that apply):

- ☒ Wood Frog
- ☒ Spotted Salamander
- ☐ Blue-spotted Salamander
- ☐ Jefferson's Salamander
- ☐ Marbled Salamander
- ☐ Fairy Shrimp

Rare Species (check all that apply):

- ☐ 4 Blanding's Turtle
- ☐ 4 Spadefoot Toad

☐ -16 Resident predator population present (check all that apply):

- ☐ Bullfrog tadpoles
- ☐ Fish
- ☐ Green Frog tadpoles
- ☐ Other (specify) _____

16 **TOTAL for Pool Species (see NOTE in text)**

SUMMARY:

24 **Pool Characteristics** 30.2 **Envelope and Critical Habitat** 16 **Pool Species**

Appendix C-2
Wetlands Delineation Report for Off-Site Resources:

Inventory and Delineation of Wetlands and Watercourses at the Route 24/Route 140 Interchange, Taunton, Massachusetts

Deval L. Patrick, Governor
Richard A. Davey, Secretary & CEO
Frank DePaola, Administrator

massDOT
Massachusetts Department of Transportation
Highway Division

INVENTORY AND DELINEATION OF WETLANDS AND WATERCOURSES

AT THE ROUTE 24/ROUTE 140 INTERCHANGE

TAUNTON, MASSACHUSETTS

Prepared For:

Massachusetts Department of Transportation
Highway Division

Prepared By:

AECOM
250 Apollo Drive
Chelmsford, MA 01824

May 2014

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Figure 1: Site Locus

Figure 2A & 2B: FEMA Map

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Appendix A: Table 1: Wetlands and Watercourses Identified along the Route 24/Route 140 Interchange Project

Appendix B: Project Maps

Appendix C: Army Corp of Engineers Wetland Transect Forms

Appendix D: Representative Wetland Photographs

1.0 Introduction

This report provides a summary of wetland and watercourse inventories and delineations conducted along the Route 24/Route 140 Interchange Project corridor in Taunton, Massachusetts. The wetland delineation work has been conducted as part of the environmental assessment for potential interchange reconfigurations and widening portions of adjacent roadways.

On behalf of the Massachusetts Department of Transportation-Highway Division (MassDOT), AECOM conducted wetland and watercourse identification and delineations along the proposed Project route that included the interchange, approximately 1.20 miles of Route 24 and approximately 0.9 miles along Route 140. The project extends north along Route 24 from just north of the Conrail railroad tracks, south of the Rte. 24/Rte. 140 interchange, to a point just south of the Hart Street overpass, and along Rte. 140 from just east of Mozzone Blvd, located west of the Rte. 24/Rte. (Figure 1: Site Locus in Appendix B). 140 interchange, to a point just west of the Stevens St overpass. Offsite desktop analyses, as well as onsite field delineations were employed to determine state and federal wetland boundaries. The onsite and offsite wetland and watercourse investigations were conducted in late 2013 and early 2014. This report discusses the methods used to identify the wetlands and watercourses encountered along the Project corridor, and summarizes the findings of the surveys.

Portions of the Project route overlap the Proposed Mashpee Wampanoag Project First Light project area, located off of Stevens Street, which was delineated by Epsilon Associates, Inc. (Epsilon). As a measure to reduce dual delineation efforts and costs, AECOM was provided with Epsilon's GPS delineation boundaries data to incorporate into the Interchange Project resource analysis. After completing desktop and field reviews of the Epsilon boundaries, AECOM incorporated them into the resource analysis and into this report.

Table 1 lists all wetlands and watercourses identified during the course of the surveys (Appendix A). Appendix B contains the wetland and watercourse mapping associated with the Project. Appendix C contains the field data forms which were used to document the wetland and watercourse delineations, and representative wetland and watercourse photographs are located in Appendix D.

2.0 Wetland and Watercourse Regulations

AECOM personnel identified wetlands and watercourses subject to state or federal jurisdiction based upon the criteria of Section 404 of the Federal Clean Water Act and the Massachusetts Wetlands Protection Act (WPA), M.G.L. Chapter 131, section 40, and its implementing Regulations at 310 CMR 10.00.

2.1 Section 404 – Clean Water Act

Wetlands, springs, and other waters of the United States are regulated under Section 404 of the Federal Clean Water Act ("CWA"; 33 U.S.C. 1341) by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers ("USACE"). The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (33 CFR 328.3(b)).

Under 33 CFR 328.4(c), the limits of federal jurisdiction for non-tidal waters of the United States extend to:

1. *the ordinary high water mark In the absence of adjacent wetlands; or*
2. *beyond the ordinary high water mark to the limit of the adjacent wetlands when adjacent wetlands are present; or*
3. *to the limit of the wetland when the water of the United States consists only of wetlands*

Wetlands meeting these criteria are subject to federal jurisdiction under Section 404 of the Federal Clean Water Act.

2.2 Massachusetts Wetlands Protection Act and its Regulations

The Massachusetts Department of Environmental Protection (MDEP) regulates wetlands and watercourses under the WPA and its implementing Regulations (310 CMR 10.00). The Regulations define a set of "wetland resource areas" that include streams, rivers, lakes, ponds, floodplains, each with specific criteria for identification and delineation. The Regulations of the WPA define Bordering Vegetated Wetlands (BVW) as "freshwater wetlands which border on creeks, rivers, streams, ponds and lakes and includes wet meadows, marshes, swamps and bogs. Bordering Vegetated Wetlands are areas where the soils are saturated and/or inundated such that they support a predominance of wetland indicator plants." The WPA also defines Riverfront Area as being associated with "any natural flowing body of water that empties to any ocean, lake, pond, or other river and which flows throughout the year." The Riverfront Area is defined as "a 200-foot wide corridor on each side of a perennial river or stream, measured from the mean annual high-water line of the river."

3.0 Wetland Delineation Procedures

3.1 Wetland Delineation Procedures

The wetland delineation methodologies outlined in the Corps of Engineers Wetland Delineation Manual ("1987 Corps Manual", USACE, Environmental Laboratory 1987), and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region Version 2.0 ("NC/NE Regional Supplement"; USACE 2012), were used to identify and delineate wetlands along the proposed Project route. Massachusetts has developed a wetland delineation manual (MADEP 1995) for identification of bordering vegetated wetlands, and this manual generally makes use of methods and information found in the 1987 Corps Manual while offering detailed alternative methods to provide users with a selection to suit a range of circumstances. Consistent with both the Corps and the MADEP criteria, a multi-parameter methodology, which incorporates the presence of hydric soils, dominance of hydrophytic vegetation, and other indicators of hydrology to determine the limits of local, state, and federal jurisdictional wetlands, was used in the wetland delineation of the Project route.

In keeping with Massachusetts WPA jurisdictional buffer zones and Riverfront Area, the Project limits were established to include areas within 100 feet from the edge of roadways for wetland boundaries and intermittent watercourses and within 200 feet for perennial streams.

3.2 Pre-Survey Desktop Investigations

Prior to the commencement of field surveys, AECOM reviewed information from multiple sources to determine the potential extent of wetlands within the survey areas. Pre-survey information reviewed included: USGS topographical quadrangles, National Wetland Inventory Maps, Natural Resource Conservation Service – Web Soil Surveys, Mass GIS Resource Mapping that includes Massachusetts Natural Heritage Endangered Species Program (NHESP) data layers.

3.3 Field Surveys

Vegetation, soils, and hydrology data were assessed during the field surveys to determine if the wetland parameters were satisfied for each potential wetland area. AECOM used the "bank" to demarcate the limits of a watercourse when no wetlands were adjacent to the channel. During the field investigations AECOM biologists identified the boundary between the water resource (wetland and/or watercourse) and the upland area, and delineated the boundary with survey flagging. Wetlands were delineated in the field with survey tape hung on vegetation at approximately 15 – 30 foot intervals. Documentation of the wetland boundaries was obtained at specific locations within wetland series. AECOM generated wetland resource field data summary sheets for the wetland and watercourse resource surveys (see Appendix C: Wetlands Field Data Forms). Representative photographs of each wetland were taken during the delineation (see Appendix D: Representative Site Photographs). Each wetland and waterbody was given a unique numeric designation, each flag was GPS surveyed and downloaded on maps. All flagged wetland resource boundaries were surveyed with a Tremble GPS for accurate depictions on the site plans (Appendix B)

The specific methods for characterizing and evaluating vegetation, hydrology, and soils for a wetland determination were performed as follows:

Soils: At the center of each data plot, AECOM characterized the soil profile to determine the hydric soil status. Borings were taken with a hand-held auger to depths necessary to accurately determine a soil's hydric status (typically 18-24 inches below ground surface). The information collected for each soil profile included soil horizons, depth, texture, color, and the presence or absence of redoximorphic features (mottles and other features). Colors of the soil matrix and mottles were identified using Munsell Soil Color Charts. AECOM based all hydric soil determinations on criteria established in the USACE Wetlands Delineation Manual (Environmental Laboratory 1987), along with *Field Indicators of Hydric Soils in the United States* (NRCS 2006) and *Field Indicators for Identifying Hydric Soils in New England* (NEIWPCC 2004). Additionally, AECOM noted the presence of any saturation and/or standing water encountered during the soil profile description.

Vegetation: Species abundance in both upland and wetland communities was visually estimated. Dominant trees and shrubs/saplings were recorded within a 30-foot and 15-foot radius, respectively, from the center of each documentation plot. Woody vines were recorded within a 30-foot radius plot. Dominant herbaceous vegetation was recorded within a 5-foot radius plot. AECOM identified plant species using appropriate botanical reference material for the region. The hydrophytic indicator status of each species was identified using the North American Digital Flora: National Wetland Plant List (Lichvar and Kartesz 2009). Indicators of hydrophytic vegetation are satisfied if the results of the rapid assessment include all species rated as OBL or FACW (Indicator 1), the dominance test is greater than 50% (Indicator 2), or the prevalence index is less than or equal to 3.0 (Indicator 3) based on the USACE Wetland Determination Data Form (USACE, 2012).

Hydrology: Site hydrology was evaluated during field surveys by initially observing whether the soil at the surface was inundated or saturated. If the ground surface was dry, the depth to freestanding groundwater or saturated soil was measured, and the presence or absence of other indicators of wetland hydrology (e.g. drift lines, water-stained leaves, etc.) was noted. The wetland hydrology criterion was met if one or more primary or two or more secondary field indicators were present (U.S. Army Corps of Engineers, 1987).

3.4 Wetland Classification

While in the field, AECOM wetland scientists classified the various wetlands and watercourses according to the "Cowardin system", which is a process discussed in the "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin et. Al 1979). Identified wetlands were classified as Palustrine Forested (PFO), Palustrine Emergent (PEM), Palustrine Scrub-Shrub (PSS) and Palustrine Open Water (POW), as further described below. In some cases, a wetland complex contained more than one wetland classification type. In those situations, each wetland type is listed and the first classification type represents the more dominant characteristic.

Palustrine Forested Wetlands (PFO)
Forested wetlands are characterized by woody vegetation that is six meters (approximately 20 feet) tall or taller and normally includes an overstory of trees, an understory of young trees and/or shrubs and an herbaceous layer.

Palustrine Scrub-Shrub Wetlands (PSS)
Scrub-shrub wetlands are typically dominated by woody vegetation less than six meters (approximately 20 feet) tall. Scrub-shrub land types may represent a successional stage leading to a forested wetland and includes shrubs, saplings, and trees or shrubs that are small and/or stunted due to environmental conditions.

Palustrine Emergent Wetlands (PEM)
Emergent wetlands are characterized by erect, rooted, herbaceous hydrophytes not including mosses and lichens. These wetlands maintain the same appearance year after year, and are typically dominated by perennial plants that are present for the majority of the growing season.

Palustrine Open Water (POW)
Areas of permanent open water that border on palustrine systems are referred to as POW. Areas of open water may exist as man-made or natural waterbodies.

3.5 Post-Survey Desktop Analysis

The wetland and watercourse boundaries, including boundaries provided by Epsilon, were plotted on aerial imagery and subsequently reviewed and confirmed by AECOM personnel. The aerial-based wetland plans in Appendix B: Route 24/Route 140 Interchange Project Maps, Massachusetts Wetlands and Watercourses, show the locations of the delineated resources relative to the existing conditions along the Project corridor. As mentioned above, the Project study limits included areas primarily within 100 feet from the edge of roadways; however perennial stream banks within 200 feet from the edge of roadway were delineated. It should be noted that one wetland, contiguous with the Bank of Cotley River, was not delineated because it was situated beyond the 100-foot buffer zone and another wetland extended from it.

4.0 Results

As a result of the site investigations 46 jurisdictional resource areas were identified. Wetland boundaries were marked in the field using pink surveyors flagging for wetland boundaries and blue flagging used for bank and surveyed with a Tremble GPS for accurate depictions on the site plans (Appendix B). Resource area delineations encompassed segments of Route 24 and Route 140 and included both sides of the highways. Several constructed stormwater drainage features were delineated within the project corridor and labeled "Non-Jurisdictional Drainage Ditches" on the site plans and in Table 1 in Appendix A. These features are not considered jurisdictional resources as defined by the MWPA because they do not exhibit hydric indicators and are situated upstream of other wetland resource areas. The wetlands are typical of those found within and adjacent to major roadway corridors and in some cases exhibit disturbed soil profiles with pioneer vegetation communities that often times colonize disturbed roadside areas.

4.1 Existing Conditions

Existing conditions along the Project route are described as primarily forested with wetlands situated in topographically low areas. These wetlands intercept the regional groundwater table and/or are associated with Cotley River or intermittent stormwater drainage from roadway shoulders and medians as well as surface sheet flow. Topography is often erratic and indicative of past land disturbances associated with roadway and railway construction (the railroad tracks bisect the Project route both north and south of interchange) with evidence of borrow-pit activity particularly within the cloverleaf. Much of the Project route drains east toward the Cotley River and Barstows Pond, located east of Route 24 and northeast of Route 140.

As a result of the site investigation 33 wetland resource areas, 12 intermittent stream channels, 4 stormwater conveyance ditches, and 2 perennial streams were identified and delineated within the Project corridor; stormwater conveyance ditches are not considered wetland resources as defined by the MWPA because they do not exhibit hyrdric indicators and are situated upstream of other wetland resources areas. The resource areas identified within the Project study area and subject to the referenced standards and regulations of WPA include Land Under Waterbodies (310 CMR 10.56), Bank (310 CMR 10.54), Bordering Vegetated Wetlands (310 CMR 10.55), Riverfront Area (310 CMR 10.58), Bordering Land Subject to Flooding (310 CMR 10.57), and associated Buffer Zone (310 CMR 10.02).

4.1 Rare Species Habitat

AECOM reviewed the 2008 Edition (MassGIS version) of the Massachusetts Natural Heritage Atlas prepared by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) for areas of Estimated Habitats of Rare Wildlife or areas of Priority Habitats of Rare Species within or in the vicinity of the project site. NHESP has not mapped Priority or Estimated Habitat within the Project area.

4.2 Bordering Vegetated Wetland

The WPA describes *Bordering Vegetated Wetlands* (BVW) as a the line within which 50% or more of the vegetation community consists of wetland indicator plants and saturated or inundated conditions exists (310 CMR 10.55(2)(c)). Thirty-two (32) BVWs were identified and delineated during the Project survey. Wetlands surveyed within the interchange cloverleaf and

adjacent to railroad beds were found to exhibit disturbed soil profiles and characteristics typical of those found within and adjacent to major roadway corridors. A few of these wetlands were with dominated by pioneer vegetative communities that often times colonize disturbed roadside areas. BVW areas closer to the Cotley River and in other interior portions of the Project area tend to be less disturbed; wetland vegetation and soils of these BVWs are further described below.

4.3 Riverfront Area

The WPA defines Riverfront Area as "any natural flowing body of water that empties to any ocean, lake, pond, or other river and which flows throughout the year" (310 CMR 10.58(2)(a)). The Act protects riverfront area and defines the area as "a 200-foot wide corridor on each side of a perennial river or stream, measured from the mean annual high-water line of the river." The Bank of the Cotley River was delineated in two locations in the field at the mean annual high-water mark which corresponds to the inner edge of Riverfront Area; accordingly, the 200-foot Riverfront Area has been plotted on the site plans (see the RFA locations on plans in Appendix B). A portion of the Cotley River is dammed along the Project corridor to form Barstows Pond, and is shown on the USGS mapping as a pond. The Regulations indicate that such areas do not contain Riverfront Area unless they contain predominantly riverine characteristics; such a determination was not made as part of this assessment, and accordingly no Riverfront Area has been mapped along the Barstows Pond area.

4.4 Bank, Land Under Water Bodies/Waterways

Bank is defined as the portion of land surface which normally abuts and confines a water body, occurs between a water body and a BVW (310 CMR 10.54(2)(a)). While the Land Under Water Bodies and Water Ways is the land beneath any creek, river, stream, pond or lake, and is therefore also associated with these streams (310 CMR (2)(a)). The limit of this resource area is bound by the mean annual low water level, with Bank resource areas adjacent to it. Land Under Water Bodies and Bank resource areas within the Project route are associated with Cotley River, along most of the eastern portion of the Project area, and intermittent streams as indicated in Table 1.

4.5 Bordering Land Subject to Flooding

The boundary of Bordering Land Subject to Flooding (BLSF) is the estimated lateral extent of flood water which will theoretically result from the statistical 100-year frequency storm. This boundary is determined by reference to the most recently available flood profile data prepared by the Federal Emergency Management Agency (310 CMR 10.57(2)(a)(3)). The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for the Town of Taunton indicates the base flood elevation is the water-surface elevation of the 1% annual chance flood, and represented as Zone A with no based flood elevation determined (Figure 2A and 2B in Appendix B).

Wetland Vegetation

The wetlands inventoried during the course of these investigations ranged from PFO wetlands, to PSS wetlands and deeper PEM habitat. Common species encountered in the various PFO wetlands included: red maple (*Acer rubrum),* white pine (*Pinus strobus*), tupelo (*Nyssa sylvatica*) swamp white oak (*Quercus bicolor*), white oak (*Quercus alba*), northern red oak (*Quercus rubra*) and hickory (*Carya glabra*). Common shrub species in PSS wetlands included

northern arrowwood (*Viburnum dentatum*), spicebush (*Lindera benzoin*), sweetpepper bush (*Clethra alnifolia*), silky dogwood (*Cornus amomum*), multiflora rose (*Rosa multiflora*), highbush blueberry (*Vaccinium corymbosum*), and American holly (*Ilex opaca*). Typical herbaceous species in PEM habitat observed included skunk cabbage (*Symplocarpus foetidus*), sensitive fern (*Onoclea sensibilis*), cinnamon fern (*Osmunda cinnamomea*), reed canary grass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), cattail (*Typha tatifolia, agnustifolia*) poison ivy (*Toxicodendron radicans*), goldenrods (*Solidago* spp.), soft rush (*Juncus effusus*), and jewelweed (*Impatiens capensis).*

Wetland Soils

Multiple soil types representing a variety of soil series designations were identified during this wetland and watercourse inventory. Soils described in the various wetlands appear to have formed in parent material including glacial till, glaciolacustrine sediments and glacial outwash. The soil types were identified as moderately drained to poorly drained mineral soil with varying degrees of organics, and included fine sandy loams, sandy loams and mucks. Poor drainage was noted in areas with the presence of deep organic soils, sapric material in the surface layers, high organic contents in the topsoil and/or prolonged standing water. Additionally, varying degrees of stoniness and rockiness were observed. In the more disturbed portions of the study area, the wetland soils were described as, or officially mapped as, disturbed.

See Appendix C, Wetland Delineation Data Forms, for additional soils details and site specific information for wetland areas.

Watercourses

The watercourses encountered during the site survey varied in type, size and character. Some of the streams that were identified are natural, whereas others were man-made. Silty sediments, sand, rock, gravel, riprap, and/or cobble bottoms dominated the natural stream beds that were identified. The shape, height, susceptibility to erosion and direction of flow of the individual watercourses also varied. Manmade watercourses that were surveyed included those with culverts and man-made stormwater drainage channels or ditches.

5.0 References

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Appendix A

Wetlands and Watercourses Identified Within the Project Corridor

Table 1 Wetlands and Watercourses Identified Along the Route 24/Route 140 Interchange Project					
Plan Sheet	Resource Number[1]	Flag Numbers	Wetland Class[2]	MAWPA Recourse[3]	Description
3,4,5,6,7	W-18, W-18B	**B18**:100-120 **18**:1-13, 100-107, 200-226, 401-414, 600-612 **21**:1-20, 20:1-5	PFO	BVW	Forested wetland associated with intermittent streams S18 and drains east under Rte. 24 and eventually to Cotley River
3,4,5	S-18	**b18**:100a-123a **b18**:100-120	Intermittent Stream	Bank	Intermittent stream channels associated with Wetland 18, drains northeast to stream S41 and Cotley River.
5	S-B18	**b18**:1-5 **b18**:1a-5a & **b18**:6-13 **B18**:6a-14a	Intermittent Stream	Bank	Intermittent stream channels associated with Wetland 18, dissipates in wetland
6	W-19	1-5 ties to 16-26	PFO/PSS	BVW	Low lying forested and scrub shrub wetland.
6	S-19	2-4		Bank	Intermittent stream channel associated with Wetland 19
6	W-22	1-6	PSS	BVW	
6	W-23	1-5	PSS	BVW	
6	W-24	1-9	PSS	BVW	
5,9,14	W-25	1-42, 100-132	PFO	BVW	Forested wetland associated with intermittent stream channels and pond
7	W-26	1-36, 100-127, AECOM 1-18	PFO/PSS	BVW	Wetland located in cloverleaf, drains north to Stream S18
8,10	W-27	1-23, 3-16	PFO	BVW	Wetland located in cloverleaf
7	S-27	27-15A-20, 27-16-19	Intermittent Stream	Bank	Flows north, under Rte. 140 to W-18
7,9	DD-27A	1-4	N/A	Non-jurisdictional	Stormwater Drainage Ditch
8	W29	1-5	PSS	IVW	Small isolated wetland located in cloverleaf
4,8	W-30	2-28	PSS	BVW	
8	S-30	N/A	Intermittent Stream	Bank	Intermittent stream channel associated with W30, drains north and east
1	W-31	1-9	PSS	BVW	
1	S-31	1-3		Intermittent Stream	Flows north, connecting with stream north of the Project site.
2	W-32	1-11	PFO	BVW	Flows east, under Rte. 24, to Barstows Pond
2	S-32	1-9	Intermittent Stream	Bank	Intermittent stream channel
1	DD-33	1-5	N/A	Non-jurisdictional	Stormwater Drainage Ditch
3	W-34	1-15	PFO	BVW	Large forested wetland northwest of Interchange
15	W-35	1-14	PFO	BVW	Large forested wetland southwest of interchange

Table 1 Wetlands and Watercourses Identified Along the Route 24/Route 140 Interchange Project					
Plan Sheet	Resource Number[1]	Flag Numbers	Wetland Class[2]	MAWPA Recourse[3]	Description
15	W-36	1-18	PFO	BVW	Wetland contiguous with W-35 beyond Project limits.
1	W-37	1-5	PFO/PSS/PEM	BVW	Large marsh drains east to Barstows Pond.
2	W-38	1-11	PFO	BVW	Bordering wetland contiguous with Barstows Pond
2	S-38	1-10	Intermittent Stream	Bank	Intermittent stream channel
3	W-39	100-110	PFO/PSS	BVW	Low lying forested wetland adjacent to Rte.24 that flows east to Barstows Pond/Cotley River during high flow.
3	W-40	100-102	PSS	BVW	Low lying forested wetland adjacent to rail tracks flows east to Barstows Pond/Cotley River during high flow.
4	W-41	100-105	PFO	BVW	Low lying forested wetland receives flow from W-25 and S-18 and flows east to Cotley River
4	S-41	1-10	Intermittent Stream	Bank	Intermittent stream channel drains east to Cotley River
4	S-41B	1-12	Intermittent Stream	Bank	Intermittent stream channel, receives drainage from catch basins on Route 24 northbound on ramp and flow from W30.
4	W-42	100-104	PFO	BVW, BLSF	Associated with Cotley River
8,10	W-43	100-115	PFO	BVW	Forested wetland situated down slope of Rte. 24 northbound on ramp, receives stormwater flow and flow from W-7.
11	W-44	100-128	PFO	BVW, BLSF	Large forested wetland adjacent to and in the floodplain of Cotley River
11	S-44	Bank 1-46	Perennial River	RFA	South and west bank of Cotley River
11,12	S-44A	1-16	Intermittent Stream	Bank	Intermittent stream channel receives flow from S52 on the south side of Rte. 140.
12	W-45	93-115	PFO	BVW, BLSF	Forested wetland adjacent to Cotley River
12	W-46	100-109	PFO/PSS/PEM	BVW, BLSF	Low lying marsh adjacent to Cotley River
13	W-47	100-104	PEM	BVW	Small wetland drains west to Cotley River
13	W-48	100-104	PFO	BVW, BLSF	Forested wetland adjacent to Cotley River
13	W-49	1-20	PFO	BVW	Forested wetland located in cloverleaf of Stevens Street overpass, receives stormwater and flow from W50 to Cotley River
13	W-50	1-15 & 1-9	PSS/PEM	BVW	Wetland drains south under Rte. 140 to W49
13	DD-50	1-4	N/A	Non-jurisdictional Ditch	Stormwater drainage ditch flows west to Cotley River and receives flow from catch basin on Stevens Street

Table 1 Wetlands and Watercourses Identified Along the Route 24/Route 140 Interchange Project					
Plan Sheet	Resource Number[1]	Flag Numbers	Wetland Class[2]	MAWPA Recourse[3]	Description
13	DD-50B	1-2	N/A	Non-jurisdictional Ditch	Ditch that conveys stromwater flow to Cotley River
13	S-51	Bank 1-3 & Bank A 1-3	Perennial River	RFA	Banks for Cotley River located on south side of Rte. 140
10,11,12	W-52	1-26	PSS	BVW	Linear wetland along the south side of Rte. 140 and drains north to Cotley River via intermittent stream S52
11	S-52	Bank 1-2 & Bank A 1-3	Intermittent Stream	Bank	Intermittent stream channel flows under Rte. 140 to Cotley River
10	W-53	1-9	PSS/PEM	BVW	During high water levels W53 flows south to W52
14,15	W-55	1-44	PFO	BVW	Large low lying marsh associated with intermittent stream.
6	W-56	1-9	PFO/PSS	BVW	Large low lying marsh connected to BVW 19 via S19.

1: Wetland series number generated by AECOM to identify wetlands within and adjacent to the Project corridor; 2: wetlands classification according to Cowardin et al 1979; PEM = Palustrine Emergent Wetland; PFO = Palustrine Forested Wetland; PSS = Palustrine Scrub-Shrub Wetland; OW = Open Water. 3: MWPA wetland resource designation.

Appendix B

Project Maps

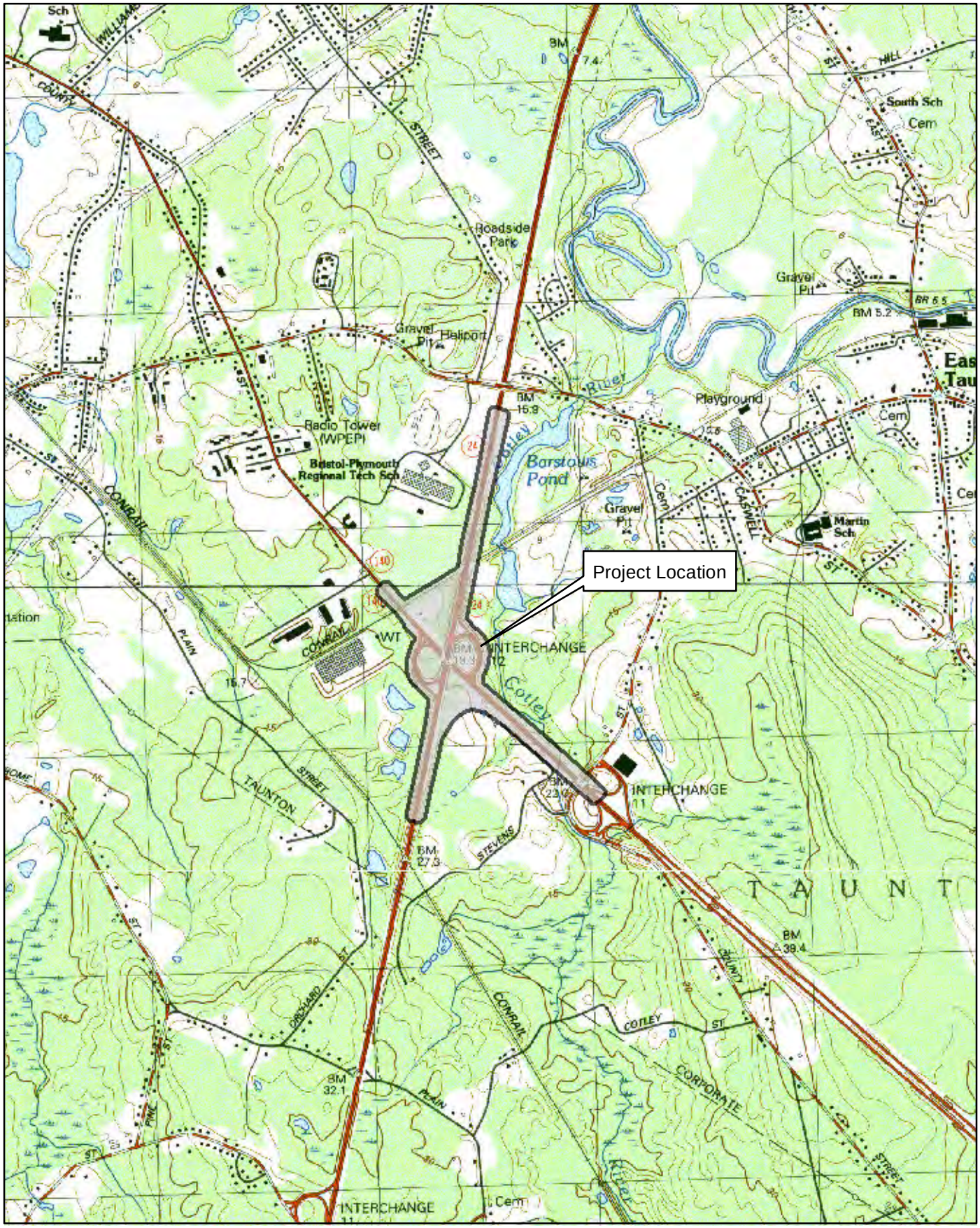

FIG 1

FIGURE 1:
Site Locus

Route 24/Route 140 Interchange Project
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1 inch = 2,000 feet

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Figure 2A: FEMA Map Northern Site

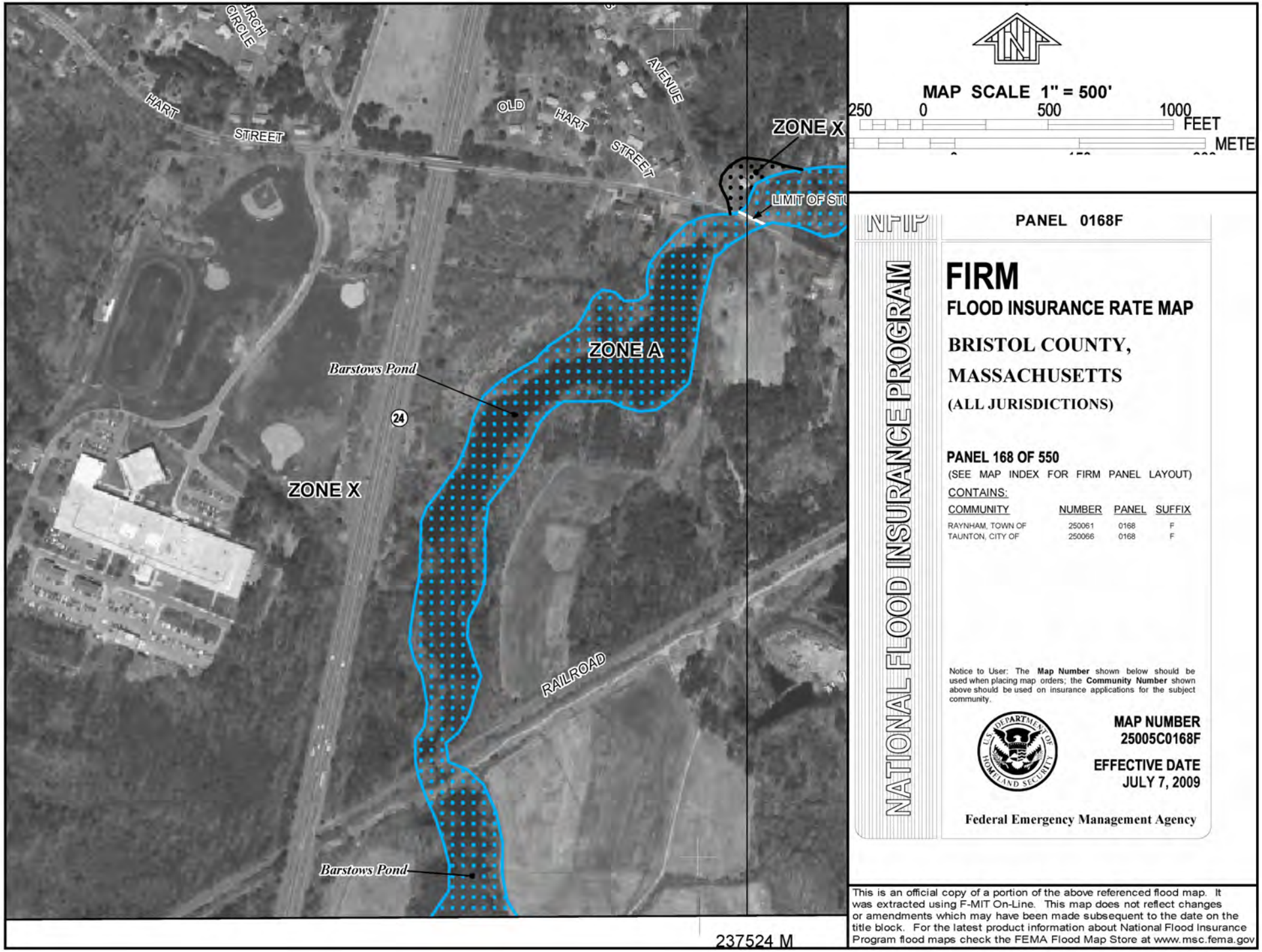
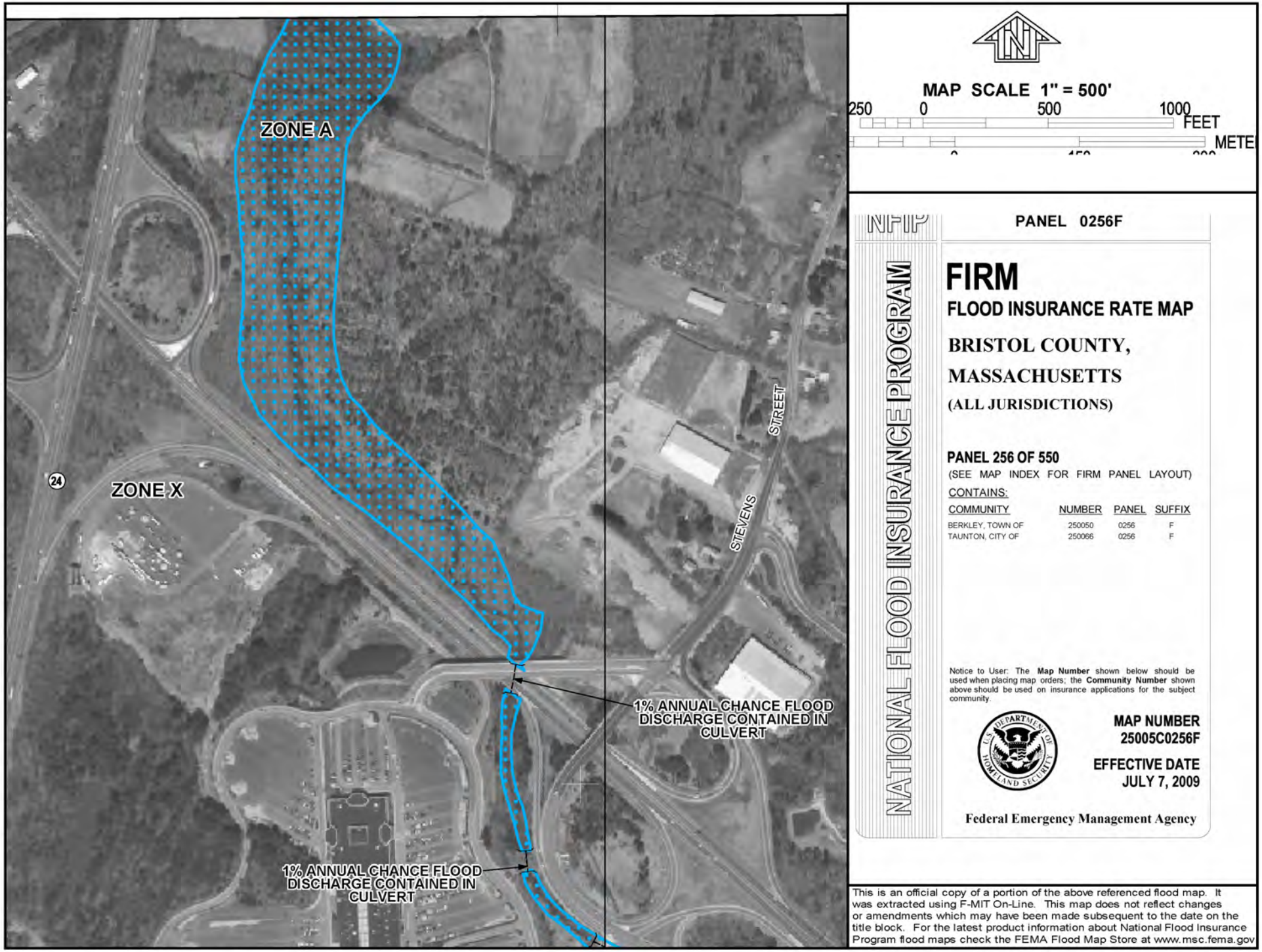
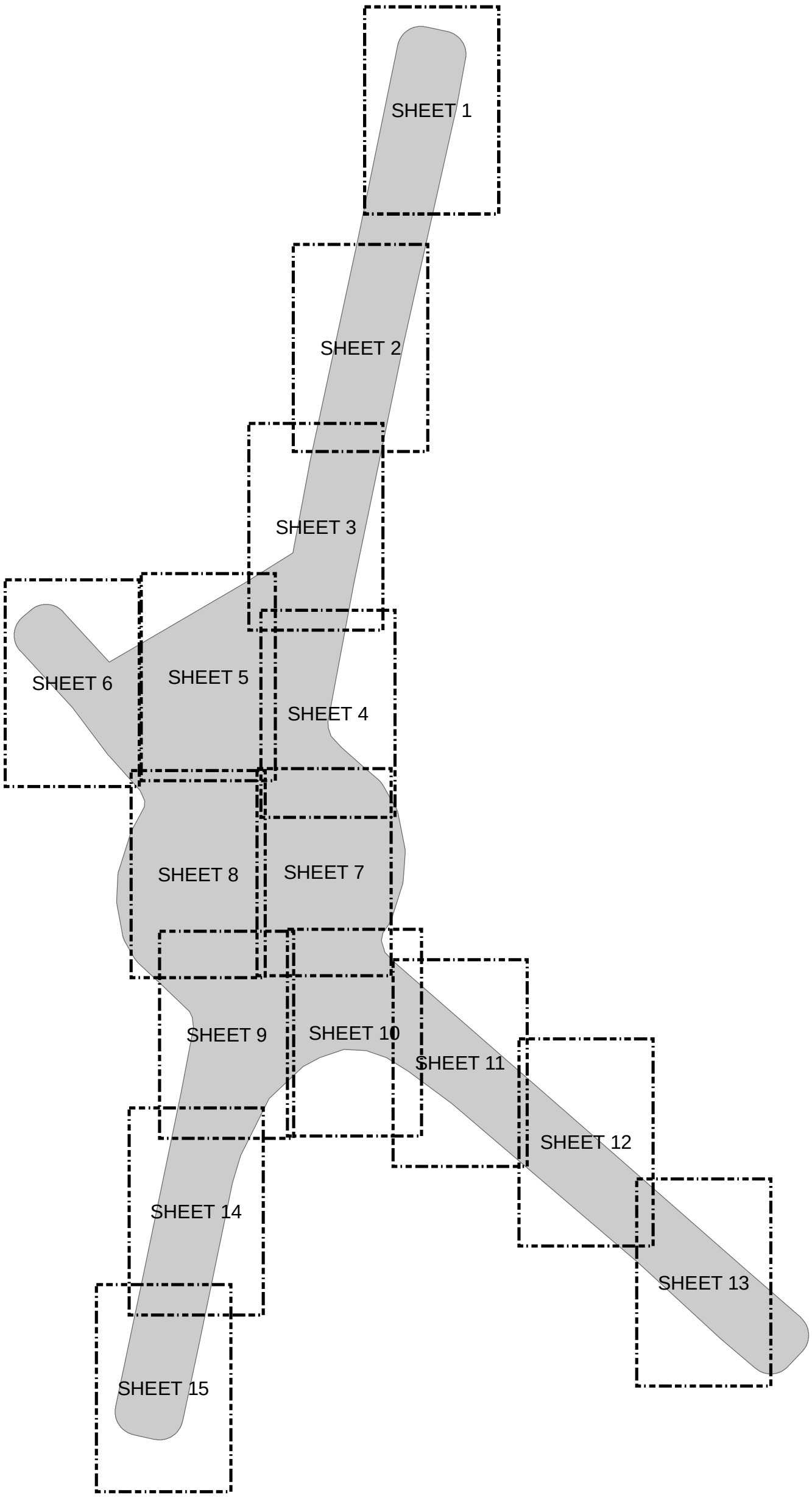
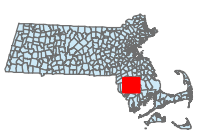


Figure 2B: FEMA Map Southern Site





Scale 1 inch = 500 feet



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KEY MAP SHEET

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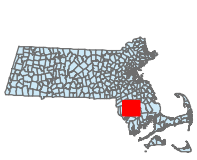

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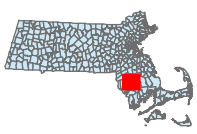

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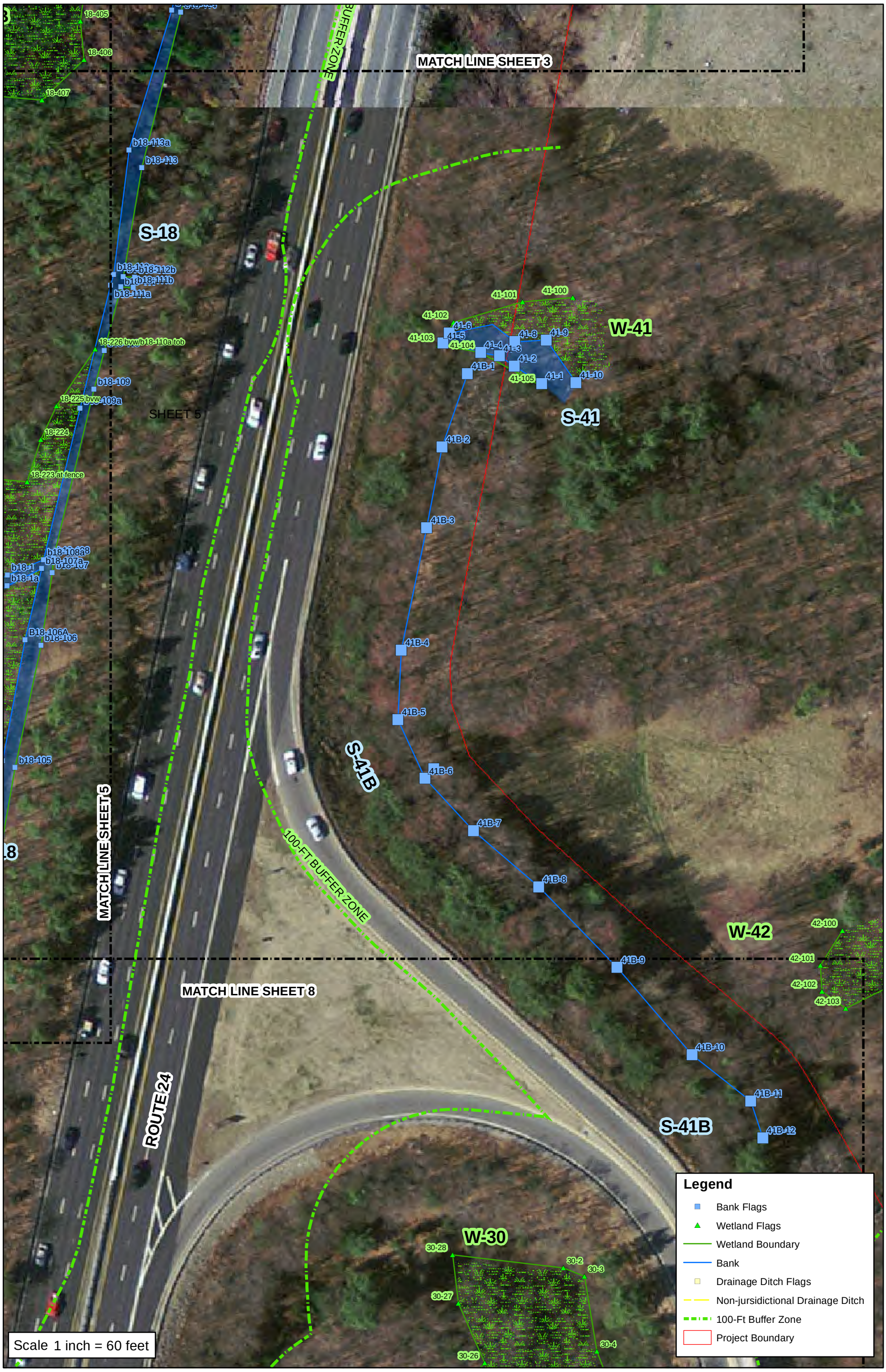

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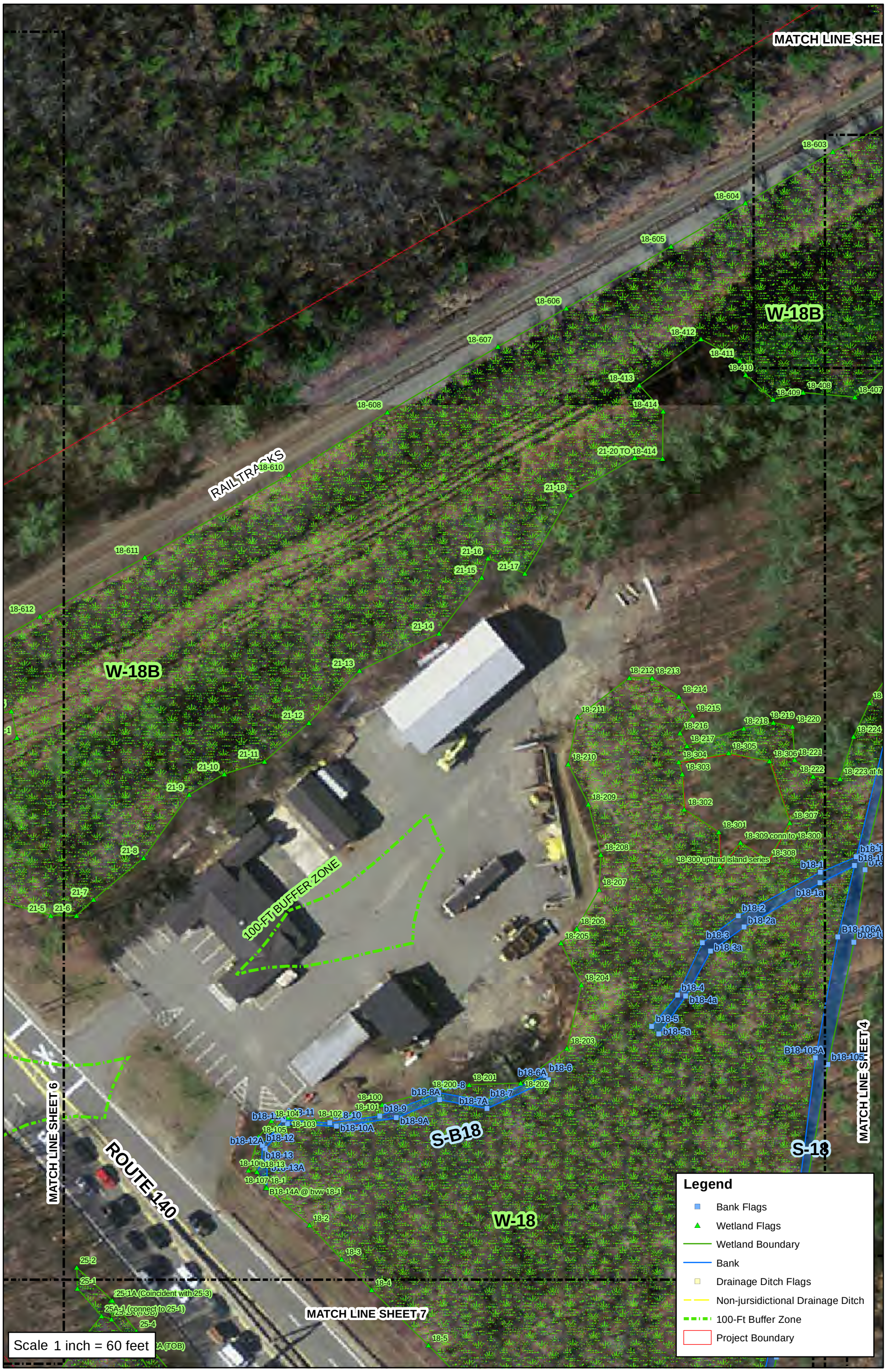

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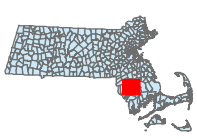

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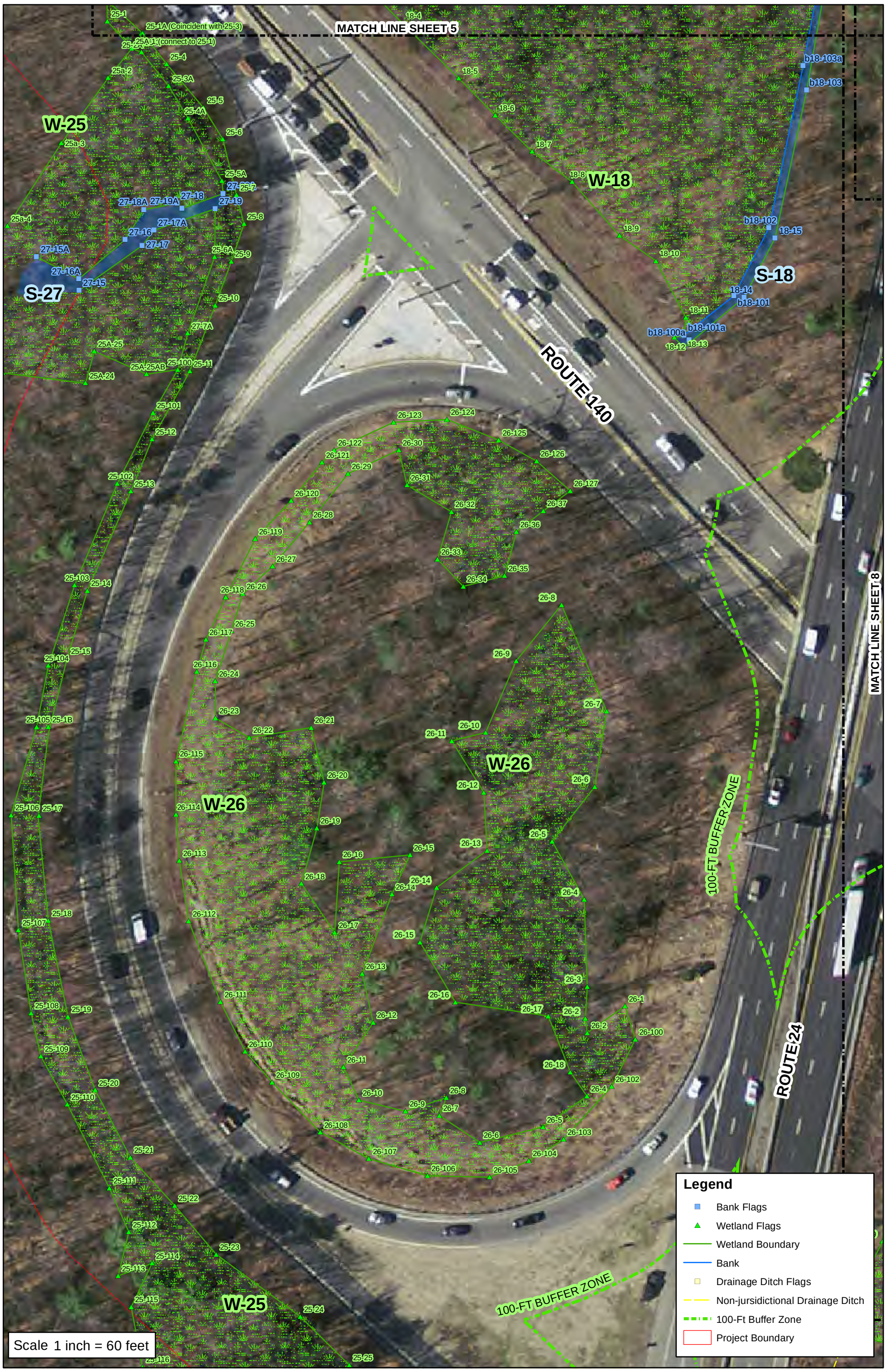

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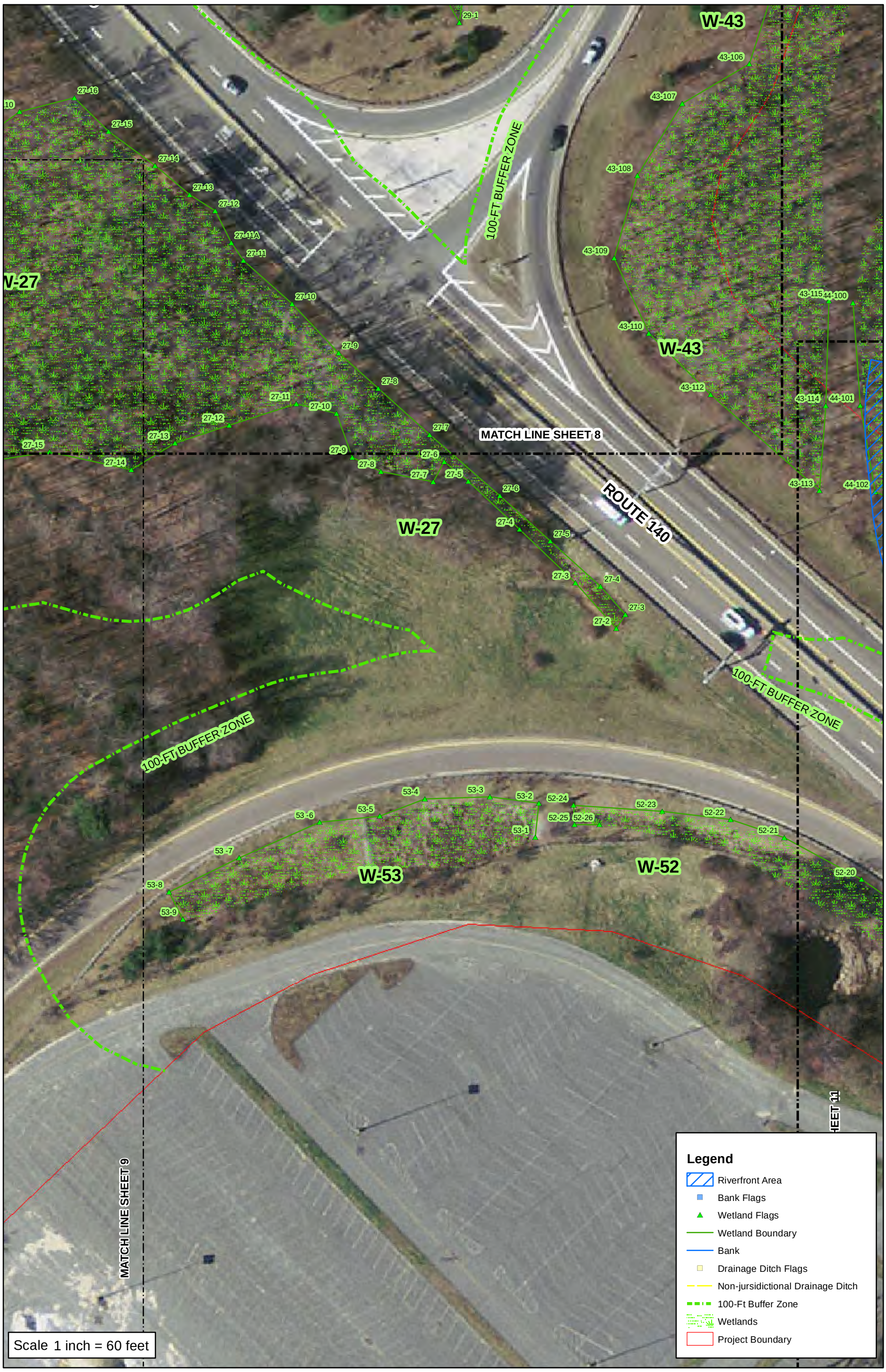

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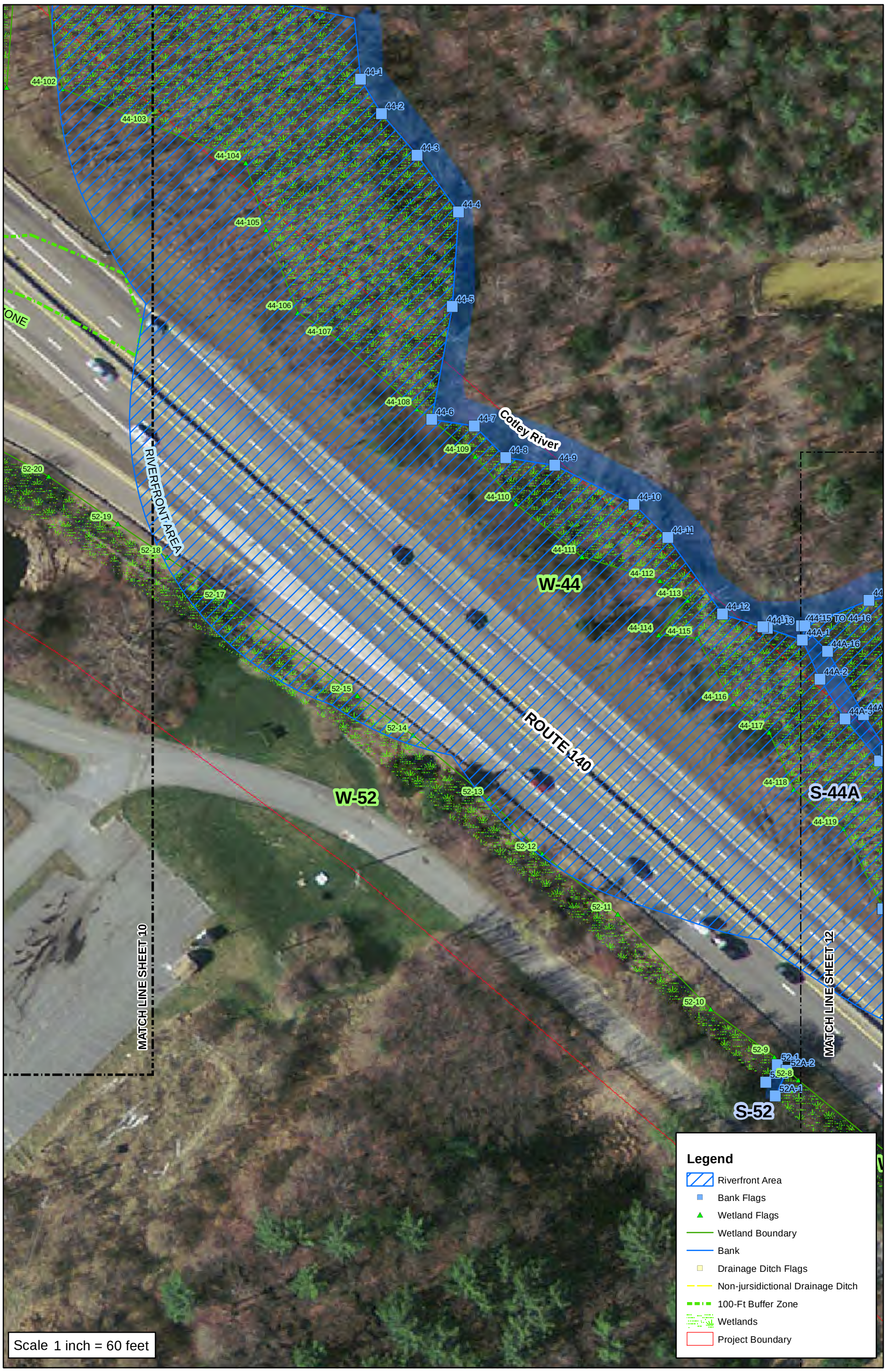

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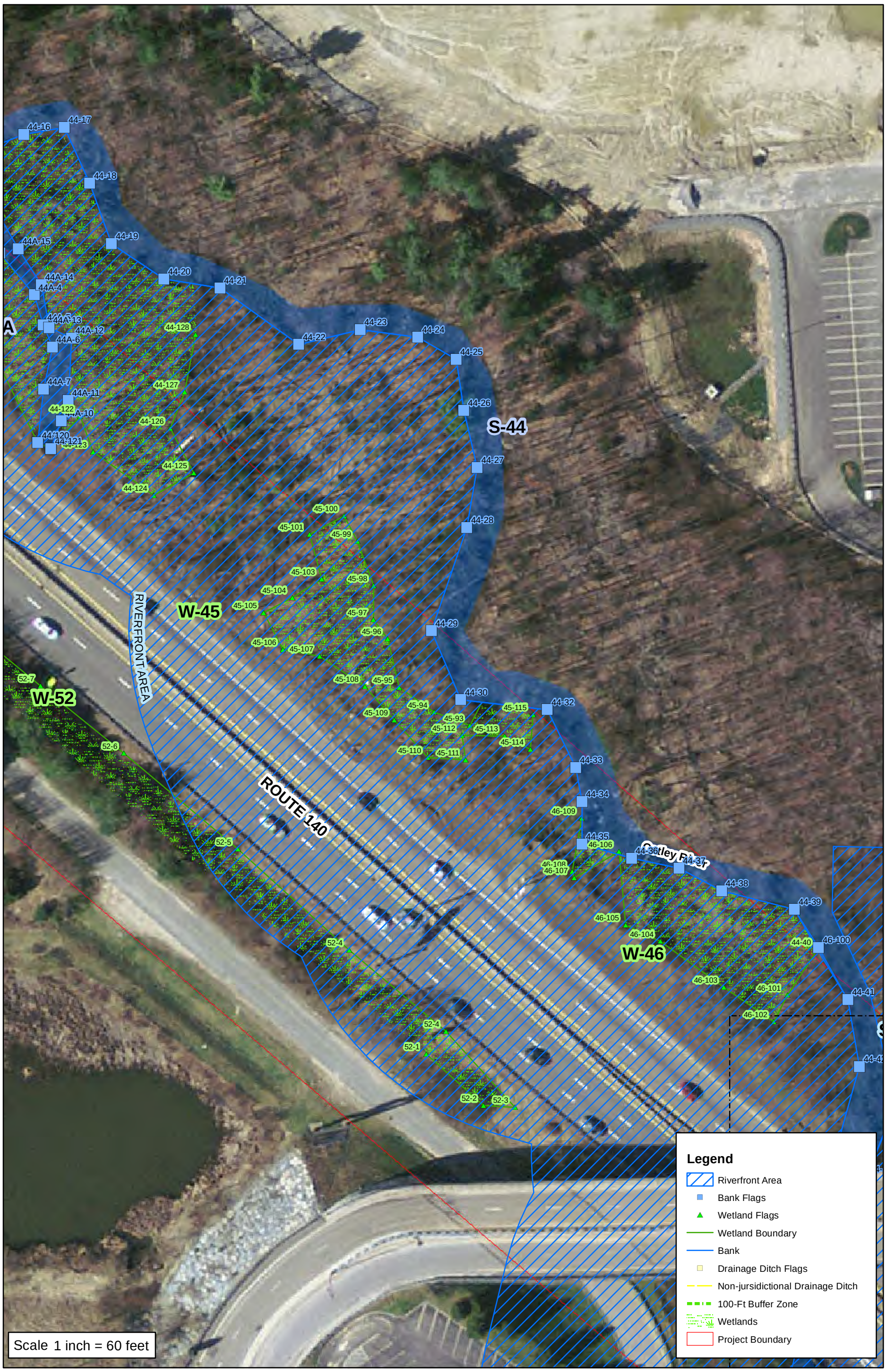

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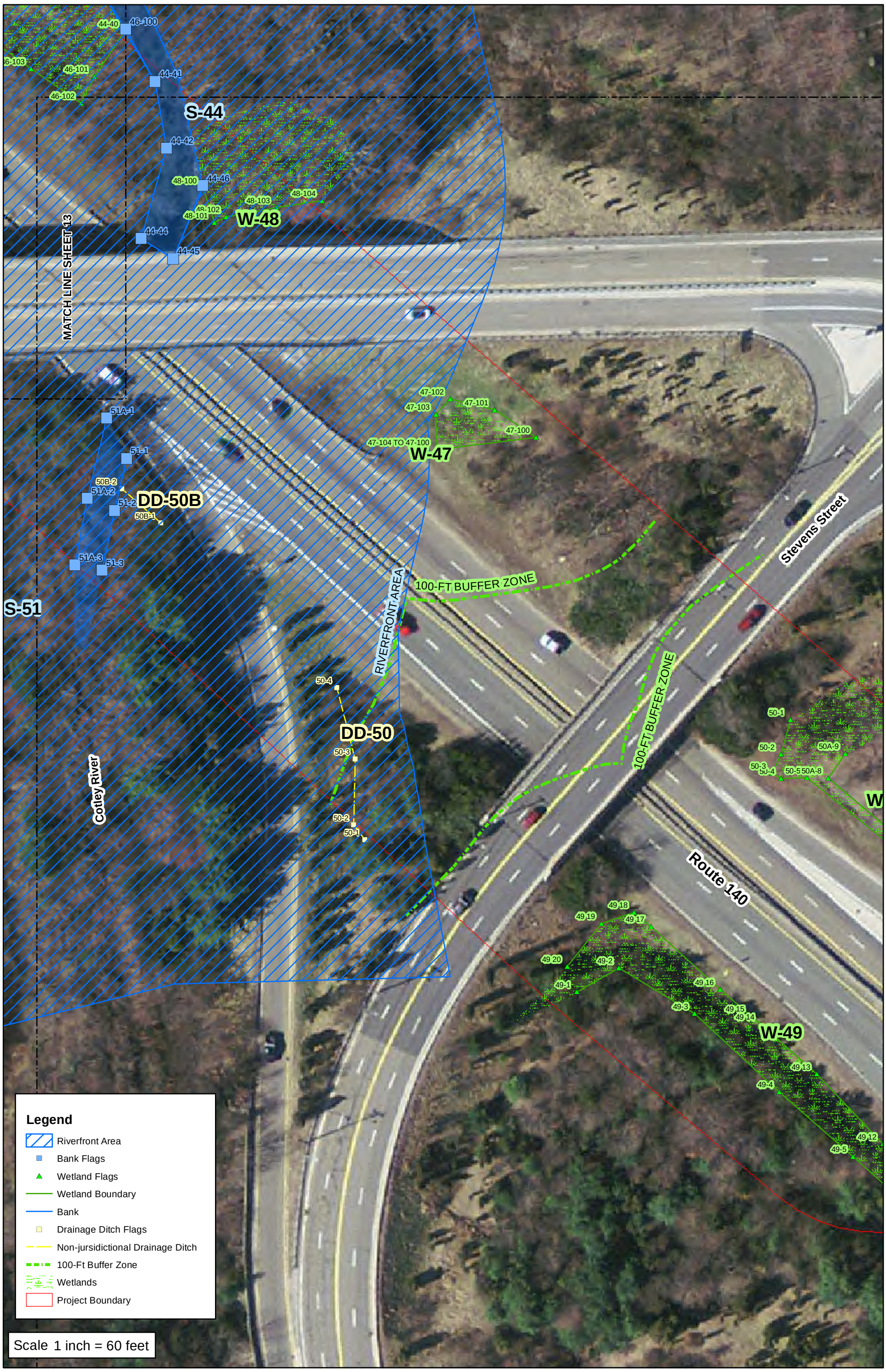
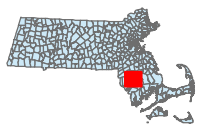
Chelmsford, MA 01824
T 978.905.2100 F 978.905.2101



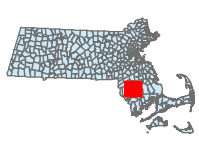


N

SHEET 13

Route 24/Route 140 Interchange Project
Taunton, Massachusetts

AECOM Environment
250 Apollo Drive
Chelmsford, MA 01824
T 978.905.2100 F 978.905.2101



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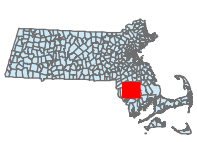
SHEET 14

Route 24/Route 140 Interchange Project
Taunton, Massachusetts

massDOT

AECOM Environment
250 Apollo Drive
Chelmsford, MA 01824
T 978.905.2100 F 978.905.2101



N

SHEET 15

Route 24/Route 140 Interchange Project
Taunton, Massachusetts

massDOT

AECOM Environment
250 Apollo Drive
Chelmsford, MA 01824
T 978.905.2100 F 978.905.2101

Appendix C

Army Corp of Engineers Wetland Transect Data Forms

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Taunton Rt. 24/140 Interchange City/County: Taunton/Bristol Sampling Date: 3/18/2014
Applicant/Owner: MassDOT State: MA Sampling Point: W27-upl
Investigator(s): JS/SB Section, Township, Range: _____
Landform (hillslope, terrace, etc.): Flat Local relief (concave, convex, none): None
Slope (%): -13 Lat: -71.025230 Long: 42.390904 Datum: WGS84
Soil Map Unit Name: _____ NWI Classification: UPL
Are climatic/hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks)
Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances present? Yes ☒ No ☐
Are Vegetation ☐, Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☐	No ☒	**Is the Sampled Area within a Wetland?** **Yes** ☐ **No** ☒
Hydric Soil Present?	Yes ☐	No ☒	
Wetland Hydrology Present?	Yes ☐	No ☒	If yes, optional Wetland Site ID: _____

Remarks: (explain alternative procedures here or in separate report)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ☐	No ☒	Depth (inches)
Water Table Present?	Yes ☐	No ☒	Depth (inches)
Saturation Present? (include capillary fringe)	Yes ☐	No ☒	Depth (inches)

Wetland Hydrology Present? **Yes** ☐ **No** ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants

Sampling Point: W27upl

Tree Stratum (Plot size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	40	Y	FAC
2. Prunus serotina	20	Y	FACU
3 .Nyssa sylvatica	5	N	FAC
4. Carya glabra	5	N	FACU
5.			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	7	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	14.3%	(C)

Prevalence Index worksheet:

6.
7.

70 = Total Cover

Sapling/Shrub Stratum (Plot size:15 ft)

1. Ostrya virginiana	20	Y	FACU
2. Carya ovata	15	Y	FACU
3 .Carpinus caroliniana	5	N	FAC
4.			
5.			
6.			
7.			
8.			

40 = Total Cover

Herb Stratum (Plot size:5 ft)

1. Dryopteris intermedia	10	Y	FACU
2. Celastrus orbiculatus	10	Y	UPL
3 .			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

20 = Total Cover

Woody Vine Stratum *(Plot size:30 ft)*

1. Celatrus orbiculatus	20	Y	UPL
2.			
3 .			
4.			

20 = Total Cover

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ Rapid Test for Hydrophytic Vegetation
- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.01
- ☐ Morphological Adaptations1 (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.
Sapling/shrub – Woody plants less than 3 in. DBHand greater than 3.28 ft (1 m) tall.
Herb – All herbaceous (non-woody) plants, regardlessof size, and woody plants less than 3.28 ft tall.
Woody vines – All woody vines greater than 3.28 ft in height

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☒

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W27upl

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
1-0	Oi	100						
0-12	10 YR4/6	100					SL	
12-20+	2.5 Y5/6	100					SL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grain. [2]Location: PL=Pore Lining M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR, R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):

Type: _____

Depth (inches): 0

Hydric Soil Present? **Yes** ☐ **No** ☒

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Taunton Rt. 24/140 Interchange City/County: Taunton/Bristol Sampling Date: 3/18/2014
Applicant/Owner: MassDOT State: MA Sampling Point: W27-wet
Investigator(s): JS/SB Section, Township, Range: _____
Landform (hillslope, terrace, etc.): Flat Local relief (concave, convex, none): None
Slope (%): -13 Lat: -71.025230 Long: 42.390904 Datum: WGS84
Soil Map Unit Name: _____ NWI Classification: PFO
Are climatic/hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks)
Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances present? Yes ☒ No ☐
Are Vegetation ☐, Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☒	No ☐	**Is the Sampled Area within a Wetland?** **Yes** ☒ **No** ☐
Hydric Soil Present?	Yes ☒	No ☐	
Wetland Hydrology Present?	Yes ☒	No ☐	If yes, optional Wetland Site ID: _____

Remarks: (explain alternative procedures here or in separate report)
Wetland is receives hydrologic input via upgradient intermittent flow from state highway layout stormwater runoff. In addition, it is located in a low-lying area with a high groundwater table.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☒ Surface Water (A1)
- ☒ High Water Table (A2)
- ☐ Saturation (A3)
- ☒ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☒ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☒ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ☐	No ☒	Depth (inches)
Water Table Present?	Yes ☒	No ☐	Depth (inches) 4
Saturation Present? (include capillary fringe)	Yes ☒	No ☐	Depth (inches) 6

Wetland Hydrology Present? **Yes** ☒ **No** ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Wetland is receives hydrologic input via upgradient intermittent flow from state highway layout stormwater runoff. In addition, it is located in a low-lying area with a high groundwater table.

VEGETATION – Use scientific names of plants

Sampling Point: W27wet

Tree Stratum (Plot size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	50	Y	FAC
2. Quercus bicolor	15	N	FACW
3 .Nyssa sylvatica	12	N	FAC
4. Quercus rubra	5	N	FACU
5. Prunus serotina	5	N	FACU

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	6	(A)
Total Number of Dominant Species Across All Strata:	7	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	85.7%	(C)

Prevalence Index worksheet:

6.
7.

87 = Total Cover

Sapling/Shrub Stratum (Plot size:15 ft)

1. Viburnum dentatum	15	Y	FAC
2. Acer rubrum	12	Y	FAC
3 .Ilex verticillata	10	Y	FACW
4. Lindera benzoin	5	N	FACW
5. Vaccinium corymbosum	5	N	FACW
6. Quercus alba	3	N	FACU
7.			
8.			

50 = Total Cover

Herb Stratum (Plot size:5 ft)

1. Osmundastrum cinnamomea	60	Y	FACW
2. Toxicodendrom radicans	10	N	FAC
3 .			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

70 = Total Cover

Woody Vine Stratum *(Plot size:30 ft)*

1. Celatrus orbiculatus	15	Y	UPL
2. Smilax rotundifolia	10	Y	FAC
3 .			
4.			

25 = Total Cover

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ Rapid Test for Hydrophytic Vegetation
- ☒ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.01
- ☐ Morphological Adaptations1 (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.
Sapling/shrub – Woody plants less than 3 in. DBHand greater than 3.28 ft (1 m) tall.
Herb – All herbaceous (non-woody) plants, regardlessof size, and woody plants less than 3.28 ft tall.
Woody vines – All woody vines greater than 3.28 ft in height

Hydrophytic Vegetation Present? **Yes** ☒ **No** ☐

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: W27wet

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
1-0	Oe	100						
0-6	10 YR3/2	100					SL	
6-20+	7.5 YR4/2	90	2.5 YR5/6	10	C	M	LS	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grain. [2]Location: PL=Pore Lining M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☒ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR, R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☒ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):

Type: _____

Depth (inches): 0

Hydric Soil Present? **Yes** ☒ **No** ☐

Remarks:

Wetland is receives hydrologic input via upgradient intermittent flow from state highway layout stormwater runoff. In addition, it is located in a low-lying area with a high groundwater table.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 01/9/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW-34 Upland Plot

Investigator(s): Julia Stearns/Alison Millaman Section, Township, Range: _____

Landform (hillslope, terrace, etc.): Low terrace Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.876431 Long: -71.054785 Datum: _____

Soil Map Unit Name: 256A Deefield Loamy sand NWI classification: PFO

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** X
Hydric Soil Present?	Yes _____	No X	If yes, optional Wetland Site ID: Flag 34-7
Wetland Hydrology Present?	Yes _____	No X	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No X	Depth (inches): _____
Water Table Present?	Yes _____	No X	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes _____	No X	Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 34-Upland Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	50	Yes	FAC
2. Pinus strobus	30	Yes	FACU
3. Quercus rubra	20	No	FACU
4.			
5.			
6.			
7.			
	100 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Vaccinium corymbosum	50	Yes	FACW
2. Pinus strobus	20	Yes	FACU
3.			
4.			
5.			
6.			
7.			
	70 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Dryopteris sp.	80	N/A	
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species	50	x 2 =	100
FAC species	50	x 3 =	150
FACU species	70	x 4 =	280
UPL species		x 5 =	
Column Totals:	170 (A)		530 (B)

Prevalence Index = B/A = 3.1

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** _____ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 34 Upland Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12"	10YR 3/2						FSL	
12-18"	2.5Y 4/3						SL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 01/9/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW-34 Wet Plot

Investigator(s): Julia Stearns/Alison Millaman Section, Township, Range: _____

Landform (hillslope, terrace, etc.): Low terrace Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.876431 Long: -71.054785 Datum: _____

Soil Map Unit Name: 256A Deefield Loamy sand NWI classification: PFO

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** **Yes** X **No** _____
Hydric Soil Present?	Yes X	No _____	
Wetland Hydrology Present?	Yes X	No _____	If yes, optional Wetland Site ID: Flag 34-7

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- X Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- X Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X	No _____	Depth (inches): _____
Water Table Present?	Yes X	No _____	Depth (inches): 12 inches
Saturation Present? (includes capillary fringe)	Yes X	No _____	Depth (inches): surface

Wetland Hydrology Present? **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 34-Wet Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	80	Yes	FAC
2. Pinus strobus	10	No	FACU
3. Quercus rubra	30	Yes	FACU
4.			
5.			
6.			
7.			
	120 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Lyonia lucida	70	Yes	FACW
2. Pinus strobus	10	No	FACU
3.			
4.			
5.			
6.			
7.			
	80 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Osmunda cinnamomea	80	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species	150	x 2 =	300
FAC species	80	x 3 =	240
FACU species	40	x 4 =	160
UPL species		x 5 =	
Column Totals:	270 (A)		700 (B)

Prevalence Index = B/A = 2.59

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 34-Wet Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12"	Black						O	
12-20+"	10YR4/2				D		FSL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- X Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- X Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 01/15/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW 35 Upland Plot

Investigator(s): Julia Stearns/Alison Millaman Section, Township, Range: _____

Landform (hillslope, terrace, etc.): Toe of hillslope Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.864895 Long: -71.057875 Datum: _____

Soil Map Unit Name: 71B Ridgebury fine sandy loam NWI classification: Poorly drained

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No X	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** X
Hydric Soil Present?	Yes _____	No X	If yes, optional Wetland Site ID: Flag 35-6
Wetland Hydrology Present?	Yes _____	No X	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No X	Depth (inches): _____
Water Table Present?	Yes _____	No X	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes _____	No X	Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 35 Upland Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	60	Yes	FAC
2. Pinus strobus	30	Yes	FACU
3. Quercus velutina	50	Yes	UP
4.			
5.			
6.			
7.			
	140 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Clethra alnifolia	20	Yes	FAC
2. Pinus strobus	40	Yes	FACU
3.			
4.			
5.			
6.			
7.			
	60 = Total Cover		

Herb Stratum (Plot size: 5')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	= Total Cover		

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 40% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species	80	x 3 =	240
FACU species	70	x 4 =	280
UPL species	50	x 5 =	250
Column Totals:	200 (A)		770 (B)

Prevalence Index = B/A = 3.8

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** _____ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 3 Upland Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-6"	10YR 3/2						FSL	
6-18+"	2.5Y 4/4						LS	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 01/15/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW-35 Wet Plot

Investigator(s): Julia Stearns/Alison Millaman Section, Township, Range: _____

Landform (hillslope, terrace, etc.): Toe of hillslope Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.864895 Long: -71.057875 Datum: _____

Soil Map Unit Name: 71B Ridgebury fine sandy loam NWI classification: Poorly drained

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** **Yes** X **No** _____
Hydric Soil Present?	Yes X	No _____	If yes, optional Wetland Site ID: Flag 35-6
Wetland Hydrology Present?	Yes X	No _____	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- X High Water Table (A2)
- ___ Saturation (A3)
- X Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X	No _____	Depth (inches): _____
Water Table Present?	Yes X	No _____	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes X	No _____	Depth (inches): _____

Wetland Hydrology Present? **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 35-Wet Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	75	Yes	FAC
2. Pinus strobus	25	Yes	FACU
3. Quercus velutina	20	No	N/A
4.			
5.			
6.			
7.			
	120 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Clethra alnifolia	70	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	70 = Total Cover		

Herb Stratum (Plot size: 5')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	= Total Cover		

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species	145	x 3 =	435
FACU species	25	x 4 =	100
UPL species		x 5 =	
Column Totals:	170 (A)		535 (B)

Prevalence Index = B/A = 3.1

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 3 Wet Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-3"	10YR 3/2						FSL	
3-10"	2.5Y 4/2		10YR 4/1 Depletions				SL	10YR 4/6 Motles
10-20"	2.5Y 5/2		10YR 4/6 Motles				SL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- X Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- X Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 01/15/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW 38 Up Plot

Investigator(s): Julia Stearns/Alison Millaman Section, Township, Range: _____

Landform (hillslope, terrace, etc.): Toe of hillslope Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.87840 Long: -71.053090 Datum: _____

Soil Map Unit Name: 256A Deerfield loamy sand NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** X
Hydric Soil Present?	Yes _____	No X	If yes, optional Wetland Site ID: Flag 38-9
Wetland Hydrology Present?	Yes _____	No X	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No X	Depth (inches): _____
Water Table Present?	Yes _____	No X	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes _____	No X	Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 38 Up Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	90	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	90 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Pinus strobus	20	Yes	UPL
2. Cornus racemosa	10	Yes	FAC
3.			
4.			
5.			
6.			
7.			
	30 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Rubus sp.	10	Yes	N/A
2. Carex pensylvanica	10	Yes	N/A
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	20 = Total Cover		

Woody Vine Stratum (Plot size:)			
1. Smilax rotundifolia	20	Yes	FAC
2.			
3.			
4.			
	20 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation

X Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 38 Up Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-10"	10YR 2/2						FSL	
10-16+"	2.5YR5/3						FSL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 01/31/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW 42 Wet Plot

Investigator(s): Julia Stearns/Alison Millaman Section, Township, Range: _____

Landform (hillslope, terrace, etc.): Toe of hillslope Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.873171 Long: -71.053562 Datum: _____

Soil Map Unit Name: 276A Ninigret Fine Sandy Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** **Yes** X **No** _____
Hydric Soil Present?	Yes X	No _____	
Wetland Hydrology Present?	Yes X	No _____	If yes, optional Wetland Site ID: Flag 42-3

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- X Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No X	Depth (inches): _____
Water Table Present?	Yes _____	No X	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes X	No _____	Depth (inches): 2"

Wetland Hydrology Present? **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 42 Wet Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	80	Yes	FAC
2. Quercus rubra	20		FACU
3.			
4.			
5.			
6.			
7.			
	100 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Herb Stratum (Plot size: 5')			
1. Onoclea sensibilis	25	Yes	FACW
2. Juncus effusus	10	Yes	OBL
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	35 = Total Cover		

Woody Vine Stratum (Plot size:)			
1. Smilax rotundifolia	35	Yes	FAC
2.			
3.			
4.			
	35 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 42 Wet Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-16"	10YR2/2			60%			FSL	
16-24"	2.5YR 4/2						FSL	RM

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- X Depleted Below Dark Surface (A11)
- X Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 01/31/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW 42 Up Plot

Investigator(s): Julia Stearns/Alison Millaman Section, Township, Range: _____

Landform (hillslope, terrace, etc.): Toe of hillslope Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.873171 Long: -71.053562 Datum: _____

Soil Map Unit Name: 276A Ninigret Fine Sandy Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** X
Hydric Soil Present?	Yes _____	No X	If yes, optional Wetland Site ID: Flag 42-3
Wetland Hydrology Present?	Yes _____	No X	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No X	Depth (inches): _____
Water Table Present?	Yes _____	No X	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes _____	No X	Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 42 Up Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	80	Yes	FAC
2. Juniperus virginiana	30	Yes	FACU
3.			
4.			
5.			
6.			
7.			
	110 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Viburnum dentatum	30	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	30 = Total Cover		

Herb Stratum (Plot size: 5')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	= Total Cover		

Woody Vine Stratum (Plot size:)			
1. Smilax rotundifolia	30	Yes	FAC
2.			
3.			
4.			
	30 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 42 Up Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12"	10YR 3/2						FSL	
12-20"	10YR 4/6						FSL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 01/31/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW 42 Wet

Investigator(s): Julia Stearns Section, Township, Range: Plot

Landform (hillslope, terrace, etc.): Toe of hillslope Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.873171 Long: -71.053562 Datum: _____

Soil Map Unit Name: 276A Ninigret Fine Sandy Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** **Yes** X **No** _____
Hydric Soil Present?	Yes X	No _____	If yes, optional Wetland Site ID: Flag 42-3
Wetland Hydrology Present?	Yes X	No _____	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- X Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X	No _____	Depth (inches): _____
Water Table Present?	Yes X	No _____	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes X	No _____	Depth (inches): _____

Wetland Hydrology Present? **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 42 Wet Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	80	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	80 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	85 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Onoclea sensibilis	30	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		

Woody Vine Stratum (Plot size:)			
1. Smilax rotundifolia	25	Yes	FAC
2.			
3.			
4.			
	25 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 42 Wet Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-16"	10YR 2/2						FSL	Redox features
16-24	2.5Y 4/2						FSL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- X Depleted Below Dark Surface (A11)
- X Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** _____

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 01/31/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW 43 Wet

Investigator(s): Julia Stearns Section, Township, Range: Plot

Landform (hillslope, terrace, etc.): Toe of hillslope Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.872039 Long: -71.053507 Datum: _____

Soil Map Unit Name: 311B Woodbridge Fine Sandy Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** **Yes** X **No** _____
Hydric Soil Present?	Yes X	No _____	
Wetland Hydrology Present?	Yes X	No _____	If yes, optional Wetland Site ID: Flag 43-103

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- X Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X	No _____	Depth (inches): _____
Water Table Present?	Yes X	No _____	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes X	No _____	Depth (inches): _____

Wetland Hydrology Present? **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 43 Wet Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	90	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	90 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Lindera benzoin	30	Yes	FACW
2. Pinuse strobus	25	Yes	FACU
3. Viburnum dentatum	30	Yes	FAC
4.			
5.			
6.			
7.			
	85 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Osmunda cinnamomea	80	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 43 Wet Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-6"	10YR 2/2						FSL	
6-18	10YR 4/2						Sand	
18-21	10YR 5/2						Sand	Redox features

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- X Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- X Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 03/14/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW 52 Wet

Investigator(s): Timothy O'Sullivan Section, Township, Range: Plot

Landform (hillslope, terrace, etc.): Toe of hillslope Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.868974 Long: -71.051467 Datum: WGS84

Soil Map Unit Name: 311B Woodbridge and 71B Ridgebury NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil X, or Hydrology X significantly disturbed? Are "Normal Circumstances" present? Yes _____ No X

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** X
Hydric Soil Present?	Yes _____	No X	If yes, optional Wetland Site ID: Flag W52-11
Wetland Hydrology Present?	Yes _____	No X	

Remarks: (Explain alternative procedures here or in a separate report.)

Wetland located adjacent to Route 140 E, soils disturbed and primarily characterized as fill.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- X Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X	No _____	Depth (inches): _____
Water Table Present?	Yes X	No _____	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes X	No _____	Depth (inches): _____

Wetland Hydrology Present? **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 52 Wet Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	40	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	40 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Sambucus nigra	20	Yes	FACW
2. Rosa multiflora	20	Yes	FACU
3.			
4.			
5.			
6.			
7.			
	40 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Typha angustifolia	60	Yes	OBL
2. Onoclea sensibilis	30	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	90 = Total Cover		

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 52 Wet Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-8"	10YR 2/2						Sandy loam	Fill disturbed conditions
8-12"	10YR 2/3							
8-12"	10YR 3/2							

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** _____

Remarks:

Hydric characteristics present within fill roadside soil profiles

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 03/24/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW 55 Up

Investigator(s): Donald Schall Section, Township, Range: Plot

Landform (hillslope, terrace, etc.): Toe of hillslope Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.868159 Long: -71.055976 Datum: WGS84

Soil Map Unit Name: 306B Paxton Fine Sandy Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** **Yes** _____ **No** X
Hydric Soil Present?	Yes _____	No X	If yes, optional Wetland Site ID: Flag W55-4
Wetland Hydrology Present?	Yes _____	No X	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No X	Depth (inches): _____
Water Table Present?	Yes _____	No X	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes _____	No X	Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 55 Up Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	15	Yes	FAC
2. Quercus coccinea	25	Yes	FACU
3.			
4.			
5.			
6.			
7.			
	40 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Acer rubrum	10	Yes	FAC
2. Vaccinium corymbosum	10	Yes	FACW
3.			
4.			
5.			
6.			
7.			
	20 = Total Cover		

Herb Stratum (Plot size: 5')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	= Total Cover		

Woody Vine Stratum (Plot size:)			
1. Smilax sp.	10		
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 55 Up Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
2-1"	Oi						Organic	
1-0"	Oe						Organic	
0-8"	10YR 2/2						loam	
8-12"	10YR 4/6						loam	
12-16"	10YR 2/1						fine sandy loam	
16-18"	10YR 4/6						fine sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** X

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Route 24/Route 140 Interchange City/County: Tauton, MA Sampling Date: 03/24/2014

Applicant/Owner: Mass DOT State: MA Sampling Point: BVW 55 Wet

Investigator(s): Donald Schall Section, Township, Range: Plot

Landform (hillslope, terrace, etc.): Toe of hillslope Local relief (concave, convex, none): _____

Slope (%): _____ Lat: 41.868159 Long: -71.055976 Datum: WGS84

Soil Map Unit Name: 306B Paxton Fine Sandy Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No _____	**Is the Sampled Area within a Wetland?** **Yes** X **No** _____
Hydric Soil Present?	Yes X	No _____	If yes, optional Wetland Site ID: Flag W55-4
Wetland Hydrology Present?	Yes X	No _____	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- X Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X	No _____	Depth (inches): _____
Water Table Present?	Yes X	No _____	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes X	No _____	Depth (inches): _____

Wetland Hydrology Present? **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: BVW 55 Wet Plot

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	25	Yes	FAC
2. Pinus strobus	10	Yes	FACU
3. Nyssa sylvatica	10	Yes	FAC
4.			
5.			
6.			
7.			
	45 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Acer rubrum	10	Yes	FAC
2. Clethra alnifolia	15	Yes	FAC
3.			
4.			
5.			
6.			
7.			
	25 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Osmunda cinnamomea	15	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 83 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: BVW 55 Wet Plot

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
2-1"	Oi						Organic	
1-0"	Oe						Organic	
0-4"	10YR 2/1							
4-12"	10YR 4/2		7.5YR 5/6				Sand	Prominent, distinct mottles

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- X Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** _____

Remarks:

Appendix D

Representative Wetland Photographs

Wetland 18

Wetland 19, Intermittent Stream S19

Wetland 25

Wetland 30

Wetland 31

Intermittent Stream S31

Wetland 32

Intermittent Stream S32

Wetland 34

Wetland 35

Wetland 36

Wetland 37

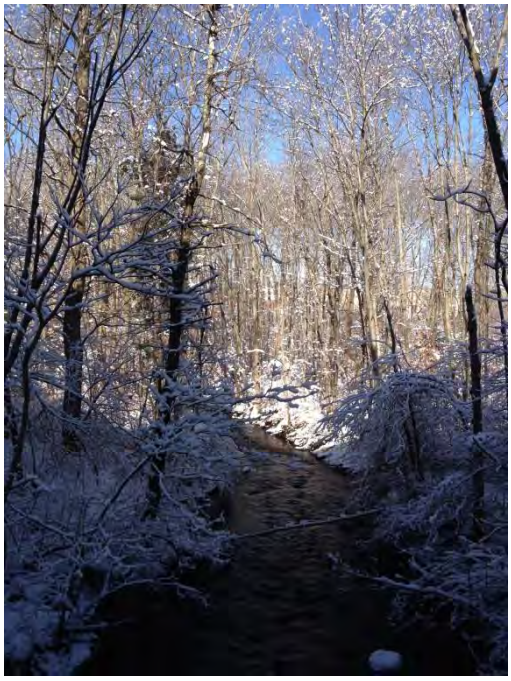
Wetland 38

Wetland 39

Intermittent Stream S41B

Wetland 42

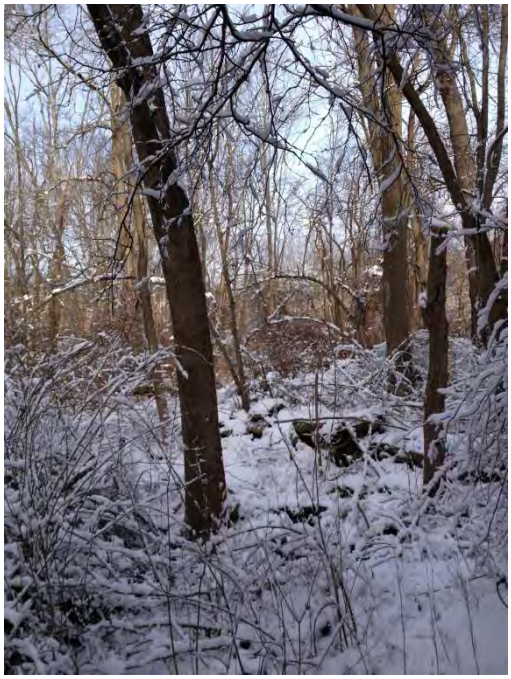
Wetland 43



Wetland 44 and Cotley River – S44

Wetland 46

Wetland 47



Wetland 48

Non-jurisdictional Drainage Ditch 50

Non-jurisdictional Drainage Ditch S50B

Cotley River –Perennial Stream S51

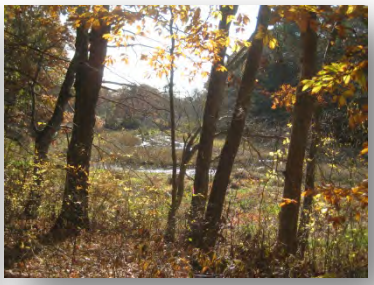
Wetland 52

Intermittent Stream S52

Wetland 53

Wetland 56

Appendix C-3
Functions and Values Assessment



Wetland Functions and Values Assessment

Mashpee Wampanoag Tribe
First Light Casino Project
Taunton, Massachusetts

NAE File No. 2012-01239

June 2013
Updated June 2014

Epsilon
ASSOCIATES INC.

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Functions and Values Assessment Report

1.0 INTRODUCTION AND PURPOSE

The Mashpee Wampanoag Tribe (the Tribe), a federally recognized tribe, is proposing that land be taken into trust in the City of Taunton, Massachusetts by the U.S. Department of Interior Bureau of Indian Affairs (BIA). The lands in Taunton would be used to meet the Tribe's economic needs through construction of a destination resort casino. The resort casino is referred to herein as "First Light". The land proposed to be taken into Trust in Taunton comprises approximately 151 acres located within and adjacent to the Liberty & Union Industrial Park (LUIP). The LUIP is a commercial/industrial development park created in 2003 and operated by the private, non-profit Taunton Development Corporation (TDC) for the purpose of generating economic development in the City of Taunton. The project site is generally bounded to the north by Middleborough Avenue, which is residential; to the east by Stevens Street, which is residential and commercial; to the south by Route 140; and to the west by Route 24. Both Routes 140 and 24 are limited access highways. The site is accessed via Stevens Street off of Exit 11 of Route 140. O'Connell Way, off of Stevens Street, provides access to the interior of the site. The project also involves a traffic mitigation component that involves improvements to the Route 24 and Route 140 interchange including the proposed construction of a new slip ramp to connect Route 24 Southbound directly to Route 140 Northbound, modifications to existing ramps, and to widening of Route 140 in order to fix a current bottleneck. Figure 1-1 shows the location of the land in Taunton.

Epsilon Associates, Inc. has prepared this updated Wetlands and Functions and Values Assessment (the "Assessment") for submittal to the Regulatory Division of the U.S. Army Corps of Engineers, New England District ("USACE") to facilitate the Corps review of the Final Environmental Impact (FEIS) Statement entitled "Mashpee Wampanoag Tribe, Fee-to-Trust Acquisition and Casino Project". The updated functions and values data provided herein was collected in response to modifications to the overall project design and layouts with a focus on the proposed off-site traffic interchange improvements required by the Massachusetts Department of Transportation (MassDOT). The proposed traffic mitigation work will result in permanent and temporary impacts to wetlands and other Waters of the United States identified herein as Wetland Series 10 and 12. The project does not propose to discharge dredged or fill material into waters of the U.S. on the proposed casino site. The USACE's Section 404 Clean Water Act regulations and guidelines require an evaluation of wetland functions and values as part of the permit application review process. The Assessment undertaken by Epsilon was developed to provide guidance on wetland functions which could be impacted as a result of the off-site traffic mitigation work. This Assessment will be used as part of wetland impact mitigation design and planning. By identifying the important functions and values attributed to a wetland or wetland system through examination of wetland characteristics and those of its surrounding watershed, a determination of wetland functional/value loss resulting from a project's impacts may be determined. This determination then allows for appropriate wetland function and value loss compensation as part of project impact mitigation planning. As noted above, wetland

impacts have been completely eliminated within the proposed casino site (within the LUIP area) and minimized to the greatest extent practicable at the intersection of Route 24 / Route 140. This report reflects the current proposed wetland impacts as presented in the FEIS.

The study area locations on the project site where data was collected for the Assessment are provided on Figure 1-2 (see off-site Wetland Series 10 and 12). A summary of the Functions and Values assessment conducted by Epsilon is provided in Section 3.0 with more detailed data provided in Attachment A. Representative wetland photographs at the data collection points are provided in Attachment B. Wildlife and vegetation diversity abundance lists are provided in Attachment C.

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Project First Light **Taunton, MA**

Epsilon Associates Inc.

Figure 1-1
Project Locus Map

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NOTE:
1. Wetland resource areas were delineated by Professional Wetland Scientists and Certified Soil Scientists from Epsilon Associates during the months of September, October, and November 2012, and June 2013. The limits of wetland resource areas located outside the Study Area were estimated by Epsilon using MassGIS mapping data and field observations. In addition, during the months of January to March 2014, professional wetland scientists from AECOM delineated wetlands and other waters of the U.S. at the Route 24/140 Interchange where roadway improvement measures are proposed.

Project First Light Taunton, MA

Epsilon ASSOCIATES INC.

Figure 1-2

Wetland Functions and Values Data Collection Points

2.0 DESCRIPTION OF WATERS OF THE U.S.

During the months of September, October, November 2012 and June 2013 professional wetland scientists and certified soil scientists from Epsilon delineated wetlands[1] and other waters of the U.S.[2] on the LIT Site and offsite locations where roadway improvement measures are proposed. The delineation work was conducted in accordance with the USACE 1987 Wetland Delineation Manual and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region, Version 2.0 (January 2012).[3]In addition, during the months of January to March 2014, professional wetland scientists from AECOM delineated wetlands and other waters of the U.S. at the Route 24/140 Interchange where roadway improvement measures are proposed. This delineation work was also conducted in accordance with the relevant Corps manuals referenced above.

On November 8, 2012, a representative from the USACE inspected sections of the proposed wetland boundaries on the LIT Site. No changes were made to the wetland lines as a result of this initial evaluation. The project proponent will provide the USACE with a detailed wetland delineation report as part of the Section 404 and Preliminary Jurisdictional Determination review processes. The delineated wetland boundaries are depicted on Figure 2-1, Waters of the U.S. (Wetland Series 1 through 12).

On January 9, 2014, a representative from the Corps and the United States Environmental Protection Agency (EPA) inspected sections of the proposed wetland boundaries primarily in areas where a discharge of fill material was proposed in the DEIS, including the Project Site and the Study Area. No changes were made to wetlands lines in these locations as a result of this visit.

---

1 According to 33 C.F.R. § 328.3(b), wetlands means "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

2 "Waters of the United States" is broadly defined in the federal regulations that implement the Clean Water Act. It includes tidal waters, rivers, streams, lakes, ponds and wetlands. 33 C.F.R. § 328.3(a).

3 Wetland resource areas were also delineated in accordance with the Massachusetts Department of Environmental Protection's handbook, "Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act" (MassDEP, 1995); and the local Taunton Conservation Commission Wetlands Ordinance (City of Taunton Ordinances, Chapter 16, Section 30-38). A discussion of local and state regulated resource areas will be presented in the separate Draft Environmental Impact Report ("DEIR") as required by the Massachusetts Environmental Policy Act ("MEPA") and implementing regulations (301 CMR 11.00).

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NOTE:
1. Wetland resource areas were delineated by Professional Wetland Scientists and Certified Soil Scientists from Epsilon Associates during the months of September, October, and November 2012, and June 2013. The limits of wetland resource areas located outside the Study Area were estimated by Epsilon using MassGIS mapping data and field observations. In addition, during the months of January to March 2014, professional wetland scientists from AECOM delineated wetlands and other waters of the U.S. at the Route 24/140 Interchange where roadway improvement measures are proposed.

Project First Light Taunton, MA

Epsilon ASSOCIATES INC.

Figure 2-1

Waters of the U.S. (Wetland Series 1 through 12)

Table 2.1-1 below presents a summary of the delineated wetlands and waters of the U.S. on the LIT Site (Wetland Series 1 through 9 and 11) and in the vicinity of the Route 24/140 interchange (Wetland Series 10 and 12). It is assumed that all of the delineated wetlands and streams are jurisdictional "waters of the U.S." for the purposes of Sections 401 and 404 of the U.S. Clean Water Act. The delineated wetlands and other waters of the U.S. were categorized to a subsystem or class level according to the U. S. Fish & Wildlife Service (USFWS) Classification of Wetlands and Deepwater Habitats of the United States (the Cowardin Approach)[4]. The USFWS System broadly defines wetland types by hydrology and vegetative cover. Wetlands are categorized within a classification hierarchy of Systems, Subsystems, and Classes. Using the Cowardin approach, the wetland systems identified within the study area include predominantly Riverine Lower Perennial Unconsolidated Bottom (UB), Riverine Intermittent Streambed and Palustrine Forested Wetlands (PFO). Palustrine Scrub-Shrub Wetlands (PSS), Palustrine Emergent Wetlands (PEM) and Lacustrine Littoral/Limnetic wetlands are also present to a lesser degree.

Table 2.1-1 Waters of the U.S. Descriptions

Wetland Series ID	Cowardin Classification	General Description of Delineated Waters of the U.S.
1	PEM	This isolated vegetated wetland occurs in a shallow topographic depression dominated by cattail (*Typha latifolia*), beggar-ticks (*Bidens* spp.), soft rush (*Juncus effusus*), spike rush (*Eleocharis* spp.) and lurid sedge (*Carex lurida*). Primary hydrologic input derived from ground-water discharge, surface runoff and precipitation. Standing water typical.
2	Riverine Lower Perennial UB (Cotley River), Riverine Intermittent Streambed, PFO, PSS	Gently sloping wetland complex consisting of the Cotley River and three intermittent streams / tributaries. Vegetated wetlands primarily consisting of forest communities are contiguous to these surface waters, and are dominated by red maple (*Acer rubrum*) and yellow birch (*Betula alleghaniensis*) in the overstory. The understory and ground cover species consist of ironwood (*Carpinus caroliniana*), arrowwood (*Viburnum recognitum*), sweet pepperbush (*Clethra anlifolia*), cinnamon fern (*Osmunda cinnamomea*) and sensitive fern (*Onoclea sensibilis*). For the most part, hydrologic input is derived from upstream watersheds/drainage areas, groundwater discharge, surface runoff and precipitation.
3	Riverine Intermittent Streambed, PFO, PSS, PEM	Topographically flat to gently sloping wetlands contiguous to two intermittent streams. The eastern portion of this wetland complex is dominated by forested wetlands with representative canopy species including red maple, swamp white oak (*Quercus bicolor*), white pine (*Pinus strobus*) and red oak (*Quercus rubra*). Understory and ground-cover species consist of ironwood, spicebush (*Lindera benzoin*), arrowwood, and marsh fern (*Thelypteris palustris*). The western portion of Wetland 3 primarily consists of emergent wetlands, with the most abundant species including cattail, blue vervain (*Verbena hastata*), soft rush, wool grass (*Scirpus cyperinus*), sensitive fern and lurid sedge. Throughout this wetland complex, hydrologic input is derived from groundwater discharge, surface runoff and precipitation.

[4] Cowardin, L. et al. (1979). Classification of Wetlands and Deepwater Habitats of the United States, United States Fish and Wildlife Service, Biological Services Program, Washington, D.C., FWS/OBS-79/31.

Table 2.1-1 Waters of the U.S. Descriptions (continued)

4	Riverine Lower Perennial UB (Cotley River), Lacustrine (Barstows Pond) PFO,PEM	Gently sloping wetland complex consisting of the Cotley River and Barstows Pond. Vegetated wetlands primarily consisting of narrow bands of forest and emergent communities are contiguous to these surface waters. Collectively, these wetlands are dominated by red maple arrowwood, sweet pepperbush, cattail, tussock sedge (*Carex stricta*) and rice cutgrass (*Leersia oryzoides*). For the most part, hydrologic input is derived from upstream watersheds/drainage areas, groundwater discharge, surface runoff and precipitation.
5 & 6	PFO	These pocket wetlands are isolated in the landscape and occur in topographic depressions. In each, the vegetative community is dominated by red maple in the overstory, with understory species including winterberry (*Ilex verticillata*), highbush blueberry (*Vaccinium corymbosum*) and arrowwood of varying densities. Evidence of periodic standing water (stains/marks on trees) was observed. Hydrologic input is limited to groundwater discharge, surface runoff and precipitation.
7	PSS	This pocket wetland is isolated in the landscape and occurs in a topographic depression. The central portion of the wetland is dominated by buttonbush (*Cephalanthus occidentalis*), with standing water present throughout. Peripheral portions of the wetland primarily include silky dogwood (*Cornus amomum*), winterberry, highbush blueberry and arrowwood. Based on site-specific observations, this wetland functions as a vernal pool breeding habitat for wood frog (*Lithobates sylvaticus*) and spotted salamander (*Ambystoma maculatum*). Hydrologic input is limited to groundwater discharge, surface runoff and precipitation.
8	PFO	This wetland is isolated in the landscape and occurs in a topographic depression similar to Wetlands 5, 6 and 7 described above. Plant species, while sparse, primarily include winterberry, arrowwood and highbush blueberry. Like Wetlands 1, 5, 6 and 7, hydrologic input is limited to groundwater discharge, surface runoff and precipitation.
9	PEM	This small pocket wetland occurs in a shallow topographic depression dominated by cattail. Primary hydrologic input is derived from surface runoff and precipitation. Periodically contains standing water over rock / dense gravels.
10	Riverine Intermittent Streambed, PFO, PSS, PEM	This wetland system is located at the Route 24/Route 140 interchange, north of Route 140 and consists of vegetated wetlands, pockets of standing water and intermittent streams / drainage ditches associated with existing roadway stormwater management systems. Primary hydrologic inputs include stormwater runoff and overland flows. Dominant wetland vegetation includes common reed (*Phragmites australis*), red maple, highbush blueberry and sweet pepperbush.
11	Riverine Lower Perennial UB (Cotley River), Riverine Intermittent Streambed, PFO, PSS, PEM	This wetland complex is centered at the Route 140/Stevens Street interchange and consists of vegetated wetlands, pockets of standing water and drainage ditches associated with existing roadway stormwater management systems. It also includes the southern extent of the Cotley River within the Study Area. Primary hydrologic inputs include stormwater and surface runoff. Dominant wetland vegetation includes common reed, red maple and a variety of wetland shrub species.
12	Riverine Intermittent Streambed, PFO, PSS, PEM	This wetland system is located at the Route 24/Route 140 interchange, south of Route 140 and consists of vegetated wetlands, pockets of standing water and drainage ditches associated with existing roadway stormwater management systems. Primary hydrologic inputs include stormwater runoff and overland flows. Dominant wetland vegetation includes common reed, red maple, and a variety of wetland shrub species.

3.0 WETLANDS FUNCTIONS AND VALUES ASSESSMENT

Representative wetland habitats in the vicinity of potential impact areas (see Wetland Series 10 and 12) were evaluated using the USACE "*Highway Methodology Workbook Supplement for Wetlands Functions and Values: A Descriptive Approach*". This method incorporates both wetland science and human judgment of values. More specifically, functions are self sustaining properties of a wetland ecosystem that exist in the absence of society. They relate to the ecological significance of wetland properties without regard to subjective human values. Values are benefits that derive from either one or more functions and the physical characteristics associated with a wetland. The value of a particular wetland function, or combination thereof, is based on human judgment of the worth, merit, quality, or importance attributed to those functions. Functions and values can be "principal" if they are an important physical component of a wetland ecosystem (function only) and/or are considered of special value to society or from a local, regional, and/or national perspective. The 13 functions and values considered by the USACE Methodology include the following:

Functions:

1. Ground Water Recharge/Discharge
2. Floodflow Alteration (Storage & Desynchronization)
3. Fish and Shellfish Habitat
4. Sediment/Toxicant/Pathogen Retention
5. Nutrient Removal/Retention/Transformation
6. Production Export
7. Sediment/Shoreline Stabilization
8. Wildlife Habitat

Values:

9. Recreation
10. Educational/Scientific Value
11. Uniqueness/Heritage
12. Visual Quality/Aesthetics
13. Threatened or Endangered Species Habitat

The wetland areas evaluated for this report include three discrete locations within Wetland Series 10 and three discrete locations within Wetland Series 12. The project site includes a variety of wetland cover types including palustrine forested, scrub-shrub, and emergent wetlands. Portions of Wetland Series 10 and 12 are located up-gradient of streams or abutting intermittent streams.

Wetland Series 10 contains palustrine forested, scrub-shrub and emergent wetlands. Wetland Series 12 contains palustrine forested and scrub-shrub wetlands. These wetland systems are naturally occurring, yet partially or largely affected by manmade traffic impoundments and / or stormwater control features.

3.1 Evaluation of Wetland Functions

3.1.1 Ground Water Recharge/Discharge

Wetlands can either recharge groundwater with surface water or discharge groundwater to surface waters. Wetlands receiving inflow from groundwater are known as discharging wetlands because water flows or discharges from the groundwater to the wetland. Discharge of groundwater maintains base flows in waterways. A recharge wetland refers to the reverse case where water flows from the wetland to the groundwater. Sediment underlying these wetlands is sandy and comprised of glacial outwash, water within these wetlands can slowly percolate into the ground, allowing near surface groundwater recharge in portions of these wetlands. Portions of Wetland Series 10 are naturally wetlands occurring with partial stormwater additions. Portions of Wetland Series 12 are largely driven by stormwater discharge. Both of these wetlands generally function as recharge wetlands, during certain portions of the year. However, the ability of wetlands to function as recharge areas is limited given the presence of a seasonally high groundwater table throughout the Project area. There is a discharge component to Wetland Series 10 and the westernmost portion of Wetland Series 12. These wetlands are associated with several intermittent watercourses and shows signs of variable water levels indicating it functions as primarily a discharge area, when the regional water table is high.

3.1.2 Floodflow Alteration (Storage & Desynchronization)

This function considers the effectiveness of the wetland in reducing flood damage by water retention for prolonged periods following precipitation events. Wetlands attenuate flooding by slowing and storing floodwaters, thereby diminishing the effects of flooding by gradually releasing floodwaters after the peak flood has passed. Trees and other wetland vegetation help slow the speed of flood waters. The effectiveness of wetlands for flood abatement may vary, depending on the size of the area, type and condition of vegetation, slope, the juxtaposition of the wetland in the floodplain and the saturation of wetland soils before flooding. The portions of the wetlands that were evaluated are primarily edges located within larger wetland systems. While Wetlands Series 10 and 12 are not located within close proximity to perennial streams or within a floodplain, these wetlands can abate floodflow to some degree. These wetlands are associated with or in close proximity to highway infrastructure and receive runoff from the adjacent roadways. These wetlands have some stormwater holding capacity and are found up-gradient and upstream the floodplain of the Cotley River. These wetlands are also primarily underlain by sandy soils that have the capacity to retain water and drain to the underlying groundwater for recharge. Wetland Series 10 is generally broad and flat, while Wetland Series 12 is modified by

artificial slopes. However, within the discrete areas evaluated as part of this review, these areas are located within the toe of slope of modified landforms and slopes that may diminish the capacity for that particular area of the wetland to function as floodflow storage. These wetlands also have varying degrees of plant community structure that could slow velocity of floodwaters and reduce the risk of downstream flash-flooding. As such, these wetlands could retain some stormwater, alleviating high volume flow to the general floodplain of the Cotley River during high flow or storm events. The overall water holding capacity during periods of seasonal flooding is likely minor and constrained by the overall stormwater infrastructure in and around the Route 24 / Route 140 interchange.

3.1.3 Fish and Shellfish Habitat

This function considers the effectiveness of seasonal or permanent waterbodies associated with the wetlands in question for fish and shellfish habitat. The wetlands systems that were analyzed including the southern portion of Wetland Series 10 and the western portion of Wetland Series 12 contain intermittent streams and / or drainage ditches; no wetlands adjacent to perennial streams were evaluated. It is unlikely that viable fish or shellfish habitat is located within these features. The Cotley River, downstream some of the wetlands that were evaluated, is likely to provide food and habitat for warmwater fish species. None of the discrete wetland resource areas reviewed as part of this assessment provide habitat directly to fish. Seasonal, or intermittent streams are not likely to provide suitable fisheries habitat due to their temporal nature, warm temperatures, and lack of deep water refuge during dry periods.

3.1.4 Sediment/Toxicant/Pathogen Retention

This function reduces or prevents degradation of water quality. Wetlands maintain and improve water quality by trapping nutrients, sediments, and contaminants. Wetlands directly associated with water courses have greater opportunity to retain sediment, nutrients, and contaminants. Given the location where these assessments occurred within the wetland (up-gradient), wetlands edges are broad and intermittently aerobic, providing the appropriate type of microbial cycling to remove pollutants. These wetland areas are located adjacent to highways that could be considered potential sources of excess sediment or toxicants These wetlands may function as traps for stormwater runoff containing road sand and salt, as well as potential toxicants from vehicle traffic.

3.1.5 Nutrient Removal/Retention/Transformation

This function relates to the effectiveness of a wetland to prevent adverse effects of excess nutrients entering aquifers or surface waters such as ponds, lakes, streams, rivers, or estuaries. This function also considers the effectiveness of wetlands as a trap for nutrients in runoff from adjacent uplands or other wetlands as well as the ability of the wetland to process these nutrients into other forms. It is well documented that the biological and chemical processes of nitrification/denitrification in the nitrogen cycle can transform and

thus remove nitrogen entering wetlands. Wetland plants also play an important role in the removal of phosphorous. Phosphorous has a sediment cycle with excess phosphorous being tied up in sediments, peat in organic soils and clay particles in mineral soils. The wetlands identified within this report border major highways and receive or are part of the overall stormwater runoff system for these roads. Wetlands receiving surface runoff can function as traps or sinks for nutrients. Certain woody vegetation is particularly effective at retaining nutrients over time.

3.1.6 Production Export

This function relates to the effectiveness of the wetland to produce food or usable products for humans or other living organisms. Factors to be considered include the presence of wildlife food sources and evidence of wildlife use, if high vegetation density is present, and if a wetland exhibits a high degree of plant community structure/species diversity. The forested and scrub shrub wetlands provide food sources (e.g. hard mast, berries) for a variety of wildlife species. While some of these wetland areas exhibited signs of wildlife usage, the wetlands are in close proximity to highways. Based on their close proximity, these wetlands are not considered optimal wildlife habitat and evidence of wildlife usage was minimal. The forested wetland contained softwood tree species that could presumably be utilized for timber. However, there are not economic usable products in a high enough concentration to be economically or commercially viable.

3.1.7 Sediment/Shoreline Stabilization

This function relates to the effectiveness of a wetland to stabilize or anchor stream banks and shorelines against erosion. Dense wetland vegetation intercepts precipitation, preventing soil loosening and erosion. The "roughness" of dense vegetation can also slow down river flows during high water events. The riparian wetlands within the LIT Site and located near the traffic mitigation improvements areas can provide this function as vegetation stabilizes stream banks and reduces erosion. Three discrete wetland areas contain intermittent streams and / or drainage ditches including the southern portion of Wetland 10 and the western portion of Wetland Series 12. Sediment and shoreline stabilization was noted to a limited degree within these areas. Overall, wetland areas outside of those discrete areas that could be potentially impacted by the project provide greater stabilization function.

3.1.8 Wildlife Habitat

This function considers the effectiveness of the wetland to provide habitat for various types and populations of animals typically associated with wetlands and the wetland edge. Generally, several of the wetlands are mosaics of wetland cover types (e.g. forested, shrub, emergent) and therefore exhibit a high degree of interspersion of vegetation classes and plant diversity and plant community structure good for a variety of generalist wildlife species. Wetlands identified within the discrete locations where potential impacts could

occur also provide habitat to generalist wildlife species. While some of these wetland areas exhibited signs of wildlife usage, the wetlands are in close proximity to highways. Based on their close proximity, these wetlands are not considered optimal wildlife habitat and evidence of wildlife usage was minimal.

3.2 Evaluation of Wetland Values

3.2.1 Recreation

This value considers the effectiveness of the wetland and associated water-courses to provide recreational opportunities such as canoeing, boating, fishing, hunting, and other active or passive recreational activities. The LIT Site is located within private property and the privately owned Liberty and Union Industrial Park. The land associated with the traffic mitigation improvements project is restricted access public land. These wetlands do not provide direct recreational value to the community.

3.2.2 Educational/Scientific Value

This value considers the effectiveness of the wetland as a site for an "outdoor classroom" or as a location for scientific study or research. The LIT Site is located entirely on private lands. The land associated with the traffic mitigation improvements project is restricted access public land. No safe access is feasible for the community within these locations.

3.2.3 Uniqueness/Heritage

This value considers the effectiveness of the wetland or its associated waterbodies to provide certain special values. These may include archaeological sites, critical habitat for endangered species, its overall health and appearance, its role in the ecological system of the area, its relative importance as a typical wetland class for this geographic location. Wetlands located within the majority of the LIT Site and associated with the traffic mitigation improvements project are surrounded by urban land or highways. Wetlands directly associated with the Cotley River present desirable viewing opportunities, such as the ability to view multiple cover types or water resources, are present to varying degrees within the LIT Site. The Cotley River is hydrologically connected to the Taunton River which has been designated a Federal Wild and Scenic River, as designated by Congress and protected under U.S. Department of Interior regulations. Archaeological investigations are currently being performed at the Site. Unique features or heritage characteristics that have been discovered could be attributed to the Cotley River and surrounding environs.

3.2.4 Visual Quality/Aesthetics

The visual quality and aesthetic value of a wetland is dependent on available views or vistas of a variety of wetland cover types and surface water regimes. Views with open vistas are generally appealing to recreational observers. Due to the developed nature of the Site and the surrounding forested areas the only potentially unique views are found in association

with the early successional upland fields and wetland and floodplain systems associated with the Cotley River north of the railroad tracks. The LIT Site and the area around the Route 24 / Route 140 interchange is heavily developed south of the railroad tracks resulting in fragmented wetland systems and limited view sheds.

3.2.5 Threatened or Endangered Species Habitat

This value relates to the effectiveness of the wetland or associated waterbodies to support threatened or endangered species. No federal or state threatened or endangered species are known to occur within the LIT Site or in the vicinity of the traffic mitigation improvements project.

4.0 CONCLUSIONS

Functions and values can be principal if they are an important physical component of a wetland ecosystem (function only) and/or are considered of special value to society or from a local, regional, and/or national perspective. The principal functions of wetlands within the study area are primarily limited to floodflow alteration. While to a lesser extent Wetland Series 10 and 12 function as groundwater discharge/recharge, sediment/toxicant/pathogen retention, and nutrient removal/retention/transformation. A more specific summary is provided on the following table relative to each wetland system where data used in this Assessment was collected.

Table 4.1-1 Summary of Principal Functions and Values

Wetland Series & Data Collection Point	Principal Functions and Values												
	Groundwater Recharge/Discharge	Floodflow Alteration	Fish and Shellfish Habitat	Sediment/Toxicant/Pathogen Retention	Nutrient Removal	Production Export	Sediment Shoreline Stabilization	Wildlife Habitat	Recreation	Educational/Scientific Value	Uniqueness/Heritage	Visual Quality/Aesthetics	Threatened or Endangered Species Habitat
Wetland Series 10													
10.1	•	•		•	•		•	•					
10.2	•	•		•	•		•	•					
10.3	•	•		•	•			•					
Wetland Series 12													
12.1	•	•		•	•			•					
12.2	•	•		•	•								
12.3	•	•		•	•			•					

Attachment A

Wetland Functions & Values Field Evaluation Forms

Wetland Function-Value Evaluation Form

Total area of wetland 2.52ac Human made? Partially (stormwater) Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Route 24 and Railroad ROW Distance to nearest roadway or other development 20-30 ft.

Dominant wetland systems present PFO1E/PEM1E/R42G (stream) Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Mid-basin

How many tributaries contribute to the wetland? 1+ Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. Wetland 10.1

Latitude: 41.873415 Longitude: -71.055962

Prepared by: AA/SH Date 6/3/14

Wetland Impact:
Type PFO/PEM Area 23,870 sf

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y X N

Function/Value	Suitability Y	Suitability N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	X		2,4,5,7,15		Wetland contains several intermittent streams/constructed ditches. Partially runoff induced, partially groundwater.
Floodflow Alteration	X		4,5,6,7,9,13	X	Several stormwater outlets flow into wetland system, part of large basin.
Fish and Shellfish Habitat		X	1,8,10,17		Wetland contains shallow, intermittent watercourses. No fish observed.
Sediment/Toxicant Retention	X		1,2,7,10,12,14		
Nutrient Removal	X				
Production Export		X	1,3,4		
Sediment/Shoreline Stabilization	X		1,3,4,6,12		
Wildlife Habitat	X		6,7,8,9,17		Common wildlife species habitat, evidence of deer and skunk. Habitat affected by proximity to highways.
Recreation		X			Wetland not accessible
Educational/Scientific Value		X			Wetland not accessible
Uniqueness/Heritage		X	1,30		Wetland is located high in watershed that drains to a tributary of Cotley River, a tributary to the Taunton River.
Visual Quality/Aesthetics		X			
ES Endangered Species Habitat		X			
Other					

* Refer to backup list of numbered considerations.

Notes:

* Wetland 10 corresponds to the 18-1 and 100 series wetland flags. This wetland is forested with an intermittent stream and large open pockets of phragmites.

Wetland Function-Value Evaluation Form

Total area of wetland 2.51ac Human made? Partially (stormwater) Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use MassDOT facility; Route 24; electric ROW Railroad ROW Distance to nearest roadway or other development 20-30 ft.

Dominant wetland systems present PFO1E/PEM1E/R42G (stream) Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Mid basin

How many tributaries contribute to the wetland? 2+ Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. Wetland 10.2

Latitude: 41.875239 Longitude: -71.055334

Prepared by: AA/SH Date 6/3/14

Wetland Impact:
Type PFO/PEM Area 5,430sf wetland
6,770sf stream

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y X N

Function/Value	Suitability Y	Suitability N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	X		2,4,5,7,15		Wetland contains several intermittent streams/constructed ditches. Partially runoff induced, partially groundwater.
Floodflow Alteration	X		4,5,6,7,9,13	X	Several stormwater outlets flow into wetland system, part of large basin.
Fish and Shellfish Habitat 4		X	1,8,10,17		Wetland contains shallow, intermittent watercourses. No fish observed.
Sediment/Toxicant Retention	X		1,2,7,10,11,12,14		Excess runoff from Route 24
Nutrient Removal	X		3,4,8,9,10		Excess runoff from Route 24
Production Export		X	1,3,4		Trees present.
Sediment/Shoreline Stabilization	X		1,3,4,6,12		
Wildlife Habitat	X		6,7,8,9,17		Bird & small mammal habitat, deer evidence. Due to proximity to highway wildlife habitat not optimal.
Recreation		X	N/A		Wetland surrounded by fences on all sides.
Educational/Scientific Value		X	N/A		Wetland is not accessible.
Uniqueness/Heritage		X	1,30		Wetland is located within a tributary of Cotley River, which is a tributary to the Taunton River.
Visual Quality/Aesthetics		X	N/A		
ES Endangered Species Habitat		X	N/A		
Other					

* Refer to backup list of numbered considerations.

Notes:

* Wetland 10 corresponds to the 18-400 series wetland flags, south of railroad tracks. Red maple dominated forested wetland and emergent wetland within the electric row.

Wetland Function-Value Evaluation Form

Total area of wetland 0.94ac Human made? No* Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Route 24; Railroad; Forested Wetland Distance to nearest roadway or other development 20-30 ft.

Dominant wetland systems present PFO1E/PEM1E Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Mid-basin

How many tributaries contribute to the wetland? 1+ Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. Wetland 10.3

Latitude: 41.876013 Longitude: -71.054906

Prepared by: AA/SH Date 6/3/14

Wetland Impact:
Type PFO Area 15,290sf

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y X N

Function/Value	Suitability Y	Suitability N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	X		2,4,5,15		Wetland is fed by intermittent streams and stormwater. Partially runoff induced, partially groundwater.
Floodflow Alteration	X		4,5,6,9	X	Stormwater outlets flow into wetland; part of a large basin.
Fish and Shellfish Habitat		X	1		No fish/shellfish habitat.
Sediment/Toxicant Retention	X		1,2,7		
Nutrient Removal	X		3,4,9,10		
Production Export		X	1,3,4		
Sediment/Shoreline Stabilization		X	1,3,4		
Wildlife Habitat	X		7,8,17		Opportunity for common wildlife habitat in broader wetland, although not optimal due to proximity to highway/railroad.
Recreation		X	N/A		Wetland is not accessible.
Educational/Scientific Value		X	N/A		Wetland is not accessible.
Uniqueness/Heritage		X	1		Located in very urban setting.
Visual Quality/Aesthetics		X	N/A		
ES Endangered Species Habitat		X	N/A		
Other					

* Refer to backup list of numbered considerations.

Notes:
Wetland 10 corresponds to the 18-500 series wetland flags, north of the railroad tracks. Red maple & white pine dominated forested wetland. *Wetland likely impounded from railroad and Route 24.

Wetland Function-Value Evaluation Form

Total area of wetland 0.90ac Human made? Partially (Stormwater) Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Route 140/24 Interchange; Forested Upland Distance to nearest roadway or other development 10 ft.

Dominant wetland systems present PSS1E/R42G (stream) Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Mid-basin

How many tributaries contribute to the wetland? 1 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. Wetland 12.1

Latitude: 41.872781 Longitude: -71.057225

Prepared by: AA/SH Date 6/3/14

Wetland Impact:
Type PFO/Int stream Area 3,530sf wetland
2,090sf stream

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y X N

Function/Value	Suitability Y	Suitability N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	X		2,4,5,7,9,15		Runoff induced wetland with limited recharge.
Floodflow Alteration	X		4,5,7,9,15,17	X	Based on deep-cut banks and proximity to stormwater runoff, this wetland/stream has the potential to hold floodwater.
Fish and Shellfish Habitat:		X	1,4,8,17		No fish habitat is present.
Sediment/Toxicant Retention	X		1,2,10		
Nutrient Removal	X		3,4,9,10,11,13,14		Based on this wetland's proximity next to highway, it has potential to remove nutrients.
Production Export		X	1,7,10,12		
Sediment/Shoreline Stabilization		X	1,2,3		
Wildlife Habitat	X		6,7,8		Based on proximity to highway wildlife habitat is not optimal. Common wildlife is likely.
Recreation		X	N/A		
Educational/Scientific Value		X	N/A		
Uniqueness/Heritage		X	1,30		Wetland is located high in the watershed that drains to a tributary of Cotley River, which is a tributary to the Taunton River.
Visual Quality/Aesthetics		X	N/A		
ES Endangered Species Habitat		X	N/A		
Other					

* Refer to backup list of numbered considerations.

Notes:
Wetland 12 corresponds to the 25-series wetland flags. It is a stormwater drainage ditch that is partially vegetated and partially functions as a stream. This feature collects surface runoff from the interchange.

Wetland Function-Value Evaluation Form

Total area of wetland 1.40ac Human made? Partially (SW) Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Route 140/24, inside Interchange Distance to nearest roadway or other development 10-20 ft.

Dominant wetland systems present PSS1E Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? High Basin

How many tributaries contribute to the wetland? Ø Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. Wetland 12.2

Latitude: 41.871880 Longitude: -71.056983

Prepared by: AA/SH Date 6/3/14

Wetland Impact:
Type PSS1E, PEM1E Area 2,880 sf

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y X N

Function/Value	Suitability Y	Suitability N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	X		2,4,5,15		Runoff induced wetland with limited recharge potential.
Floodflow Alteration	X		2,3,4,5,6,9,17,18	X	Based on location and broad area, it receives water from impervious roadway and has potential to impact floodwaters.
Fish and Shellfish Habitat		X	N/A		
Sediment/Toxicant Retention	X		1,2,7		
Nutrient Removal	X				Local watershed is in the interchange.
Production Export		X	1,3,4,7,12		Trees and berry produces are present.
Sediment/Shoreline Stabilization		X	1,2,3		
Wildlife Habitat		X	8,13		Based on proximity to highway, wildlife habitat is not optimal. Common wildlife is likely
Recreation		X	N/A		Wetland is not accessible
Educational/Scientific Value		X	N/A		Wetland is not accessible
Uniqueness/Heritage		X	1,30		Wetland is located high in the watershed that drains to a tributary of Cotley River, which is a tributary to the Taunton River.
Visual Quality/Aesthetics		X	N/A		
ES Endangered Species Habitat		X	N/A		
Other					

* Refer to backup list of numbered considerations.

Notes: Wetland 12 corresponds to the 26-series wetland flags. This wetland is primarily fed by stormwater runoff from the Route 24/140 interchange. It's connected by culvert under Rt 140 to stream that conveys water via culvert to tributary of Cotley River located within the LIT site.

Wetland Function-Value Evaluation Form

Total area of wetland 0.44ac Human made? Partially (SW) Is wetland part of a wildlife corridor? No or a "habitat island"? No

Adjacent land use Route 140; Route 24/140 Interchange Distance to nearest roadway or other development 10 ft.

Dominant wetland systems present PFO1E/PEM1E/PSS1E Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? High Basin

How many tributaries contribute to the wetland? Ø Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. Wetland 12.3

Latitude: 41.871379 Longitude: -71.055076

Prepared by: AA Date 6/5/14

Wetland Impact:
Type PEM1E/PSS Area 5,820 sf

Evaluation based on:
Office X Field X

Corps manual wetland delineation completed? Y X N

Function/Value	Suitability Y	Suitability N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	X		4,5,15		Runoff induced wetland with limited recharge.
Floodflow Alteration	X		1,3,4,5,6,9	X	Some stormwater holding capacity from water flowing off the highway.
Fish and Shellfish Habitat		X			
Sediment/Toxicant Retention	X		1,2,7		Excess runoff from Route 24.
Nutrient Removal	X		1,3,4,10,11		
Production Export		X	3,12		Trees are present.
Sediment/Shoreline Stabilization		X	1,3		Not connected to bank or shoreline.
Wildlife Habitat	X		8		Based on proximity to highway wildlife habitat is not optimal. Common wildlife is likely.
Recreation		X	N/A		Wetland is not accessible.
Educational/Scientific Value		X	N/A		Wetland is not accessible.
Uniqueness/Heritage		X	1		Primarily urban environment.
Visual Quality/Aesthetics		X	N/A		
ES Endangered Species Habitat		X	N/A		
Other					

* Refer to backup list of numbered considerations.

Notes:
Portion is pragmites ditch from outfall. Connected by culvert to stream/wetland located within the interchange north of this wetland. Wetland 12 corresponds to wetland 27 flag series.

Attachment B

Representative Site Photographs

Photo 1: Site of Functions and Values Assessment 10.1.

Photo 2: Site of Functions and Values Assessment 10.2 in forested/emergent wetland.

Photo 3: View of intermittent stream portion of Functions and Values Assessment 10.2.

Photo 4: Site of Functions and Values Assessment 10.3.

Photo 5: View of intermittent stream portion at Functions and Values Assessment Site 12.1

Photo 6: View of Functions & Values Assessment Site 12.1, scrub-shrub wetland.

Photo 7: View of scrub shrub wetland at Functions and Values Assessment Site 12.2.

Photo 8: View of wetland at Functions and Values Assessment Site 12.3.

Attachment C

Wildlife & Vegetation Diversity/Abundance List

Attachment C - Wildlife & Vegetation Diversity/Abundance List

A. Potential Wildlife Species List

Common Name	Scientific Name
Mammals	
Shorttail Shrew	*Blarina brevicauda*
Star-nosed Mole	*Condylura cristata*
Coyote	*Canis latrans*
Opossum	*Didelphis virginiana*
Woodchuck	*Marmota monax*
Striped Skunk	*Mephitis mephitis* **animal observed*
Meadow Vole	*Microtus pennsylvanicus*
House Mouse	*Mus musculus*
Whitetail Deer	*Odocoileus virginianus* **scat observed*
White-footed Mouse	*Peromyscus leucopus*
Raccoon	*Procyon lotor*
Gray Squirrel	*Sciurus carolinensis* ** signs observed*
Eastern Cottontail	*Sylvilagus floridanus* **signs observed*
Red Squirrel	*Tamiasciurus hudsonicus*
Eastern Chipmunk	*Tamias striatus*
Red Fox	*Vulpes fulva*
Birds	
Red-winged Blackbird	*Agelaius phoeniceus* **heard and/or saw*
Mallard	*Anas platyrhynchos*
Tufted Titmouse	*Baeolophus bicolor* **heard and/or saw*
Canada Goose	*Branta canadensis*
Red-shouldered Hawk	*Buteo lineatus*
Red-tailed Hawk	*Buteo jamaicensis*
Great-horned Owl	*Bubo virginianus*
Northern Cardinal	*Cardinalis cardinalis*
American Goldfinch	*Carduelis tristis*
Purple Finch	*Carpodacus purpureus*
Veery	*Catharus fuscescens*
Evening Grosbeak	*Coccothraustes vespertinus*
Northern Flicker	*Colaptes auratus* **heard and/or saw*
American Crow	*Corvus brachythynchos*
Blue Jay	*Cyanocitta cristata* **heard and/or saw*
Yellow Warbler	*Dendroica petechia*
Gray Catbird	*Dumetella carolinensis*
Common Yellowthroat	*Geothlypis trichas* **heard and/or saw*
Wood Thrush	*Hylocichla mustelina*
Baltimore Oriole	*Icterus galbula*
Dark-eyed Junco	*Junco hyemalis*
Red-bellied Woodpecker	*Melanerpes carolinus*

Wild Turkey	*Meleagris gallopavo*
Song Sparrow	*Melospiza melodia* **heard and/or saw
Swamp Sparrow	*Melospiza georgiana*
Northern Mockingbird	*Mimus polyglottos* **heard and/or saw
Black-and-white Warbler	*Mniotilta varia*
House Sparrow	*Passer domesticus* **heard and/or saw
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus* **heard and/or saw
Eastern Towhee	*Pipilo erythrophthalmus*
Black-capped Chickadee	*Poecile atricapilla*
Common Grackle	*Quiscalus quiscula*
Eastern Phoebe	*Sayornis phoebe*
American Woodcock	*Scolopax minor*
Eastern Bluebird	*Sialia sialis*
White-breasted Nuthatch	*Sitta carolinensis*
American Tree Sparrow	*Spizella arborea*
Chipping Sparrow	*Spizella passerina*
Field Sparrow	*Spizella pusilla*
Barred Owl	*Strix varia*
European Starling	*Sturnus vulgaris*
Tree Swallow	*Tachycineta bicolor*
American Robin	*Turdus migratorius* **heard and/or saw
Eastern Kingbird	*Tyrannus tyrannus*
Yellow-throated Vireo	*Vireo flavifrons*
Blue-winged Warbler	*Vermivora pinus*
Canada Warbler	*Wilsonia canadensis*
White-throated Sparrow	*Zonotrichia albicollis*
Mourning Dove	*Zenaida macroura*

Reptiles

Common Snapping Turtle	*Chelydra s. serpentina*
Painted Turtle	*Chrysemys picta*
Spotted Turtle	*Clemmys guttata*
Eastern Milk Snake	*Lampropeltis t. triangulum*
Eastern Smooth Green Snake	*Liochorophis vernalis*
Northern Water Snake	*Nerodia s. sipedon*
Northern Brown Snake	*Storeria d. dekayi*
Common Garter Snake	*Thamnophis sirtalis*

Amphibians

American Toad	*Bufo a. americanus*
Gray Treefrog	*Hyla versicolor*
Red-spotted Newt	*Notophthalmus v. viridescens*
Northern Spring Peeper	*Pseudacris c. crucifer*
Bullfrog	*Rana catesbeiana*
Green Frog	*Rana clamitans melanota*
Northern Leopard Frog	*Rana pipiens*

B. Observed Dominant Vegetation Species List

Common Name	Scientific Name
Tree/Sapling	
Red Maple	*Acer rubrum*
Hickory	*Carya* spp.
White Ash	*Fraxinus americana*
Green Ash	*Fraxinus pennsylvanica*
White Pine	*Pinus strobus*
Black Tupelo	*Nyssa sylvatica*
Oak	*Quercus* spp.
Northern Red Oak	*Quercus rubra*
White Oak	*Quercus alba*
Shrub	
Sweet Pepperbush	*Clethra alnifolia*
Silky dogwood	*Cornus amomum*
Autumn Olive	*Elaeagnus umbellata*
Winterberry	*Ilex verticillata*
Spicebush	*Lindera benzoin*
Honeysuckle	*Lonicera* spp.
Swamp Azalea	*Rhododendron viscosum*
Multiflora rose	*Rosa multiflora*
American Elderberry	*Sambucus canadensis*
Meadowsweet	*Spirea latifolia*
Highbush Blueberry	*Vaccinium corymbosum*
Northern arrowwood	*Viburnum dentatum*
Groundcover	
Aster	*Aster* spp.
Sedges	*Carex* spp.
Fringed sedge	*Carex crinata*
Fox sedge	*Carex vulpinoidea*
Oriental bittersweet	*Celastrus orbiculata*
Hayscented Fern	*Dennstaedtia punctilobula*
Jewelweed	*Impatiens capensis*
Soft Rush	*Juncus effusus*
Purple Loosestrife	*Lythrum saliaria*
Sensitive Fern	*Onoclea sensibilis*
Cinnamon Fern	*Osmunda cinnamomea*
Royal Fern	*Osmunda regalis*
Virginia Creeper	*Parthenocissus quinquefolia*
Common Reed	*Phragmities australis*
Bristly Dewberry	*Rubus hispidus*

Woolgrass	*Scirpus cyperinus*
Common Greenbriar	*Smilax rotundifolia*
Goldenrod	*Solidago* spp.
Skunk Cabbage	*Symplocarpus foetidus*
New York Fern	*Thelypteris noveboracensis*
Marsh Fern	*Thelypteris palustris*
Poison Ivy	*Toxidodendron radicans*
Cattail	*Typha* spp.
Grape	*Vitus* spp.

Appendix C-4
Vernal Pool Information

Including the:
Vernal Pool Characterization and Valuation Form from April 10, 2012

Vernal Pool Characterization and Valuation Form from April 14, 2014

Oxbow Associates Memorandum, dated May 9, 2014

US Army Corps of Engineers - New England District
Vernal Pool Characterization Form

Project File # _____ Project Name First Light Pool ID Wetland 7 (flags I)
Observer Amanda Atwell, Jeremy Fennell, Epsilon Associates Phone or E-mail 978-897-7100
Landowner/Applicant Ap: Mashpee Wampanoag Tribe: Cedric Cromwell Phone or E-mail 508-477-0208
Address 483 Great Road, South City Mashpee State MA Zip 02649
Location of vernal pool: City/State Taunton, MA
Brief directions to pool _____
Survey date(s) VP identification 4/10/12, Delineated July, 2012, Reviewed 10/26/12
Longitude/Latitude (in decimal degrees) -71.048621W, 41.879459N
USGS Quad Taunton Plat # _____ Lot # _____

A. VERNAL POOL LANDSCAPE CHARACTERISTICS (fill in all information known):

1. Landscape setting (check all that apply):

☒ Upland depression ☐ Floodplain depression ☐ Pool within larger wetland system
☐ Pool part of a pool complex (within 1000 feet of one or more other vernal pools) ☐ Pool part of wildlife corridor
☐ Other _____

2. Vernal pool origin:

☒ Natural ☐ Natural, but Human Altered ☐ Anthropogenic ☐ Unknown

Describe any recent modifications to the pool and associated landscape: Appears to have a spoil pile or soil stock-pile associated with the southern edge, this area is covered with Japanese knotweed

3. Parent material:

☒ Glacial fluvial ("outwash") ☐ Loose till ☐ Peat
☐ Dense till ☐ Alluvium

B. VERNAL POOL CHARACTERISTICS (fill in all information known):

1. Wetland type(s) that best apply to this pool:

☐ Forested wetland ☐ Herbaceous wetland ☐ Floodplain (overflow/oxbow)
☒ Shrub wetland ☐ Open water ☒ Other: Forest overstory contributes to shading within the pool.
☐ Peatland (acidic fen or bog) ☒ Intermittent stream

2. Pool canopy cover (%) 60

3. Predominant substrate:

☒ Mineral soil
☒ Organic matter (peat/muck) Depth 1.5 ft (histic epipedon)
Organic matter sampling location (e.g., deepest zone, edge, etc.) Edge is mineral, center of pool is histic

4. Pool size:

a. Approximate dimensions of pool (at maximum capacity; include units): Length 200 feet Width 75 feet
b. Approximate area of pool (at maximum capacity): 37,500 square feet
c. Maximum depth at deepest point at time of survey (include units): 18 inches

5. Hydrology

a. Estimated hydroperiod (unless actual, observed hydroperiod value(s) is(are) known, use the example indicator species to best predict the expected hydroperiod of the pool):

☐ Dries between early March and early July (e.g., *Thelypteris palustris, Carex stricta, Impatiens capensis, Ilex verticillata*)
☒ Dries between early July and early September (e.g., *Sagittaria latifolia, Scirpus cyperinus, Dulichium arundinaceum, Cephalanthus occ.*)
☐ Dries between early September and early November (e.g., *Eleocharis palustris, Glyceria canadensis, Utricularia* spp., *Decodon vert.*)
☐ Dries between early November and late December, or intermittently exposed (e.g., *Nuphar* spp., *Potamogeton* spp.)

b. Inlet/outlet (circle which in each instance): Pool ID Wetland 7

☒ No inlet/outlet ☐ Permanent inlet or outlet (channel with well-defined banks and permanent flow)

☐ Temporary inlet/outlet ☐ Other _____

C. VERNAL POOL ENVELOPE (100 ft) AND CRITICAL HABITAT AREA (100-750 ft) CHARACTERISTICS (fill in all information known):

1. Surrounding forest cover within 100 ft (30.5 m) (%) 95 **100-750 ft (230 m)** (%) 60

2. Landuse type and approximate percentage within the 100-ft vernal pool envelope:

☐ Forested wetland _____ % ☒ Agriculture field (4%) %

☒ Forested upland 96 % ☐ Developed (<25% impervious surface) _____ %

☐ Shrub/herbaceous wetland _____ % ☐ Developed (>25% impervious surface) _____ %

☐ Shrub/herbaceous upland _____ % ☐ Other (please specify) _____ %

3. **Landuse type and approximate percentage within the 100 - 750-ft vernal pool critical terrestrial habitat:**

☒ Forested wetland 6 % ☐ Agriculture _____ %

☒ Forested upland 46 % ☒ Developed (<25% impervious surface) 16 %

☒ Shrub/herbaceous wetland 5 % ☒ Developed (>25% impervious surface) 12 %

☒ Shrub/herbaceous upland (field) 15 % ☐ Other (please specify) _____ %

Based on: ☒ Field estimate ☒ GIS

D. SPECIES PRESENT IN VERNAL POOL

Was the entire pool comprehensively surveyed for egg masses? ☐ Yes ☐ No

INDICATOR SPECIES	DATE	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvaticus*)	4/10	2	
Spotted Salamander (*Ambystoma maculatum*)	4/10	166	
Blue-spotted Salamander (*Ambystoma laterale*)			
Jefferson's Salamander (*Ambystoma jeffersonianum*)			
Marbled Salamander (*Ambystoma opacum*)			
Fairy Shrimp (*Eubranchipus* spp.)		**PRESENCE/ABSENCE/**	**ABUNDANCE:**
FACULTATIVE SPECIES	**DATE**	**PRESENCE/ABSENCE**	**FEW/COMMON/MANY**
Spring Peeper (*Pseudacris crucifer*)			
Gray Tree Frog (*Hyla versicolor*)			
American Toad (*Anaxyrus americanus*)			
Eastern Spadefoot Toad (*Scaphiopus holbrookii*)			
Fowler's Toad (*Anaxyrus fowleri*)			
Fingernail Clams (Sphaeriidae, Pisidiidae)			
Caddisflies (Limnephilidae, Phryganeidae)			
OTHER SPECIES	**DATE**	**PRESENCE/ABSENCE**	**FEW/COMMON/MANY**
Rare Species (list): _____			
Predator Species (e.g., Bullfrog/Green frog tadpoles, Fish) (list): _____			

Other comments (append photographs, additional notes, sketch of pool and surrounding landscape):

3-16-2012 Also found large 1.5 to 2 inch unidentified tadpoles in pools. April 2012 was very dry, temperatures were high, many pools dried out this Spring prior to amphibian lifecycle completion.

US Army Corps of Engineers - New England District
Vernal Pool Valuation Score Form

Wetland 7

Project File # _____ Project Name First Light Pool ID (flags I)
Observer A. Atwell, J. Fennell, Epsilon Associates Phone or E-mail 978-897-7100
Survey date(s) VP identification 4/10/12, Delineated July 2012, Reviewed 10/26/12
Longitude/Latitude (in decimal degrees) -71.048621W, 41.879459N

Use data from Vernal Pool Characterization Form to fill out below.

A. VERNAL POOL CHARACTERISTICS (fill in all information known):

1. Landscape setting:

☒ 4 Upland depression ☐ 2 Floodplain depression ☐ 4 Pool within larger wetland system (if this is also in a floodplain , use 2)

2. Wetland type(s) that best apply to this pool:

☐ 4 Forested wetland
☒ 4 Shrub wetland
☐ 4 Peatland (acidic fen or bog)
☐ 4 Herbaceous wetland
☐ 2 Open water
☐ 2 Intermittent stream
☐ 3 Floodplain (overflow/oxbow)

3. Hydrology

a. Estimated hydroperiod range:

☐ 6 Dries between early March and early July
☒ 8 Dries between early July and early September
☐ 8 Dries between early September and early November
☐ 2 Dries between early November and late December, or intermittently exposed

b. Inlet/outlet (specify which):

☒ 8 No inlet/outlet
☐ 6 Temporary inlet/outlet
☐ 2 Permanent inlet or outlet (channel with well-defined banks and permanent flow)

24 **TOTAL for Pool Characteristics**

B. VERNAL POOL ENVELOPE (100 ft) AND CRITICAL HABITAT AREA (100-750 ft) CHARACTERISTICS (fill in all information known):

☒ 4 Are immediate surroundings and pool part of a wildlife corridor? Check box if yes.

1. Landuse type and approximate percentage within the 100-ft vernal pool envelope (value assumes 100% per type; if multiple types, use percentage of values for each type present):

☐ 16 Forested wetland ____ %
☒ 16 Forested upland 96 %
☐ 10 Shrub/herbaceous wetland ____ %
☒ 8 Shrub/herbaceous upland 4 %
☐ 2 Agriculture ____ %
☐ 2 Developed (<25%) ____ %
☐ 1 Developed (>25%) ____ %
☐ Other (please specify) ____ %

2. Landuse type and approximate percentage within the 100 - 750-ft vernal pool critical terrestrial habitat (value assumes 100% per type; if multiple types, use percentage of values for each type present):

☒ 16 Forested wetland 6 %
☒ 16 Forested upland 46 %
☒ 10 Shrub/herbaceous wetland 5 %
☒ 8 Shrub/herbaceous upland 15 %
☐ 2 Agriculture ____ %
☒ 2 Developed (<25%) 16 %
☒ 1 Developed (>25%) 12 %
☐ Other (please specify) ____ %

30.2 **TOTAL for Pool Envelope and Critical Habitat Area**

C. SPECIES PRESENT IN VERNAL POOL

☒ 16 Indicator species present (check all that apply):

- ☒ Wood Frog
- ☒ Spotted Salamander
- ☐ Blue-spotted Salamander
- ☐ Jefferson's Salamander
- ☐ Marbled Salamander
- ☐ Fairy Shrimp

Rare Species (check all that apply):

- ☐ 4 Blanding's Turtle
- ☐ 4 Spadefoot Toad

☐ -16 Resident predator population present (check all that apply):

- ☐ Bullfrog tadpoles
- ☐ Fish
- ☐ Green Frog tadpoles
- ☐ Other (specify) _____

16 **TOTAL for Pool Species (see NOTE in text)**

SUMMARY:

24 **Pool Characteristics** 30.2 **Envelope and Critical Habitat** 16 **Pool Species**

US Army Corps of Engineers - New England District
DRAFT Vernal Pool Characterization Form

Project File # 2975 Project Name Project First Light Pool ID Wetland 7
Observer Amanda Atwell, Epsilon Assoc.; Scott Smyers, Oxbow Assoc. Phone or E-mail 978-897-7100
Landowner/Applicant Mashpee Wampanoag Tribe, Attn Cedric Cromwell Phone or E-mail 508-477-0208
Address 483 Great Road, South City Mashpee State MA Zip 02649
Location of vernal pool: City/State Taunton, Massachusetts
Survey date(s) April 10, 2014 with representatives from EPA and COE, April 14, 2014 with Oxbow Associates.
Longitude/Latitude (in decimal degrees) -71.048621W, 41.879459N

A. VERNAL POOL CHARACTERISTICS (fill in all information known):

1. Landscape setting (check all that apply):

[X] Upland depression (4 pts; if this is also in a floodplain, use 2 pts)
[ ] Pool part of wildlife corridor (4 pts)
[ ] Pool part of a pool complex (within 1000 feet of one or more other vernal pools) (NA)
[ ] Pool within larger wetland system (4 pts; if this is also in a floodplain, use 2 pts)
[ ] Other: _____ (variable pts)

2. Vernal pool condition:

Describe any recent modifications to the pool and associated landscape: Appears to have a spoil pile or soil stockpile associated with the southern edge, this area is covered with Japanese knotweed. Knotweed area appears to have increased since 2012

3. Parent material:

[X] Glacial fluvial ("outwash")
[ ] Loose till
[ ] Peat
[ ] Dense till
[ ] Alluvium
[ ] Coastal marine sediments

4. Aquatic resource type that best applies to this pool (choose dominant):

[ ] Forested wetland (4 pts)
[ ] Herbaceous wetland (4 pts)
[ ] Floodplain (overflow/oxbow) (3 pts)
[X] Shrub wetland (4 pts)
[ ] Open water (2 pts)
[ ] Other: _____ (variable points)
[ ] Peatland (acidic fen or bog) (4 pts)
[ ] Intermittent stream reach (2 pts)

5. Pool canopy cover (%): 60%, Upland forest overstory contributes to shading within the pool.

6. Predominant substrate:

[X] Mineral soil
[X] Organic matter (peat/muck) Depth 1.5 ft Sampling location (e.g., deepest zone, edge, etc.) Deepest zone (the edge is mineral, while the center of the pool is histic)

7. Pool size:

a. Approximate dimensions of pool (at maximum capacity; include units): Length 200 ft Width 75 ft
Area: 37,500 square feet

b. Maximum depth at deepest point at time of survey (include units): 24 inches

8. Hydrology:

a. Estimated hydroperiod (unless actual, observed hydroperiod value(s) is(are) known, use the presence of these example indicator species to best predict the expected hydroperiod of the pool):

[ ] Dries between early March and early July (e.g., *Thelypteris palustris, Carex stricta, Impatiens capensis, Ilex verticillata*) (6 pts)
[X] Dries between early July and early September (e.g., *Sagittaria latifolia, Scirpus cyperinus, Dulichium arund., Cephalanthus occ.*) (8 pts)
[ ] Dries between early September and early November (e.g., *Eleocharis palustris, Glyceria cana., Utricularia* spp., *Decodon vert.*) (8 pts)
[ ] Dries between early November and late December, or intermittently exposed (e.g., *Nuphar* spp., *Potamogeton* spp.) (2 pts)

b. Inlet/outlet (pick one):

[X] No inlet/outlet (8 pts)
[ ] Permanent inlet or outlet (channel with well-defined banks and permanent flow) (2 pts)
[ ] Temporary inlet/outlet (6 pts)

9. Water quality:

[ ] Clear
[ ] High turbidity
[X] High algae content
[X] Tannic

24 **TOTAL for Pool Characteristics (out of 28 max.)**

DRAFT

Pool ID Wetland 7

B. VERNAL POOL ENVELOPE (100 ft) AND CRITICAL HABITAT AREA (100-750 ft) CHARACTERISTICS (fill in all information known):

1. Landuse type and approximate percentage within the 100-ft vernal pool envelope:

[X] Forested 95 % (16 pts) [X] Open (e.g., meadow, agriculture, golf course) field 4 % (4 pts)

[ ] Shrub ____ % (10 pts) [ ] Developed ____ % (0 pts)

2. **Landuse type and approximate percentage within the 100 - 750-ft vernal pool critical terrestrial habitat:**

[X] Forested 50 % (16 pts) [X] Open (e.g., agriculture, golf course) 15 % (4 pts)

[X] Shrub 5 % (10 pts) [X] Developed 30 % (0 pts)

[X] Are there one or more barriers to vernal pool fauna movement within the envelope and/or critical terrestrial habitat? If so, check here and see directions for explanation of how to incorporate this information. There is a railroad track to the south.

Based on: [X] Field estimate [X] GIS [ ] Aerial photo estimate

24.5 **TOTAL for Pool Envelope and Critical Terrestrial Habitat Area (out of 32 max.)**

C. SPECIES PRESENT IN VERNAL POOL

INDICATOR SPECIES	DATE	EGG MASSES (#)	TADPOLES/LARVAE
Wood Frog (*Lithobates sylvaticus*)	4/14	15	Present
Spotted Salamander (*Ambystoma maculatum*)	4/14	around 100	
Blue-spotted Salamander (*Ambystoma laterale*)			
Jefferson's Salamander (*Ambystoma jeffersonianum*)			
Marbled Salamander (*Ambystoma opacum*)			
Fairy Shrimp (*Eubranchipus* spp.)	4/14	PRESENT/ABSENT	ABUNDANCE: at least 10
OTHER SPECIES	**DATE**	**PRESENCE/ABSENCE**	**FEW/COMMON/MANY**
Facultative Species (e.g., Spring Peeper (*Pseudacris crucifer*), Gray Tree Frog (*Hyla versicolor*), Caddisflies (Limnephilidae, Phryganeidae), American Toad (*Anaxyrus americanus*), Eastern Spadefoot Toad (*Scaphiopus holbrookii*), Fowler's Toad (*Anaxyrus fowleri*), Fingernail Clams (Sphaeriidae, Pisidiidae))(list):	4/14	Fingernail clams	common
Rare Species (list):			
Predator Species (e.g., Bullfrog/Green frog tadpoles, Fish) (list):			
Other species (e.g., Ducks, Turtles, etc.)(list):			

Presence of Indicator Species [X] Yes [ ] No

SUMMARY:

24 **TOTAL for Pool Characteristics** 24.5 **TOTAL for Pool Envelope and Critical Terrestrial Habitat Area**

Other comments (append photographs, additional notes, sketch of pool and surrounding landscape):

OXBOW ASSOCIATES, INC.

Wetlands Delineation and Permitting • Wildlife Studies • Herpetology • Vernal Pool Ecology

May 9, 2014

Mr. Michael Howard
Epsilon Associates, Inc.
3 Clock Tower Place, Suite 250
Maynard, MA 01754

Re: Vernal Pool Evaluation
Proposed First Light Casino Property
Taunton, MA

Dear Mr. Howard:

In response to your request, Oxbow Associates, Inc. (OA: specifically, S. Smyers) reviewed the above referenced site with you and Amanda Atwell on April 14, 2014. This site is located south of Hart Street, east of the Cotley River, and north of railroad tracks. The property is mix of forested uplands and wetlands with some fields and an existing gravel road.

The purpose for this site evaluation was to review the salamander egg masses within the seasonal pond located in the southern portion of the property. We used chest waders and a dip-net to conduct visual survey of egg masses within a portion of the pond. It is our understanding that one egg mass was questioned as possibly a blue-spotted salamander (*Ambystoma laterale*) during a site review from the Environmental Protection Agency (EPA).

Seasonal Pond Description

The subject property has a varying topography with small hills and depressions. The upland surrounding the subject pond includes moderately steep slopes within a forested upland vegetated with eastern white pine (*Pinus strobus*), oaks (*Quercus* spp.), and maples (*Acer* spp.). The pond is approximately 12-30 inches deep with a organic rich substrate with wetland shrubs including buttonbush (*Cephalanthus occidentalis*), highbush blueberry (*Vaccinium corymbosum*) arrowwood (*Viburnum recognitum*), northern manna grass (*Glyceria borealis*), and tussock sedge (*Carex stricta*) scattered throughout the basin. Invertebrates found using a dipnet include caddisflies (Limnephilidae) fairy shrimp (*Eubranchipus vernalis*), water striders (Gerridae), and ramshorn snails (Planorbidae).

P.O. Box 971 • Acton, Massachusetts 01720-0971
Telephone: 978.929.9058 • Facsimile: 978.635.1892 • E-mail: oxbow@oxbowassociates.com

The vegetation and invertebrate community is typical of seasonal ponds in southeastern Massachusetts. The number of egg masses of both spotted salamander (*Ambystoma maculatum*) and wood frogs (*Lithobates sylvatica*) indicate that this pond provides adequate hydrology so that many amphibians rely on this pond for breeding and larval development.

Egg Mass Characteristics

Ms. Atwell was successful in relocating the exact egg mass that was questioned by the staff of EPA. This egg mass was somewhat unusual in that it had an appendage of four eggs connected to the outer margin of the main mass. I photographed this egg mass from both sides and the appendage became detached during handling, but it was attached when I first observed the mass (see attached photos). I have seen thousands of egg masses throughout New England, mostly in Massachusetts, and there is considerable variability in shapes and sizes, but there are some characteristics that are commonly uniform within species of amphibians.

The following characteristics lead me to conclude that this egg mass, and the eggs attached were deposited by spotted salamander, NOT a blue-spotted salamander (or more accurately, *A. laterale X jeffersonianum*). 1. The consistency of the gelatinous matrix of both the mass and egg appendage is firm, not loose. 2. The semi-opaque coloration is uniform throughout the primary egg mass and the appendicular portion. 3. The number of eggs in the primary mass is much larger than blue-spotted salamanders. 4. The appendage of eggs was connected to the egg mass, not attached after the larger egg mass was deposited as evidenced by the size, consistency, development stage, and nature of the connective egg material. 5. Eggs of *A. laterale* X *jeffersonianum* group are characterized by a relatively narrow gap between the vitelline membrane and the outer margin of the egg compared to spotted salamander. The eggs examined all had a vitelline membrane consistent with the spotted salamander.

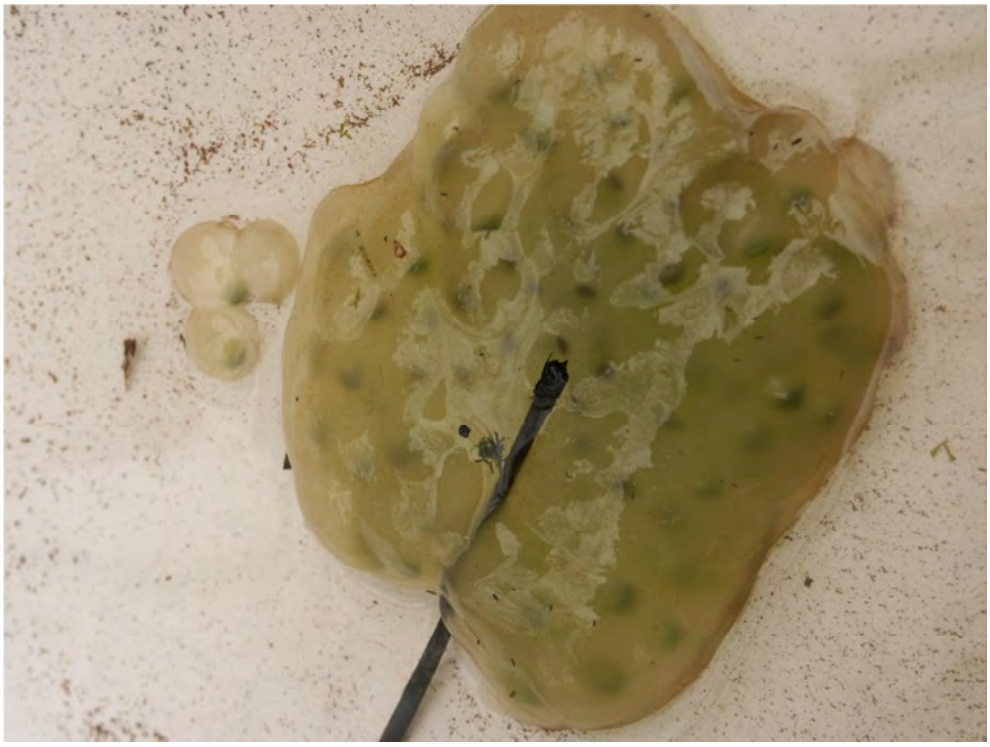
I also examined a minimum of 50 other egg masses to determine if there were any other eggs that could possibly be those of blue-spotted salamanders and I did not find any such eggs.

If you have any questions, please do not hesitate to contact us.

Sincerely,

Scott D. Smyers, M.S.
Senior Scientist
encs.

1. Egg mass of spotted salamander (from A. Atwell 4/9/14)



2. Opposite side of same egg mass with detached appendage

3. View of seasonal pond

4. Other spotted salamander egg masses within the same seasonal pond

Updated Stormwater Management Plan
Land into Trust Casino Site

O'CONNELL WAY/STEVENS STREET
EAST TAUNTON, MASSACHUSETTS

Prepared for:

Mashpee Wampanoag Tribal Gaming Authority
436 Great Neck Road South
Mashpee, MA 02649

Prepared by:

Field Engineering Co., Inc.
11D Industrial Drive
PO Box 1178
Mattapoisett, Massachusetts 02739

April 11, 2014
Project No. 1905

FIELD ENGINEERING CO., INC.
CONSULTING ENGINEERS

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Preface

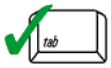
Checklist for Stormwater Report

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

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



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☒ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☒ Bioretention Cells (includes Rain Gardens)
- ☒ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☒ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☒ Other (describe): Subsurface infiltration systems

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☒ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☒ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☒ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☒ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☒ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan (O&M Plan to be submitted prior to construction)

☐ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☐ Name of the stormwater management system owners;
- ☐ Party responsible for operation and maintenance;
- ☐ Schedule for implementation of routine and non-routine maintenance tasks;
- ☐ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☐ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Section 1

Hydrologic Overview

1.0 INTRODUCTION

1.1 Report Description

This report presents the results of the updated hydrologic analysis for the Mashpee Wampanoag Tribe Fee to Trust Acquisition Final Environmental Impact Study of the proposed casino development under existing and proposed conditions. This report also includes a description of measures to be implemented to mitigate potential stormwater impacts including the implementation of various Low Impact Development (LID) measures, as well as a description of the stormwater permitting requirements for the Project.

The site will be constructed in a manner that respects existing drainage patterns and maintains stormwater flow toward wetland areas, while maintaining the quality of runoff to groundwater, wetlands, and associated water bodies. The site is designed to make use of existing stormwater Best Management Practices (BMP's) to the maximum extent practicable while implementing various new LID measures to comply with updated Stormwater Management Regulations. An emphasis on flood control particularly at the wetlands associated with the Cotley River and the upper Barstow Pond area was a primary consideration of the analysis. It should be noted that the analysis performed was on the quantity (and quality) of the runoff to the wetlands associated with the Cotley River and Barstow Pond area. Anticipated changes within the Barstow Pond complex due to the proposed dam removal (by others) was not included in this analysis. It would be anticipated that with the removal of the Barstow Pond dam, additional flood storage volume would be available within the wetland system, however, this has not been included in the on-site stormwater management system analysis.

The basic approach to the stormwater management plan is to balance the needs of the project while preserving the integrity of the adjacent wetland ecosystem and the groundwater aquifer. The primary target areas for treatment are the stormwater discharges towards the receiving wetland resource areas.

1.2 Design Criteria

Stormwater discharges from this project have been designed to comply with the applicable standards of the Massachusetts Stormwater Management Policy (MASMP). In critical areas beyond the 100-foot wetland buffer zone, the applicable standards of the MASMP will be complied with to the maximum extent practicable. Consistency with the ten (10) Standards of the MASMP criteria is further demonstrated in the Section 1.13 of this report.

A hydrologic analysis for the pre and post developed conditions for the project site has been prepared and is submitted in the following sections of this Conceptual Stormwater Management Plan. The primary goal of this analysis is to evaluate and mitigate the potential impacts of the proposed development to the adjacent properties and on-site wetland resource areas. The post-development hydrologic analysis that is presented in this Plan takes into account the most intensive of the three development alternatives. Summary tables of the proposed impervious areas, required water quality volumes and required recharge volumes are also presented for each of the three development alternatives.

On the south side of the railroad tracks, particular consideration has been given to stormwater quantity and quality at the bordering vegetated wetland system associated with the Cotley River located south of the existing O'Connell Way. In addition, consideration has also been given to two (2) particular culvert or stream crossings under O'Connell Way. These three (3) locations have been considered the analysis points for this analysis for Phase I. The pre-developed

condition consists of extensive previously developed and permitted areas of the project that currently contribute runoff to the subject analysis points. The existing O'Connell Way roadway system was permitted and constructed by the Taunton Development Corporation in 2007. These areas are further described in the following sections of this report.

On the north side of the railroad tracks, particular consideration has been given to stormwater quantity and quality at the bordering vegetated wetland systems associated with Barstow Pond as well as at the boundary of an existing isolated wetland with vernal characteristics on the project site. This portion of the project site is currently undeveloped with existing wooded and field areas.

The analysis of the present condition and the proposed condition hydrology includes a calculated estimation of the runoff volume and peak storm flow rates from the site for each individual drainage area. The HydroCAD hydrologic program, developed by Applied Microcomputer Systems, was utilized in the preparation of the stormwater runoff models. The HydroCAD software is based upon the Soil Conservation Service, "Technical Release 20 – Urban Hydrology for Small Watersheds" and is a generally accepted industry standard methodology.

An analysis was performed for the 2, 10 and 100-year frequency rainfall events. These events were based on a 24-hour duration storm with a SCS Type III storm distribution curve. Time of Concentration (Tc) values and runoff curve numbers (CN) were developed for each of the calculated existing drainage areas based upon prevalent topographic patterns, ground cover conditions, and SCS Hydrologic Soil Group classifications. To be conservative, minimum Tc values were used for the proposed drainage areas. The primary goal of this analysis is to determine the water quality and quantity impacts of the proposed development in comparison to the present conditions of the site. The 2-, 10-, and 100-year storm events have been evaluated to confirm that there will be no negative impacts to the receiving wetlands and surrounding areas as a result of the development of the project. As previously noted, the analysis points of this study are at the boundary of the bordering vegetated wetland system associated with the Cotley River and the Barstow Pond. Anticipated changes within the Barstow Pond complex, including the removal of the dam, have not been considered in this analysis. It is assumed that a reduction in the rates of runoff at the boundary of the bordering vegetated wetland system complies with the applicable Standards for Stormwater Management. As the following analysis confirms, the pre-development rates of runoff from the subject parcels have been met or reduced in the post-development conditions for the 2, 10, and 100 year storm event at all analysis points. Therefore the stormwater management system, as currently proposed will adequately attenuate the increased runoff from the increased impervious surfaces on the site at the boundary of the bordering vegetated wetland system associated with the Cotley River (and Barstow Pond).

The hydrologic study area in the existing condition of the LIT Site-South Parcel project area consists of eighteen (18) watershed areas with four distinct analysis points. The hydrologic study area in the existing condition of the LIT Site-North Parcel project area consists of two (2) watershed areas with two (2) distinct analysis points.

The Bristol County Soil Conservation Service (SCS) mapping for this area indicates a number of different soil types ranging from Merrimac fine sandy loam to Birdsall silt loam (in the wetland areas). The predominant soil classifications are as follows:

- Merrimac fine sandy loam (MeB), 3 to 8 percent slopes – Hydrologic Soil Group A
- Woodbridge stony fine sandy loam (WtB), 0 to 3 percent slopes – Hydrologic Soil Group C.

- Ridgebury stony fine sandy loam (ReA), 0 to 3 percent slopes – Hydrologic Soil Group C.
- Unadilla very fine sandy loam (UnA), 0 to 3 percent slopes – Hydrologic Soil Group B.
- Ninigret fine sandy loam, 0 to 3 percent slopes – Hydrologic Soil Group B
- Raynham silt loam (Ra), 0 to 3 percent soils – Hydrologic Soil Group C.
- Birdsall silt loam (Bd), 0 to 3 percent slopes – Hydrologic Soil Group D.

A number of test pits have been performed throughout the South Parcel and Lot 13 portion of the project site and these test pits were consistent with the soil mapping.

1.3 Existing Conditions Hydrologic Summary-LIT Site-South Parcel

In the present condition, the subject parcel on the south side of the railroad tracks is comprised of eighteen (18) watershed areas as shown on the attached Pre Development Watershed Plans. This area consists of previously permitted and constructed developments located at 61 Stevens Street (B&D Construction), 71 Stevens Street, 73 Stevens Street, 50 O'Connell Way (known as the Maggiore 1 building), 60 O'Connell Way (known as the Maggiore 2 building) and the O'Connell Way roadway corridor. These developments were all designed, permitted, and constructed in compliance with the State Wetland Regulations in place at the time of development and all of these developments complied with the Massachusetts Stormwater Management Policy. This area also consists of the currently undeveloped "DaRosa" lot which is adjacent to 71 Stevens Street and fronts on O'Connell Way. This area was designed and approved to support an approximate 21,000 square foot commercial building with parking and loading, however, the building was not constructed. The subject parcel also consists of various unattenuated areas and single family residences along Stevens Street that would also contribute flow to the subject analysis points. Finally, the South Parcel of the project also includes a remote area being considered for surface parking that doesn't flow directly into the currently developed portions of the project area. This area is designated as the Lot 9 surface parking lot in the analysis.

A specific description of each watershed area and the corresponding stormwater management system and subject analysis points is as follows:

Subcatchment PRE-1 is a 0.67-acre area consisting of the front portion of the 73 Stevens Street development which was permitted and constructed in 2008 by Jamins, LLC. This area consists of a portion of the existing office building and front parking area which drains to an existing recharge system, modeled as POND-1 in the Pre Development hydrologic analysis. POND-1 provides a recharge component for the impervious surfaces associated with the 73 Stevens Street development prior to overtopping and discharging to a grassed swale (Reach 1R). The grassed swale discharges to the wetland system south of O'Connell Way associated with the Cotley River. This wetland system in its entirety is taken as Analysis Point 1 in the Hydrologic Analysis.

Subcatchment PRE-2 is a 0.44-acre area consisting of the rear portion of the 73 Stevens Street development. This area consists of a portion of the existing office building and rear driveway area drains to an existing recharge system, modeled as POND-2 in the Pre Development hydrologic analysis. POND-2 also provides a recharge component for the impervious surfaces associated with the 73 Stevens Street development prior to overtopping and discharging to the grassed swale (Reach 1R) prior to discharging to Analysis Point 1.

Subcatchment PRE-3 is a 10.80-acre area consisting of undeveloped areas to the south of the proposed development that currently flow unattenuated to the wetland system south of O'Connell Way, associated with the Cotley River (Analysis Point 1).

Subcatchment PRE-4 is a 11.44-acre area consisting of the roof of the existing Maggiore 2 Building, the common driveway between Maggiore 1 and Maggiore 2 and the parking areas associated with Maggiore 1 and Maggiore 2. This area was designed, permitted, and constructed in 2008 through 2011 by Stevens One and Stevens Two LLC. Subcatchment PRE-4 flows via a closed conduit drainage piping system to an existing large extended detention basin and sediment forebay (POND-3) prior to discharging at a controlled rate to the wetlands being taken as Analysis Point 1.

Subcatchment PRE-5 is a 1.22-acre area consisting of a portion of the roof of the existing Maggiore 1 Building. Subcatchment PRE-5 flows via a closed conduit drainage piping system to an existing underground roof drain recharge system consisting of large plastic chambers sitting on a bed of stone (POND-4). POND-4 discharges at a controlled rate to the existing extended detention basin on the Maggiore 1 property (POND-5).

Subcatchment PRE-6 is a 2.21-acre area consisting primarily of the loading areas for the Maggiore 1 Building. Subcatchment PRE-6 flows via a closed conduit drainage piping system to an existing extended detention basin and sediment forebay (POND-5) prior to discharging at a controlled rate to the wetlands being taken as Analysis Point 1.

Subcatchment PRE-7 is a 1.20-acre area consisting of additional undeveloped areas to the south of the existing O'Connell Way that currently flow unattenuated to the wetland system south of O'Connell Way, associated with the Cotley River (Analysis Point 1).

Subcatchment PRE-8 is a 4.94-acre area consisting of the existing O'Connell Way roadway and shoulder areas which was designed, permitted, and constructed in 2007 by the Taunton Development Corporation. O'Connell Way was the subject of a local Conservation Commission Notice of Intent, a MADEP 401 Water Quality Certification, and a US Army Corps of Engineering Section 404 Permit. Subcatchment PRE-8 flows via a closed conduit drainage piping system to an existing large extended detention basin and sediment forebay (POND-6), prior to discharging at a controlled rate to the wetlands being taken as Analysis Point 1.

Subcatchment PRE-9 is a 1.98-acre area consisting of the front parking areas of 71 Stevens Street, half of the roof runoff from 71 Stevens Street, and ancillary landscaping areas along the Stevens Street and O'Connell Way sides of the existing building. The current configuration and layout of 71 Stevens Street was designed, permitted, and constructed by 71 Stevens Street LLC in 2008. Subcatchment PRE-9 currently flows unattenuated via a closed conduit drainage piping system to an existing grassed swale which discharges to an existing cross-culvert underneath O'Connell Way (POND-9).

Subcatchment PRE-10 is a 2.89-acre area consisting of the rear parking/loading areas of 71 Stevens Street, half of the roof runoff from the 71 Stevens Street building, and a large portion of the gravel area behind 71 Stevens Street, including the fenced storage area. PRE-10 flows to an existing extended detention wetland and sediment forebay system (POND-7) prior to discharging a controlled rate to the grassed swale (POND-9). POND-9 discharges to the wetland system associated with the Cotley River (Analysis Point 1).

Subcatchment PRE-11 is a 0.96-acre area consisting of additional undeveloped gravel areas associated with the 71 Stevens Street parcel. PRE-11 flows unattenuated to the existing cross-culvert underneath O'Connell Way (POND-9).

Subcatchment PRE-12 is a 1.84-acre area consisting of additional undeveloped gravel and grassed areas associated with the 71 Stevens Street parcel. This portion of the parcel flows unattenuated to an existing drainage ditch on the adjacent parcel (DaRosa Parcel). This ditch

eventually discharges to an existing stream which crosses O'Connell Way. The portion of this stream to the north of O'Connell Way is taken as Analysis Point 2 in the Pre Development Hydrologic Analysis.

Subcatchment PRE-13 is a 2.72-acre area consisting of the previously developed 61 Stevens Street parcel. This parcel consists of parking and loading areas and a commercial building. Subcatchment PRE-13 flows via a closed conduit drainage piping system to an existing flared-end which discharges flow unattenuated to the wetlands associated with the stream to the north of O'Connell Way (Analysis Point 2).

Subcatchment PRE-14 is a 1.31-acre area consisting of a portion of the currently undeveloped "DaRosa Lot" which flows unattenuated to the existing stream north of O'Connell Way (Analysis Point 2).

Subcatchment PRE-15 is a 0.45-acre area consisting of a gravel portion of the currently undeveloped "DaRosa Lot" which flows to a constructed depression (POND-8) prior to overtopping towards the existing stream north of O'Connell Way (Analysis Point 2). The constructed depression was built in 2008 as part of the contemplated development of the "DaRosa Lot."

Subcatchment PRE-16 is a 0.48-acre area consisting of a portion of the undeveloped area north of O'Connell Way known as "Lot 11." This area flows unattenuated to the existing stream north of O'Connell Way (Analysis Point 2). "Lot 11" had been previously designed and permitted to support a 33,000 square foot warehouse building, however, this contemplated development has not been constructed at the time of this report. Wetlands fill and mitigation associated with the construction of "Lot 11" was included in the MADEP 401 Water Quality Certification and USACOE Section 404 Permit.

Subcatchment PRE-17 is a 1.35-acre area consisting of a large portion of "Lot 11" which flows unattenuated to an existing swale and cross culvert underneath O'Connell Way to the existing extended detention basin servicing the O'Connell Way roadway layout (POND-6).

Subcatchment PRE-18 is a 2.45-acre area consisting of a large portion of "Lot 11" which flows unattenuated to an existing cross culvert at the entrance driveway to the Crossroads Commerce Center located at the end of O'Connell Way. This entrance driveway was constructed as part of the O'Connell Way subdivision and the wetland alteration associated with this entrance driveway was permitted during the O'Connell Way subdivision permitting. This cross culvert is taken as Analysis Point 3 in the Pre Development Hydrologic Analysis.

Subcatchment PRE-19 is a 4.22-acre area consisting of the upland areas of "Lot 9" which will be developed into a surface parking lot in the Post developed condition. PRE-19 flows unattenuated to the wetlands associated with the Cotley River, south of the existing O'Connell Way roadway. A driveway with a wetland crossing to access this lot off of O'Connell Way was provided and approved under the USACOE permitting for the O'Connell Way subdivision, however, this driveway and associated wetland crossing have not yet been constructed.

It should be noted that the runoff associated with Analysis Points 2 and 3 eventually flows to the wetland system associated with the Cotley River, which is being taken as Analysis Point 1 in the Hydrologic Model. We have segregated these areas in the Pre-Development Analysis and subsequently the Post-Development Analysis to ensure that the proposed development will have no adverse impact on the existing cross-culvert due to an increase in the rates or volumes of runoff to these locations. It is assumed that a reduction in the rate and volume of runoff to these cross culverts will have no adverse impact in these locations.

A summary of the pre development hydrologic conditions for the 2, 10, and 100-year storm events is submitted in the table below.

Table 1.3 Pre Development Hydrologic Summary-LIT Site-South Parcel

Storm Event	Analysis Point 1 Rate of Flow (c.f.s.)	Analysis Point 2 Rate of Flow (c.f.s.)	Analysis Point 3 Rate of Flow (c.f.s.)	SUM Of Analysis Points To Cotley River Wetlands (c.f.s.)
2-year storm	26.80	10.17	1.14	36.31
10-year storm	55.11	17.60	2.97	70.41
100-year storm	121.63	31.01	6.85	152.89

1.4 Existing Conditions Hydrologic Summary-LIT Site-North Parcel

In the present condition, the subject parcel on the north side of the railroad tracks is comprised of two major watershed areas. This area is mainly vacant and consists of fields and wooded areas.

A specific description of each watershed area and the corresponding stormwater management system and subject analysis points is as follows:

Subcatchment PRE-20 is a 28.3-acre area consisting of the majority of the Phase II portion of the project site. Subcatchment PRE-19 flows overland unattenuated to the wetland system associated with the Barstow Pond impoundment, located to the west of the project area, taken as Analysis Point 4 in the hydrologic model.

Subcatchment PRE-21 is a 1.43-acre area consisting of a portion of the Phase II area which flows overland unattenuated to an existing isolated wetland located on the parcel. This isolated wetland system is taken as Analysis Point 5 in the hydrologic model.

A summary of the pre development hydrologic conditions for the 2, 10, and 100-year storm events is submitted in the table below.

Table 1.4 Pre Development Hydrologic Summary-LIT Site-North Parcel

Storm Event	Analysis Point 4 Rate of Flow (c.f.s.)	Analysis Point 5 Rate of Flow (c.f.s.)
2-year storm	20.59	1.74
10-year storm	41.05	3.21
100-year storm	80.63	5.93

1.5 Proposed Conditions Hydrologic Summary-LIT Site-South Parcel

In the proposed condition, the subject parcel on the south side of the railroad tracks is comprised of sixteen (16) watershed areas as shown on the attached Post Development Watershed Plans. As previously mentioned, this hydrologic analysis has been performed on the most intensive of the three development alternatives being considered in the EIS. It is assumed that if either of the two "Reduced Intensity" alternatives is chosen, the impacts related to the hydrologic model will also be reduced due to a reduction in the proposed impervious surfaces for the project. The South Parcel portion of the project consists of the proposed development along the existing O'Connell Way including the Casino (Phase I-A), 2 hotels (Phase I-B and I-C), the 5 story parking garage with associated service entry and the two surface parking lots located on "Lot 11" and "Lot 9".

A specific description of each watershed area and the corresponding stormwater management system and subject analysis points is as follows:

Subcatchment POST-1 is a 8.52-acre area consisting of undeveloped areas to the south of the proposed development that currently flow unattenuated to the wetland system south of O'Connell Way, associated with the Cotley River (Analysis Point 1).

Subcatchment POST-2 is a 10.25-acre area consisting of the roof areas of the full buildout of the proposed casino and hotel development. POST-2 will flow via a closed conduit roof drain piping system to to the existing large detention basin that will be modified to function as an extended detention wetland system (POND-1). The outlet structures of the extended detention wetland system will also be modified to discharge runoff at a controlled rate to the wetlands associated with the Cotley River south of the project (Analysis Point 1).

Subcatchment POST-3 is a 9.05-acre area of the development consisting of the proposed driveway, parking, and loading areas surrounding the proposed casino and hotel development. POST-3 will flow via a closed conduit piping system to the existing large detention basin that will be modified to function as an extended detention wetland system (POND-1). The outlet structures of the extended detention wetland system will also be modified to discharge runoff at a controlled rate to the wetlands associated with the Cotley River south of the project (Analysis Point 1).

Subcatchment POST-4 is a 0.92-acre area consisting of grassed areas around the proposed parking garage and along the exsiting O'Connell Way which will flow through a proposed bioretention pond (POND-2) prior to overtopping to a second bioretention pond (POND-3) which will ultimately discharge to POND-1.

Subcatchment POST-4A is a 0.52-acre area consisting of grassed areas around the proposed parking garage which will flow through a proposed bioretention pond (POND-3) prior to discharging to the existing large detention basin (POND-1).

Subcatchment POST-5 is a 2.55-acre area consisting of a portion of the proposed parking garage which will flow through a proposed bioretention pond (POND-3) prior to discharging to the existing large detention basin (POND-1).

Subcatchment POST-5A is a 0.84-acre area consisting of a portion of the grassed surfaces and parked driveways around the proposed parking garage which will flow through a proposed bioretention pond (POND-3) prior to discharging to the existing large detention basin (POND-1).

Subcatchment POST-6 is a 4.22-acre area consisting of the remaining portion the proposed parking garage that will flow through a bioretention pond (POND-4) prior to discharging through two outlet control structures. The first outlet control structure will direct runoff towards the existing O'Connell Way roadway system that currently flows to the existing large extended detention basin located at the end of the road (POND-6). The second outlet control structure will discharge flow at a controlled rate towards an existing drainage ditch adjacent to "Lot 11" (Analysis Point 2).

Subcatchment POST-7 is a 2.04-acre area consisting of a portion of the service road that runs around the proposed parking garage and associated grass shoulder areas which will flow through a proposed bioretention pond (POND-5) prior to discharging at a controlled rate towards an existing drainage ditch adjacent to "Lot 11" (Analysis Point 2).

Subcatchment POST-8 is a 0.96-acre area consisting of a portion of the service road that runs around the proposed parking garage and associated grass shoulder areas which will flow through a proposed bioretention pond (POND-6) prior to discharging at a controlled rate towards an existing drainage ditch adjacent to "Lot 11" (Analysis Point 2).

Subcatchment POST-9A is a 1.41-acre area located on "Lot 9" consisting of the northerly subcatchment of the paved parking lot. Runoff from POST-9A will flow overland to a bioretention swale located in a landscaped island. This swale will provide treatment and some attenuation prior to overtopping to a drainage structure connected to a subsurface storage facility. This facility will also provide additional recharge and will be set a minimum of two feet above the seasonal high groundwater observed in the test pits. The subsurface storage facility will be equipped with an overflow that will discharge to a series of above-ground depressions for additional attenuation prior to discharge to the existing wetland system (Analysis Point 1).

Subcatchment POST-9B is a 1.36-acre area located on "Lot 9" consisting of the southerly subcatchment of the paved parking lot. Runoff from POST-9B will flow overland to a bioretention swale located in a landscaped island. This swale will provide treatment and some attenuation prior to overtopping to a drainage structure connected to a subsurface storage facility. This facility will also provide additional recharge and will be set a minimum of two feet above the seasonal high groundwater. The subsurface storage facility will be equipped with an overflow that will discharge to a series of above-ground depressions for additional attenuation prior to discharge to the existing wetland system (Analysis Point 1).

Subcatchment POST-9C is a 1.68-acre area located on "Lot 9" consisting of the undeveloped areas surrounding the proposed parking area which will flow unattenuated to the wetlands surrounding the lot (Analysis Point 1)

Subcatchment POST-10 is a 1.34-acre subcatchment area consisting of undeveloped areas to the north of the proposed parking lot on "Lot 11" which will contribute flow to the existing wetland system associated with the cross culvert at the Crossroads Commerce Center driveway (Analysis Point 3).

Subcatchment POST-11 is a small 0.21-acre area on "Lot 11" consisting of a portion of undeveloped area to the north of O'Connell Way which will flow unattenuated towards the existing ditch adjacent to "Lot 11" (Analysis Point 2).

Subcatchment POST-12 is a 5.54-acre area consisting of the remaining portion of the existing O'Connell Way roadway system that currently flows to the existing large extended detention basin located at the end of the road. POST-12 also includes the proposed surface parking lot on "Lot 11" which will flow through an expanded water quality swale prior to discharging to the O'Connell Way basin (POND-7). Runoff will discharge from POND-7 via two existing flow control structures that release water at a controlled rate to the wetland system (Analysis Point 1).

Subcatchment POST-13 is a 1.20-acre area consisting of undeveloped areas to the south of the existing O'Connell Way Roadway and to the west of the existing stream crossing beneath O'Connell Way. POST-13 runoff will continue to flow unattenuated to the wetland system (Analysis Point 1). Also included in POST-13 are the downhill slopes of the existing O'Connell Way detention basin which contribute flow to the Analysis Point.

Table 1.5 Post Development Hydrologic Summary-LIT Site-South Parcel

Storm Event	Analysis Point 1 Rate of Flow (c.f.s.)	Analysis Point 2 Rate of Flow (c.f.s.)	Analysis Point 3 Rate of Flow (c.f.s.)	SUM Of Analysis Points To Cotley River Wetlands (c.f.s.)
2-year storm	23.71	7.26	0.90	30.83
10-year storm	52.25	10.39	2.12	58.51
100-year storm	112.47	15.27	4.64	126.80

The hydrologic analysis indicates that the stormwater management system design for the site meets or reduces peak runoff rates for the 2, 10 and 100 year, 24 hour, Type III storm events from the pre developed levels at all analysis points. In summary, when you combine the flows to the three analysis points, there is an approximate 15-16% reduction in the rates of runoff to the Cotley River as a result of the development on the South Parcel of the proposed development depending on the storm event.

1.6 Proposed Conditions Hydrologic Summary-LIT Site-North Parcel

In the proposed condition, the subject parcel on the north side of the railroad tracks will consist of a proposed water park and hotel with associated driveways and surface parking areas. This area will be comprised of five (5) major watershed areas as shown on the attached Post Development Watershed Plans. The conceptual design of the stormwater management facilities to service this phase of the project will mimic the new LID measures being considered in LIT Site-South Parcel, including bioretention swales for the proposed parking areas, extended detention wetlands for flow attenuation and additional treatment and subsurface recharge systems for the clean roof runoff from the proposed water park/hotel structure.

A specific description of each watershed area and the corresponding stormwater management system and subject analysis points is as follows:

Subcatchment POST-N1 is a 4.31-acre area consisting of undeveloped areas to the south of the proposed development that will continue to flow unattenuated towards the bordering vegetated wetland system associated with Barstows Pond (Analysis Point 4).

Subcatchment POST-N2 is a 14.12-acre area consisting of the proposed water park and hotel buildings as well as a portion of the paved access driveways to the facility. POST-N2 will flow via a closed conduit piping system to a proposed extended detention basin system (POND-N-1) prior to discharge a controlled rate towards the bordering vegetated wetland system associated with Barstows Pond (Analysis Point 4).

Subcatchment POST-N3 is a 1.81-acre area consisting of undeveloped areas to the north of the proposed development that will continue to flow unattenuated towards the bordering vegetated wetland system associated with Barstows Pond (Analysis Point 4).

Subcatchment POST-N4 is a 7.15-acre area consisting of a portion of the paved access driveways and the proposed surface parking lots associated with the proposed water park and hotel. POST-N3 will flow via a closed conduit piping system to a proposed extended detention basin system (POND-N-2) prior to discharge a controlled rate towards the bordering vegetated wetland system associated with Barstows Pond (Analysis Point 4).

Subcatchment PRE-N5 is a 1.43-acre area consisting of a portion of the North Parcel which flows overland unattenuated to an existing isolated wetland located on the parcel. This isolated wetland system is taken as Analysis Point 5 in the hydrologic model.

Table 1.6 Post Development Hydrologic Summary-LIT Site-North Parcel

Storm Event	Analysis Point 4 Rate of Flow (c.f.s.)	Analysis Point 5 Rate of Flow (c.f.s.)
2-year storm	11.57	1.74
10-year storm	20.12	3.21
100-year storm	53.26	5.93

The hydrologic analysis indicates that the stormwater management system design for the site meets or reduces peak runoff rates for the 2, 10 and 100 year, 24 hour, Type III storm events from the pre developed levels at all analysis points. In summary, there is an approximate 35-45% reduction in the rates of runoff to the Cotley River as a result of the development on the North Parcel of the proposed development depending on the storm event.

Preliminary calculations of required water quality volumes and recharge volumes have been prepared for the proposed of the project. The water quality volume is based on 1” of runoff over the paved surfaces on the site. These calculations are provided in the table below. The proposed stormwater management system will be designed to attenuate flows to the pre-development rates as presented in previous sections of this EIS.

The following tables present a comparative analysis of the overall required (and provided) Water Quality and Recharge Volumes for each of the three development alternatives being considered in this analysis.

Table 1.6.2 Stormwater Requirement Summary

	Water Quality Volume Required (Based on 1" over the paved areas) (acre-feet)	Water Quality Volume Provided (acre-feet)	Recharge Volume Required (acre-feet)	Recharge Volume Provided (acre-feet)
Proposed Development (Alternative A)	2.14	8.55	0.87	1.72
Reduced Intensity I (Alternative B)	2.14		0.87	
Reduced Intensity II (Alternative C)	1.61		0.72	

As the above table indicates the proposed stormwater management systems will provide more than adequate water quality and recharge volumes for the proposed development. It would be anticipated that the buildout of the stormwater management system for the Reduced Intensity alternatives would closely resemble that of the Proposed Development, therefore requirements for water quality and recharge volumes would also be met under these reduced schemes.

1.7 Stormwater Management System Summary

The proposed stormwater management system incorporates a number of Best Management Practices (BMPs), as prescribed in the Massachusetts Department of Environmental Protection Stormwater Handbook. These practices include structural and non-structural measures providing stormwater quantity and quality management. These BMPs will function to minimize potential adverse water quality impacts to the surrounding wetland ecosystem. The BMPs will maintain or reduce peak stormwater discharge rates released off-site, ensuring no erosive conditions will be generated. The following sections describe the temporary and permanent stormwater BMPs proposed for the site development.

The proposed stormwater management plan has been developed based on the projected site conditions and the present condition of the water resource areas that receive stormwater runoff from the site. The proposed BMPs have been designed to comply with the Stormwater Management Policy Handbook. A number of Low Impact Development (LID) measures have been incorporated into the stormwater management plan and these measures are also described below. The proposed stormwater management plan for each of the proposed alternatives will also make use of existing stormwater management features currently serving the project site to the maximum extent practicable and these features will be supplemented by strategically placed LID measures for additional enhancement of the stormwater quality that eventually reaches the wetland system associated with the Cotley River. Schematic drawings of the site including the locations of the various stormwater BMP's have been provided. Typical detail drawings of the various stormwater BMP's are also provided.

The proposed paved and impervious areas of the development are the primary target area for water quantity and quality control measures for the project. Runoff from the majority of the paved areas are first captured in a deep sump catch basin and then conveyed to the sediment forebay in the existing detention basins currently servicing the Maggiore 1 and 2 developments and the O'Connell Way corridor where natural screening and physical settling of pollutants will facilitate

the removal of total suspended solids (TSS). Riprap pads have been implemented downgradient of the detention basin outfall to minimize erosion and induce sheet flow conditions. Runoff from the remote surface parking areas will be captured in surface "bioretention areas" for initial pollutant removal prior to discharge to either subsurface detention/retention areas or above ground extended detention wetland systems. The predicted Total Suspended Solids (TSS) Removal and Water Quality calculations for the developed areas are submitted as an Appendix to this Report. As the calculations show, the proposed stormwater management system provides adequate water quality volume and recharge volume to handle the impervious areas of the project site for the most intense of the three alternative development schemes.

1.10 Stormwater Quality

The proposed paved parking and loading areas are the primary target area for water quantity and quality control measures. Runoff from the parking and driveway areas is first captured in deep sump catch basins and then conveyed to a multi stage extended detention basin, where physical settling and pollutant burial facilitate the removal of total suspended solids (TSS). Level spreaders lined with modified rock fill will be implemented down gradient of the detention basin outfalls to minimize erosion and induce sheet flow conditions. Site management practices include regular pavement sweeping, facility maintenance, and restrictions on the use of salt and other de-icing agents to minimize the opportunity for pollutant transport through the runoff from the site.

1.11 Select Structural Best Management Practices (BMPs)

The following section presents a brief description of the select structural best management practices (BMPs) considered in the design of the stormwater management facilities for the proposed project. Each of the select BMPs will be designed in compliance with the minimum guidelines set forth in the MADEP Stormwater Management Policy Handbook.

Hooded Catch Basins with Deep Sumps

Stormwater from the majority of the existing (and proposed) roadway will be collected in a closed conduit piping system fitted with 4-foot, deep-sump catch basins with hooded outlets. Catch basin sump systems are effective devices for removal of large matter and pollutants that adsorb to sediments and other particulates. Catch basins with sumps and hooded outlets are designed to trap sediment particles and floating contaminants (e.g., oil and greases), which are typically the most significant constituents of the urban runoff pollutant load. Regular maintenance and cleaning of catch basins is required to assure adequate performance of these structures.

Extended Detention Basin with Sediment Forebay

Runoff from the roadway and parking areas, once routed through the initial pollutant attenuation stage of the collection system, will be conveyed to the existing extended detention basin located at the end of O'Connell Way. The existing extended detention basin has been designed with a sediment forebay and a multi-stage outlet control structure to extend the detention time of runoff within the basin and to enhance sediment deposition. Water quality treatment will be provided by capturing the required water quality volume (1.0 inch of runoff over the contributing paved area) within the sediment forebay, trapping particulates and allowing treated stormwater to slowly outlet through a stone filter berm to the detention stage of the basin. The detention stage of the basin will serve to attenuate flow rates and, through extended detention time, encourage infiltration of the treated stormwater.

Extended Detention Wetland System with Sediment Forebay

For the areas currently flowing to the large combined Maggiore extended detention basin, runoff from a portion of the roadway, parking/loading areas and building, once routed through the initial pollutant attenuation stage of the collection system, will be conveyed to the existing sediment forebay. The forebays will be designed to accept a minimum 0.10 inch per contributing acre of watershed area and is approximately 1.5 feet deep. The existing extended detention stage of the basin will be modified to function as an extended detention wetland with excavated areas and plantings to provide a constructed wetland stage of the facility. Water quality treatment will be provided by capturing the required water quality volume (1.0 inch of runoff over the contributing paved area) within the sediment traps, trapping particulates and allowing treated stormwater to slowly outlet through a stone filter berm to the detention stage of the basin. The detention stage of the basin will serve to attenuate flow rates and, through extended detention time, provide for additional treatment and pollutant removal. Additional pollutant removal will be made possible by biological treatment performed by the diverse variety of wetland plant being proposed within the constructed wetland stages of the extended detention/constructed wetland system. Storage volume is provided in the extended detention wetland system above an outlet "low-flow" orifice to provide attenuation of the runoff for larger storm events. This type of system is an acceptable form of LID that is currently being promoted by the MADEP in their Stormwater Management Handbook.

Level Spreader

A level spreader sump will be provided down gradient of the of all stormwater management BMP's to reduce the channeled flow velocities and induce non-erosive sheet flow conditions prior to discharge to the receiving wetland.

Subsurface Recharge Systems

Where feasible, roof drainage from the proposed building structures will be serviced by individual subsurface recharge systems. In areas where unsuitable soils and/or groundwater conditions prohibit the proper placement of subsurface recharge systems, above ground retention storage will be provided. Systems intended to accept roof drainage will be connected directly to the roof leader systems and will consist of high density polyethylene leaching chambers in a trench configuration, encased in an envelope of washed stone.

Water Quality Swale

A multi-cell water quality swale will be provided along the Lot 11 Surface Parking Lot to intercept a majority of the paved parking area runoff. The sub grade of the swale will be prepared with a native sand fill with a minimum infiltration rate of 0.05 feet per minute. The water quality swale will be partitioned with filter berm check dams to extend the stormwater detention time and promote infiltration through the sub grade prior to overtopping to the existing extended detention basin currently servicing O'Connell Way.

Bioretention Swales/Areas

Stormwater from much of the paved remote surface parking areas will discharge directly to surface bioretention areas which are also effective devices for removal of large matter and pollutants that adsorb to sediments and other particulates. The bioretention areas consists of depressed areas which allow pollutants to settle out prior to discharging either via a surface spillway or a closed piping system to additional stormwater BMP's for further treatment and flow attenuation. The bioretention areas are constructed with a mulch surface over a soil amendment zone which will also promote some recharge in the remote areas of the site.

1.12 Select Non-Structural Best Management Practices (BMPs)

The following section presents a brief description of the select non-structural best management practices (BMPs) considered in the design of the Project stormwater management facilities. While specific structural BMPs are intended to enhance water quality by removal of pollutants, these non-structural practices are particularly effective in source reduction prior to routing through the treatment train.

Pavement Sweeping Program

All driveways and parking areas will be swept twice annually (fall and spring). The sweeping program will remove contaminants directly from the paved surfaces prior to their uptake by the stormwater runoff. The U.S. Environmental Protection Agency has determined that pavement sweeping can be an effective initial treatment for reducing pollutant loading into stormwater runoff.

Stormwater Management System Maintenance Program

All structural components of the stormwater management system will be inspected and maintained on a regular basis in accordance with the minimum requirements of the MADEP Stormwater Management Policy. Catch basin sumps and hoods will be inspected twice annually. Any accumulated sand and sediment the sumps (greater than 6 inches thick) or debris in the hoods will be removed annually. Any accumulated debris and litter within the stormwater management basins and water quality swales will be removed at least twice annually or more frequently as needed. Excess sediment (greater than six inches thick) that accumulates in the forebays will be removed annually or more frequently as needed. A complete stormwater management system operation and maintenance plan will be developed for the owner prior to construction.

1.13 Consistency with Massachusetts Stormwater Management Policy

The Massachusetts Stormwater Handbook, Volume 3 (February, 2008), has been used as the primary guidance for the selection and design of permanent non-structural and structural BMPs for the long-term protection of existing wetland and water resources. The Stormwater Management Plan developed for this project incorporates water quantity and quality controls that will protect surface and groundwater resources, wetlands and adjacent properties from potential impacts due to increased impervious areas on the site. The Stormwater Management Plan also incorporates select LID measures in accordance with the new Stormwater Management Policies.

The stormwater performance standards developed by the DEP and a brief discussion on how the proposed project will achieve the standards are provided below.

Standard 1. No new stormwater conveyances may discharge untreated stormwater directly to, or cause erosion in wetlands or waters of the Commonwealth.

- No proposed site stormwater conveyance system will discharge untreated stormwater runoff directly to wetlands. Stormwater runoff from the developed areas of the site will run overland to various Stormwater BMP's located throughout the site. Riprap pads and level spreader spillways will be installed where necessary at the point of discharge of any Stormwater BMP to eliminate potential erosive flow velocities and dissipate the energy of the discharged stormwater, thereby avoiding sedimentation to the downgradient areas.

Standard 2. **Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates.**

- The storage volume and recharge capabilities within the various Stormwater BMP's will serve to limit the peak rates of stormwater runoff at or below pre development levels for the 2-, 10-, and 100-year storm events to all of the critical analysis points. Refer to the the Appendices at the end of this Report for supporting hydrologic calculations for the most intensive development alternative.

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

- Provisions for groundwater recharge have been provided via various stromwater BMP's located throughout the site. The proposed roof area of the parking garage will be directed to subsurface roof drain recharge systems strategically located in areas of with good infiltrative capacities to provide substantial recharge in this location. The existing roadway and building footprints which will be modified as a result of this project will also be recharged within existing modified stormwater BMP's. The remote surface parking lots will also be treated by bioretention areas and subsurface storage areas which will also provide recharge. The provided stormwater BMP's will provide enough recharge volume to account for this project's proposed impervious areas. Recharge volume calculations for the project are submitted in the technical appendices.

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

a) Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
b) Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and
c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

- The 80 percent TSS removal rate will be achieved will the implementation of deep sump/hooded catch basins, sediment forebay, extended detention basins, extended detention wetland system, bioretention swales, and water quality swales. The aggregate total of both structural and non-structural BMPs will meet or exceed the target 80% removal rate. Detailed conceptual TSS removal calculations are submitted in an Appendix at the back of this Conceptual Plan.

Standard 5. **For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff**

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

- The parking areas and roadway areas of the proposed development would be considered land uses with higher potential pollutant loads. The stormwater management facilities associated with these areas will incorporate the necessary stormwater BMP's to comply with this Standard including, but not limited to deep sump catch basins, bioretention swales, water quality swales, and extended detention wetlands. Proper pretreatment of the runoff from these areas will be provided prior to discharge to any infiltration BMP's. A unit water quality volume of 1" has been used in calculating the required water quality volumes for the project. Detailed water quality volume calculations are provided in the the Appendices at the back of this Conceptual Plan.

Standard 6. **Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.**

- The project does not discharge stormwater to any designated critical areas as defined in the Massachusetts Stormwater Handbook.

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

- Portions of the proposed development south of the railroad tracks (Phase I) would be considered redevelopment as those portions consist of the reconstruction of an existing industrial park development. These areas were constructed after 2007 and fully complied with the Massachusetts Stormwater Management Policy at the time of their approvals. The proposed development will represent an improvement from existing conditions as the existing stormwater management system will be enhanced with design modifications including the creation of a large extended detention wetland system in the area of the existing detention basin currently servicing the Maggiore 1 and Maggiore 2 buildings.

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

- The proposed development will incorporate erosion and sedimentation controls to minimize the potential for sedimentation in down gradient resources. These controls will include hay bales/silt fence barriers, and slope stabilization measures such as hay/straw blankets and jute matting. The proponent will be required to complete a Stormwater Pollution Prevention Plan in accordance with the NPDES General Permit for Stormwater Discharges associated with Construction Projects and this SWPPP will also be used as the plan to meet this standard.

Standard 9. A Long -Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

- The Stormwater Management Plan for this project has been developed in full compliance with the MADEP Stormwater Management Policy. The Plan is based on a multi-dimensional approach to stormwater management that recognizes the need for proper site planning, source control of potential contaminants, and implementation of structural and non-structural treatment methods to ensure the protection of water resources in the vicinity of the site and adjacent properties. The Stormwater Operation and Maintenance Plan will be provided on the construction drawings and in document form to the regulatory authorities prior to construction.

Standard 10. Illicit Discharges to the Stormwater Management System are prohibited.

- The proposed stormwater management system BMP's to service the project will be designed to eliminate and sources of illicit discharge to the system. An Illicit Discharge Compliance Statement will be completed by the applicant and submitted to the regulatory authorities prior to construction.

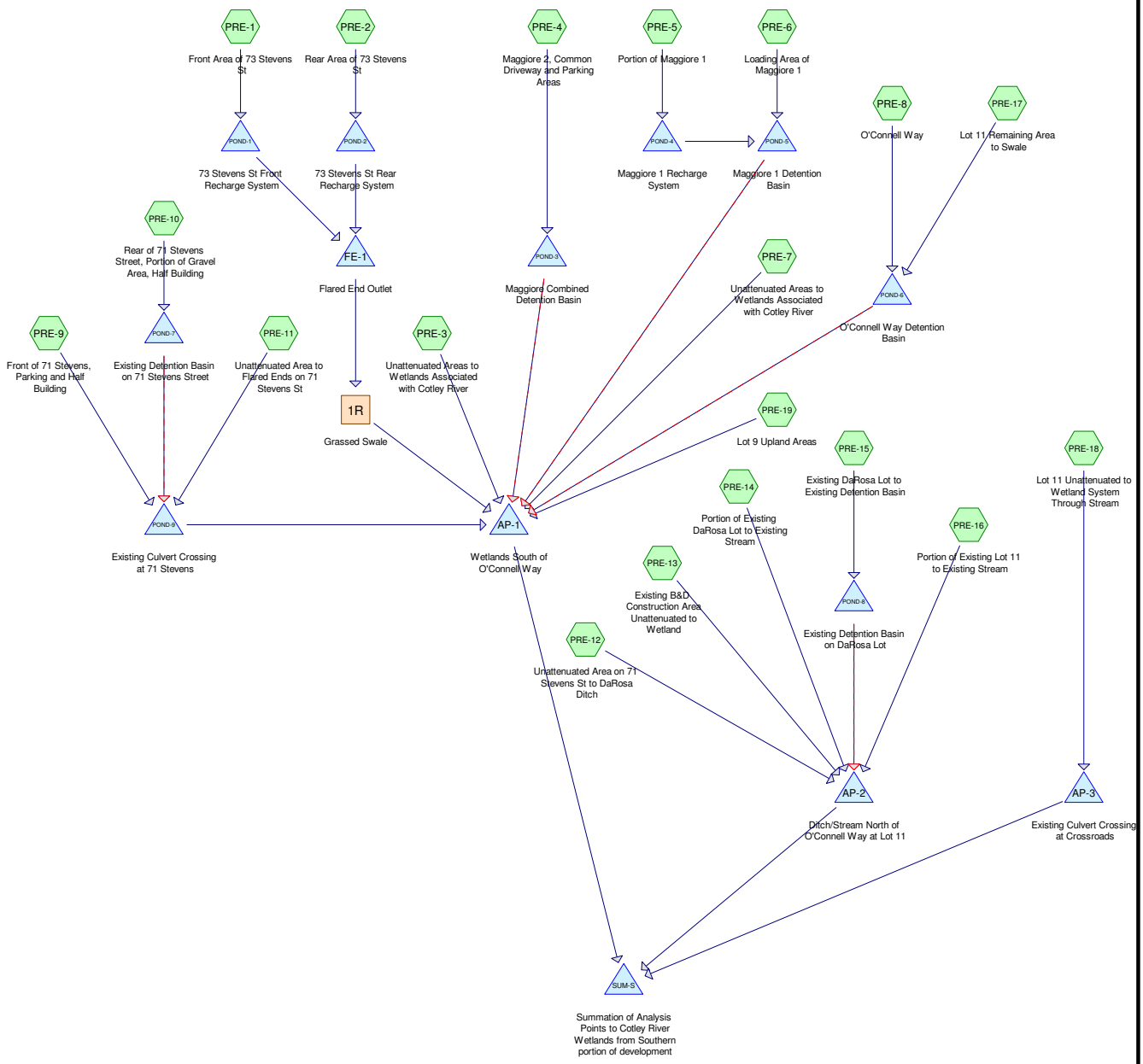
1.13 Conclusion

The protection of surface water and off-site areas in the vicinity of the site is the primary objective in the development of the stormwater management program. The Stormwater Management Plan for this project has been developed in full compliance with the MADEP Stormwater Management Policy. The Plan is based on a multi-dimensional approach to stormwater management that recognizes the need for proper site planning, source control of potential contaminants, and implementation of structural and non-structural treatment methods to ensure the protection of water resources in the vicinity of the site and adjacent properties. Low Impact Development measures will be implemented where feasible to supplement the existing stormwater BMPs currently services the proposed development site.

The specific structural BMPs designated for this project will serve to maintain the peak rates of runoff up to the 100-year storm event, at or below pre-development levels at all subject analysis points. Therefore adequate attenuation has been provided within the on-site stormwater management system to handle the increaed impervious areas associated with the development prior to discharge to the bordering vegetated wetlands associated with the Cotley River (and Barstow Pond complex). The implementation of other long-term water quality controls (deep sump/hooded catch basins, pavement sweeping, catch basin maintenance, and restrictions on deicing agents) will further ensure the protection of water resources in the area.

Section 2

Pre Development Hydrologic Analysis
LIT Site-South Parcel



Subcat Reach Pond Link

Routing Diagram for 1905-Pre-Development-LIT Site-South-FEIS
Prepared by Field Engineering Co. Inc., Printed 4/10/2014
HydroCAD® 10.00 s/n 01897 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.952	39	>75% Grass cover, Good, HSG A (PRE-10, PRE-12, PRE-13, PRE-17, PRE-7, PRE-8, PRE-9)
4.758	61	>75% Grass cover, Good, HSG B (PRE-17, PRE-18, PRE-3, PRE-7, PRE-8)
12.359	74	>75% Grass cover, Good, HSG C (PRE-1, PRE-10, PRE-11, PRE-12, PRE-13, PRE-14, PRE-15, PRE-2, PRE-3, PRE-4, PRE-6, PRE-8, PRE-9)
0.993	80	>75% Grass cover, Good, HSG D (PRE-14, PRE-16, PRE-17, PRE-18, PRE-3, PRE-7, PRE-8)
0.134	76	Gravel roads, HSG A (PRE-10)
1.875	89	Gravel roads, HSG C (PRE-10, PRE-11, PRE-13, PRE-4)
0.897	30	Meadow, non-grazed, HSG A (PRE-19)
2.222	71	Meadow, non-grazed, HSG C (PRE-19)
0.109	78	Meadow, non-grazed, HSG D (PRE-19)
0.944	98	Paved Areas (PRE-10)
0.867	98	Paved Parking and New Driveway/Sidewalks (PRE-9)
15.857	98	Paved parking & roofs (PRE-1, PRE-11, PRE-12, PRE-13, PRE-14, PRE-2, PRE-4, PRE-5, PRE-6, PRE-8)
0.433	98	Roof (PRE-10)
1.443	98	Water Surface (PRE-10, PRE-4, PRE-6, PRE-8)
0.725	30	Woods, Good, HSG A (PRE-10, PRE-12, PRE-19, PRE-7)
1.263	55	Woods, Good, HSG B (PRE-17, PRE-18, PRE-3, PRE-7)
5.540	70	Woods, Good, HSG C (PRE-14, PRE-15, PRE-19, PRE-3)
0.737	77	Woods, Good, HSG D (PRE-17, PRE-18, PRE-19, PRE-3, PRE-7)
53.109	**79**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PRE-1: Front Area of 73 Runoff Area=29,061 sf 67.72% Impervious Runoff Depth=2.45"
Flow Length=85' Tc=10.5 min CN=90 Runoff=1.62 cfs 0.136 af

Subcatchment PRE-10: Rear of 71 Runoff Area=125,958 sf 50.18% Impervious Runoff Depth=1.71"
Flow Length=335' Tc=7.9 min CN=81 Runoff=5.39 cfs 0.412 af

Subcatchment PRE-11: Unattenuated Area Runoff Area=41,813 sf 3.98% Impervious Runoff Depth=1.37"
Flow Length=395' Tc=8.7 min CN=76 Runoff=1.36 cfs 0.109 af

Subcatchment PRE-12: Unattenuated Area Runoff Area=80,250 sf 5.95% Impervious Runoff Depth=1.12"
Flow Length=410' Tc=8.6 min CN=72 Runoff=2.08 cfs 0.172 af

Subcatchment PRE-13: Existing B&D Runoff Area=118,483 sf 47.33% Impervious Runoff Depth=1.64"
Flow Length=700' Tc=6.0 min CN=80 Runoff=5.18 cfs 0.371 af

Subcatchment PRE-14: Portion of Existing Runoff Area=56,946 sf 16.24% Impervious Runoff Depth=1.50"
Flow Length=630' Tc=6.5 min CN=78 Runoff=2.22 cfs 0.163 af

Subcatchment PRE-15: Existing DaRosa Runoff Area=19,680 sf 0.00% Impervious Runoff Depth=1.24"
Flow Length=215' Tc=8.7 min CN=74 Runoff=0.57 cfs 0.047 af

Subcatchment PRE-16: Portion of Existing Runoff Area=20,900 sf 0.00% Impervious Runoff Depth=1.64"
Flow Length=150' Tc=8.2 min CN=80 Runoff=0.85 cfs 0.065 af

Subcatchment PRE-17: Lot 11 Remaining Runoff Area=58,635 sf 0.00% Impervious Runoff Depth=0.71"
Flow Length=395' Tc=8.8 min CN=64 Runoff=0.81 cfs 0.079 af

Subcatchment PRE-18: Lot 11 Runoff Area=106,859 sf 0.00% Impervious Runoff Depth=0.62"
Flow Length=530' Tc=10.1 min CN=62 Runoff=1.14 cfs 0.126 af

Subcatchment PRE-19: Lot 9 Upland Areas Runoff Area=184,240 sf 0.00% Impervious Runoff Depth=0.49"
Flow Length=540' Tc=14.5 min CN=59 Runoff=1.19 cfs 0.173 af

Subcatchment PRE-2: Rear Area of 73 Runoff Area=19,260 sf 75.97% Impervious Runoff Depth=2.64"
Flow Length=70' Tc=7.1 min CN=92 Runoff=1.28 cfs 0.097 af

Subcatchment PRE-3: Unattenuated Areas Runoff Area=470,600 sf 0.00% Impervious Runoff Depth=1.01"
Flow Length=440' Tc=10.1 min CN=70 Runoff=10.17 cfs 0.908 af

Subcatchment PRE-4: Maggiore 2, Runoff Area=498,594 sf 73.64% Impervious Runoff Depth=2.73"
Flow Length=1,320' Tc=9.5 min CN=93 Runoff=31.41 cfs 2.609 af

Subcatchment PRE-5: Portion of Runoff Area=53,288 sf 100.00% Impervious Runoff Depth=3.27"
Tc=6.0 min CN=98 Runoff=4.16 cfs 0.333 af

Subcatchment PRE-6: Loading Area of Runoff Area=96,485 sf 89.73% Impervious Runoff Depth=3.05"
Flow Length=975' Tc=6.0 min CN=96 Runoff=7.31 cfs 0.562 af

Subcatchment PRE-7: Unattenuated Areas Runoff Area=52,366 sf 0.00% Impervious Runoff Depth=0.31"
Flow Length=45' Slope=0.0560 '/' Tc=7.2 min CN=54 Runoff=0.17 cfs 0.031 af

Subcatchment PRE-8: O'Connell Way Runoff Area=215,174 sf 63.77% Impervious Runoff Depth=2.10"
Flow Length=2,195' Tc=13.1 min CN=86 Runoff=9.67 cfs 0.864 af

Subcatchment PRE-9: Front of 71 Stevens, Runoff Area=64,847 sf 58.27% Impervious Runoff Depth=1.71"
Flow Length=190' Tc=6.5 min CN=81 Runoff=2.92 cfs 0.212 af

Reach 1R: Grassed Swale Avg. Flow Depth=0.07' Max Vel=1.08 fps Inflow=0.22 cfs 0.071 af
n=0.030 L=540.0' S=0.0185 '/' Capacity=104.91 cfs Outflow=0.22 cfs 0.071 af

Pond AP-1: Wetlands South of O'Connell Way Inflow=26.80 cfs 5.912 af
Primary=26.80 cfs 5.912 af

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11 Inflow=10.17 cfs 0.772 af
Primary=10.17 cfs 0.772 af

Pond AP-3: Existing Culvert Crossing at Crossroads Inflow=1.14 cfs 0.126 af
Primary=1.14 cfs 0.126 af

Pond FE-1: Flared End Outlet Inflow=0.22 cfs 0.071 af
Primary=0.22 cfs 0.071 af

Pond POND-1: 73 Stevens St Front Recharge Peak Elev=58.11' Storage=3,557 cf Inflow=1.62 cfs 0.136 af
Discarded=0.03 cfs 0.074 af Primary=0.12 cfs 0.037 af Outflow=0.14 cfs 0.111 af

Pond POND-2: 73 Stevens St Rear Recharge Peak Elev=56.48' Storage=2,272 cf Inflow=1.28 cfs 0.097 af
Discarded=0.02 cfs 0.063 af Primary=0.11 cfs 0.034 af Outflow=0.13 cfs 0.097 af

Pond POND-3: Maggiore Combined Peak Elev=32.60' Storage=41,772 cf Inflow=31.41 cfs 2.609 af
Primary=8.84 cfs 2.604 af Secondary=0.00 cfs 0.000 af Outflow=8.84 cfs 2.604 af

Pond POND-4: Maggiore 1 Recharge System Peak Elev=43.91' Storage=7,128 cf Inflow=4.16 cfs 0.333 af
Discarded=0.21 cfs 0.333 af Primary=0.00 cfs 0.000 af Outflow=0.21 cfs 0.333 af

Pond POND-5: Maggiore 1 Detention Basin Peak Elev=40.37' Storage=8,589 cf Inflow=7.31 cfs 0.562 af
Primary=3.43 cfs 0.553 af Secondary=0.00 cfs 0.000 af Outflow=3.43 cfs 0.553 af

Pond POND-6: O'Connell Way Detention Peak Elev=22.74' Storage=18,552 cf Inflow=10.44 cfs 0.943 af
Primary=2.73 cfs 0.839 af Secondary=0.00 cfs 0.000 af Outflow=2.73 cfs 0.839 af

Pond POND-7: Existing Detention Basin on Peak Elev=54.97' Storage=3,681 cf Inflow=5.39 cfs 0.412 af
Primary=2.67 cfs 0.412 af Secondary=0.00 cfs 0.000 af Outflow=2.67 cfs 0.412 af

Pond POND-8: Existing Detention Basin on Peak Elev=42.85' Storage=2,033 cf Inflow=0.57 cfs 0.047 af
Outflow=0.00 cfs 0.000 af

Pond POND-9: Existing Culvert Crossing at 71 Peak Elev=46.98' Storage=464 cf Inflow=6.12 cfs 0.733 af
18.0" Round Culvert x 2.00 n=0.013 L=75.0' S=0.0040 '/' Outflow=6.03 cfs 0.733 af

Pond SUM-S: Summation of Analysis Points to Cotley River Wetlands from Inflow=36.31 cfs 6.809 af
Primary=36.31 cfs 6.809 af

Total Runoff Area = 53.109 ac Runoff Volume = 7.469 af Average Runoff Depth = 1.69"
63.20% Pervious = 33.565 ac 36.80% Impervious = 19.544 ac

Summary for Subcatchment PRE-1: Front Area of 73 Stevens St

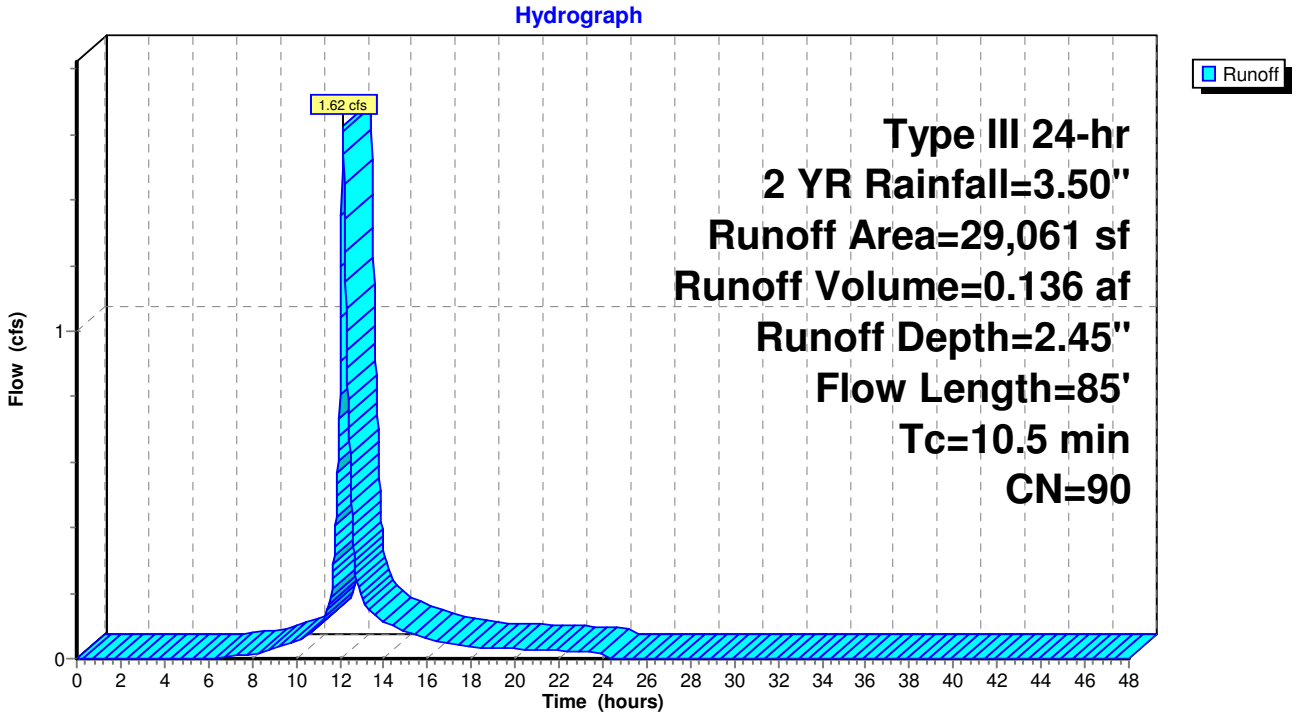
Runoff = 1.62 cfs @ 12.14 hrs, Volume= 0.136 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
19,681	98	Paved parking & roofs
9,380	74	>75% Grass cover, Good, HSG C
29,061	90	Weighted Average
9,380		32.28% Pervious Area
19,681		67.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	50	0.0100	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.2	35	0.0500	3.60		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
10.5	85	Total			

Subcatchment PRE-1: Front Area of 73 Stevens St



Summary for Subcatchment PRE-10: Rear of 71 Stevens Street, Portion of Gravel Area, Half Building

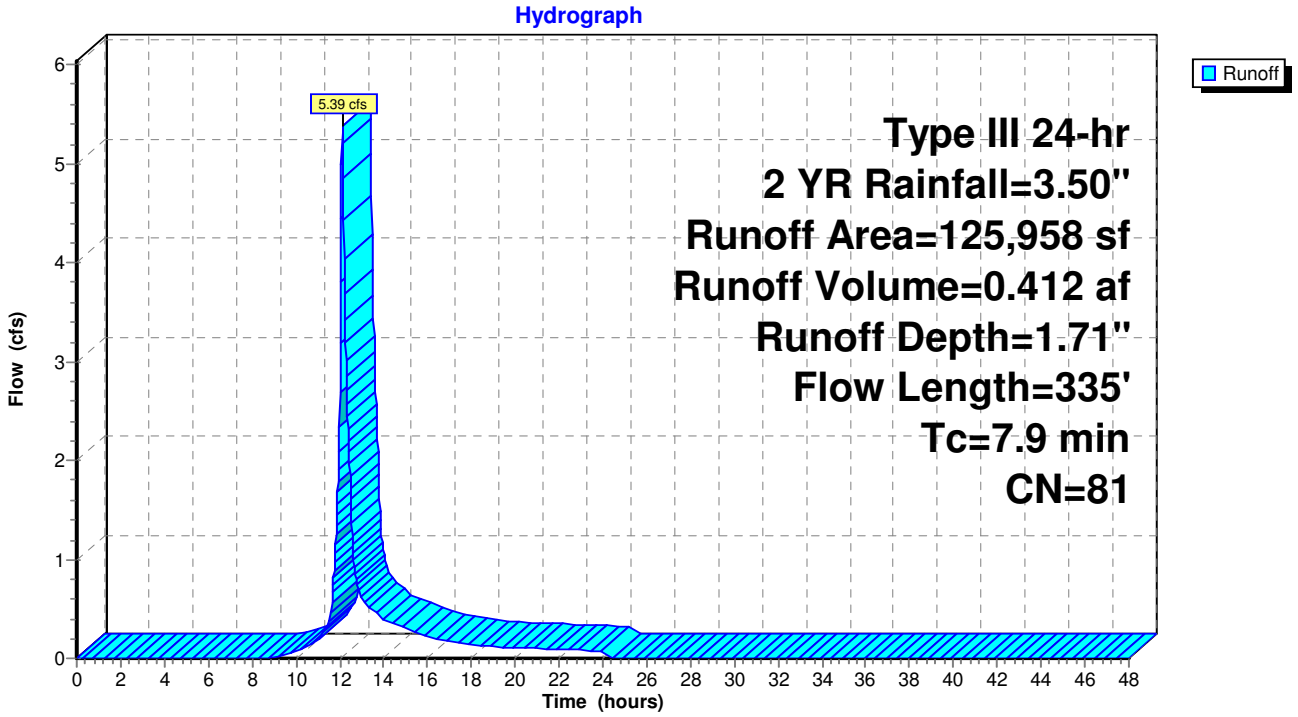
Runoff = 5.39 cfs @ 12.12 hrs, Volume= 0.412 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

	Area (sf)	CN	Description
*	41,109	98	Paved Areas
*	18,846	98	Roof
	5,844	76	Gravel roads, HSG A
	14,995	89	Gravel roads, HSG C
	3,257	98	Water Surface
	19,672	39	>75% Grass cover, Good, HSG A
	18,619	74	>75% Grass cover, Good, HSG C
	3,616	30	Woods, Good, HSG A
	125,958	81	Weighted Average
	62,746		49.82% Pervious Area
	63,212		50.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0110	0.14		**Sheet Flow, 50' down slope (A-B)** Range n= 0.130 P2= 3.50"
1.3	135	0.0110	1.69		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	35	0.0700	4.26		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.4	115	0.0090	4.30	3.38	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
7.9	335	Total			

Subcatchment PRE-10: Rear of 71 Stevens Street, Portion of Gravel Area, Half Building



Summary for Subcatchment PRE-11: Unattenuated Area to Flared Ends on 71 Stevens St

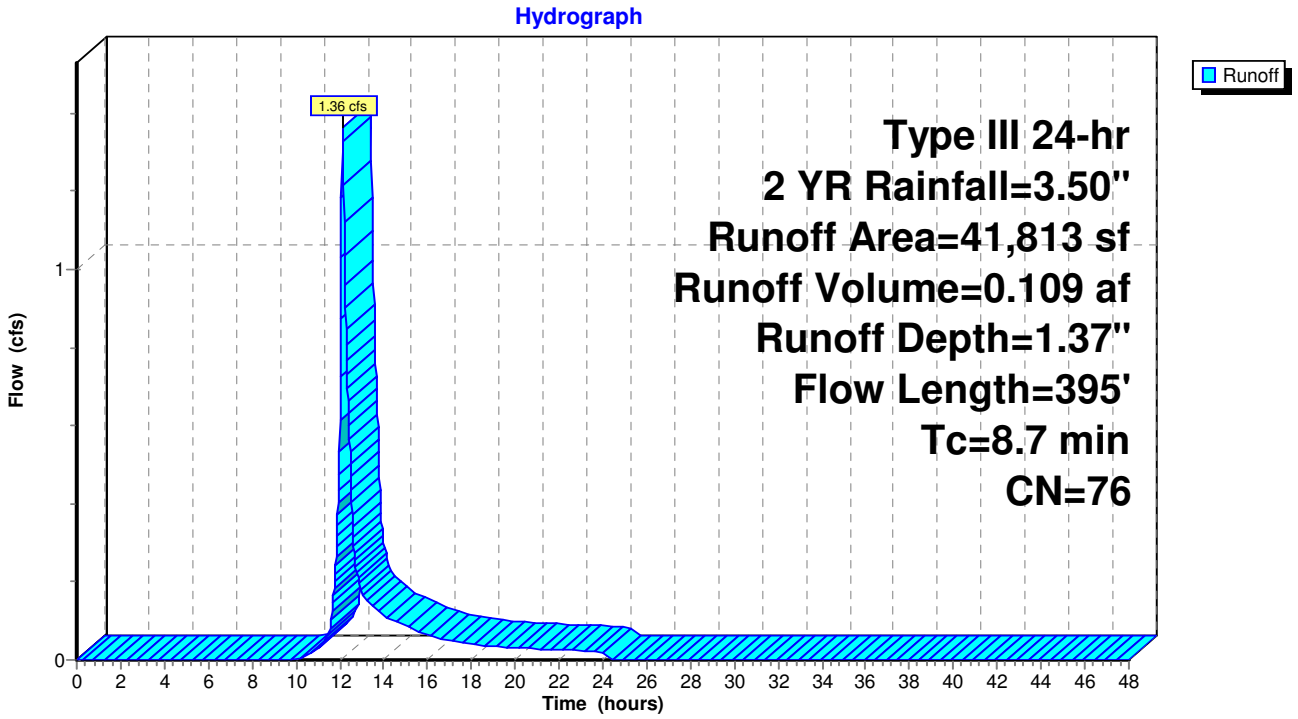
Runoff = 1.36 cfs @ 12.13 hrs, Volume= 0.109 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
1,665	98	Paved parking & roofs
2,206	89	Gravel roads, HSG C
37,942	74	>75% Grass cover, Good, HSG C
41,813	76	Weighted Average
40,148		96.02% Pervious Area
1,665		3.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0110	0.14		**Sheet Flow, A-B** Range n= 0.130 P2= 3.50"
0.5	55	0.0110	1.69		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
2.1	290	0.0210	2.33		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
8.7	395	Total			

Subcatchment PRE-11: Unattenuated Area to Flared Ends on 71 Stevens St



Summary for Subcatchment PRE-12: Unattenuated Area on 71 Stevens St to DaRosa Ditch

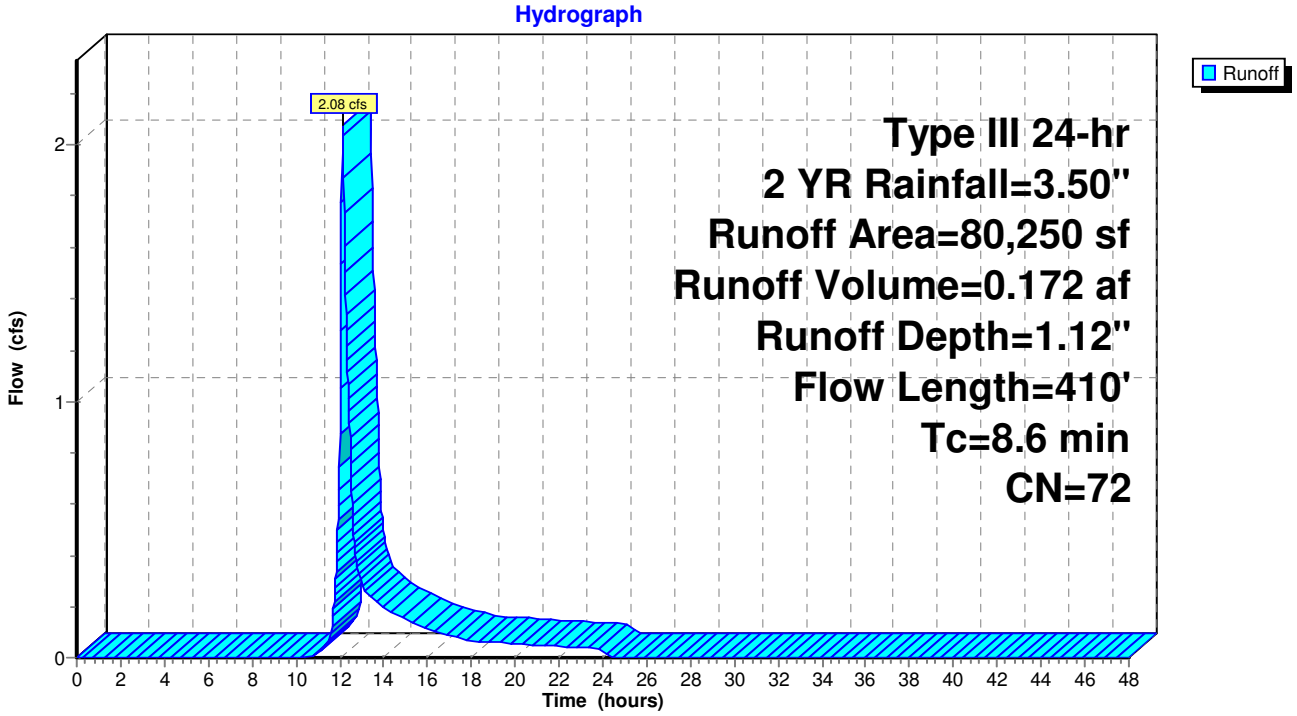
Runoff = 2.08 cfs @ 12.13 hrs, Volume= 0.172 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
4,772	98	Paved parking & roofs
6,028	39	>75% Grass cover, Good, HSG A
67,592	74	>75% Grass cover, Good, HSG C
1,858	30	Woods, Good, HSG A
80,250	72	Weighted Average
75,478		94.05% Pervious Area
4,772		5.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0110	0.14		**Sheet Flow, A-B** Range n= 0.130 P2= 3.50"
2.5	360	0.0220	2.39		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.6	410	Total			

Subcatchment PRE-12: Unattenuated Area on 71 Stevens St to DaRosa Ditch



Summary for Subcatchment PRE-13: Existing B&D Construction Area Unattenuated to Wetland

Existing B&D Construction Lot

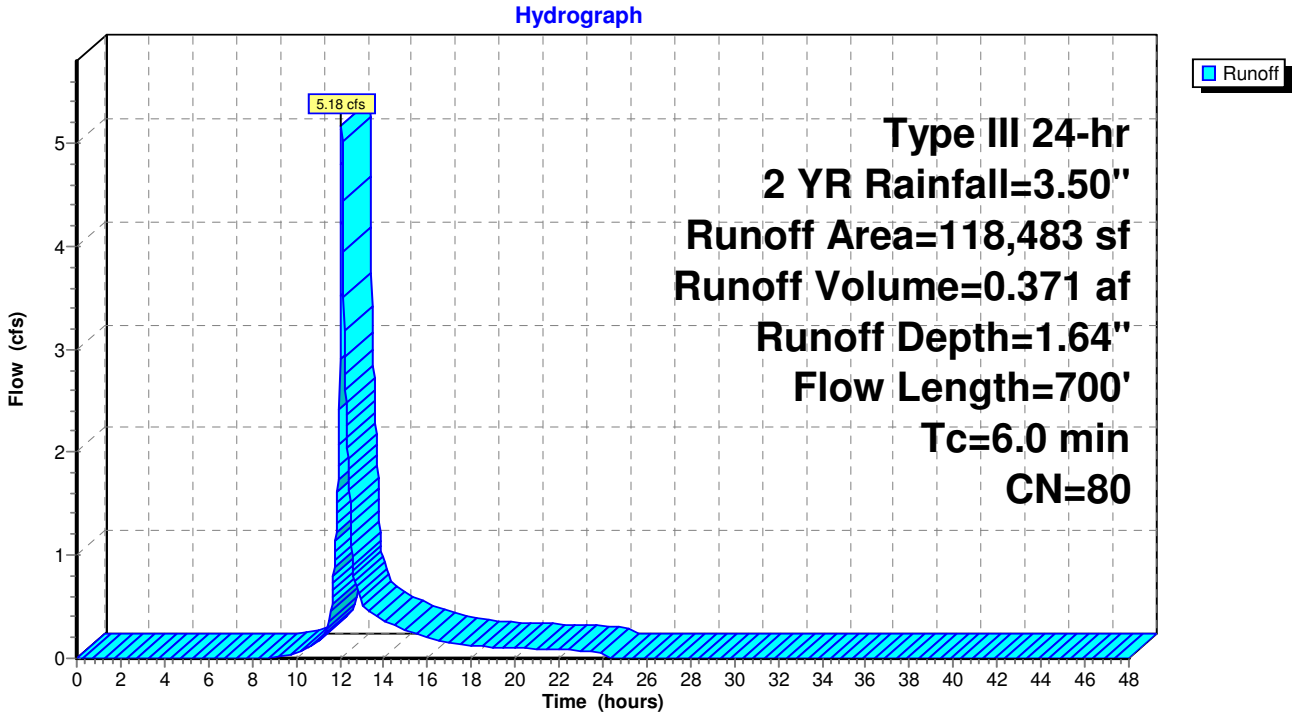
Runoff = 5.18 cfs @ 12.09 hrs, Volume= 0.371 af, Depth= 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
56,082	98	Paved parking & roofs
3,884	89	Gravel roads, HSG C
19,480	39	>75% Grass cover, Good, HSG A
39,037	74	>75% Grass cover, Good, HSG C
118,483	80	Weighted Average
62,401		52.67% Pervious Area
56,082		47.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.25		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.50"
1.3	320	0.0400	4.06		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
1.0	330	0.0100	5.36	4.21	**Pipe Channel, C-D** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
3.0	700	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PRE-13: Existing B&D Construction Area Unattenuated to Wetland



Summary for Subcatchment PRE-14: Portion of Existing DaRosa Lot to Existing Stream

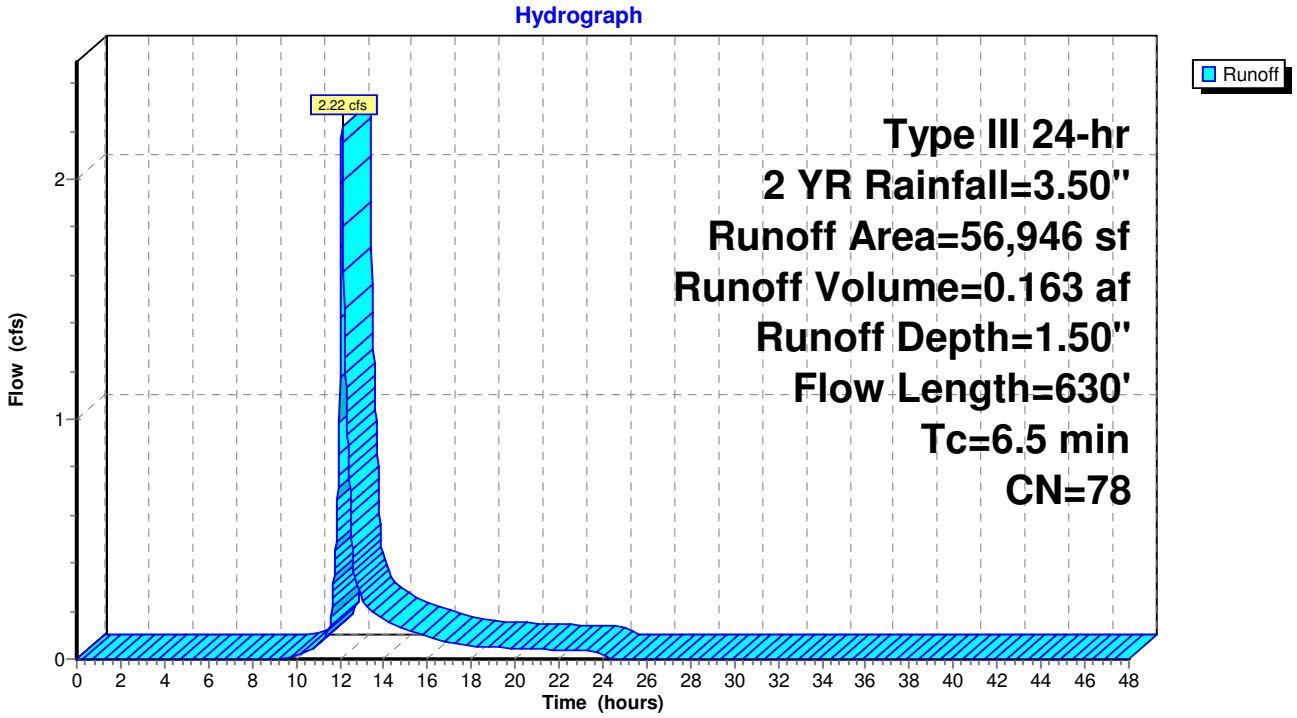
Runoff = 2.22 cfs @ 12.10 hrs, Volume= 0.163 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
9,246	98	Paved parking & roofs
45,102	74	>75% Grass cover, Good, HSG C
367	80	>75% Grass cover, Good, HSG D
2,231	70	Woods, Good, HSG C
56,946	78	Weighted Average
47,700		83.76% Pervious Area
9,246		16.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	40	0.0500	0.15		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.2	210	0.0400	3.00		**Shallow Concentrated Flow, B-C** Grassed Waterway Kv= 15.0 fps
0.8	380	0.0200	8.41	14.86	**Pipe Channel, C-D** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
6.5	630	Total			

Subcatchment PRE-14: Portion of Existing DaRosa Lot to Existing Stream



Summary for Subcatchment PRE-15: Existing DaRosa Lot to Existing Detention Basin

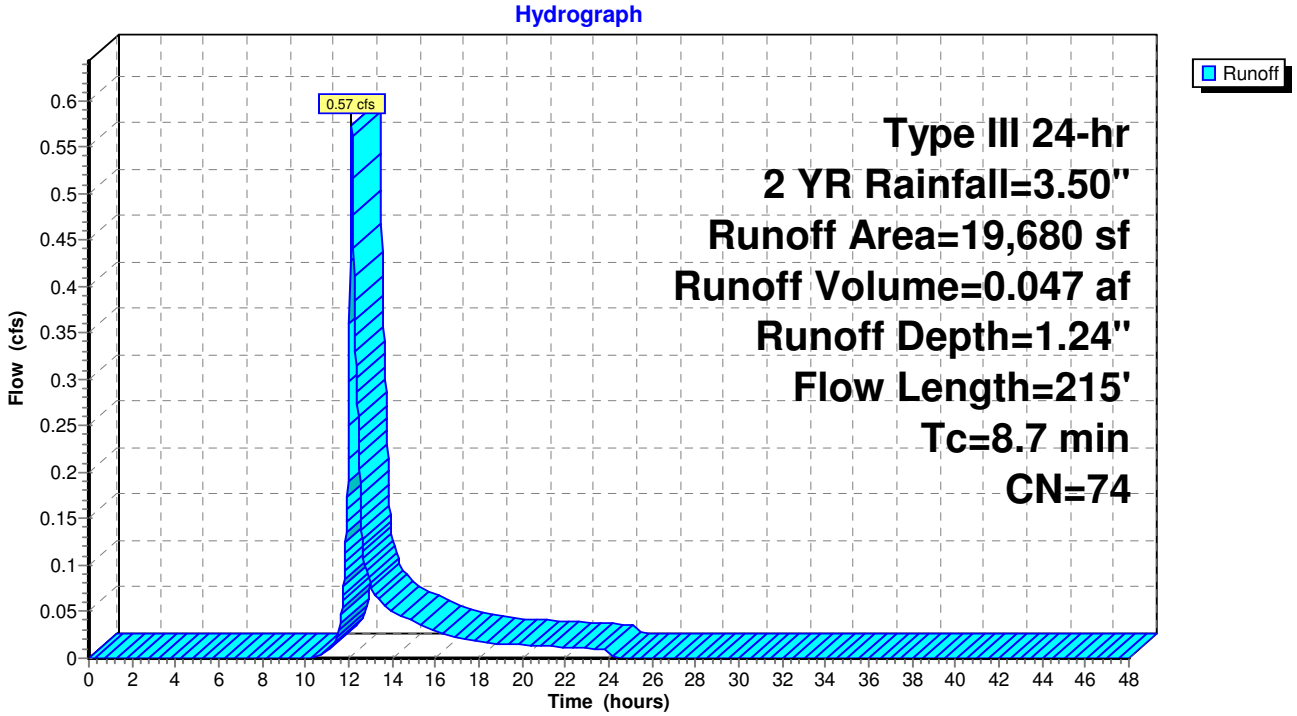
Runoff = 0.57 cfs @ 12.13 hrs, Volume= 0.047 af, Depth= 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
19,500	74	>75% Grass cover, Good, HSG C
180	70	Woods, Good, HSG C
19,680	74	Weighted Average
19,680		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.9	165	0.0390	3.18		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.7	215	Total			

Subcatchment PRE-15: Existing DaRosa Lot to Existing Detention Basin



Summary for Subcatchment PRE-16: Portion of Existing Lot 11 to Existing Stream

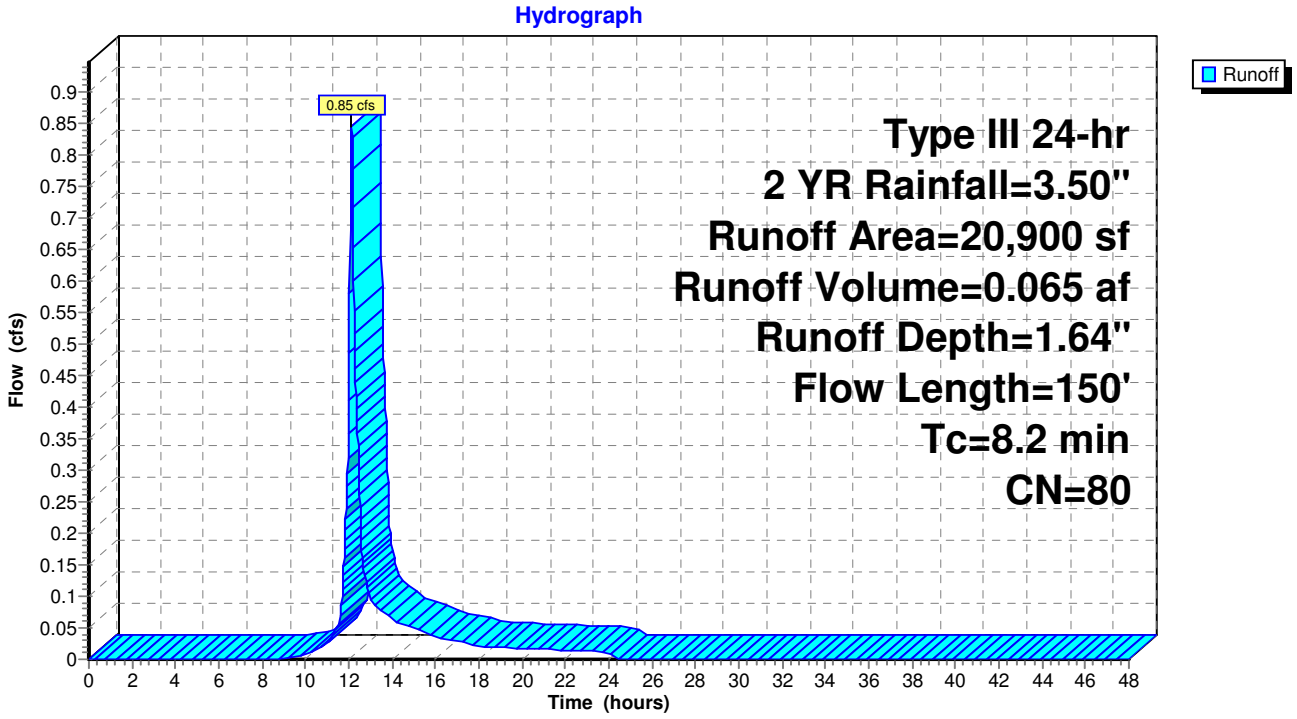
Runoff = 0.85 cfs @ 12.12 hrs, Volume= 0.065 af, Depth= 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
20,900	80	>75% Grass cover, Good, HSG D
20,900		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.4	100	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.2	150	Total			

Subcatchment PRE-16: Portion of Existing Lot 11 to Existing Stream



Summary for Subcatchment PRE-17: Lot 11 Remaining Area to Swale

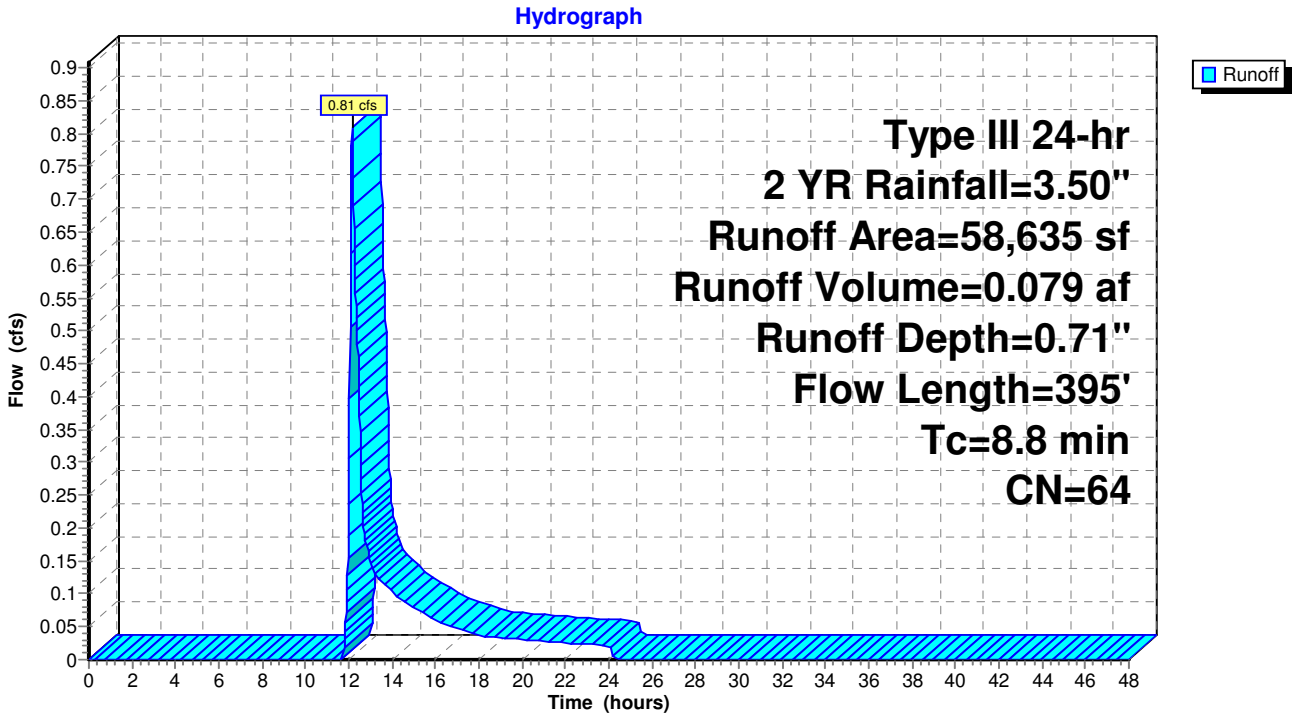
Runoff = 0.81 cfs @ 12.15 hrs, Volume= 0.079 af, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
318	39	>75% Grass cover, Good, HSG A
47,126	61	>75% Grass cover, Good, HSG B
6,212	80	>75% Grass cover, Good, HSG D
1,095	55	Woods, Good, HSG B
3,884	77	Woods, Good, HSG D
58,635	64	Weighted Average
58,635		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0300	0.13		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.2	205	0.0290	2.74		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.9	140	0.0290	2.55		**Shallow Concentrated Flow, C-D** Grassed Waterway Kv= 15.0 fps
8.8	395	Total			

Subcatchment PRE-17: Lot 11 Remaining Area to Swale



Summary for Subcatchment PRE-18: Lot 11 Unattenuated to Wetland System Through Stream

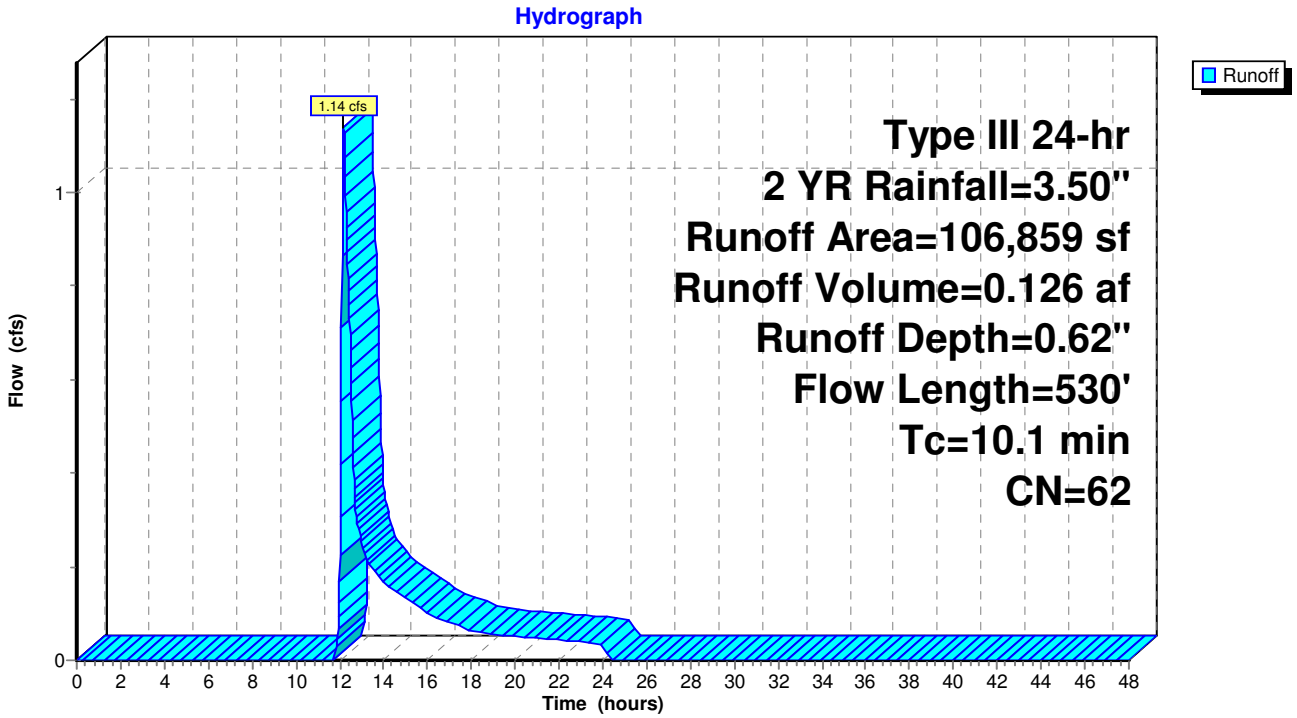
Runoff = 1.14 cfs @ 12.17 hrs, Volume= 0.126 af, Depth= 0.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
102,707	61	>75% Grass cover, Good, HSG B
3,076	80	>75% Grass cover, Good, HSG D
848	55	Woods, Good, HSG B
228	77	Woods, Good, HSG D
106,859	62	Weighted Average
106,859		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0300	0.13		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
3.4	480	0.0210	2.33		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
10.1	530	Total			

Subcatchment PRE-18: Lot 11 Unattenuated to Wetland System Through Stream



Summary for Subcatchment PRE-19: Lot 9 Upland Areas

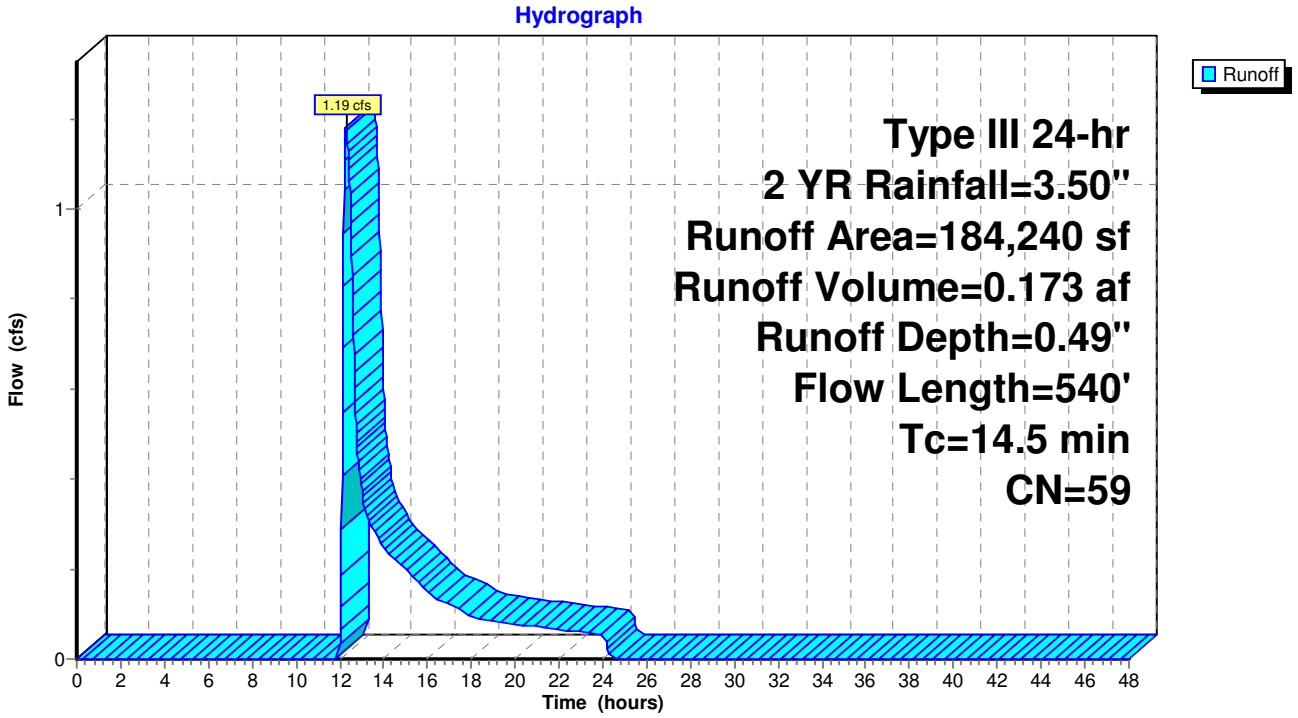
Runoff = 1.19 cfs @ 12.28 hrs, Volume= 0.173 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
39,080	30	Meadow, non-grazed, HSG A
96,780	71	Meadow, non-grazed, HSG C
4,760	78	Meadow, non-grazed, HSG D
19,930	30	Woods, Good, HSG A
3,730	70	Woods, Good, HSG C
19,960	77	Woods, Good, HSG D
184,240	59	Weighted Average
184,240		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0200	0.17		**Sheet Flow, A-B** Range n= 0.130 P2= 3.50"
7.8	365	0.0123	0.78		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
1.9	125	0.0248	1.10		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
14.5	540	Total			

Subcatchment PRE-19: Lot 9 Upland Areas



Summary for Subcatchment PRE-2: Rear Area of 73 Stevens St

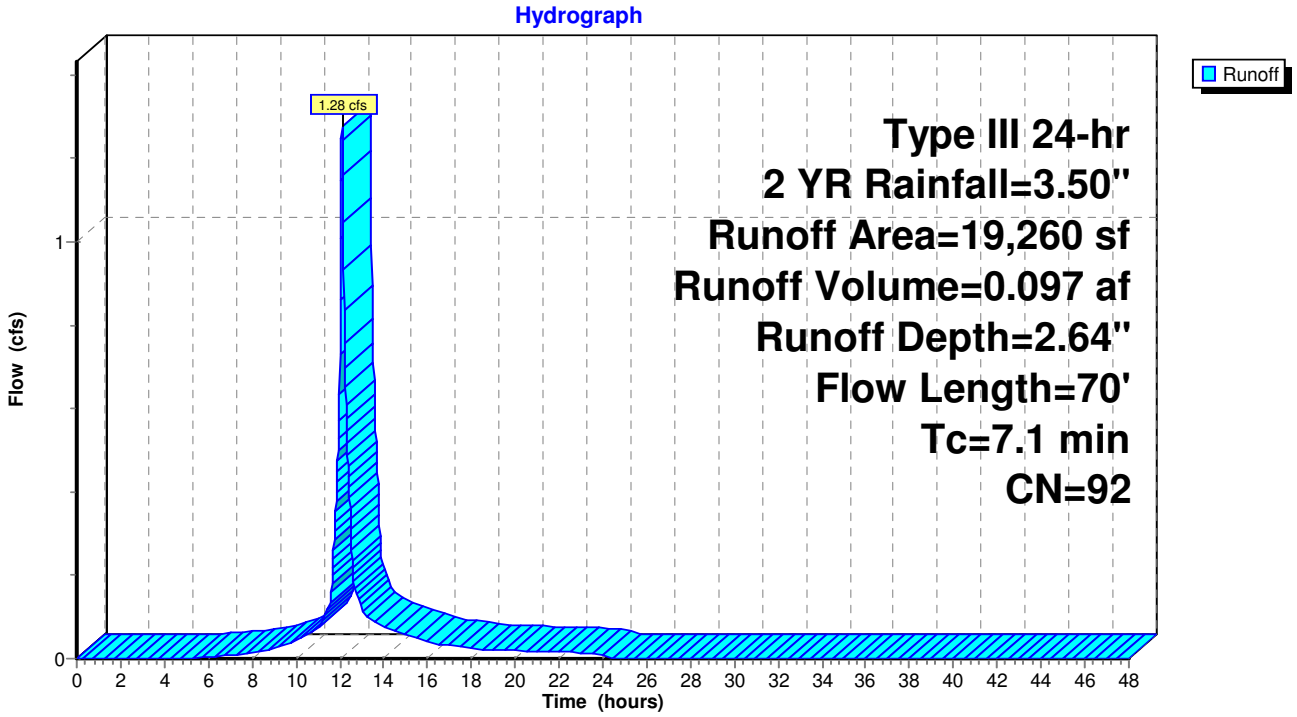
Runoff = 1.28 cfs @ 12.10 hrs, Volume= 0.097 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
14,632	98	Paved parking & roofs
4,628	74	>75% Grass cover, Good, HSG C
19,260	92	Weighted Average
4,628		24.03% Pervious Area
14,632		75.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	20	0.0050	0.05		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.5	50	0.0080	1.82		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
7.1	70	Total			

Subcatchment PRE-2: Rear Area of 73 Stevens St



Summary for Subcatchment PRE-3: Unattenuated Areas to Wetlands Associated with Cotley River

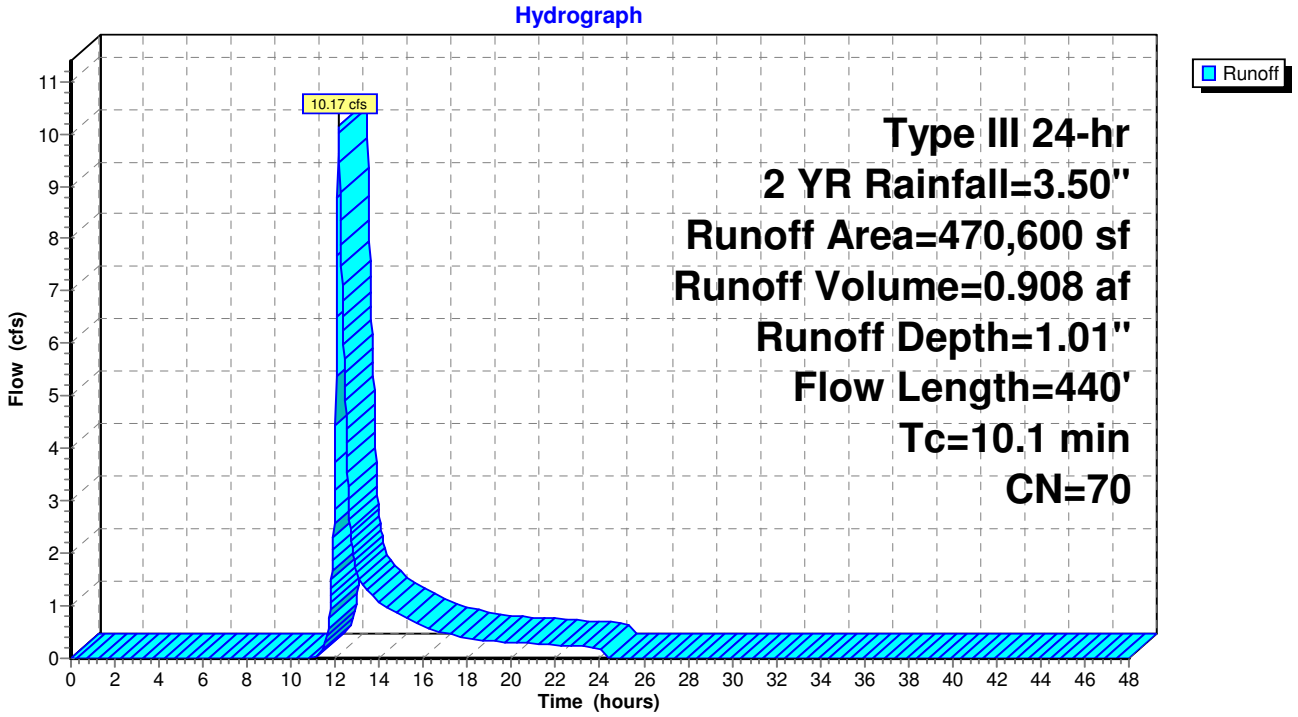
Runoff = 10.17 cfs @ 12.15 hrs, Volume= 0.908 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
13,744	61	>75% Grass cover, Good, HSG B
167,771	74	>75% Grass cover, Good, HSG C
472	80	>75% Grass cover, Good, HSG D
52,648	55	Woods, Good, HSG B
235,170	70	Woods, Good, HSG C
795	77	Woods, Good, HSG D
470,600	70	Weighted Average
470,600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.3	80	0.0560	3.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	60	0.1800	6.83		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
1.9	250	0.0190	2.22		**Shallow Concentrated Flow, D-E** Unpaved Kv= 16.1 fps
10.1	440	Total			

Subcatchment PRE-3: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment PRE-4: Maggiore 2, Common Driveway and Parking Areas

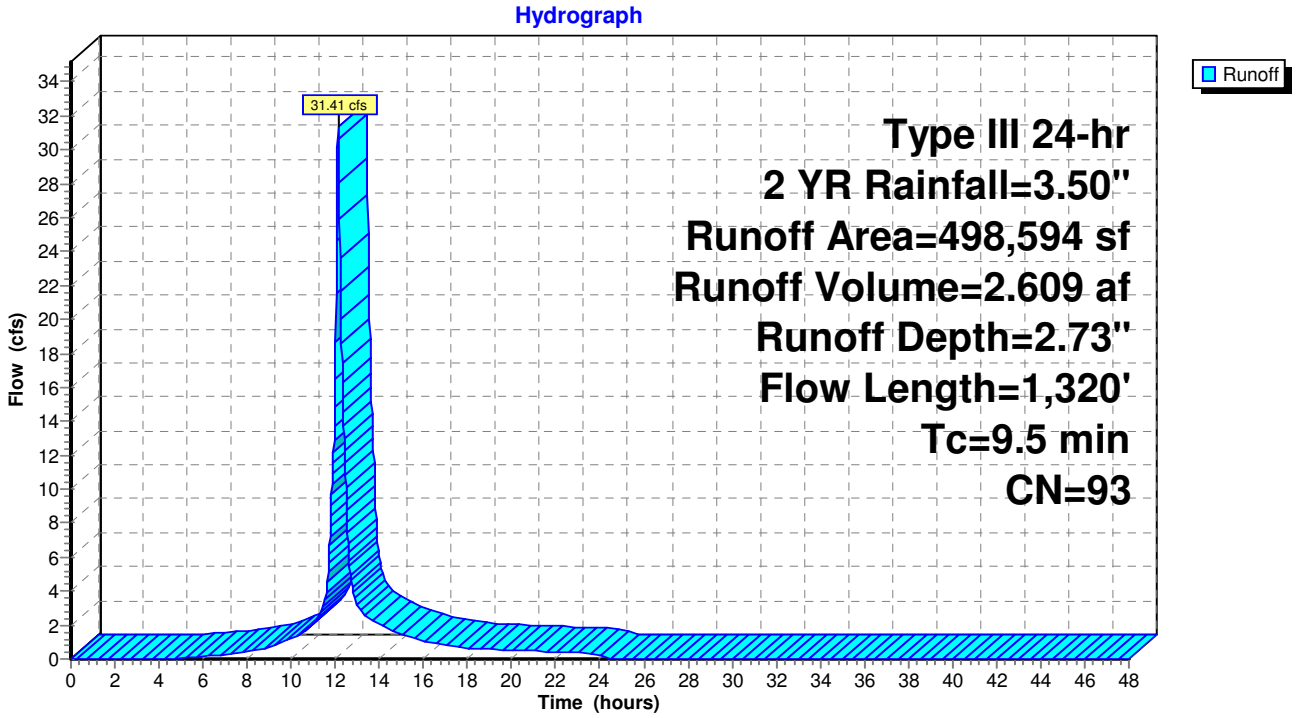
Runoff = 31.41 cfs @ 12.13 hrs, Volume= 2.609 af, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
341,295	98	Paved parking & roofs
60,601	89	Gravel roads, HSG C
25,888	98	Water Surface
70,810	74	>75% Grass cover, Good, HSG C
498,594	93	Weighted Average
131,411		26.36% Pervious Area
367,183		73.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0400	0.14		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.6	270	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
2.0	1,000	0.0100	8.36	41.02	**Pipe Channel, C-D** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013 Concrete pipe, bends & connections
9.5	1,320	Total			

Subcatchment PRE-4: Maggiore 2, Common Driveway and Parking Areas



Summary for Subcatchment PRE-5: Portion of Maggiore 1

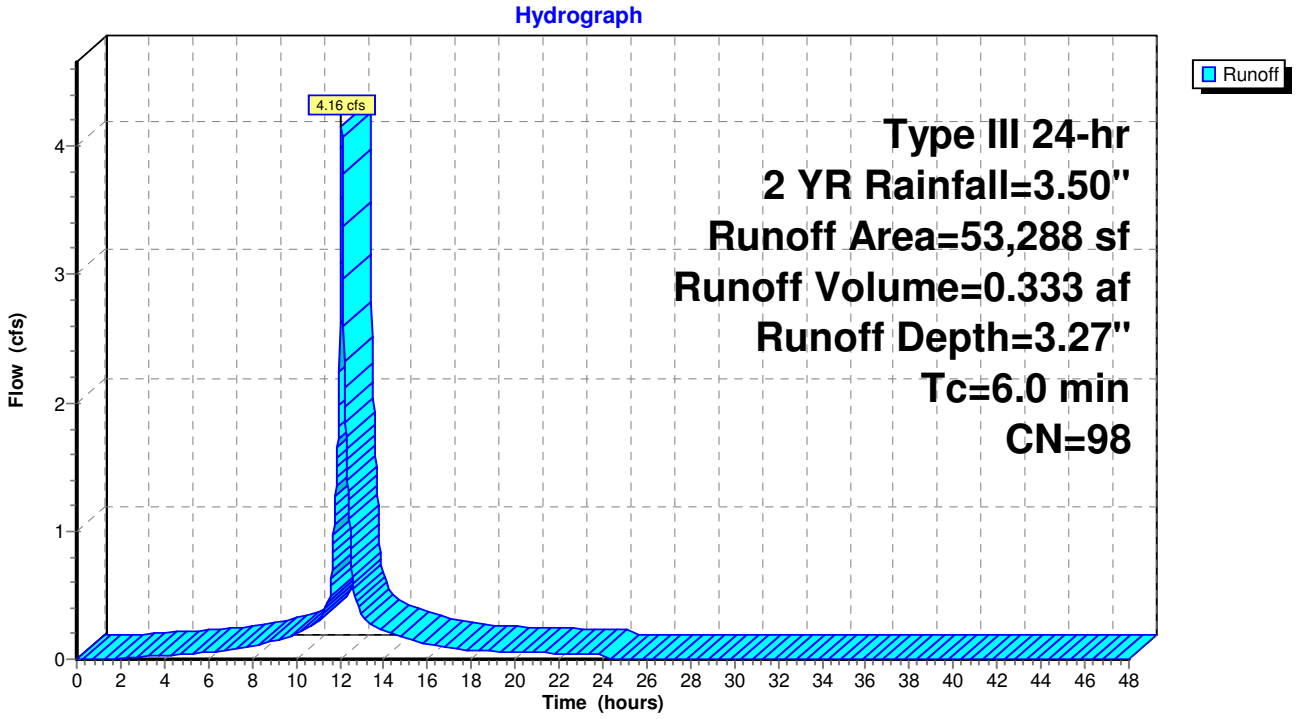
Runoff = 4.16 cfs @ 12.08 hrs, Volume= 0.333 af, Depth= 3.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
53,288	98	Paved parking & roofs
53,288		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PRE-5: Portion of Maggiore 1



Summary for Subcatchment PRE-6: Loading Area of Maggiore 1

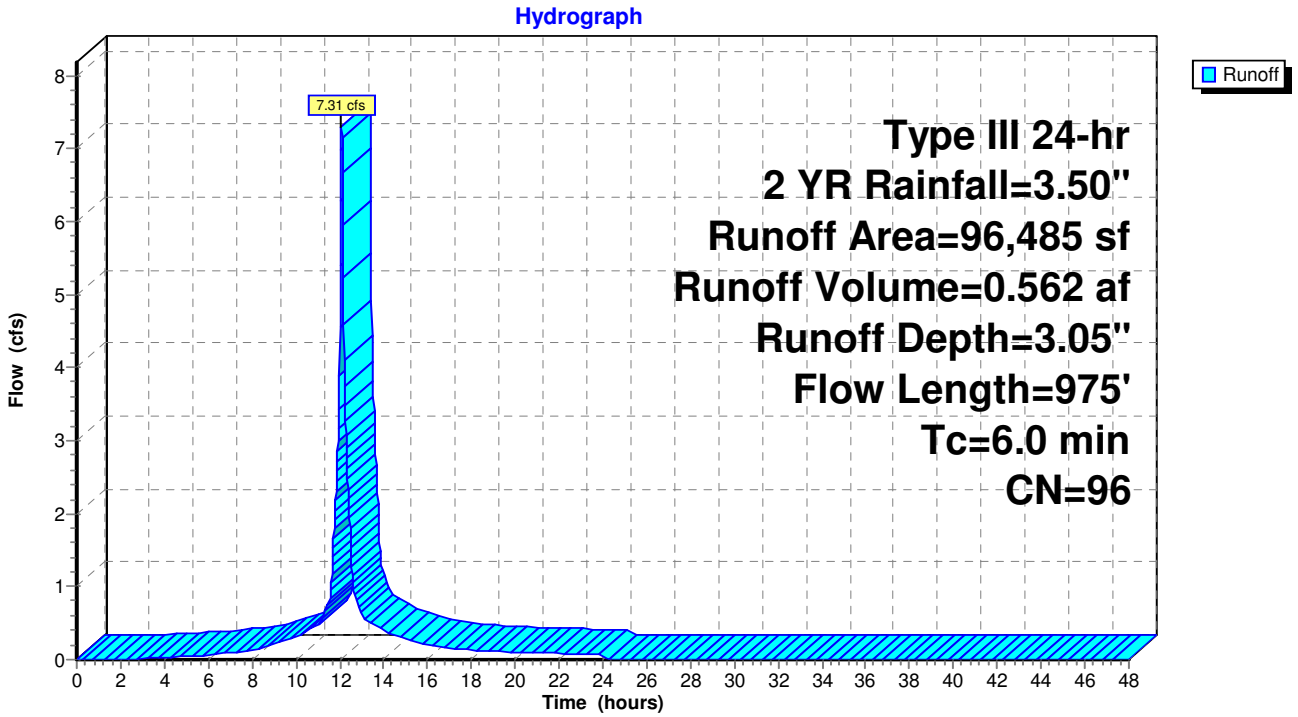
Runoff = 7.31 cfs @ 12.08 hrs, Volume= 0.562 af, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
79,890	98	Paved parking & roofs
6,682	98	Water Surface
9,913	74	>75% Grass cover, Good, HSG C
96,485	96	Weighted Average
9,913		10.27% Pervious Area
86,572		89.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.25		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.50"
2.0	300	0.0150	2.49		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
1.9	625	0.0060	5.44	9.62	**Pipe Channel, C-D** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
4.6	975	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PRE-6: Loading Area of Maggiore 1



Summary for Subcatchment PRE-7: Unattenuated Areas to Wetlands Associated with Cotley River

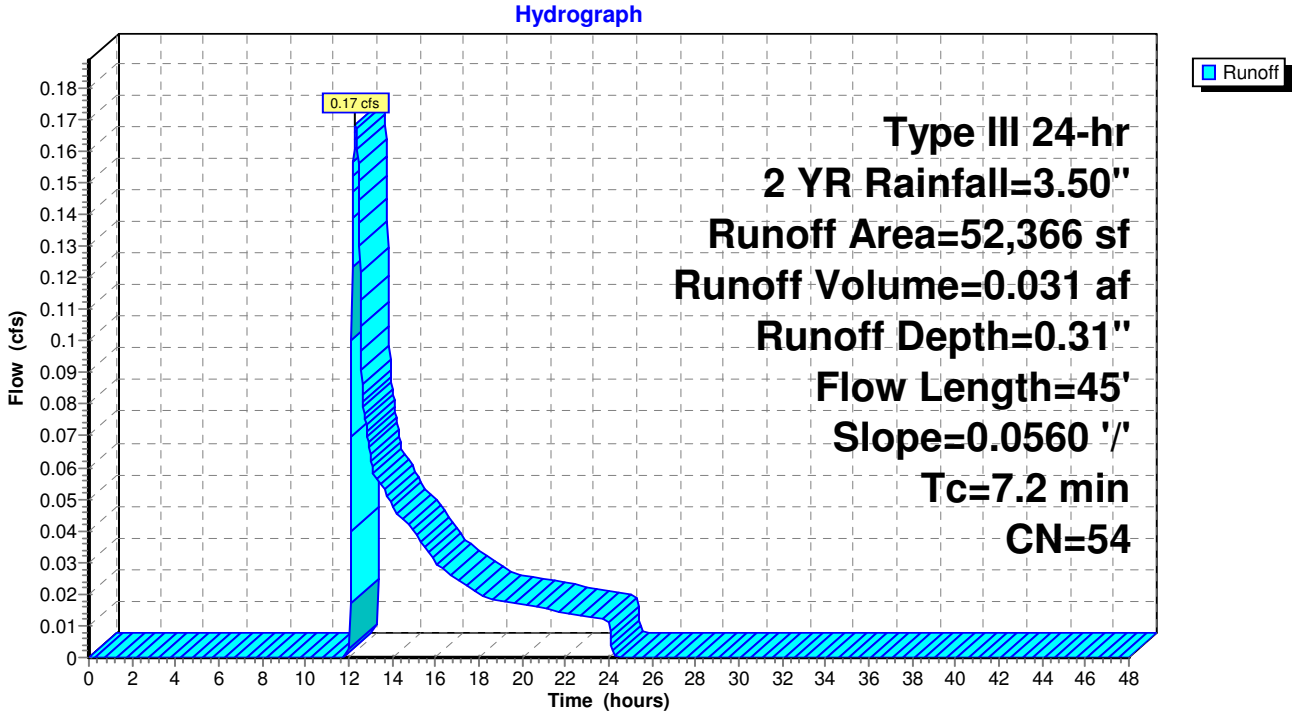
Runoff = 0.17 cfs @ 12.32 hrs, Volume= 0.031 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
18,717	39	>75% Grass cover, Good, HSG A
11,926	61	>75% Grass cover, Good, HSG B
7,879	80	>75% Grass cover, Good, HSG D
6,196	30	Woods, Good, HSG A
432	55	Woods, Good, HSG B
7,216	77	Woods, Good, HSG D
52,366	54	Weighted Average
52,366		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	45	0.0560	0.10		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.50"

Subcatchment PRE-7: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment PRE-8: O'Connell Way

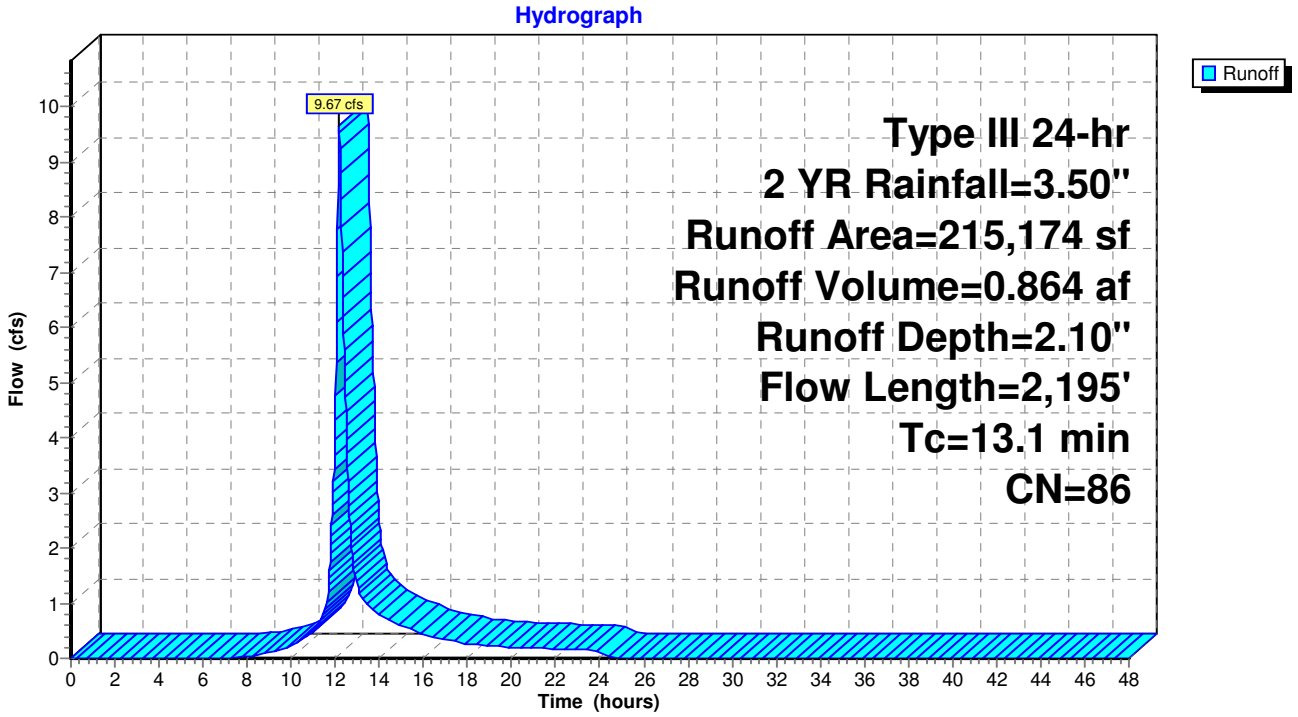
Runoff = 9.67 cfs @ 12.18 hrs, Volume= 0.864 af, Depth= 2.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
110,196	98	Paved parking & roofs
27,017	98	Water Surface
8,285	39	>75% Grass cover, Good, HSG A
31,759	61	>75% Grass cover, Good, HSG B
33,571	74	>75% Grass cover, Good, HSG C
4,346	80	>75% Grass cover, Good, HSG D
215,174	86	Weighted Average
77,961		36.23% Pervious Area
137,213		63.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	65	0.0460	0.16		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.3	230	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
4.9	1,900	0.0080	6.44	20.23	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
13.1	2,195	Total			

Subcatchment PRE-8: O'Connell Way



Summary for Subcatchment PRE-9: Front of 71 Stevens, Parking and Half Building

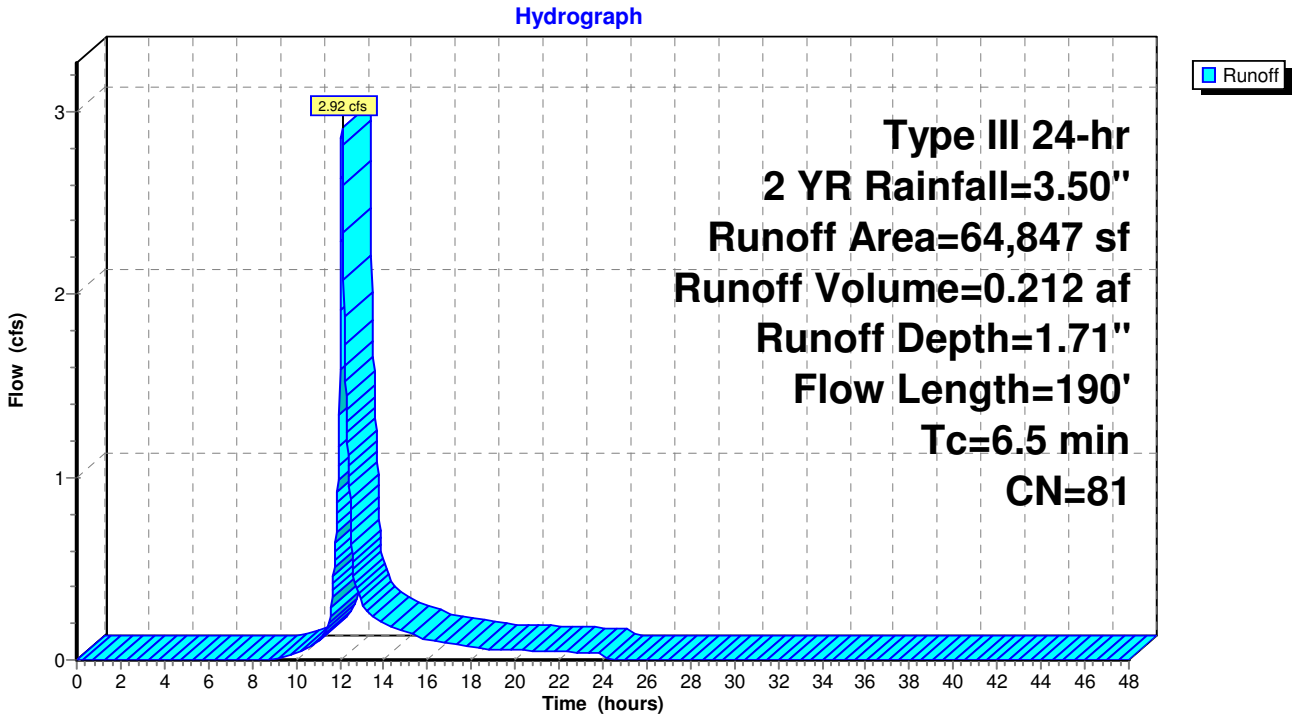
Runoff = 2.92 cfs @ 12.10 hrs, Volume= 0.212 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

	Area (sf)	CN	Description
*	37,786	98	Paved Parking and New Driveway/Sidewalks
	12,548	39	>75% Grass cover, Good, HSG A
	14,513	74	>75% Grass cover, Good, HSG C
	64,847	81	Weighted Average
	27,061		41.73% Pervious Area
	37,786		58.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0400	0.14		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.2	50	0.0700	4.26		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.4	90	0.0400	4.06		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
6.5	190	Total			

Subcatchment PRE-9: Front of 71 Stevens, Parking and Half Building



Summary for Reach 1R: Grassed Swale

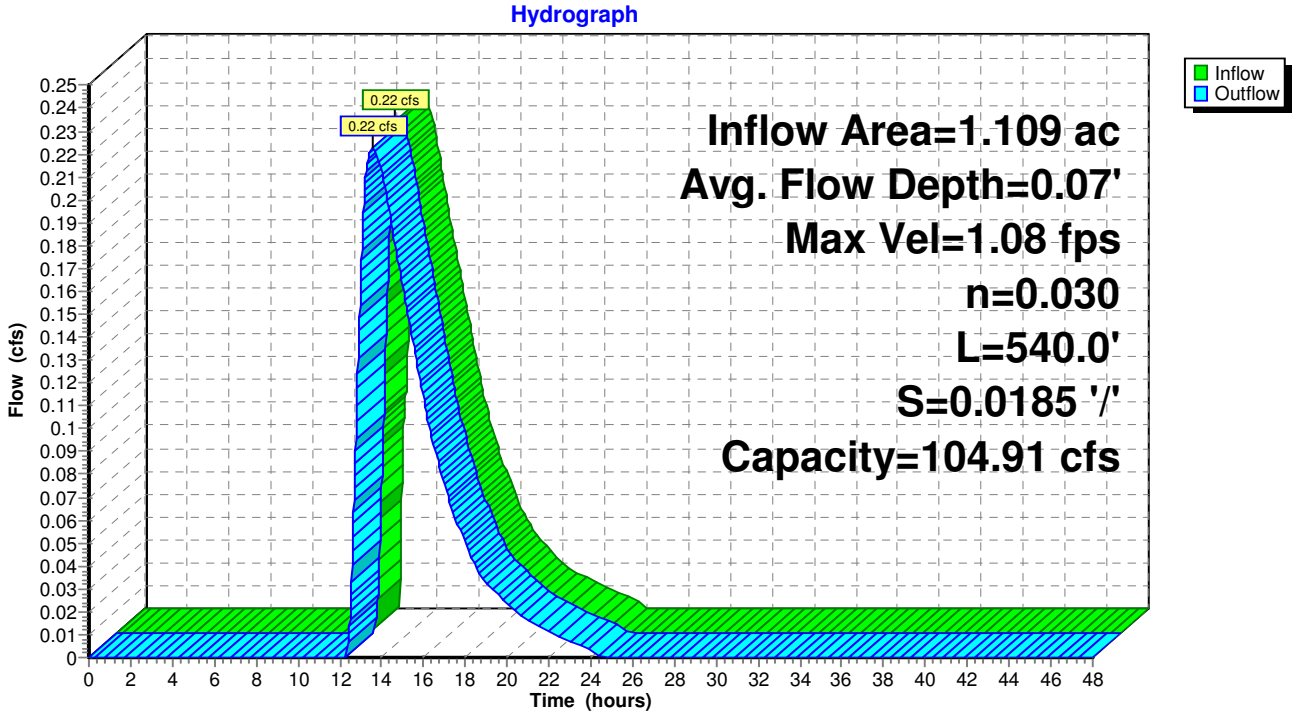
Inflow Area = 1.109 ac, 71.01% Impervious, Inflow Depth = 0.77" for 2 YR event
Inflow = 0.22 cfs @ 13.34 hrs, Volume= 0.071 af
Outflow = 0.22 cfs @ 13.57 hrs, Volume= 0.071 af, Atten= 0%, Lag= 14.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 1.08 fps, Min. Travel Time= 8.4 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 13.7 min

Peak Storage= 112 cf @ 13.43 hrs
Average Depth at Peak Storage= 0.07'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 104.91 cfs

3.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 540.0' Slope= 0.0185 '/'
Inlet Invert= 49.00', Outlet Invert= 39.00'

Reach 1R: Grassed Swale



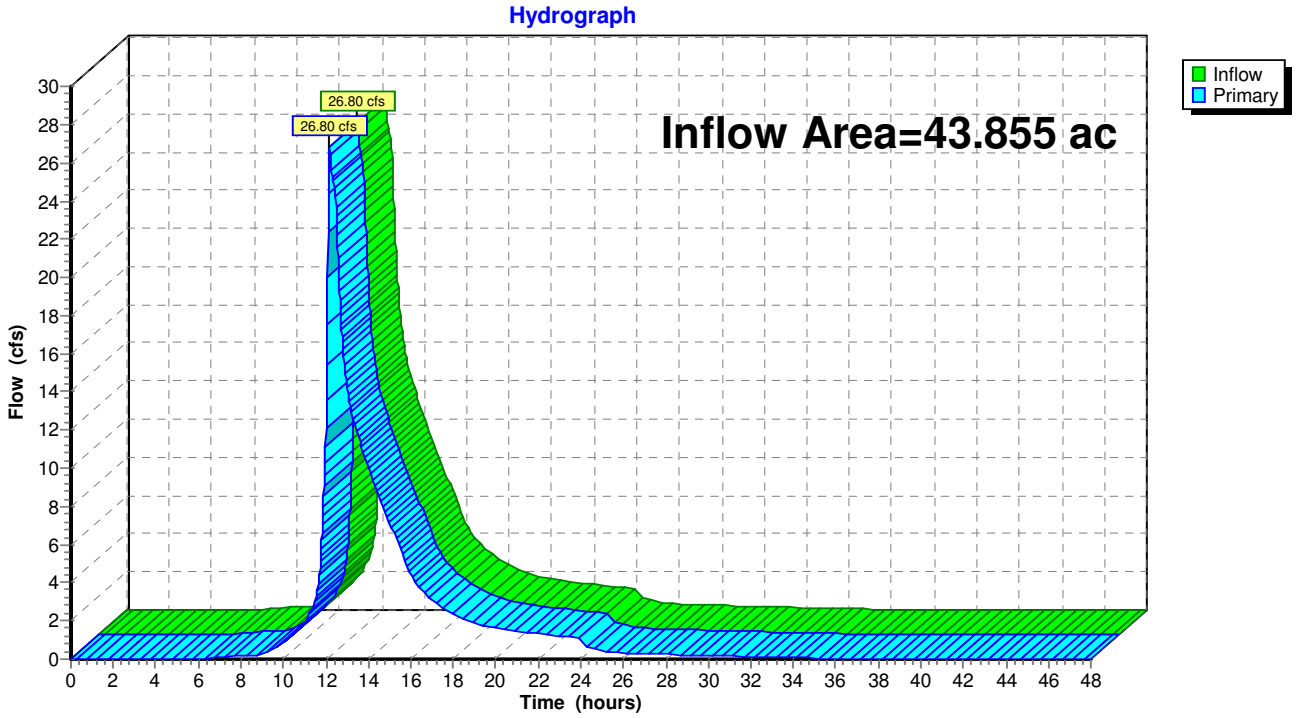
Summary for Pond AP-1: Wetlands South of O'Connell Way

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 43.855 ac, 40.90% Impervious, Inflow Depth > 1.62" for 2 YR event
Inflow = 26.80 cfs @ 12.18 hrs, Volume= 5.912 af
Primary = 26.80 cfs @ 12.18 hrs, Volume= 5.912 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-1: Wetlands South of O'Connell Way



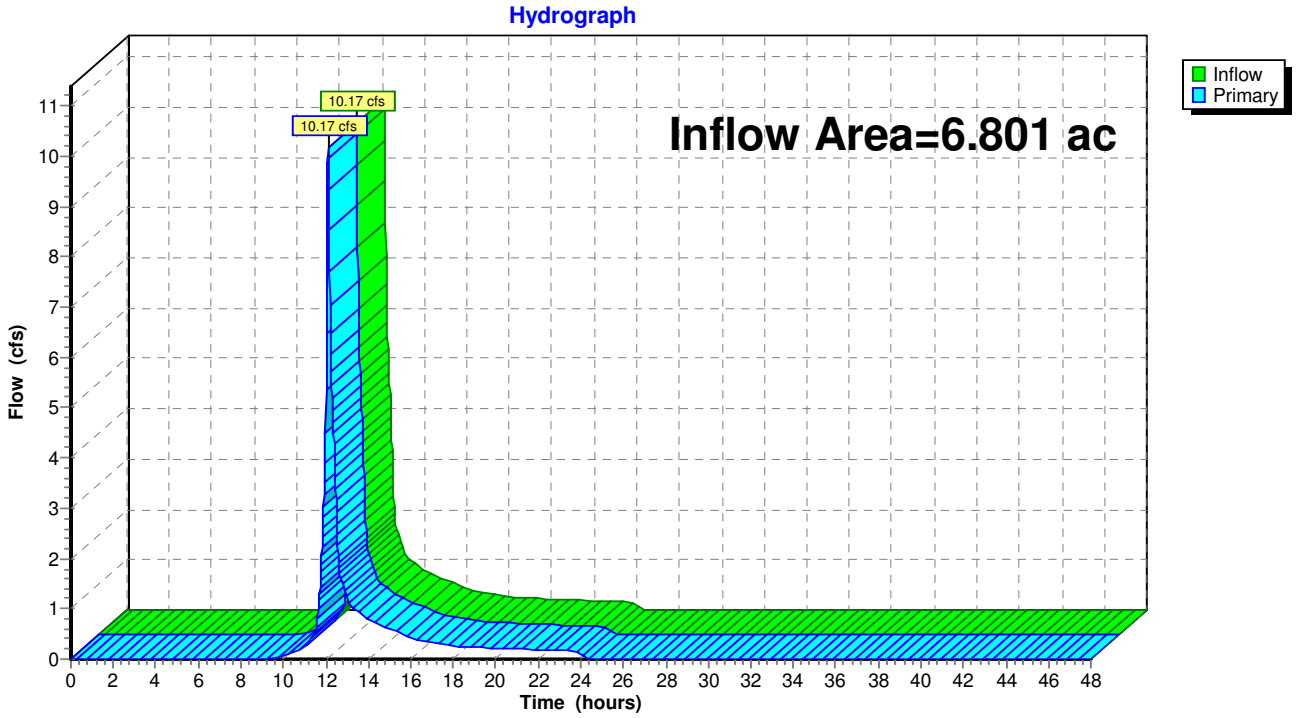
Summary for Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.801 ac, 23.66% Impervious, Inflow Depth = 1.36" for 2 YR event
Inflow = 10.17 cfs @ 12.10 hrs, Volume= 0.772 af
Primary = 10.17 cfs @ 12.10 hrs, Volume= 0.772 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11



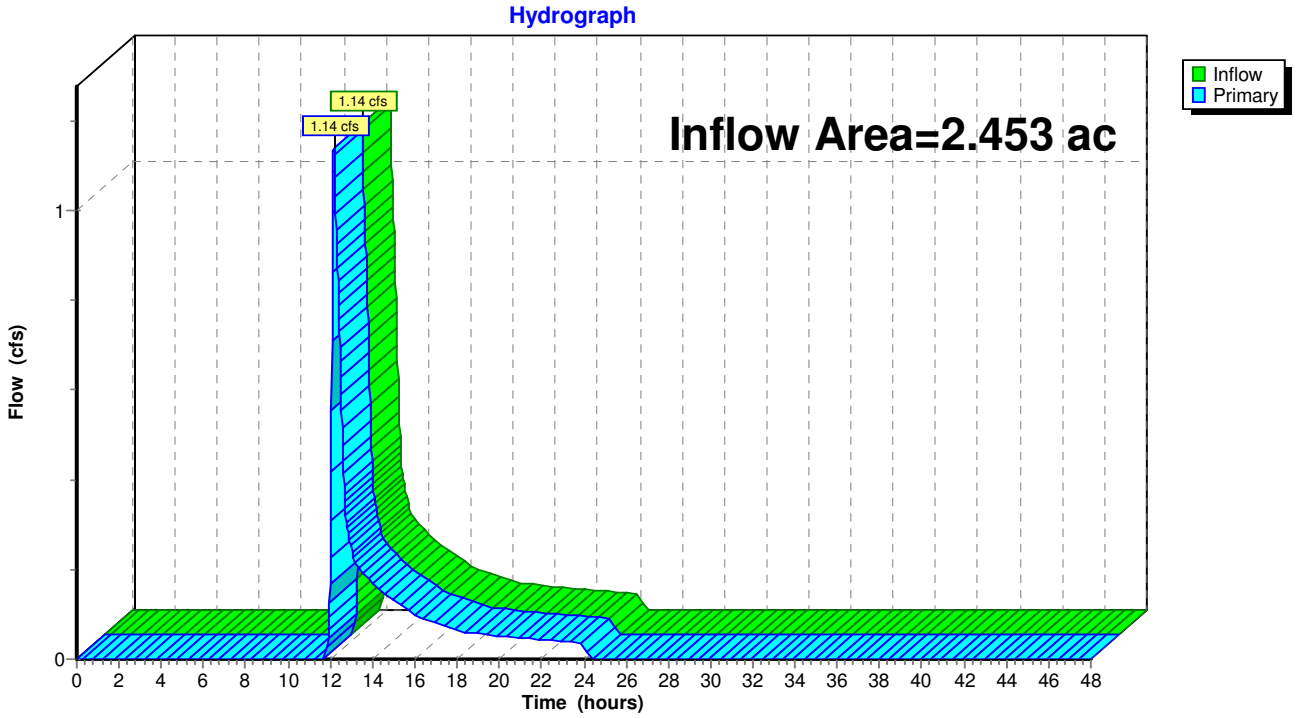
Summary for Pond AP-3: Existing Culvert Crossing at Crossroads

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.453 ac, 0.00% Impervious, Inflow Depth = 0.62" for 2 YR event
Inflow = 1.14 cfs @ 12.17 hrs, Volume= 0.126 af
Primary = 1.14 cfs @ 12.17 hrs, Volume= 0.126 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-3: Existing Culvert Crossing at Crossroads



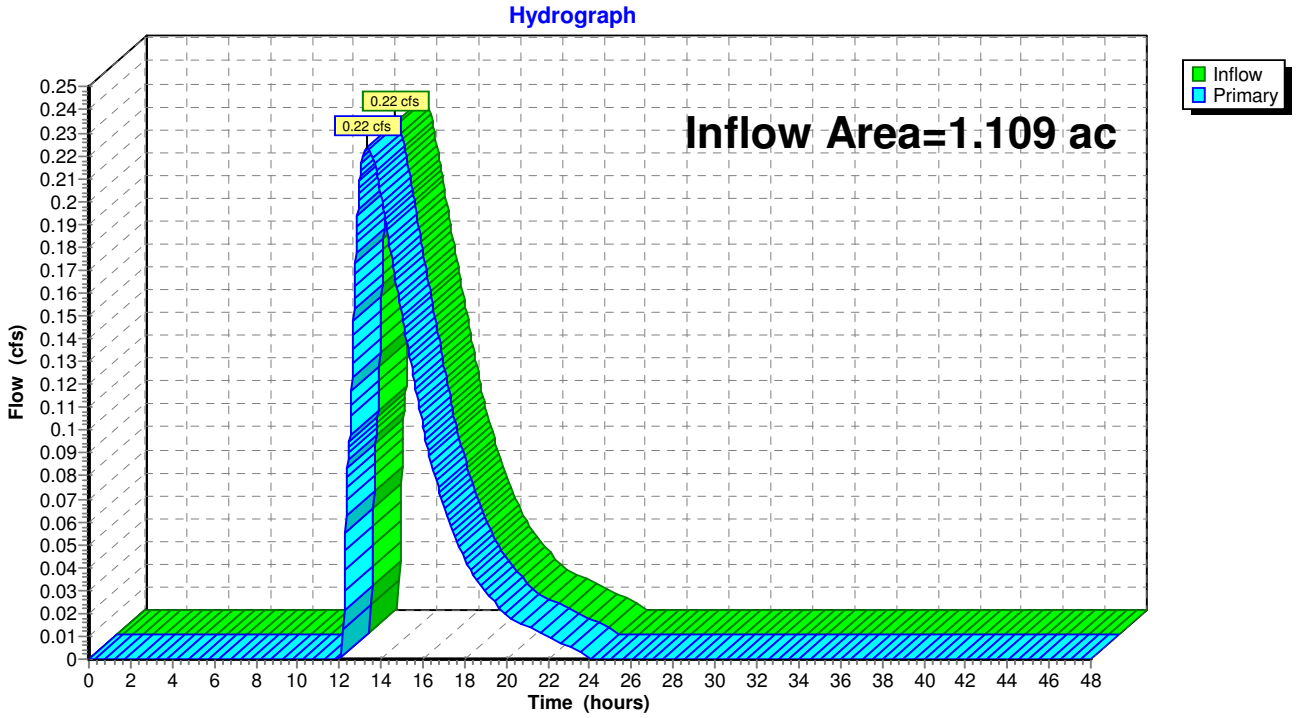
Summary for Pond FE-1: Flared End Outlet

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.109 ac, 71.01% Impervious, Inflow Depth = 0.77" for 2 YR event
Inflow = 0.22 cfs @ 13.34 hrs, Volume= 0.071 af
Primary = 0.22 cfs @ 13.34 hrs, Volume= 0.071 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond FE-1: Flared End Outlet



Summary for Pond POND-1: 73 Stevens St Front Recharge System

Inflow Area =	0.667 ac, 67.72% Impervious, Inflow Depth = 2.45" for 2 YR event				
Inflow =	1.62 cfs @	12.14 hrs,	Volume=	0.136 af	
Outflow =	0.14 cfs @	13.43 hrs,	Volume=	0.111 af,	Atten= 91%, Lag= 77.4 min
Discarded =	0.03 cfs @	11.76 hrs,	Volume=	0.074 af	
Primary =	0.12 cfs @	13.43 hrs,	Volume=	0.037 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 58.11' @ 13.43 hrs Surf.Area= 3,455 sf Storage= 3,557 cf

Plug-Flow detention time= 751.6 min calculated for 0.111 af (81% of inflow)
Center-of-Mass det. time= 678.9 min (1,486.6 - 807.7)

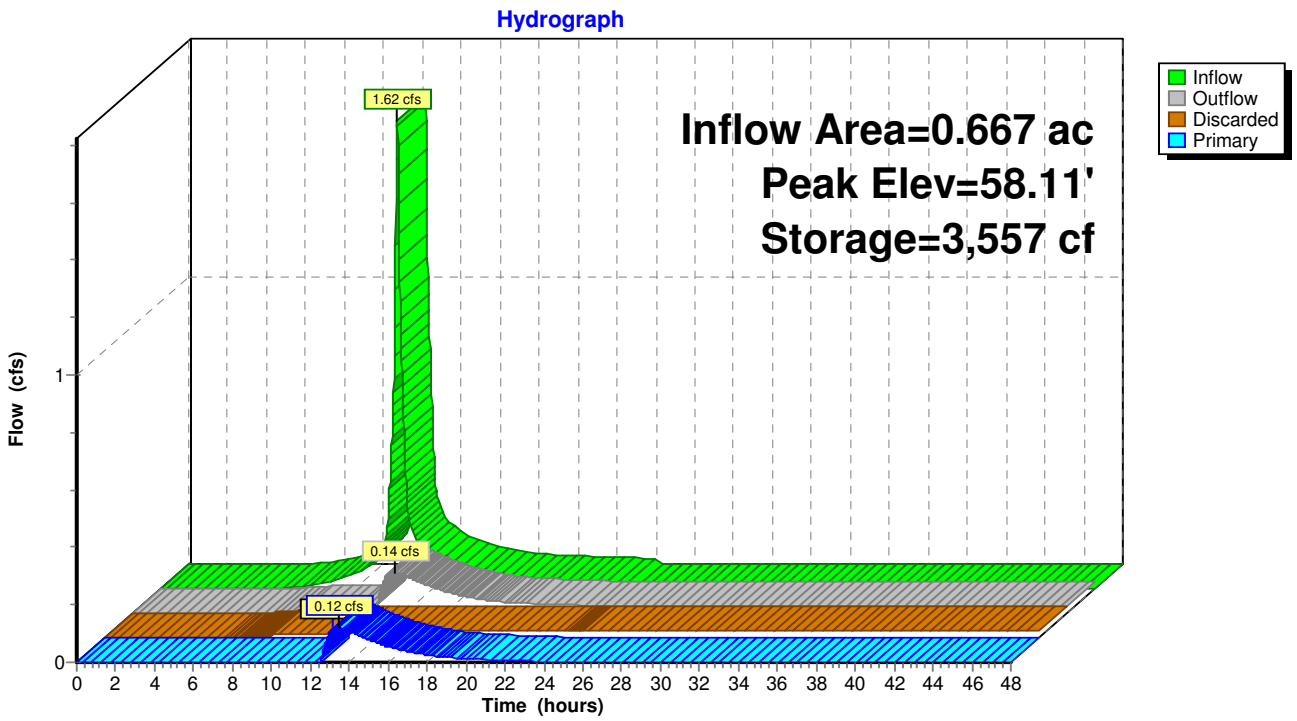
Volume	Invert	Avail.Storage	Storage Description
#1	56.90'	3,284 cf	**23.25'W x 110.00'L x 3.21'H Prismatoid** 8,210 cf Overall x 40.0% Voids
#2	56.40'	2,550 cf	**Cultec R-280** x 60 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
		5,834 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	57.90'	**12.0" Round Culvert** L= 175.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 57.90' / 56.15' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	57.90'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	59.40'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.5' Crest Height
#4	Discarded	56.40'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 11.76 hrs HW=56.91' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.12 cfs @ 13.43 hrs HW=58.11' (Free Discharge)
└─**1=Culvert** (Passes 0.12 cfs of 0.18 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.12 cfs @ 1.55 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-1: 73 Stevens St Front Recharge System



Summary for Pond POND-2: 73 Stevens St Rear Recharge System

Inflow Area =	0.442 ac, 75.97% Impervious, Inflow Depth = 2.64" for 2 YR event				
Inflow =	1.28 cfs @	12.10 hrs,	Volume=	0.097 af	
Outflow =	0.13 cfs @	12.94 hrs,	Volume=	0.097 af,	Atten= 90%, Lag= 50.5 min
Discarded =	0.02 cfs @	38.62 hrs,	Volume=	0.063 af	
Primary =	0.11 cfs @	12.94 hrs,	Volume=	0.034 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 56.48' @ 12.94 hrs Surf.Area= 3,354 sf Storage= 2,272 cf

Plug-Flow detention time= 551.9 min calculated for 0.097 af (100% of inflow)
Center-of-Mass det. time= 551.7 min (1,347.3 - 795.6)

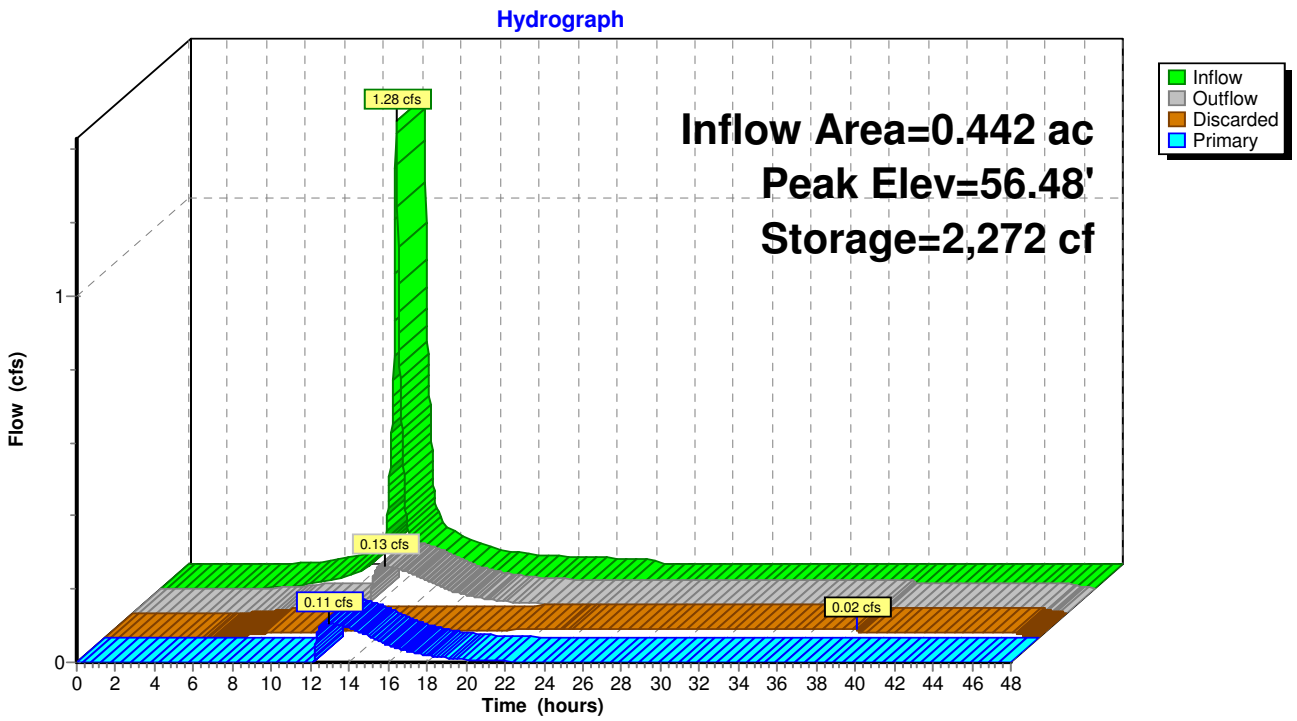
Volume	Invert	Avail.Storage	Storage Description
#1	55.15'	2,632 cf	**10.25'W x 200.00'L x 3.21'H Prismatoid** 6,581 cf Overall x 40.0% Voids
#2	55.65'	2,380 cf	**Cultec R-280** x 56 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
		5,012 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	56.15'	**12.0" Round Culvert** L= 90.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 56.15' / 55.45' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	56.15'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	57.55'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.5' Crest Height
#4	Discarded	55.15'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 38.62 hrs HW=55.65' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.11 cfs @ 12.94 hrs HW=56.48' (Free Discharge)
└─**1=Culvert** (Passes 0.11 cfs of 0.40 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.11 cfs @ 2.19 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-2: 73 Stevens St Rear Recharge System



Summary for Pond POND-3: Maggiore Combined Detention Basin

Inflow Area = 11.446 ac, 73.64% Impervious, Inflow Depth = 2.73" for 2 YR event
Inflow = 31.41 cfs @ 12.13 hrs, Volume= 2.609 af
Outflow = 8.84 cfs @ 12.52 hrs, Volume= 2.604 af, Atten= 72%, Lag= 23.3 min
Primary = 8.84 cfs @ 12.52 hrs, Volume= 2.604 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 32.60' @ 12.52 hrs Surf.Area= 27,680 sf Storage= 41,772 cf

Plug-Flow detention time= 96.1 min calculated for 2.603 af (100% of inflow)
Center-of-Mass det. time= 95.3 min (888.2 - 792.9)

Volume	Invert	Avail.Storage	Storage Description
#1	30.00'	117,074 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

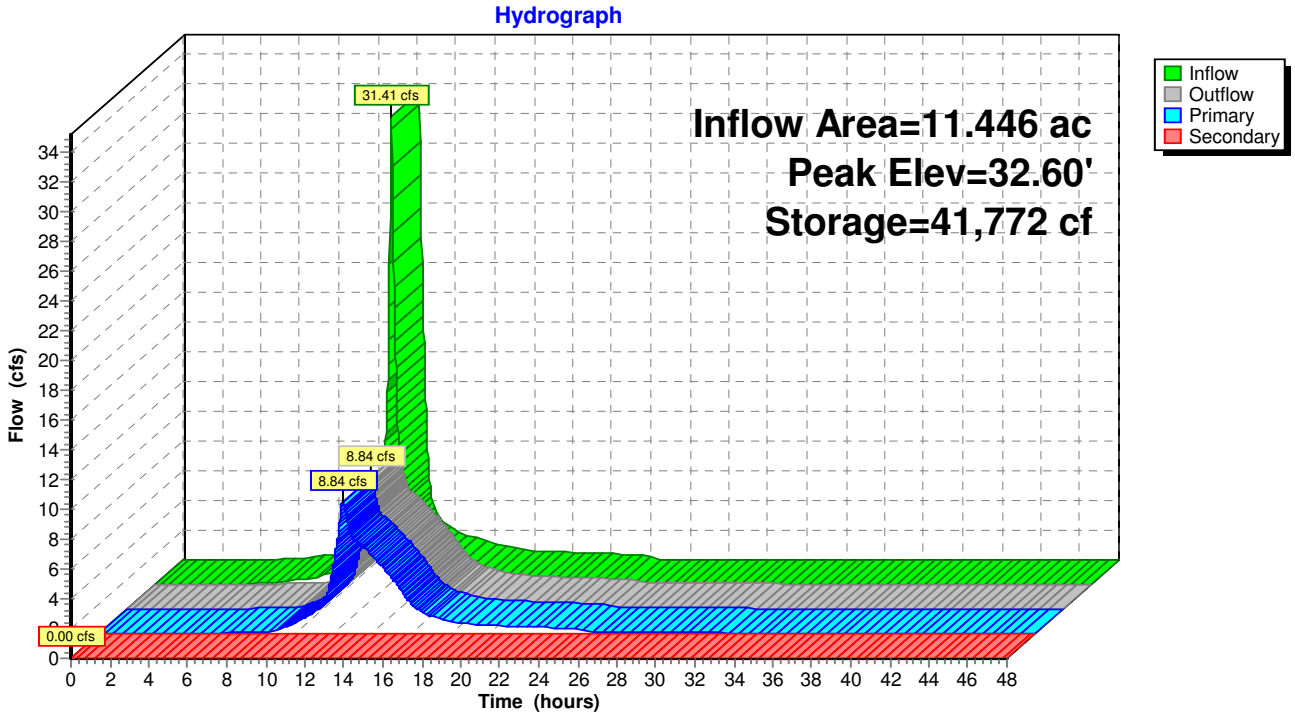
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
30.00	402	0	0
31.00	12,578	6,490	6,490
32.00	25,888	19,233	25,723
33.00	28,878	27,383	53,106
34.00	31,850	30,364	83,470
35.00	35,357	33,604	117,074

Device	Routing	Invert	Outlet Devices
#1	Primary	29.25'	**18.0" Round Culvert X 2.00** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 28.20' / 29.25' S= -0.0210 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	30.14'	**2.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 1	30.64'	**10.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	32.42'	**4.0' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s) 2.0' Crest Height
#5	Secondary	34.25'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=8.83 cfs @ 12.52 hrs HW=32.60' (Free Discharge)
└─**1=Culvert** (Passes 8.83 cfs of 27.44 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 7.42 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 6.52 cfs @ 5.98 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Weir Controls 1.99 cfs @ 1.40 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=30.00' (Free Discharge)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-3: Maggiore Combined Detention Basin



Summary for Pond POND-4: Maggiore 1 Recharge System

Inflow Area =	1.223 ac,100.00% Impervious, Inflow Depth = 3.27" for 2 YR event				
Inflow =	4.16 cfs @	12.08 hrs,	Volume=	0.333 af	
Outflow =	0.21 cfs @	14.05 hrs,	Volume=	0.333 af,	Atten= 95%, Lag= 118.1 min
Discarded =	0.21 cfs @	14.05 hrs,	Volume=	0.333 af	
Primary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 43.91' @ 14.05 hrs Surf.Area= 11,604 sf Storage= 7,128 cf

Plug-Flow detention time= 303.2 min calculated for 0.333 af (100% of inflow)
Center-of-Mass det. time= 303.2 min (1,057.8 - 754.6)

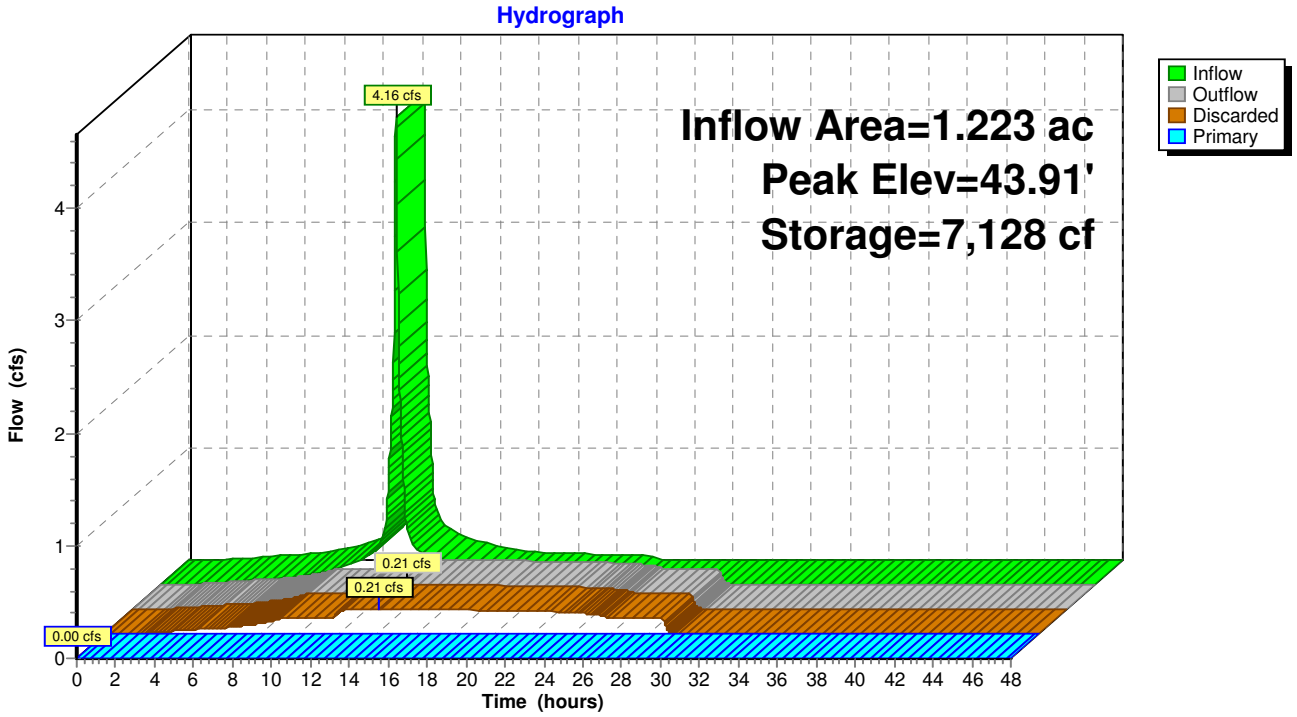
Volume	Invert	Avail.Storage	Storage Description
#1	42.50'	7,420 cf	**53.00'W x 140.00'L x 2.50'H Prismatoid** 18,550 cf Overall x 40.0% Voids
#2	43.00'	6,597 cf	**24.0" Round Pipe Storage** x 15 L= 140.0'
		14,017 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	42.00'	**12.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 42.00' / 41.25' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	44.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.5' Crest Height
#3	Discarded	42.50'	**0.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.21 cfs @ 14.05 hrs HW=43.91' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=42.50' (Free Discharge)
└─**1=Culvert** (Passes 0.00 cfs of 0.95 cfs potential flow)
  └─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-4: Maggiore 1 Recharge System



Summary for Pond POND-5: Maggiore 1 Detention Basin

Inflow Area = 3.438 ac, 93.38% Impervious, Inflow Depth = 1.96" for 2 YR event
Inflow = 7.31 cfs @ 12.08 hrs, Volume= 0.562 af
Outflow = 3.43 cfs @ 12.25 hrs, Volume= 0.553 af, Atten= 53%, Lag= 9.7 min
Primary = 3.43 cfs @ 12.25 hrs, Volume= 0.553 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 40.37' @ 12.25 hrs Surf.Area= 7,140 sf Storage= 8,589 cf

Plug-Flow detention time= 146.1 min calculated for 0.553 af (98% of inflow)
Center-of-Mass det. time= 136.3 min (907.8 - 771.5)

Volume	Invert	Avail.Storage	Storage Description
#1	38.50'	21,749 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

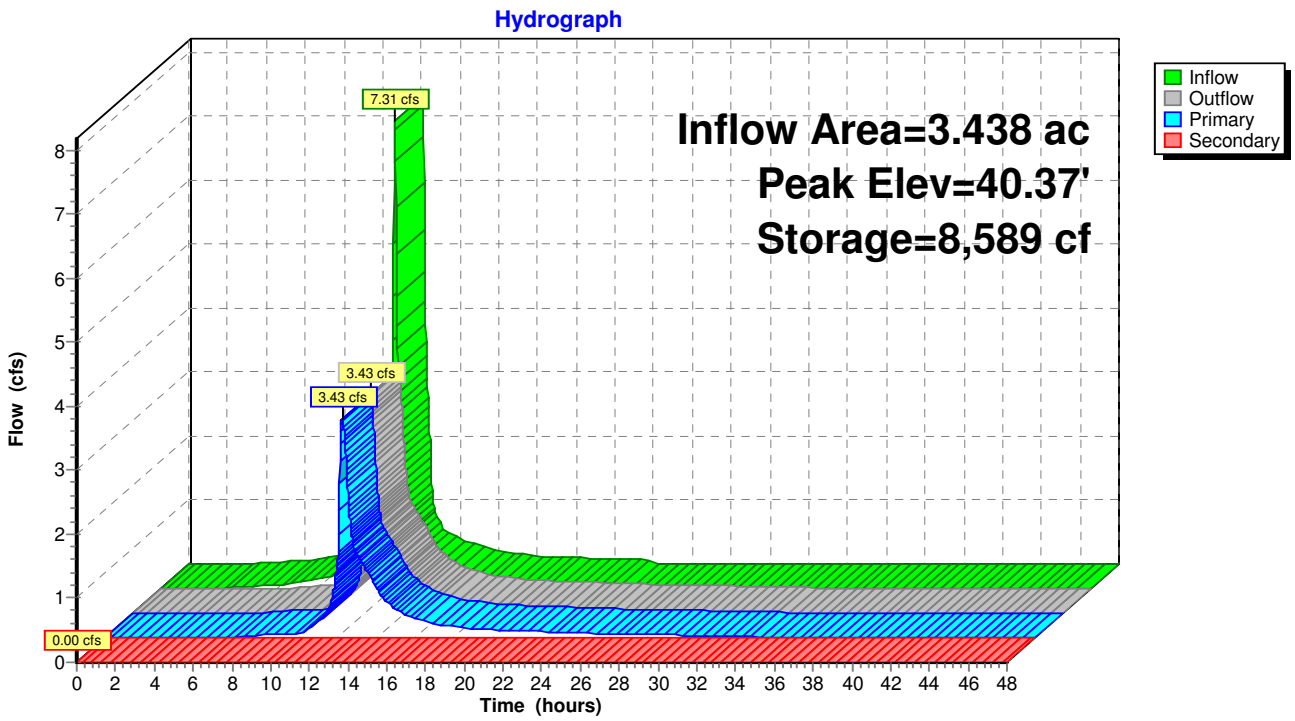
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.50	1,000	0	0
39.00	3,213	1,053	1,053
40.00	6,682	4,948	6,001
41.00	7,905	7,294	13,294
42.00	9,005	8,455	21,749

Device	Routing	Invert	Outlet Devices
#1	Primary	38.50'	**24.0" Round Culvert** L= 20.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.50' / 38.29' S= 0.0105 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	38.74'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	39.24'	**8.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	40.11'	**4.0' long x 1.75' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.7' Crest Height
#5	Secondary	40.95'	**10.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=3.42 cfs @ 12.25 hrs HW=40.37' (Free Discharge)
└─**1=Culvert** (Passes 3.42 cfs of 11.97 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.13 cfs @ 6.00 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 1.50 cfs @ 4.31 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Weir Controls 1.79 cfs @ 1.71 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.50' (Free Discharge)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-5: Maggiore 1 Detention Basin



Summary for Pond POND-6: O'Connell Way Detention Basin

Inflow Area = 6.286 ac, 50.11% Impervious, Inflow Depth = 1.80" for 2 YR event
Inflow = 10.44 cfs @ 12.18 hrs, Volume= 0.943 af
Outflow = 2.73 cfs @ 12.65 hrs, Volume= 0.839 af, Atten= 74%, Lag= 28.3 min
Primary = 2.73 cfs @ 12.65 hrs, Volume= 0.839 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 22.74' @ 12.65 hrs Surf.Area= 25,998 sf Storage= 18,552 cf

Plug-Flow detention time= 236.5 min calculated for 0.838 af (89% of inflow)
Center-of-Mass det. time= 184.4 min (1,015.4 - 831.0)

Volume	Invert	Avail.Storage	Storage Description
#1	22.00'	149,253 cf	**Custom Stage Data (Prismatic)** Listed below

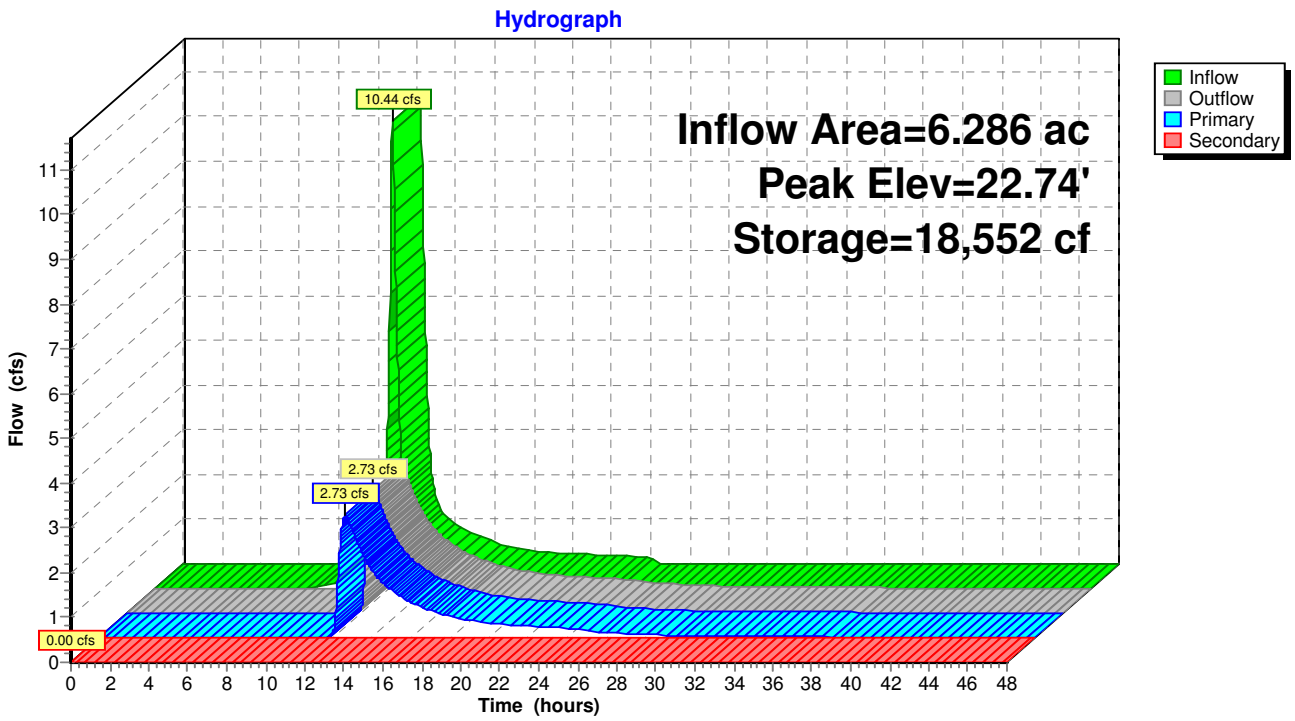
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
22.00	22,688	0	0
23.00	27,133	24,911	24,911
24.00	31,645	29,389	54,300
25.00	36,863	34,254	88,554
26.00	40,469	38,666	127,220
26.50	47,663	22,033	149,253

Device	Routing	Invert	Outlet Devices
#1	Primary	22.15'	**24.0" Round Culvert X 2.00** L= 46.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 22.15' / 22.00' S= 0.0033 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	22.15'	**18.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 1	24.25'	**4.0' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s) 1.0' Crest Height
#4	Secondary	26.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.72 cfs @ 12.65 hrs HW=22.74' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.72 cfs @ 2.61 fps)
  ├─**2=Orifice/Grate** (Passes 2.72 cfs of 3.42 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=22.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-6: O'Connell Way Detention Basin



Summary for Pond POND-7: Existing Detention Basin on 71 Stevens Street

Inflow Area = 2.892 ac, 50.18% Impervious, Inflow Depth = 1.71" for 2 YR event
Inflow = 5.39 cfs @ 12.12 hrs, Volume= 0.412 af
Outflow = 2.67 cfs @ 12.33 hrs, Volume= 0.412 af, Atten= 50%, Lag= 12.6 min
Primary = 2.67 cfs @ 12.33 hrs, Volume= 0.412 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 54.97' @ 12.33 hrs Surf.Area= 4,308 sf Storage= 3,681 cf

Plug-Flow detention time= 20.6 min calculated for 0.412 af (100% of inflow)
Center-of-Mass det. time= 20.6 min (857.5 - 836.9)

Volume	Invert	Avail.Storage	Storage Description
#1	54.00'	8,617 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

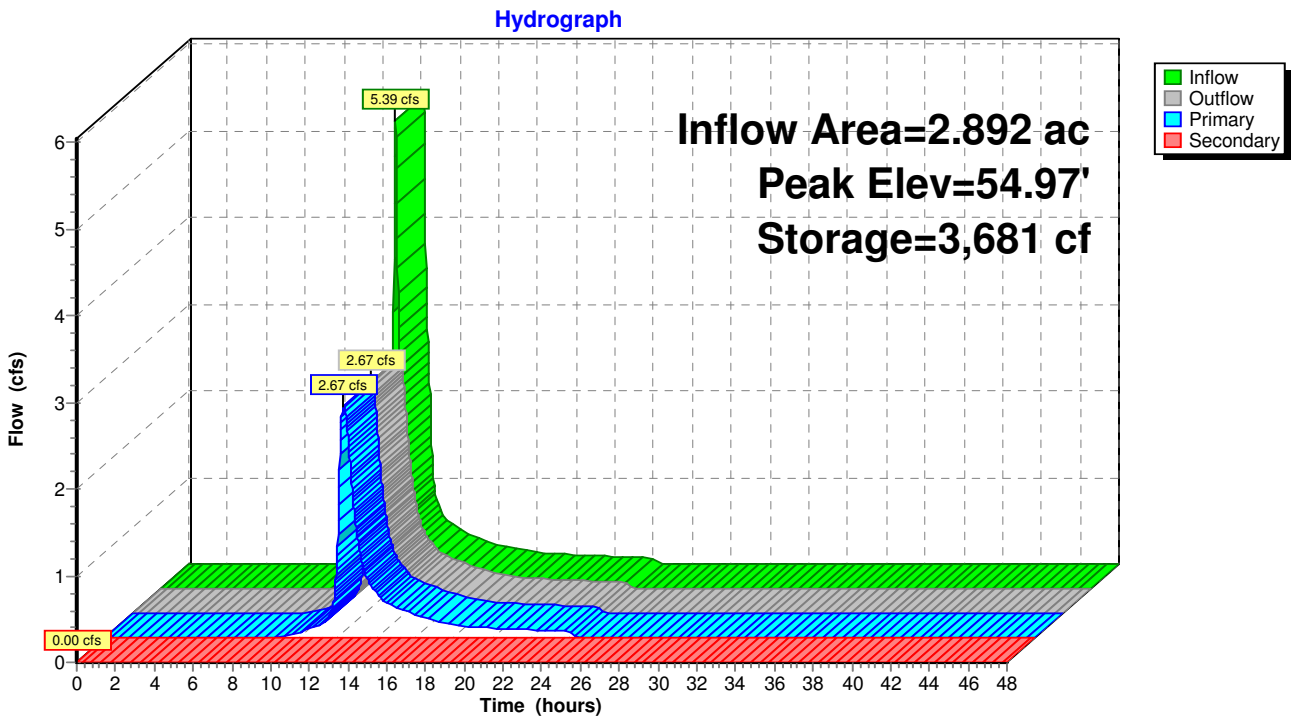
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
54.00	3,306	0	0
55.00	4,342	3,824	3,824
56.00	5,244	4,793	8,617

Device	Routing	Invert	Outlet Devices
#1	Primary	53.81'	**12.0" Round 12" HDPE** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.81' / 53.73' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Secondary	55.50'	**12.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.67 cfs @ 12.33 hrs HW=54.97' (Free Discharge)
└**1=12" HDPE** (Barrel Controls 2.67 cfs @ 3.69 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=54.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-7: Existing Detention Basin on 71 Stevens Street



Summary for Pond POND-8: Existing Detention Basin on DaRosa Lot

Proposed Detention Basin

Inflow Area =	0.452 ac,	0.00% Impervious,	Inflow Depth =	1.24"	for 2 YR event
Inflow =	0.57 cfs @	12.13 hrs,	Volume=	0.047 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= 0.02 hrs
Peak Elev= 42.85' @ 24.52 hrs Surf.Area= 2,619 sf Storage= 2,033 cf

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

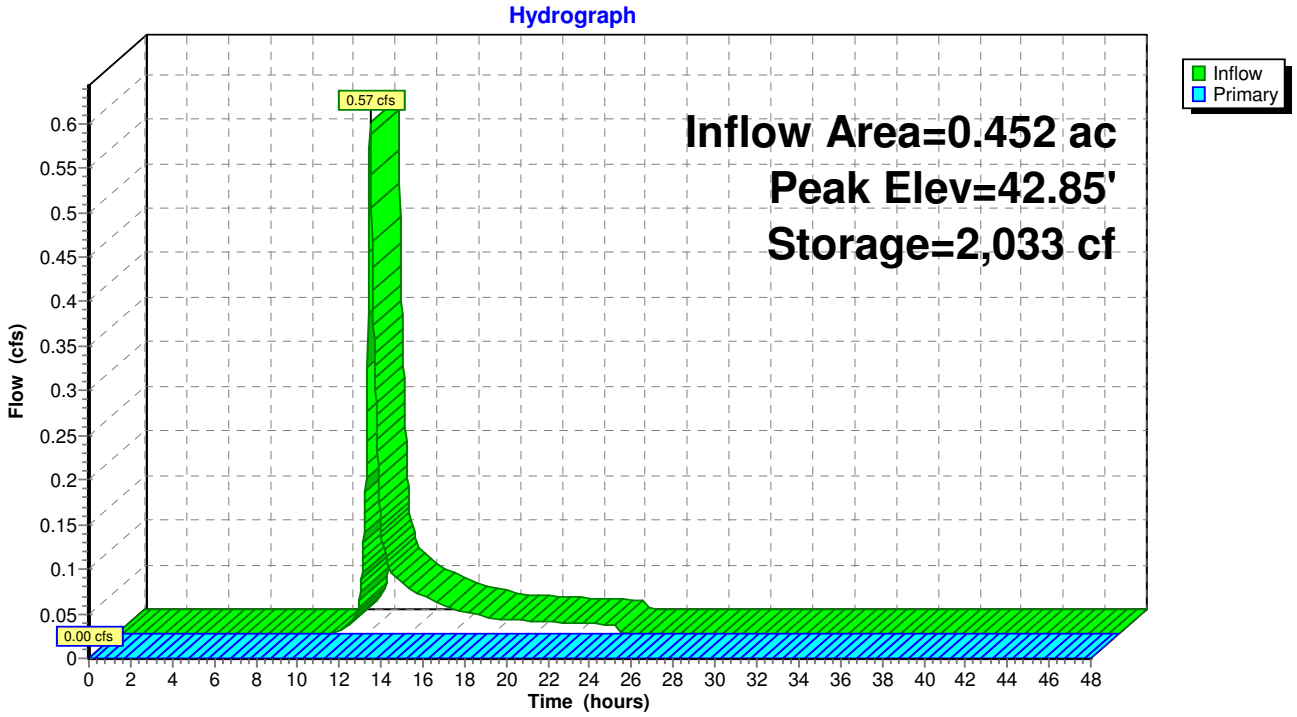
Volume	Invert	Avail.Storage	Storage Description
#1	42.00'	9,217 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
42.00	2,064	0	0
43.00	2,716	2,390	2,390
44.00	3,374	3,045	5,435
45.00	4,189	3,782	9,217

Device	Routing	Invert	Outlet Devices
#1	Primary	44.50'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=42.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-8: Existing Detention Basin on DaRosa Lot



Summary for Pond POND-9: Existing Culvert Crossing at 71 Stevens

Inflow Area = 5.340 ac, 44.13% Impervious, Inflow Depth = 1.65" for 2 YR event
Inflow = 6.12 cfs @ 12.13 hrs, Volume= 0.733 af
Outflow = 6.03 cfs @ 12.15 hrs, Volume= 0.733 af, Atten= 1%, Lag= 1.2 min
Primary = 6.03 cfs @ 12.15 hrs, Volume= 0.733 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 5
Peak Elev= 46.98' @ 12.15 hrs Surf.Area= 644 sf Storage= 464 cf

Plug-Flow detention time= 2.5 min calculated for 0.733 af (100% of inflow)
Center-of-Mass det. time= 2.5 min (853.0 - 850.5)

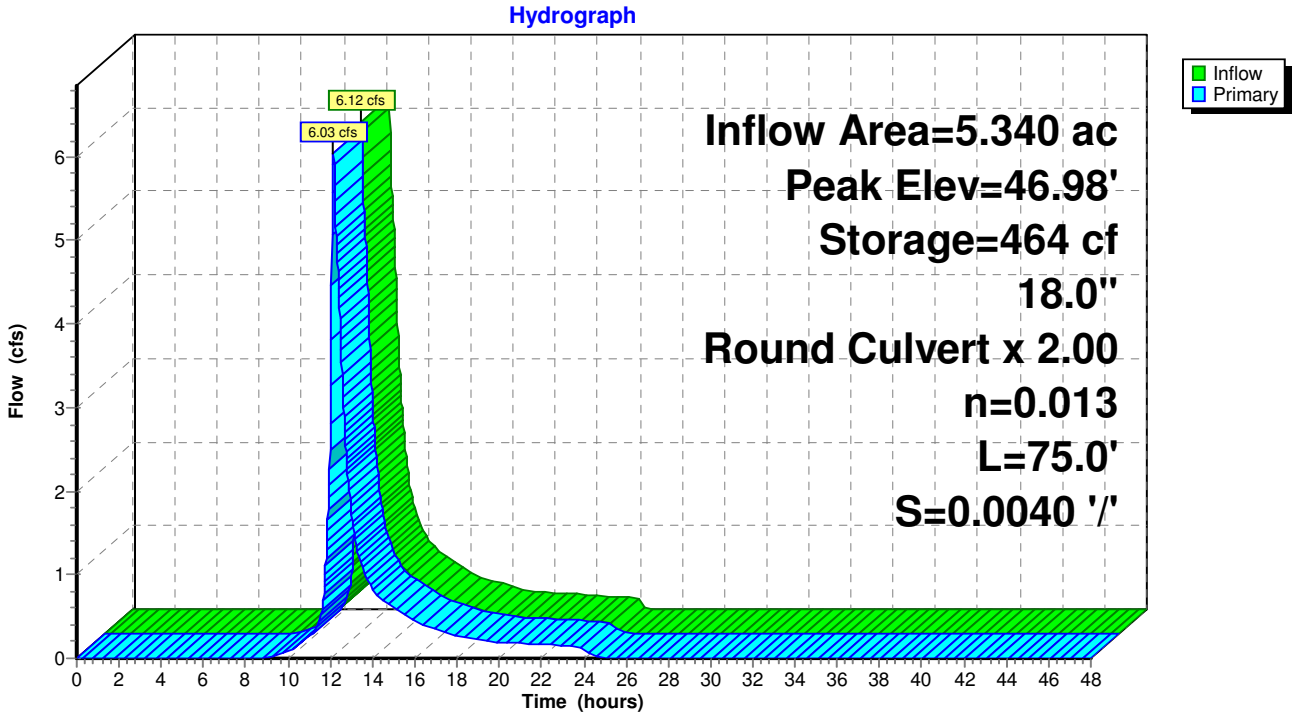
Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	5,400 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
46.00	300	0	0
47.00	650	475	475
48.00	1,000	825	1,300
49.00	1,500	1,250	2,550
50.00	2,000	1,750	4,300
50.50	2,400	1,100	5,400

Device	Routing	Invert	Outlet Devices
#1	Primary	46.00'	**18.0" Round Culvert X 2.00** L= 75.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 46.00' / 45.70' S= 0.0040 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=6.02 cfs @ 12.15 hrs HW=46.98' (Free Discharge)
└**1=Culvert** (Barrel Controls 6.02 cfs @ 3.48 fps)

Pond POND-9: Existing Culvert Crossing at 71 Stevens



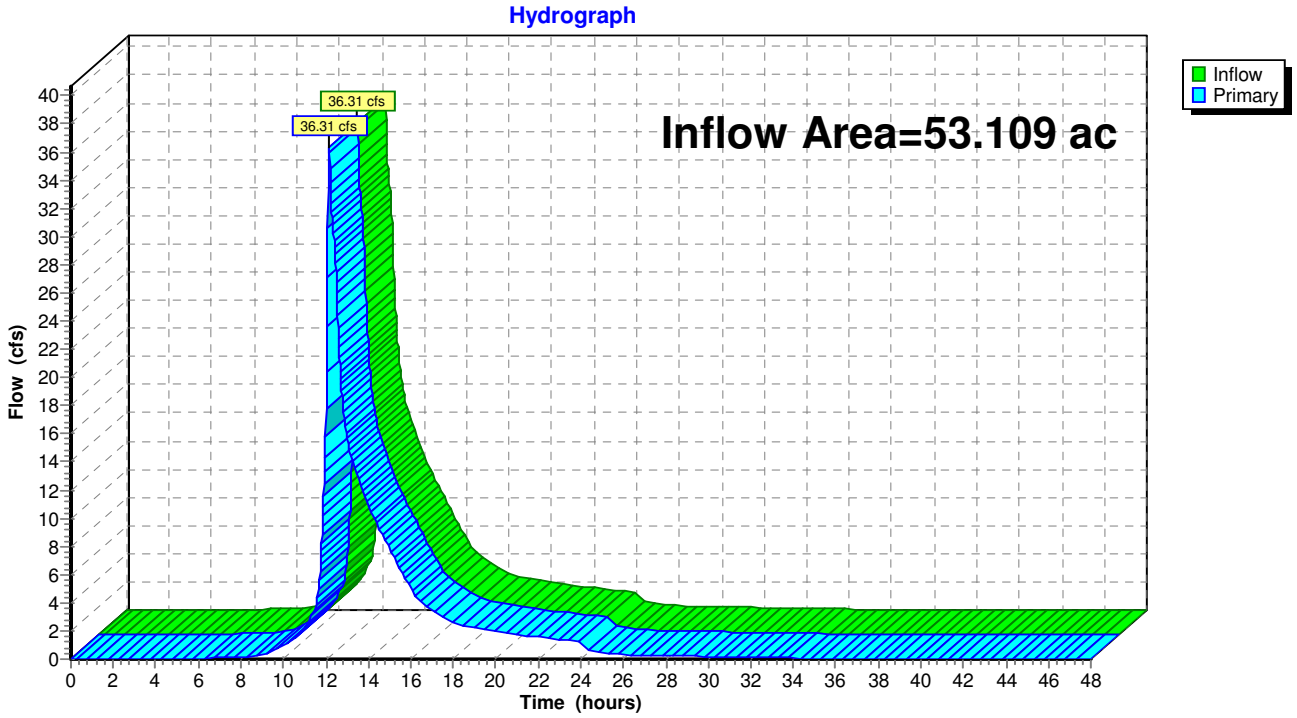
ry for Pond SUM-S: Summation of Analysis Points to Cotley River Wetlands from Southern portion of deve

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 53.109 ac, 36.80% Impervious, Inflow Depth > 1.54" for 2 YR event
Inflow = 36.31 cfs @ 12.15 hrs, Volume= 6.809 af
Primary = 36.31 cfs @ 12.15 hrs, Volume= 6.809 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond SUM-S: Summation of Analysis Points to Cotley River Wetlands from Southern portion of developmen



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PRE-1: Front Area of 73 Runoff Area=29,061 sf 67.72% Impervious Runoff Depth=3.68"
Flow Length=85' Tc=10.5 min CN=90 Runoff=2.40 cfs 0.205 af

Subcatchment PRE-10: Rear of 71 Runoff Area=125,958 sf 50.18% Impervious Runoff Depth=2.81"
Flow Length=335' Tc=7.9 min CN=81 Runoff=8.90 cfs 0.677 af

Subcatchment PRE-11: Unattenuated Area Runoff Area=41,813 sf 3.98% Impervious Runoff Depth=2.37"
Flow Length=395' Tc=8.7 min CN=76 Runoff=2.42 cfs 0.190 af

Subcatchment PRE-12: Unattenuated Area Runoff Area=80,250 sf 5.95% Impervious Runoff Depth=2.05"
Flow Length=410' Tc=8.6 min CN=72 Runoff=3.98 cfs 0.314 af

Subcatchment PRE-13: Existing B&D Runoff Area=118,483 sf 47.33% Impervious Runoff Depth=2.72"
Flow Length=700' Tc=6.0 min CN=80 Runoff=8.66 cfs 0.616 af

Subcatchment PRE-14: Portion of Existing Runoff Area=56,946 sf 16.24% Impervious Runoff Depth=2.54"
Flow Length=630' Tc=6.5 min CN=78 Runoff=3.82 cfs 0.277 af

Subcatchment PRE-15: Existing DaRosa Runoff Area=19,680 sf 0.00% Impervious Runoff Depth=2.21"
Flow Length=215' Tc=8.7 min CN=74 Runoff=1.06 cfs 0.083 af

Subcatchment PRE-16: Portion of Existing Runoff Area=20,900 sf 0.00% Impervious Runoff Depth=2.72"
Flow Length=150' Tc=8.2 min CN=80 Runoff=1.42 cfs 0.109 af

Subcatchment PRE-17: Lot 11 Remaining Runoff Area=58,635 sf 0.00% Impervious Runoff Depth=1.45"
Flow Length=395' Tc=8.8 min CN=64 Runoff=1.93 cfs 0.163 af

Subcatchment PRE-18: Lot 11 Runoff Area=106,859 sf 0.00% Impervious Runoff Depth=1.32"
Flow Length=530' Tc=10.1 min CN=62 Runoff=2.97 cfs 0.269 af

Subcatchment PRE-19: Lot 9 Upland Areas Runoff Area=184,240 sf 0.00% Impervious Runoff Depth=1.12"
Flow Length=540' Tc=14.5 min CN=59 Runoff=3.64 cfs 0.396 af

Subcatchment PRE-2: Rear Area of 73 Runoff Area=19,260 sf 75.97% Impervious Runoff Depth=3.89"
Flow Length=70' Tc=7.1 min CN=92 Runoff=1.85 cfs 0.143 af

Subcatchment PRE-3: Unattenuated Areas Runoff Area=470,600 sf 0.00% Impervious Runoff Depth=1.89"
Flow Length=440' Tc=10.1 min CN=70 Runoff=20.29 cfs 1.701 af

Subcatchment PRE-4: Maggiore 2, Runoff Area=498,594 sf 73.64% Impervious Runoff Depth=4.00"
Flow Length=1,320' Tc=9.5 min CN=93 Runoff=45.03 cfs 3.817 af

Subcatchment PRE-5: Portion of Runoff Area=53,288 sf 100.00% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=98 Runoff=5.73 cfs 0.465 af

Subcatchment PRE-6: Loading Area of Runoff Area=96,485 sf 89.73% Impervious Runoff Depth=4.33"
Flow Length=975' Tc=6.0 min CN=96 Runoff=10.20 cfs 0.800 af

Subcatchment PRE-7: Unattenuated Areas Runoff Area=52,366 sf 0.00% Impervious Runoff Depth=0.83"
Flow Length=45' Slope=0.0560 '/' Tc=7.2 min CN=54 Runoff=0.82 cfs 0.083 af

Subcatchment PRE-8: O'Connell Way Runoff Area=215,174 sf 63.77% Impervious Runoff Depth=3.28"
Flow Length=2,195' Tc=13.1 min CN=86 Runoff=14.98 cfs 1.351 af

Subcatchment PRE-9: Front of 71 Stevens, Runoff Area=64,847 sf 58.27% Impervious Runoff Depth=2.81"
Flow Length=190' Tc=6.5 min CN=81 Runoff=4.81 cfs 0.349 af

Reach 1R: Grassed Swale Avg. Flow Depth=0.15' Max Vel=1.78 fps Inflow=0.90 cfs 0.180 af
n=0.030 L=540.0' S=0.0185 '/' Capacity=104.91 cfs Outflow=0.89 cfs 0.180 af

Pond AP-1: Wetlands South of O'Connell Way Inflow=55.11 cfs 9.623 af
Primary=55.11 cfs 9.623 af

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11 Inflow=17.60 cfs 1.316 af
Primary=17.60 cfs 1.316 af

Pond AP-3: Existing Culvert Crossing at Crossroads Inflow=2.97 cfs 0.269 af
Primary=2.97 cfs 0.269 af

Pond FE-1: Flared End Outlet Inflow=0.90 cfs 0.180 af
Primary=0.90 cfs 0.180 af

Pond POND-1: 73 Stevens St Front Recharge Peak Elev=58.70' Storage=4,396 cf Inflow=2.40 cfs 0.205 af
Discarded=0.03 cfs 0.075 af Primary=0.70 cfs 0.103 af Outflow=0.72 cfs 0.178 af

Pond POND-2: 73 Stevens St Rear Recharge Peak Elev=56.99' Storage=3,315 cf Inflow=1.85 cfs 0.143 af
Discarded=0.02 cfs 0.066 af Primary=0.20 cfs 0.077 af Outflow=0.22 cfs 0.143 af

Pond POND-3: Maggiore Combined Peak Elev=33.00' Storage=53,062 cf Inflow=45.03 cfs 3.817 af
Primary=19.24 cfs 3.812 af Secondary=0.00 cfs 0.000 af Outflow=19.24 cfs 3.812 af

Pond POND-4: Maggiore 1 Recharge System Peak Elev=44.33' Storage=10,073 cf Inflow=5.73 cfs 0.465 af
Discarded=0.22 cfs 0.428 af Primary=0.28 cfs 0.037 af Outflow=0.49 cfs 0.465 af

Pond POND-5: Maggiore 1 Detention Basin Peak Elev=40.59' Storage=10,162 cf Inflow=10.20 cfs 0.837 af
Primary=6.24 cfs 0.828 af Secondary=0.00 cfs 0.000 af Outflow=6.24 cfs 0.828 af

Pond POND-6: O'Connell Way Detention Peak Elev=23.07' Storage=27,000 cf Inflow=16.78 cfs 1.513 af
Primary=6.26 cfs 1.409 af Secondary=0.00 cfs 0.000 af Outflow=6.26 cfs 1.409 af

Pond POND-7: Existing Detention Basin on Peak Elev=55.53' Storage=6,275 cf Inflow=8.90 cfs 0.677 af
Primary=4.19 cfs 0.675 af Secondary=0.20 cfs 0.002 af Outflow=4.38 cfs 0.677 af

Pond POND-8: Existing Detention Basin on Peak Elev=43.40' Storage=3,617 cf Inflow=1.06 cfs 0.083 af
Outflow=0.00 cfs 0.000 af

Pond POND-9: Existing Culvert Crossing at Peak Elev=47.35' Storage=723 cf Inflow=10.17 cfs 1.215 af
18.0" Round Culvert x 2.00 n=0.013 L=75.0' S=0.0040 '/' Outflow=10.04 cfs 1.215 af

Pond SUM-S: Summation of Analysis Points to Cotley River Wetlands from Inflow=70.41 cfs 11.208 af
Primary=70.41 cfs 11.208 af

Total Runoff Area = 53.109 ac Runoff Volume = 12.006 af Average Runoff Depth = 2.71"
63.20% Pervious = 33.565 ac 36.80% Impervious = 19.544 ac

Summary for Subcatchment PRE-1: Front Area of 73 Stevens St

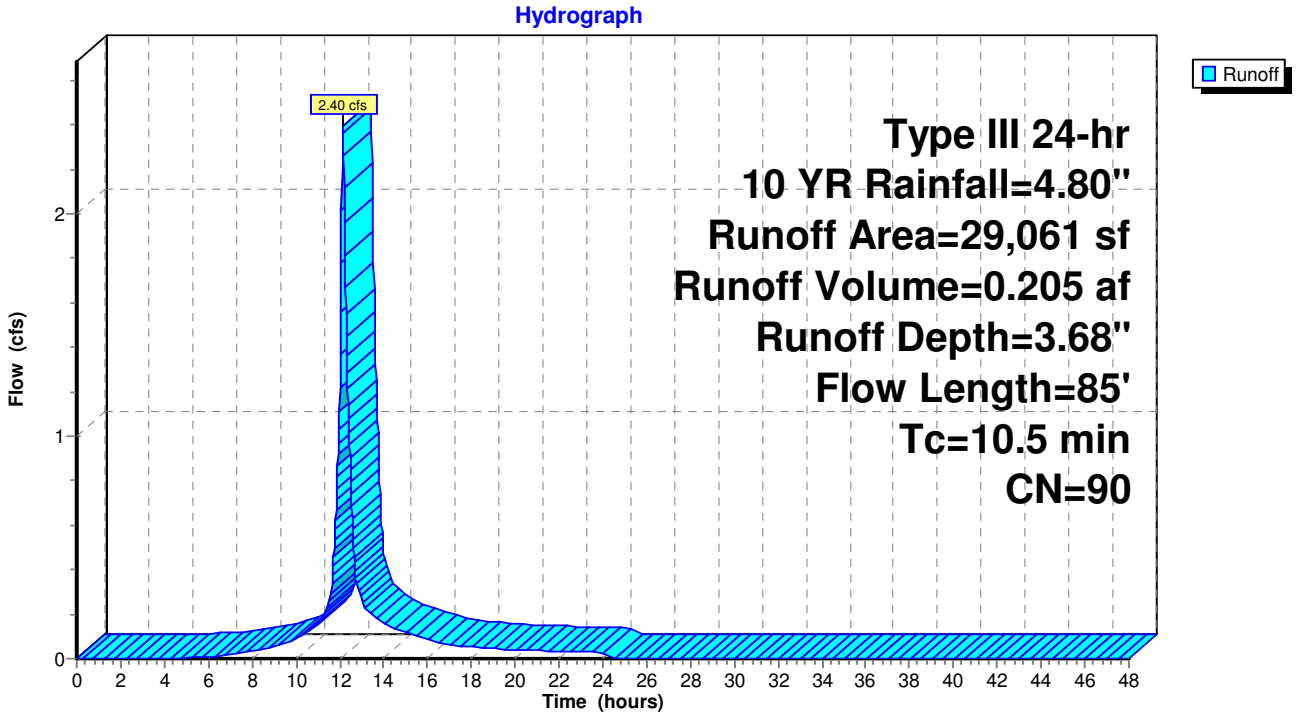
Runoff = 2.40 cfs @ 12.14 hrs, Volume= 0.205 af, Depth= 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
19,681	98	Paved parking & roofs
9,380	74	>75% Grass cover, Good, HSG C
29,061	90	Weighted Average
9,380		32.28% Pervious Area
19,681		67.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	50	0.0100	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.2	35	0.0500	3.60		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
10.5	85	Total			

Subcatchment PRE-1: Front Area of 73 Stevens St



Summary for Subcatchment PRE-10: Rear of 71 Stevens Street, Portion of Gravel Area, Half Building

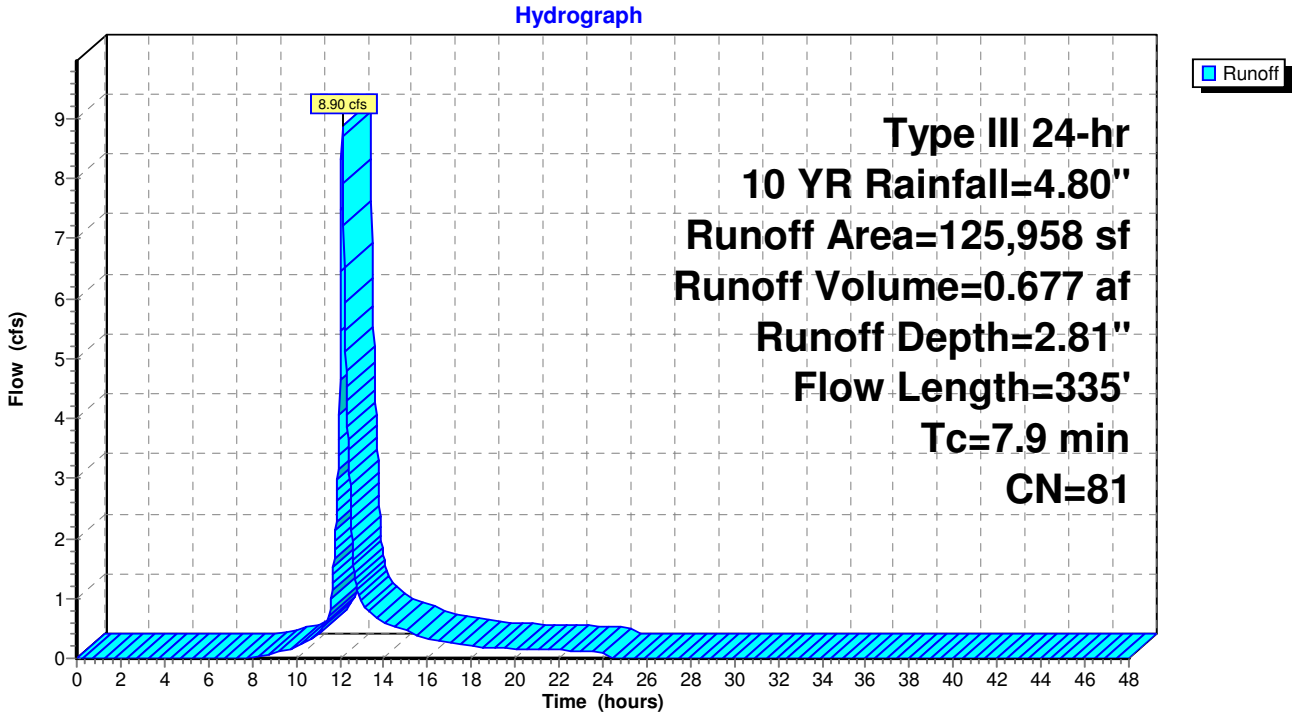
Runoff = 8.90 cfs @ 12.11 hrs, Volume= 0.677 af, Depth= 2.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

	Area (sf)	CN	Description
*	41,109	98	Paved Areas
*	18,846	98	Roof
	5,844	76	Gravel roads, HSG A
	14,995	89	Gravel roads, HSG C
	3,257	98	Water Surface
	19,672	39	>75% Grass cover, Good, HSG A
	18,619	74	>75% Grass cover, Good, HSG C
	3,616	30	Woods, Good, HSG A
	125,958	81	Weighted Average
	62,746		49.82% Pervious Area
	63,212		50.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0110	0.14		**Sheet Flow, 50' down slope (A-B)** Range n= 0.130 P2= 3.50"
1.3	135	0.0110	1.69		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	35	0.0700	4.26		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.4	115	0.0090	4.30	3.38	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
7.9	335	Total			

Subcatchment PRE-10: Rear of 71 Stevens Street, Portion of Gravel Area, Half Building



Summary for Subcatchment PRE-11: Unattenuated Area to Flared Ends on 71 Stevens St

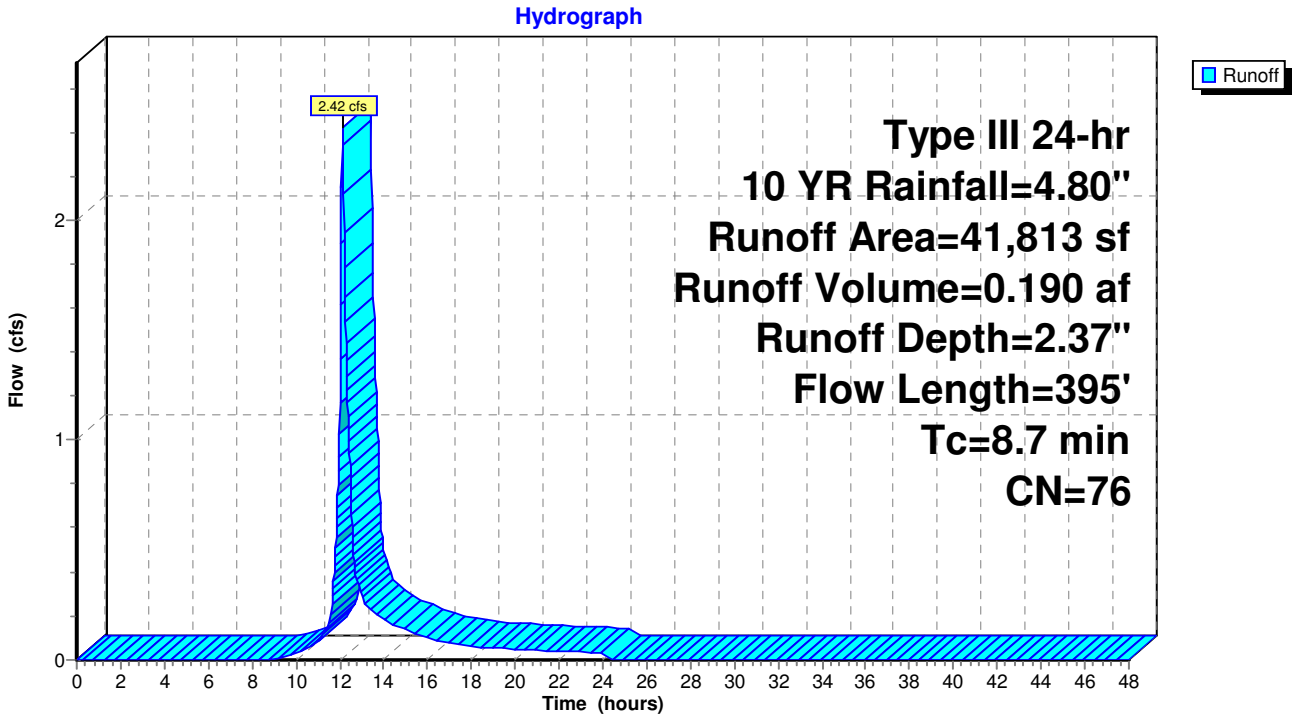
Runoff = 2.42 cfs @ 12.13 hrs, Volume= 0.190 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
1,665	98	Paved parking & roofs
2,206	89	Gravel roads, HSG C
37,942	74	>75% Grass cover, Good, HSG C
41,813	76	Weighted Average
40,148		96.02% Pervious Area
1,665		3.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0110	0.14		**Sheet Flow, A-B** Range n= 0.130 P2= 3.50"
0.5	55	0.0110	1.69		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
2.1	290	0.0210	2.33		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
8.7	395	Total			

Subcatchment PRE-11: Unattenuated Area to Flared Ends on 71 Stevens St



Summary for Subcatchment PRE-12: Unattenuated Area on 71 Stevens St to DaRosa Ditch

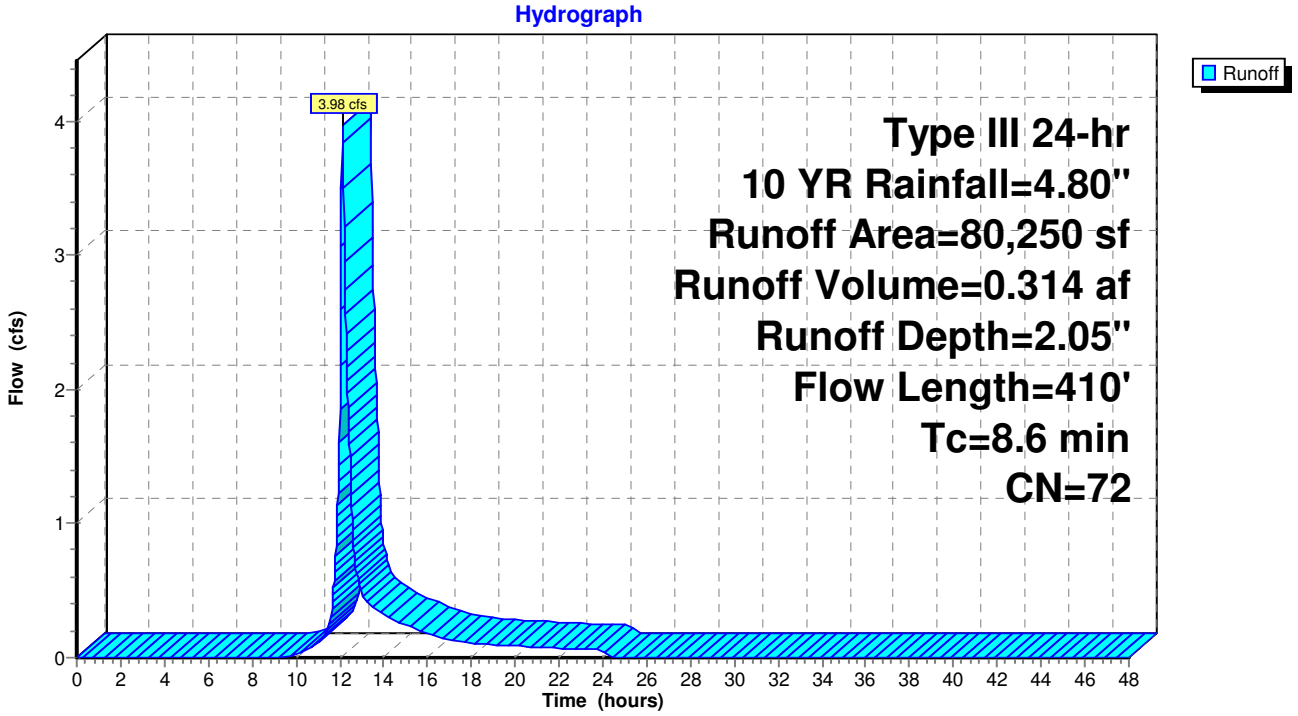
Runoff = 3.98 cfs @ 12.13 hrs, Volume= 0.314 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
4,772	98	Paved parking & roofs
6,028	39	>75% Grass cover, Good, HSG A
67,592	74	>75% Grass cover, Good, HSG C
1,858	30	Woods, Good, HSG A
80,250	72	Weighted Average
75,478		94.05% Pervious Area
4,772		5.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0110	0.14		**Sheet Flow, A-B** Range n= 0.130 P2= 3.50"
2.5	360	0.0220	2.39		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.6	410	Total			

Subcatchment PRE-12: Unattenuated Area on 71 Stevens St to DaRosa Ditch



Summary for Subcatchment PRE-13: Existing B&D Construction Area Unattenuated to Wetland

Existing B&D Construction Lot

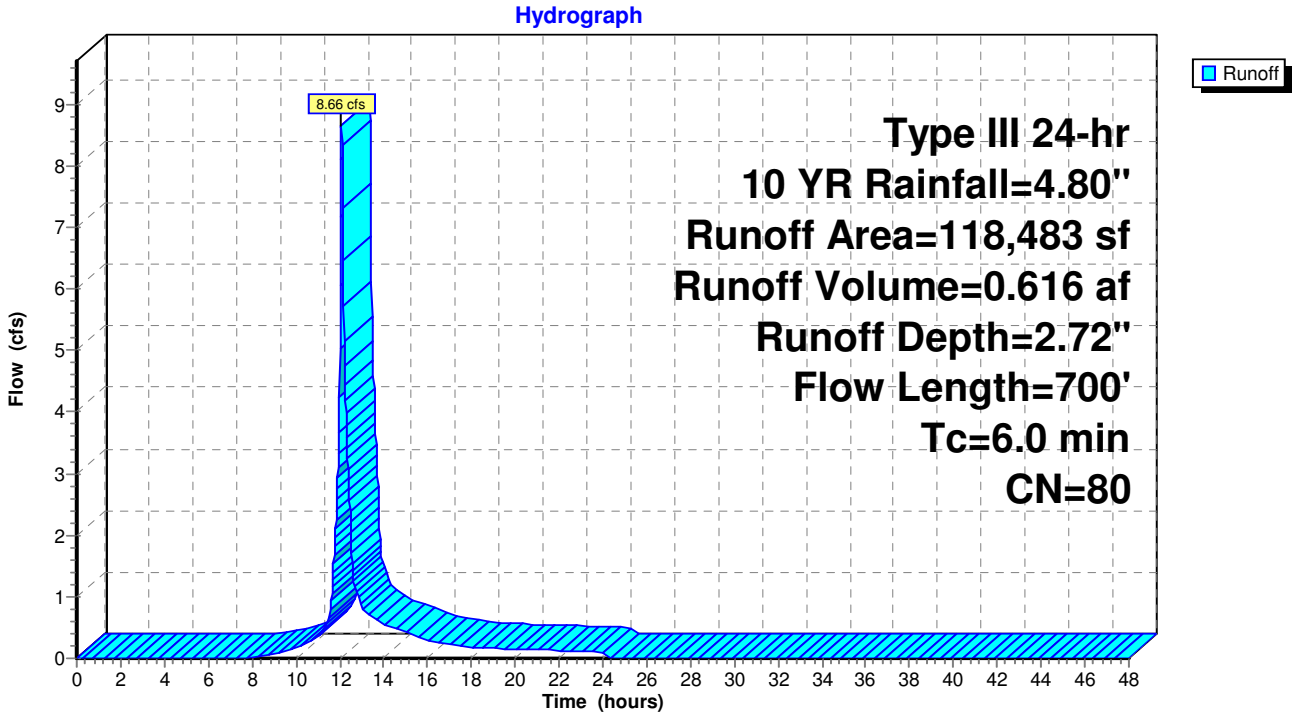
Runoff = 8.66 cfs @ 12.09 hrs, Volume= 0.616 af, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
56,082	98	Paved parking & roofs
3,884	89	Gravel roads, HSG C
19,480	39	>75% Grass cover, Good, HSG A
39,037	74	>75% Grass cover, Good, HSG C
118,483	80	Weighted Average
62,401		52.67% Pervious Area
56,082		47.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.25		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.50"
1.3	320	0.0400	4.06		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
1.0	330	0.0100	5.36	4.21	**Pipe Channel, C-D** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
3.0	700	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PRE-13: Existing B&D Construction Area Unattenuated to Wetland



Summary for Subcatchment PRE-14: Portion of Existing DaRosa Lot to Existing Stream

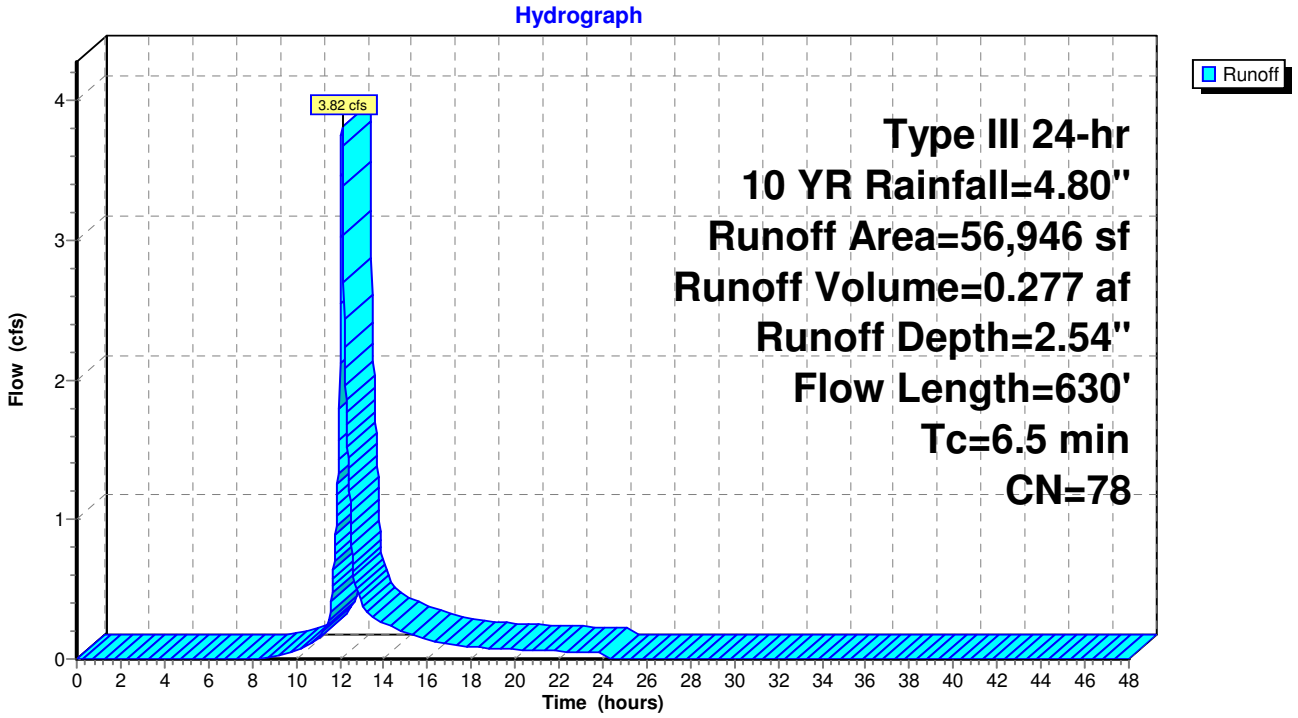
Runoff = 3.82 cfs @ 12.10 hrs, Volume= 0.277 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
9,246	98	Paved parking & roofs
45,102	74	>75% Grass cover, Good, HSG C
367	80	>75% Grass cover, Good, HSG D
2,231	70	Woods, Good, HSG C
56,946	78	Weighted Average
47,700		83.76% Pervious Area
9,246		16.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	40	0.0500	0.15		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.2	210	0.0400	3.00		**Shallow Concentrated Flow, B-C** Grassed Waterway Kv= 15.0 fps
0.8	380	0.0200	8.41	14.86	**Pipe Channel, C-D** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
6.5	630	Total			

Subcatchment PRE-14: Portion of Existing DaRosa Lot to Existing Stream



Summary for Subcatchment PRE-15: Existing DaRosa Lot to Existing Detention Basin

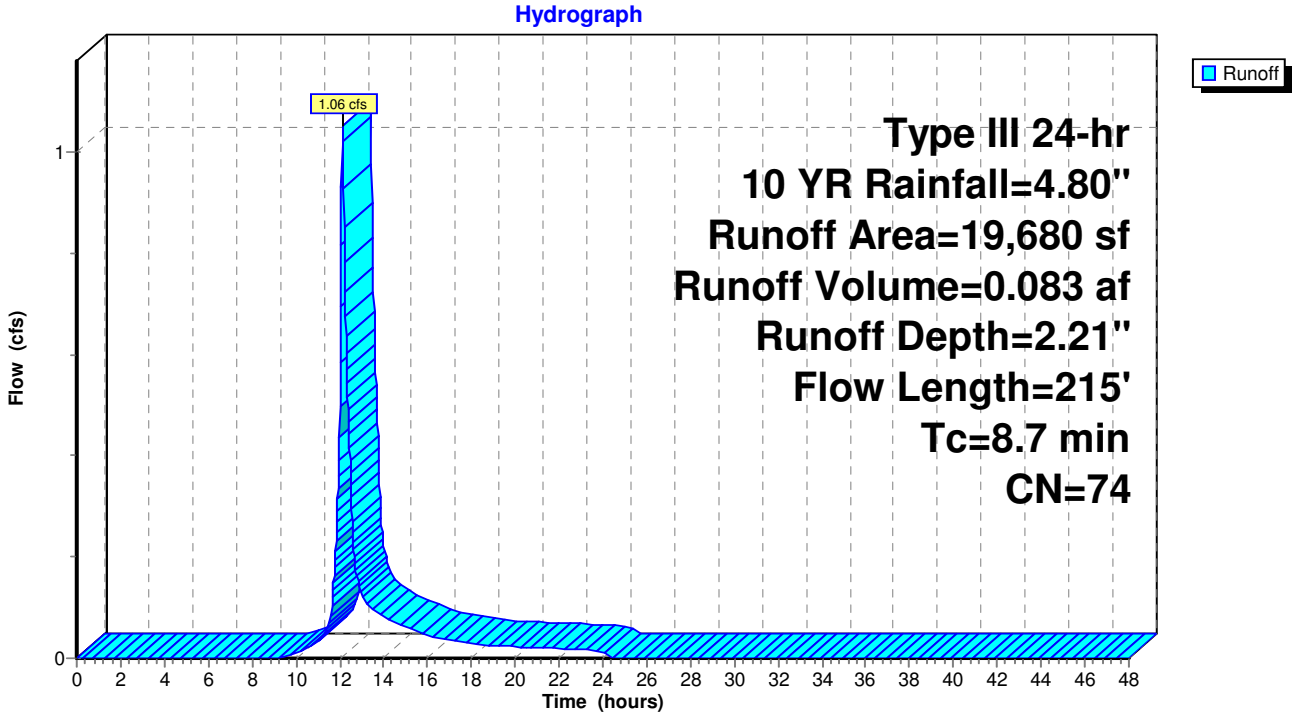
Runoff = 1.06 cfs @ 12.13 hrs, Volume= 0.083 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
19,500	74	>75% Grass cover, Good, HSG C
180	70	Woods, Good, HSG C
19,680	74	Weighted Average
19,680		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.9	165	0.0390	3.18		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.7	215	Total			

Subcatchment PRE-15: Existing DaRosa Lot to Existing Detention Basin



Summary for Subcatchment PRE-16: Portion of Existing Lot 11 to Existing Stream

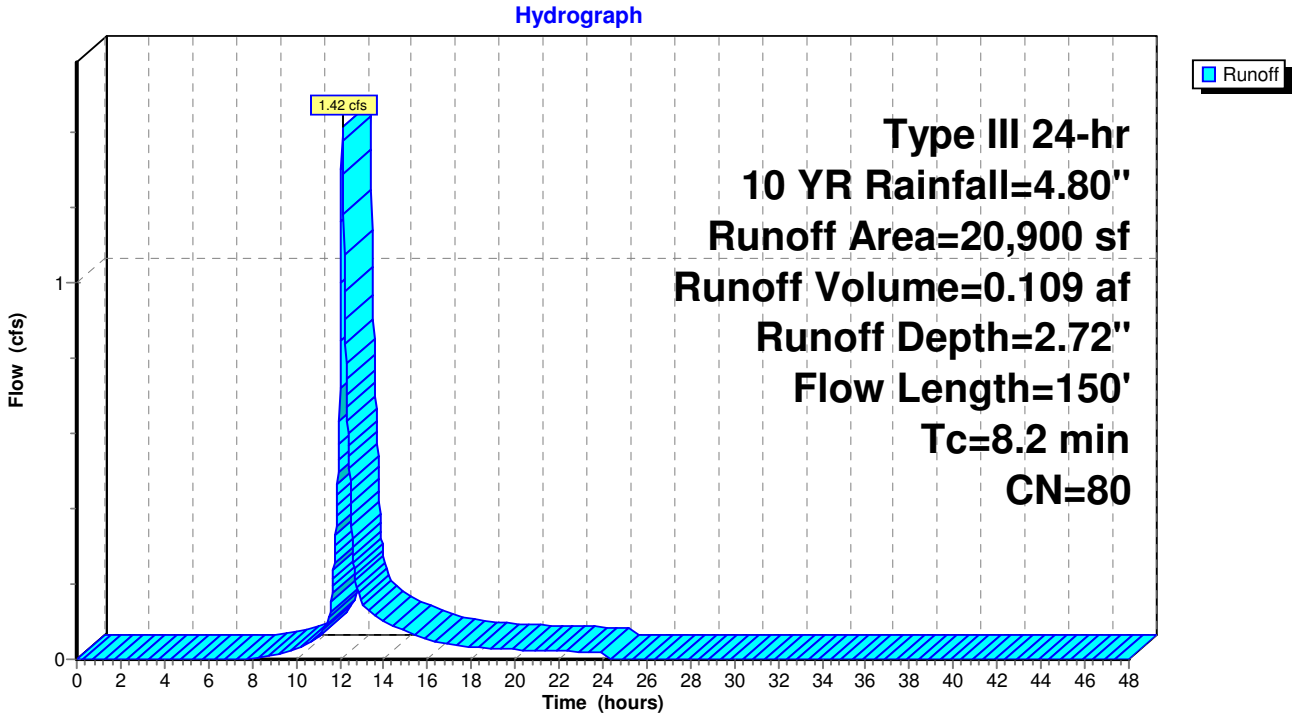
Runoff = 1.42 cfs @ 12.12 hrs, Volume= 0.109 af, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
20,900	80	>75% Grass cover, Good, HSG D
20,900		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.4	100	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.2	150	Total			

Subcatchment PRE-16: Portion of Existing Lot 11 to Existing Stream



Summary for Subcatchment PRE-17: Lot 11 Remaining Area to Swale

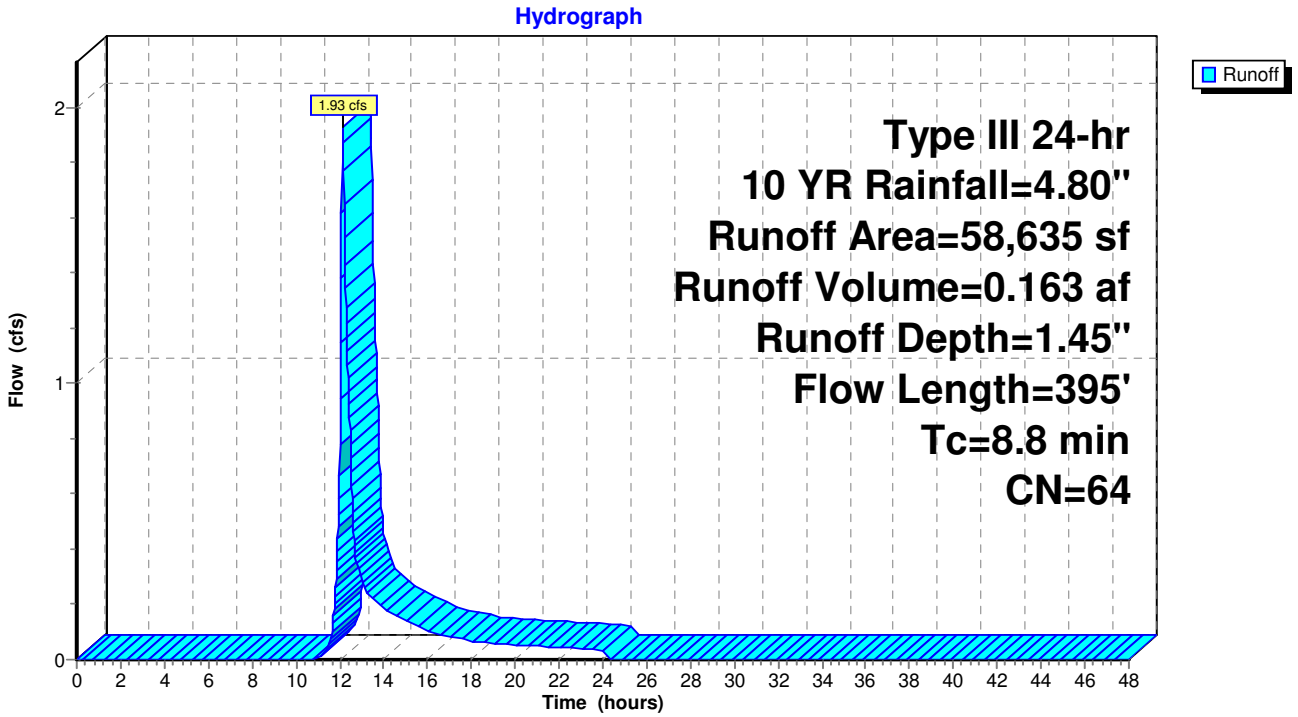
Runoff = 1.93 cfs @ 12.14 hrs, Volume= 0.163 af, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
318	39	>75% Grass cover, Good, HSG A
47,126	61	>75% Grass cover, Good, HSG B
6,212	80	>75% Grass cover, Good, HSG D
1,095	55	Woods, Good, HSG B
3,884	77	Woods, Good, HSG D
58,635	64	Weighted Average
58,635		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0300	0.13		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.2	205	0.0290	2.74		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.9	140	0.0290	2.55		**Shallow Concentrated Flow, C-D** Grassed Waterway Kv= 15.0 fps
8.8	395	Total			

Subcatchment PRE-17: Lot 11 Remaining Area to Swale



Summary for Subcatchment PRE-18: Lot 11 Unattenuated to Wetland System Through Stream

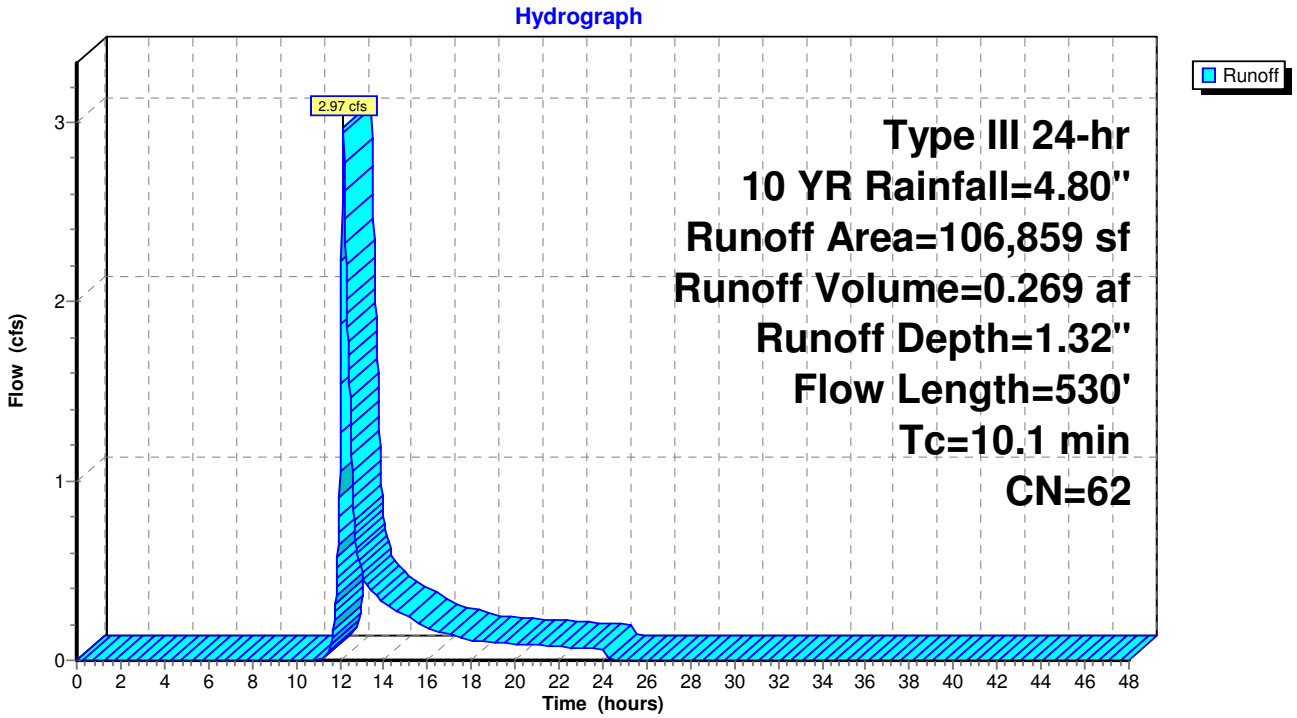
Runoff = 2.97 cfs @ 12.16 hrs, Volume= 0.269 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
102,707	61	>75% Grass cover, Good, HSG B
3,076	80	>75% Grass cover, Good, HSG D
848	55	Woods, Good, HSG B
228	77	Woods, Good, HSG D
106,859	62	Weighted Average
106,859		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0300	0.13		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
3.4	480	0.0210	2.33		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
10.1	530	Total			

Subcatchment PRE-18: Lot 11 Unattenuated to Wetland System Through Stream



Summary for Subcatchment PRE-19: Lot 9 Upland Areas

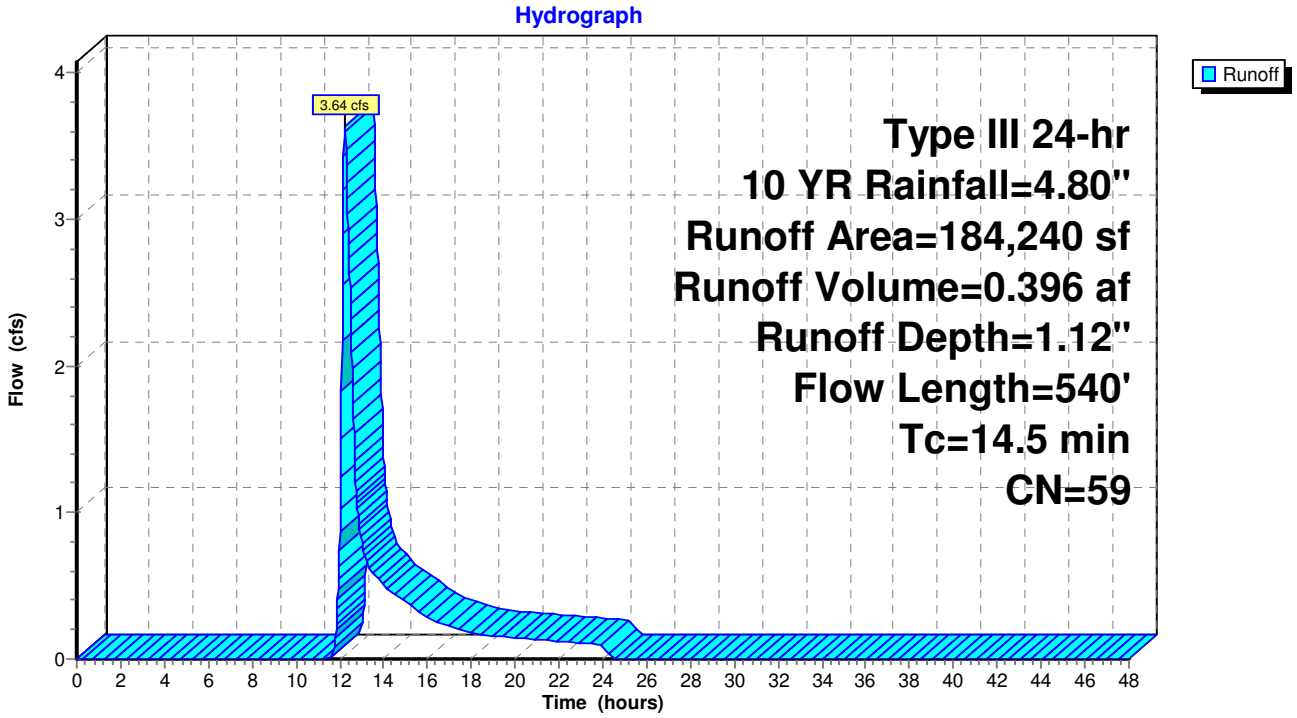
Runoff = 3.64 cfs @ 12.23 hrs, Volume= 0.396 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
39,080	30	Meadow, non-grazed, HSG A
96,780	71	Meadow, non-grazed, HSG C
4,760	78	Meadow, non-grazed, HSG D
19,930	30	Woods, Good, HSG A
3,730	70	Woods, Good, HSG C
19,960	77	Woods, Good, HSG D
184,240	59	Weighted Average
184,240		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0200	0.17		**Sheet Flow, A-B** Range n= 0.130 P2= 3.50"
7.8	365	0.0123	0.78		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
1.9	125	0.0248	1.10		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
14.5	540	Total			

Subcatchment PRE-19: Lot 9 Upland Areas



Summary for Subcatchment PRE-2: Rear Area of 73 Stevens St

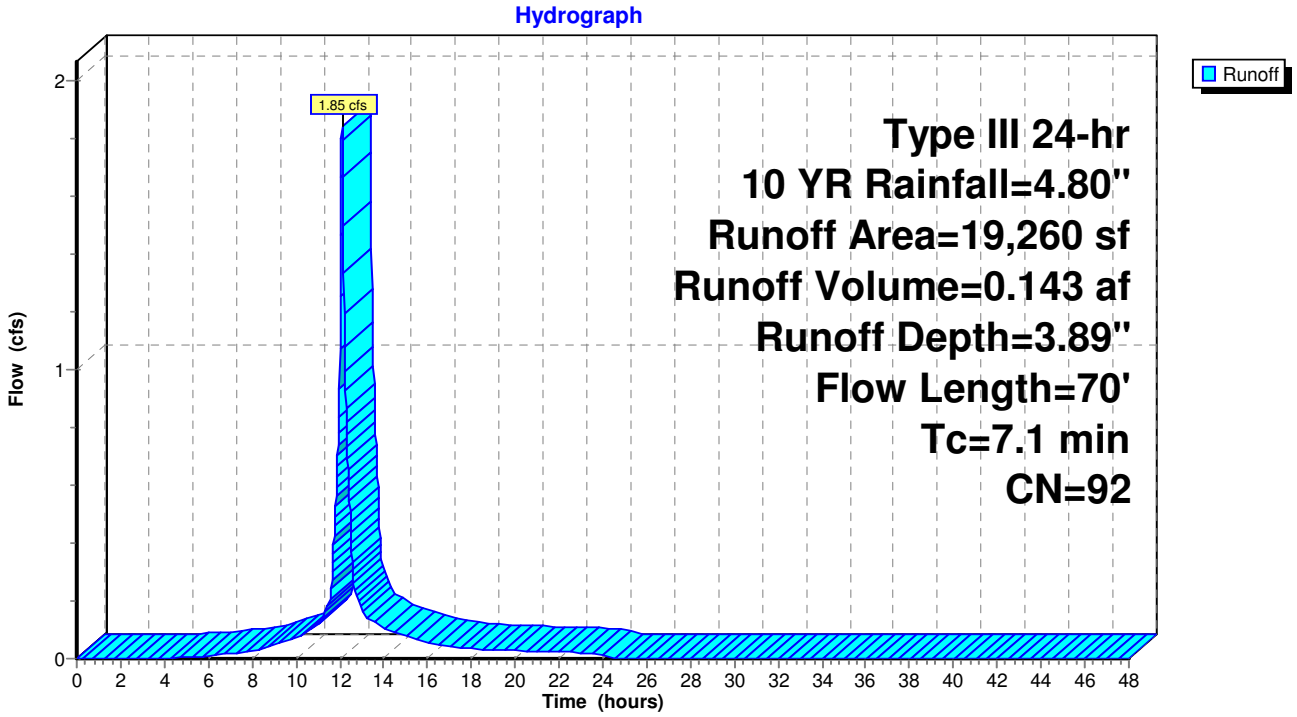
Runoff = 1.85 cfs @ 12.10 hrs, Volume= 0.143 af, Depth= 3.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
14,632	98	Paved parking & roofs
4,628	74	>75% Grass cover, Good, HSG C
19,260	92	Weighted Average
4,628		24.03% Pervious Area
14,632		75.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	20	0.0050	0.05		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.5	50	0.0080	1.82		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
7.1	70	Total			

Subcatchment PRE-2: Rear Area of 73 Stevens St



Summary for Subcatchment PRE-3: Unattenuated Areas to Wetlands Associated with Cotley River

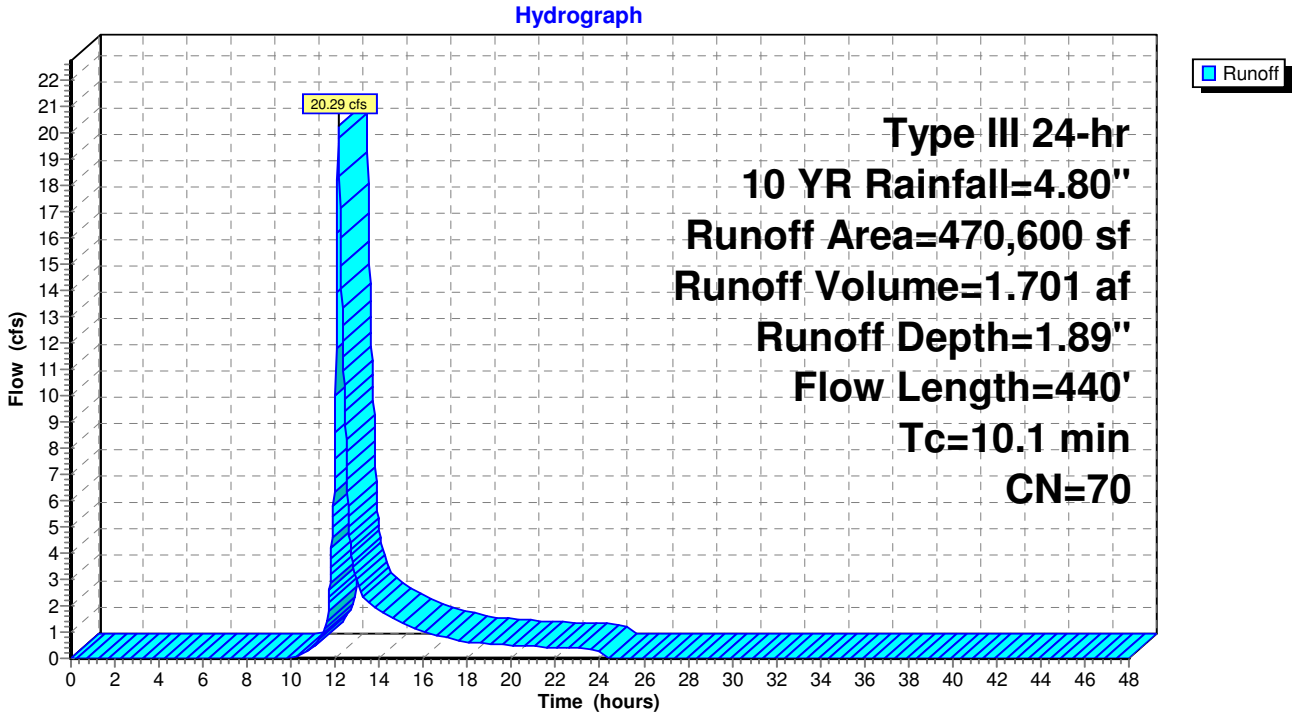
Runoff = 20.29 cfs @ 12.15 hrs, Volume= 1.701 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
13,744	61	>75% Grass cover, Good, HSG B
167,771	74	>75% Grass cover, Good, HSG C
472	80	>75% Grass cover, Good, HSG D
52,648	55	Woods, Good, HSG B
235,170	70	Woods, Good, HSG C
795	77	Woods, Good, HSG D
470,600	70	Weighted Average
470,600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.3	80	0.0560	3.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	60	0.1800	6.83		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
1.9	250	0.0190	2.22		**Shallow Concentrated Flow, D-E** Unpaved Kv= 16.1 fps
10.1	440	Total			

Subcatchment PRE-3: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment PRE-4: Maggiore 2, Common Driveway and Parking Areas

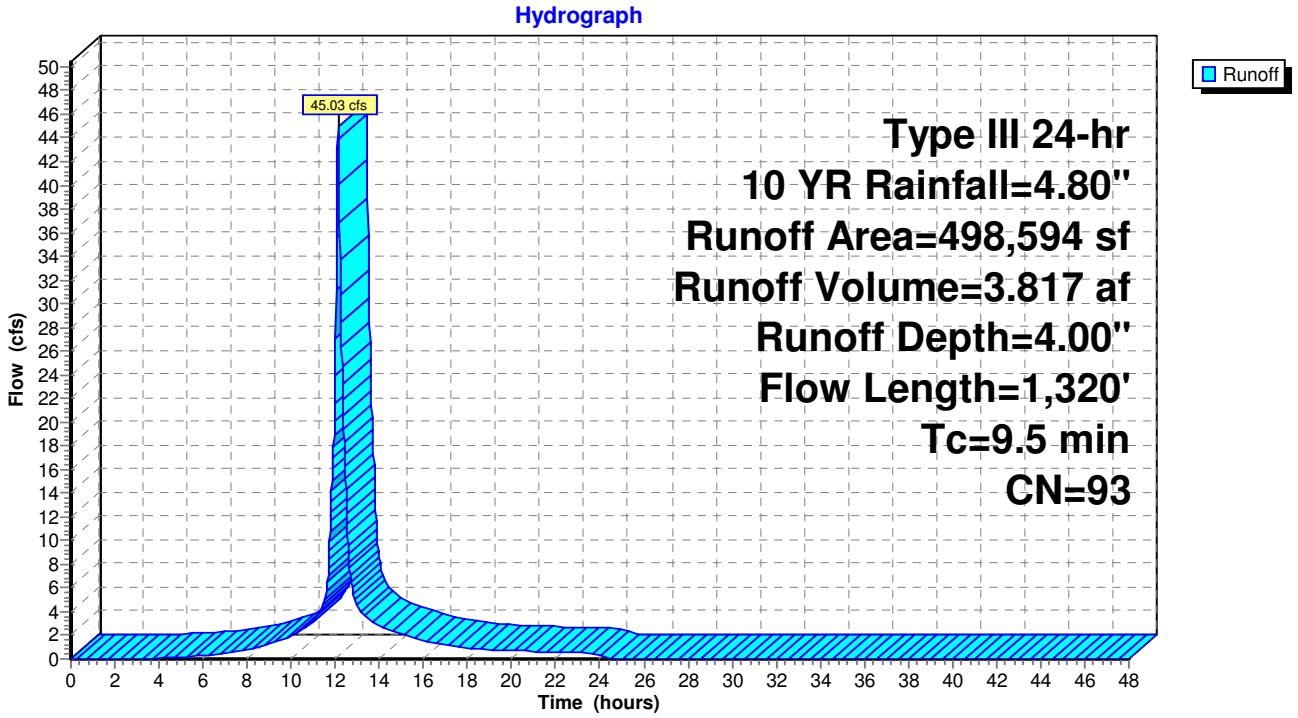
Runoff = 45.03 cfs @ 12.13 hrs, Volume= 3.817 af, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
341,295	98	Paved parking & roofs
60,601	89	Gravel roads, HSG C
25,888	98	Water Surface
70,810	74	>75% Grass cover, Good, HSG C
498,594	93	Weighted Average
131,411		26.36% Pervious Area
367,183		73.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0400	0.14		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.6	270	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
2.0	1,000	0.0100	8.36	41.02	**Pipe Channel, C-D** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013 Concrete pipe, bends & connections
9.5	1,320	Total			

Subcatchment PRE-4: Maggiore 2, Common Driveway and Parking Areas



Summary for Subcatchment PRE-5: Portion of Maggiore 1

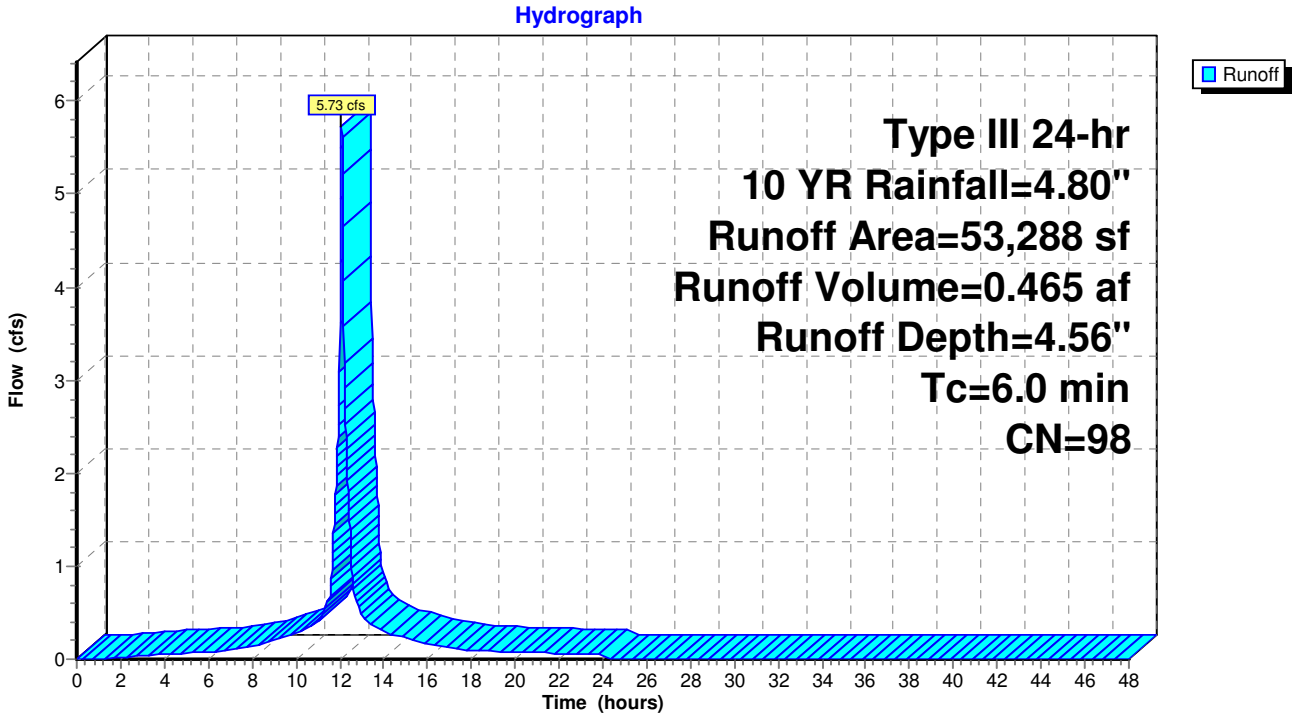
Runoff = 5.73 cfs @ 12.08 hrs, Volume= 0.465 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
53,288	98	Paved parking & roofs
53,288		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PRE-5: Portion of Maggiore 1



Summary for Subcatchment PRE-6: Loading Area of Maggiore 1

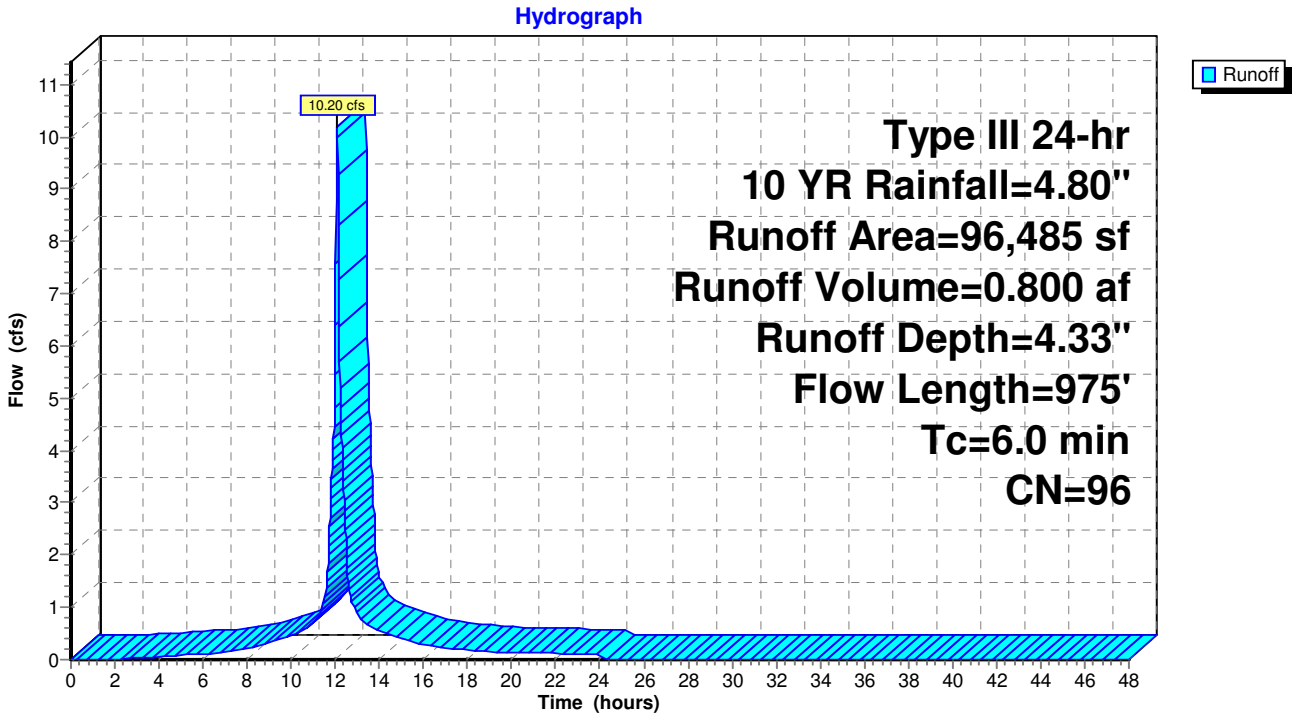
Runoff = 10.20 cfs @ 12.08 hrs, Volume= 0.800 af, Depth= 4.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
79,890	98	Paved parking & roofs
6,682	98	Water Surface
9,913	74	>75% Grass cover, Good, HSG C
96,485	96	Weighted Average
9,913		10.27% Pervious Area
86,572		89.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.25		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.50"
2.0	300	0.0150	2.49		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
1.9	625	0.0060	5.44	9.62	**Pipe Channel, C-D** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
4.6	975	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PRE-6: Loading Area of Maggiore 1



Summary for Subcatchment PRE-7: Unattenuated Areas to Wetlands Associated with Cotley River

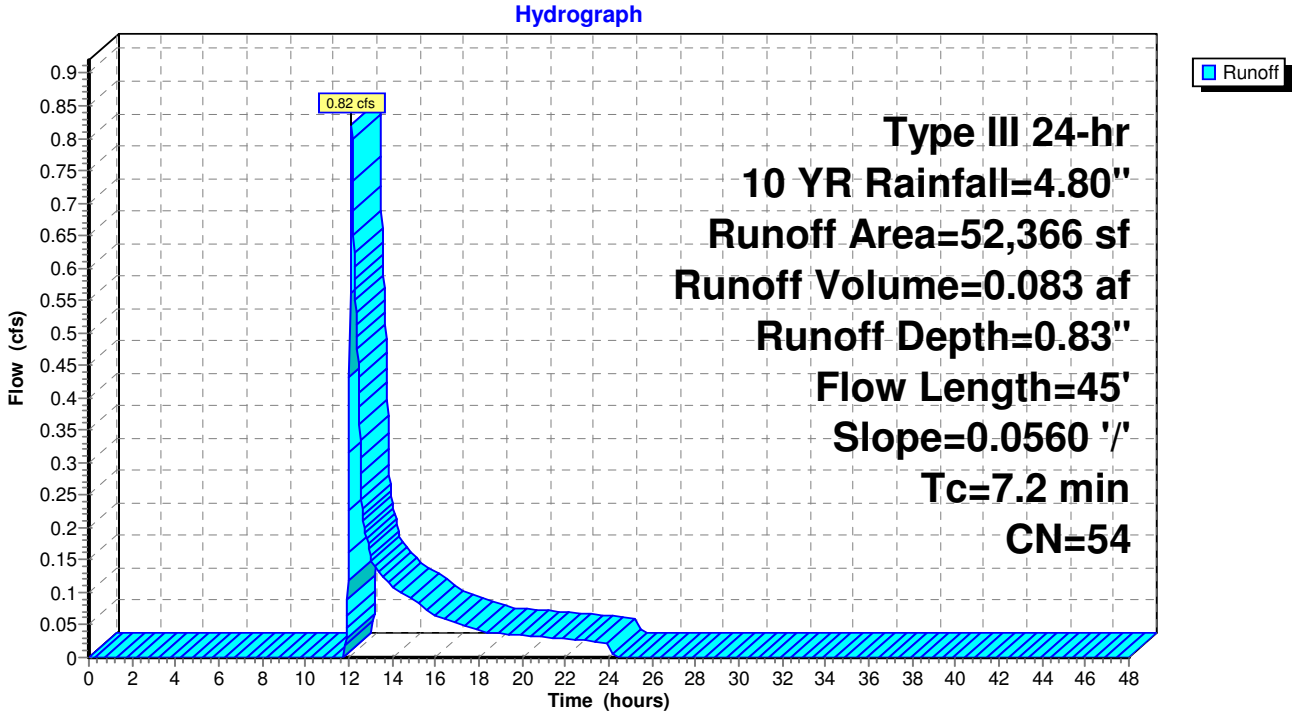
Runoff = 0.82 cfs @ 12.13 hrs, Volume= 0.083 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
18,717	39	>75% Grass cover, Good, HSG A
11,926	61	>75% Grass cover, Good, HSG B
7,879	80	>75% Grass cover, Good, HSG D
6,196	30	Woods, Good, HSG A
432	55	Woods, Good, HSG B
7,216	77	Woods, Good, HSG D
52,366	54	Weighted Average
52,366		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	45	0.0560	0.10		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.50"

Subcatchment PRE-7: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment PRE-8: O'Connell Way

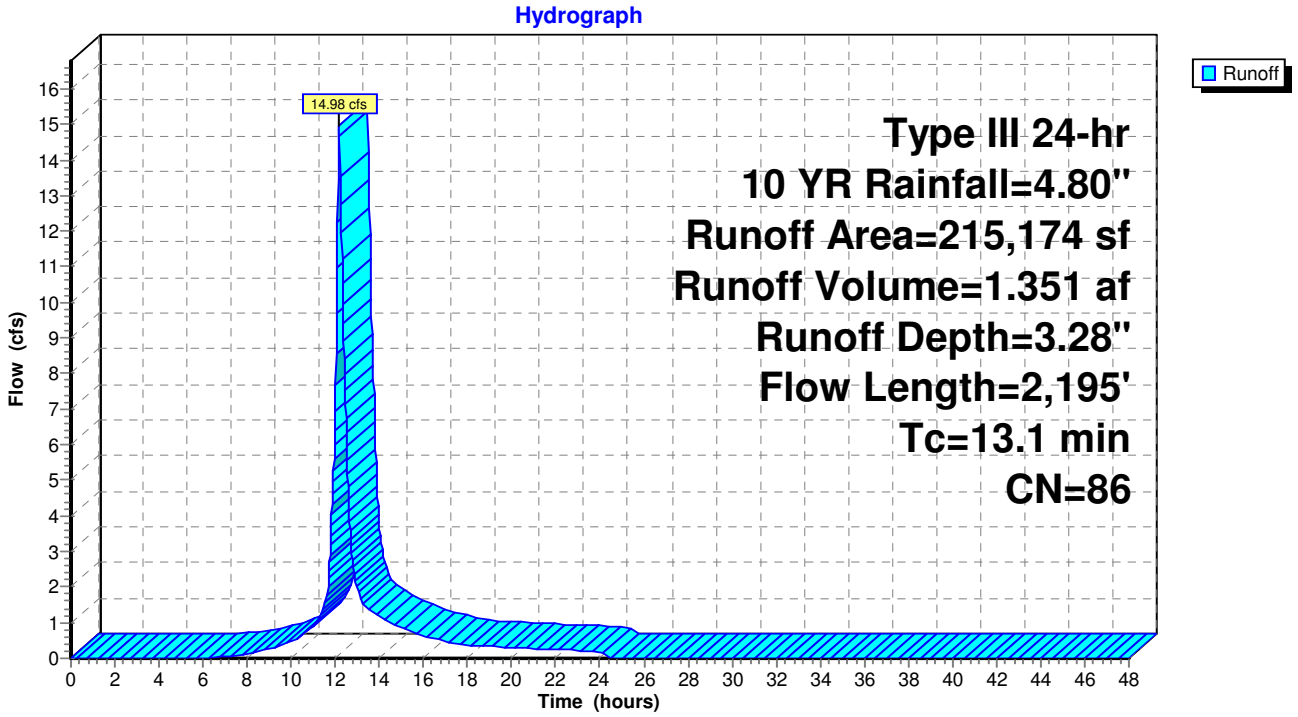
Runoff = 14.98 cfs @ 12.18 hrs, Volume= 1.351 af, Depth= 3.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
110,196	98	Paved parking & roofs
27,017	98	Water Surface
8,285	39	>75% Grass cover, Good, HSG A
31,759	61	>75% Grass cover, Good, HSG B
33,571	74	>75% Grass cover, Good, HSG C
4,346	80	>75% Grass cover, Good, HSG D
215,174	86	Weighted Average
77,961		36.23% Pervious Area
137,213		63.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	65	0.0460	0.16		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.3	230	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
4.9	1,900	0.0080	6.44	20.23	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
13.1	2,195	Total			

Subcatchment PRE-8: O'Connell Way



Summary for Subcatchment PRE-9: Front of 71 Stevens, Parking and Half Building

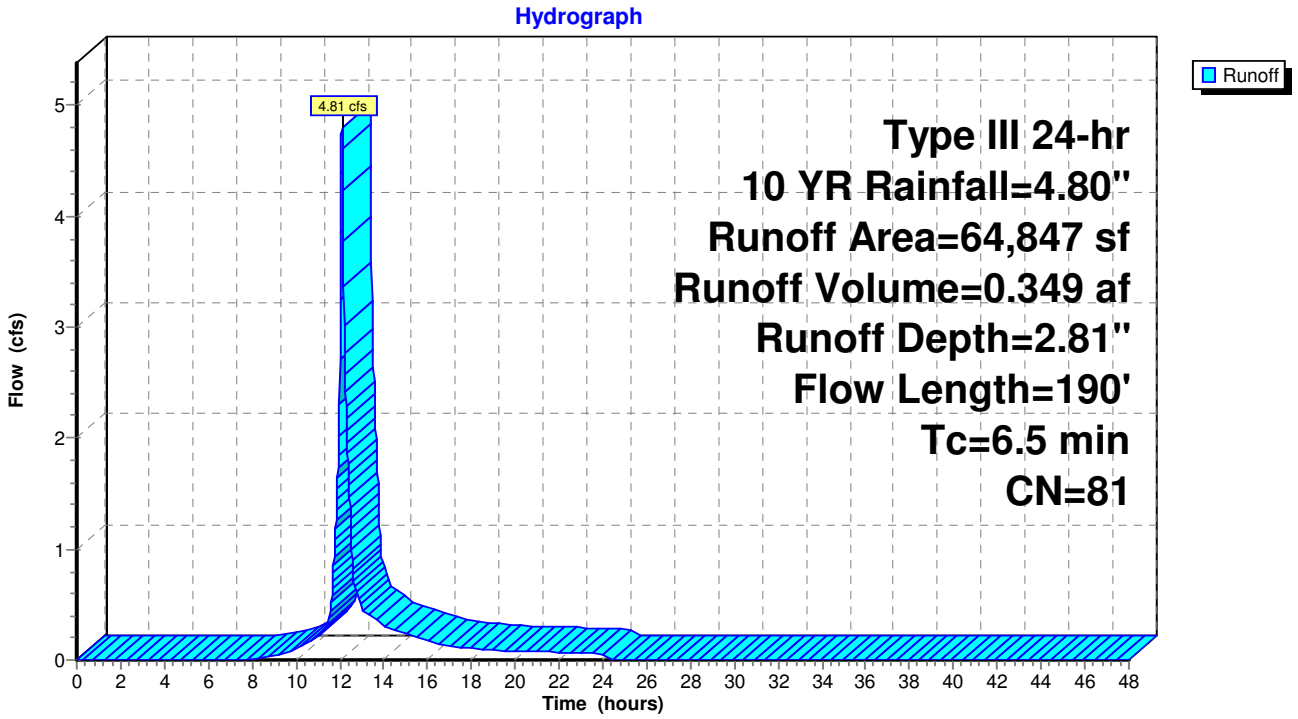
Runoff = 4.81 cfs @ 12.10 hrs, Volume= 0.349 af, Depth= 2.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

	Area (sf)	CN	Description
*	37,786	98	Paved Parking and New Driveway/Sidewalks
	12,548	39	>75% Grass cover, Good, HSG A
	14,513	74	>75% Grass cover, Good, HSG C
	64,847	81	Weighted Average
	27,061		41.73% Pervious Area
	37,786		58.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0400	0.14		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.2	50	0.0700	4.26		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.4	90	0.0400	4.06		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
6.5	190	Total			

Subcatchment PRE-9: Front of 71 Stevens, Parking and Half Building



Summary for Reach 1R: Grassed Swale

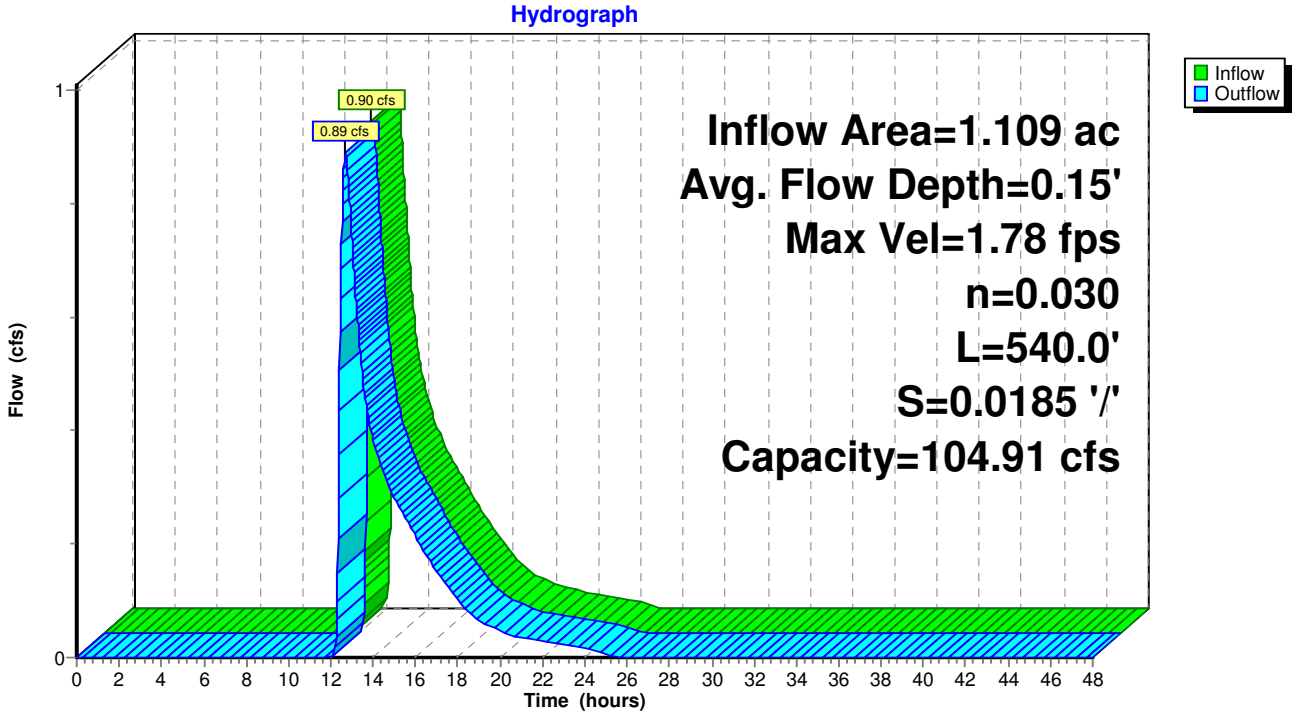
Inflow Area = 1.109 ac, 71.01% Impervious, Inflow Depth = 1.94" for 10 YR event
Inflow = 0.90 cfs @ 12.53 hrs, Volume= 0.180 af
Outflow = 0.89 cfs @ 12.68 hrs, Volume= 0.180 af, Atten= 1%, Lag= 8.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 1.78 fps, Min. Travel Time= 5.0 min
Avg. Velocity = 0.81 fps, Avg. Travel Time= 11.1 min

Peak Storage= 269 cf @ 12.60 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 104.91 cfs

3.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 540.0' Slope= 0.0185 '/'
Inlet Invert= 49.00', Outlet Invert= 39.00'

Reach 1R: Grassed Swale



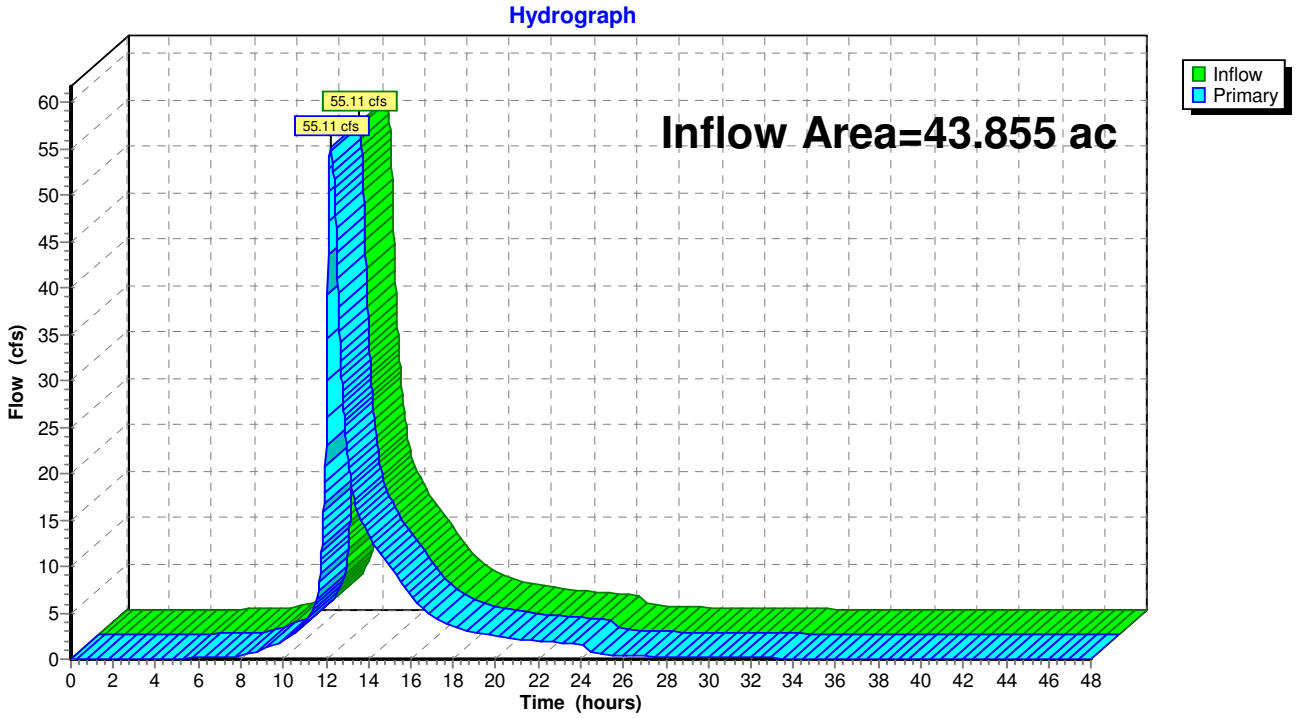
Summary for Pond AP-1: Wetlands South of O'Connell Way

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 43.855 ac, 40.90% Impervious, Inflow Depth > 2.63" for 10 YR event
Inflow = 55.11 cfs @ 12.22 hrs, Volume= 9.623 af
Primary = 55.11 cfs @ 12.22 hrs, Volume= 9.623 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-1: Wetlands South of O'Connell Way



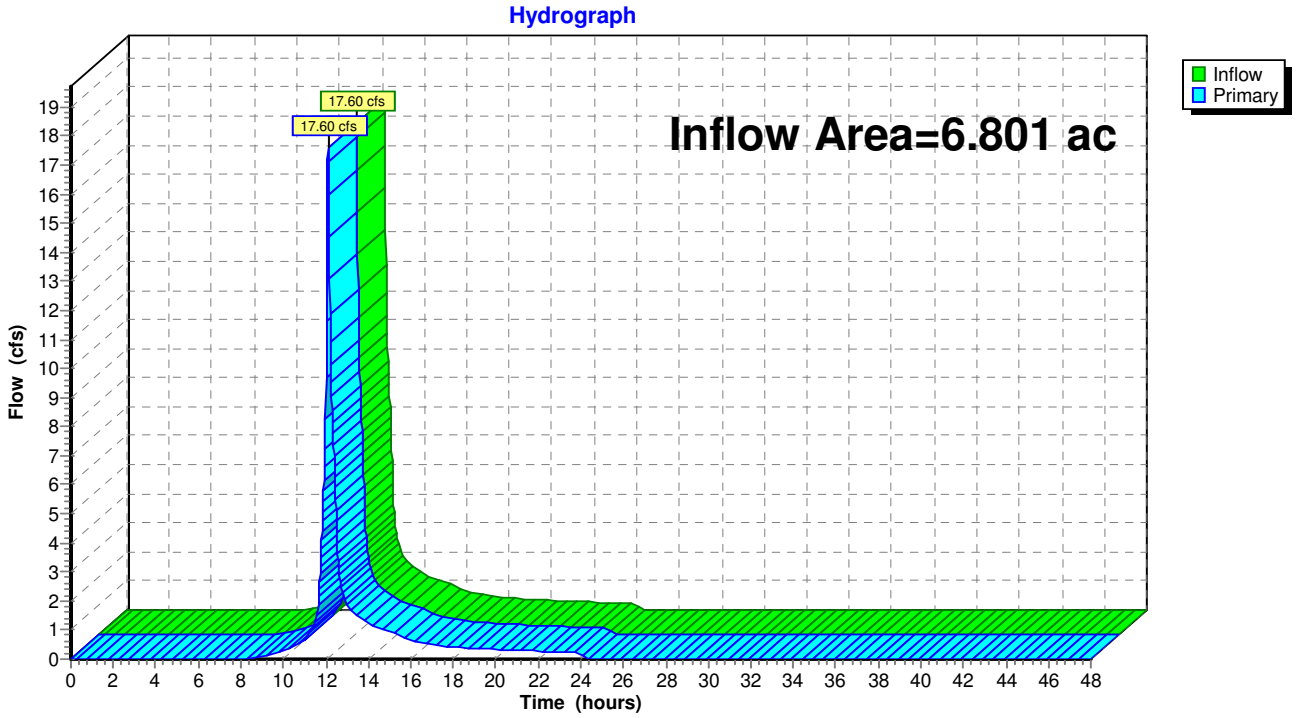
Summary for Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.801 ac, 23.66% Impervious, Inflow Depth = 2.32" for 10 YR event
Inflow = 17.60 cfs @ 12.10 hrs, Volume= 1.316 af
Primary = 17.60 cfs @ 12.10 hrs, Volume= 1.316 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11



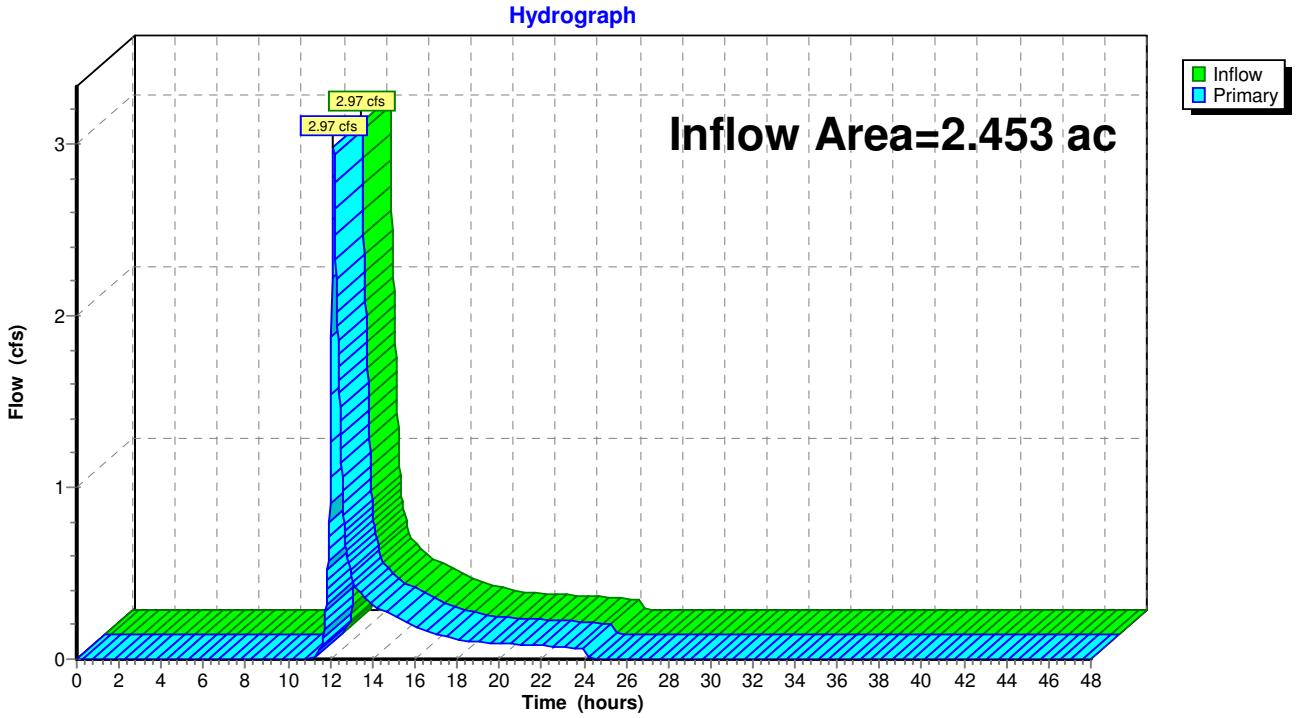
Summary for Pond AP-3: Existing Culvert Crossing at Crossroads

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =	2.453 ac,	0.00% Impervious,	Inflow Depth =	1.32"	for 10 YR event
Inflow =	2.97 cfs @	12.16 hrs,	Volume=	0.269 af	
Primary =	2.97 cfs @	12.16 hrs,	Volume=	0.269 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-3: Existing Culvert Crossing at Crossroads



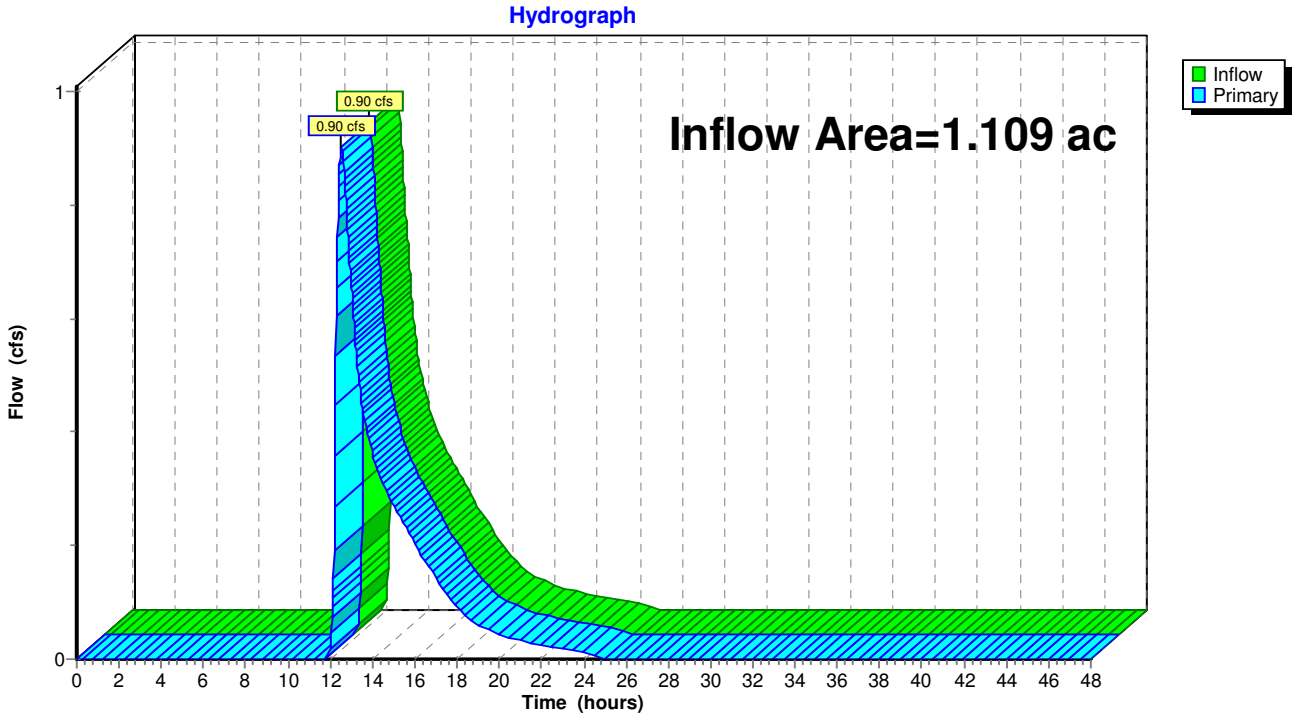
Summary for Pond FE-1: Flared End Outlet

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.109 ac, 71.01% Impervious, Inflow Depth = 1.94" for 10 YR event
Inflow = 0.90 cfs @ 12.53 hrs, Volume= 0.180 af
Primary = 0.90 cfs @ 12.53 hrs, Volume= 0.180 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond FE-1: Flared End Outlet



Summary for Pond POND-1: 73 Stevens St Front Recharge System

Inflow Area = 0.667 ac, 67.72% Impervious, Inflow Depth = 3.68" for 10 YR event
Inflow = 2.40 cfs @ 12.14 hrs, Volume= 0.205 af
Outflow = 0.72 cfs @ 12.53 hrs, Volume= 0.178 af, Atten= 70%, Lag= 23.1 min
Discarded = 0.03 cfs @ 10.88 hrs, Volume= 0.075 af
Primary = 0.70 cfs @ 12.53 hrs, Volume= 0.103 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 58.70' @ 12.53 hrs Surf.Area= 2,575 sf Storage= 4,396 cf

Plug-Flow detention time= 498.5 min calculated for 0.178 af (87% of inflow)
Center-of-Mass det. time= 440.0 min (1,236.3 - 796.3)

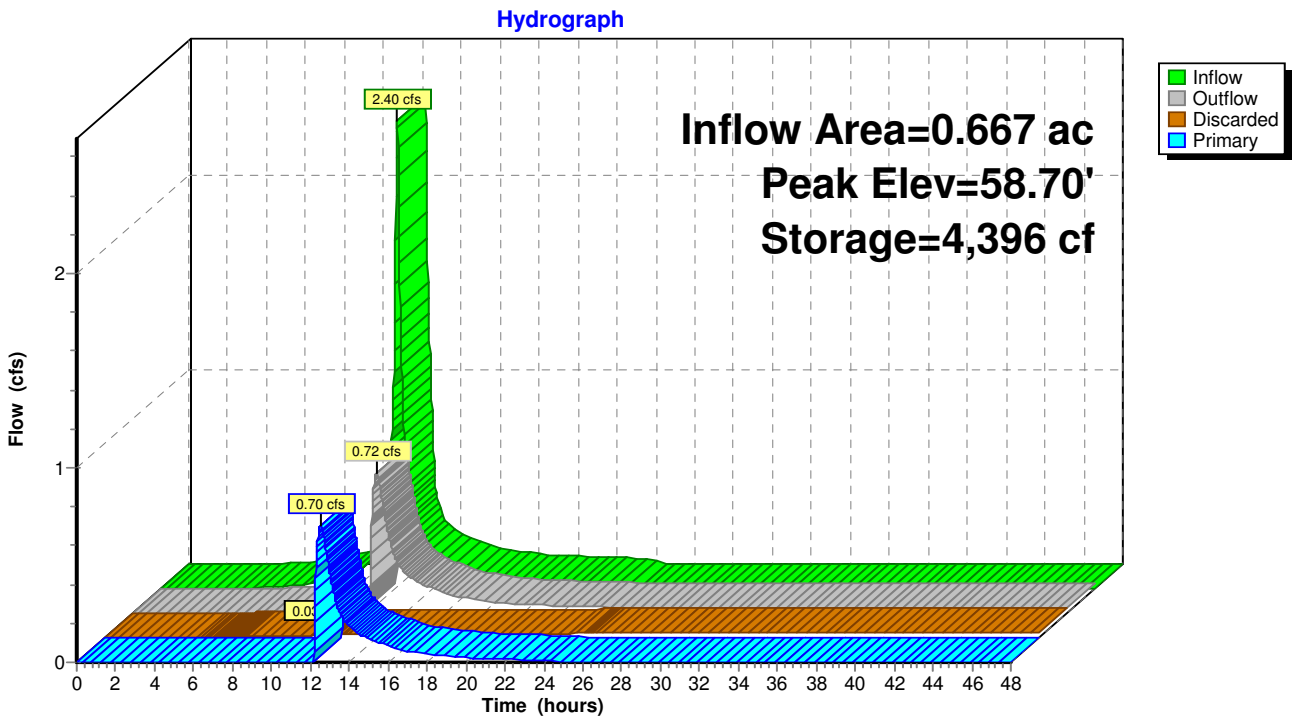
Volume	Invert	Avail.Storage	Storage Description
#1	56.90'	3,284 cf	**23.25'W x 110.00'L x 3.21'H Prismatoid** 8,210 cf Overall x 40.0% Voids
#2	56.40'	2,550 cf	**Cultec R-280** x 60 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
		5,834 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	57.90'	**12.0" Round Culvert** L= 175.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 57.90' / 56.15' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	57.90'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	59.40'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.5' Crest Height
#4	Discarded	56.40'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 10.88 hrs HW=56.90' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.70 cfs @ 12.53 hrs HW=58.70' (Free Discharge)
└─**1=Culvert** (Passes 0.70 cfs of 2.07 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.70 cfs @ 3.58 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-1: 73 Stevens St Front Recharge System



Summary for Pond POND-2: 73 Stevens St Rear Recharge System

Inflow Area =	0.442 ac, 75.97% Impervious, Inflow Depth = 3.89" for 10 YR event				
Inflow =	1.85 cfs @	12.10 hrs,	Volume=	0.143 af	
Outflow =	0.22 cfs @	12.74 hrs,	Volume=	0.143 af,	Atten= 88%, Lag= 38.7 min
Discarded =	0.02 cfs @	39.60 hrs,	Volume=	0.066 af	
Primary =	0.20 cfs @	12.74 hrs,	Volume=	0.077 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 56.99' @ 12.74 hrs Surf.Area= 3,158 sf Storage= 3,315 cf

Plug-Flow detention time= 436.6 min calculated for 0.143 af (100% of inflow)
Center-of-Mass det. time= 434.5 min (1,219.5 - 785.0)

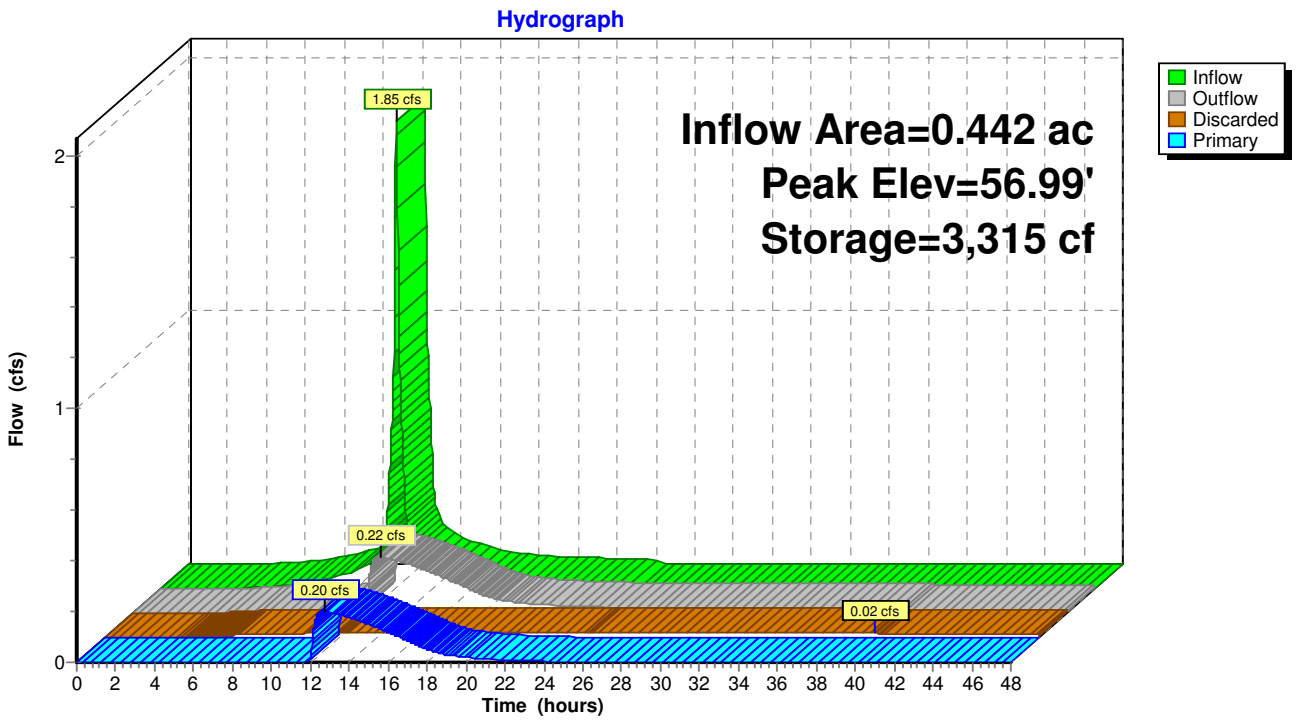
Volume	Invert	Avail.Storage	Storage Description
#1	55.15'	2,632 cf	**10.25'W x 200.00'L x 3.21'H Prismatoid** 6,581 cf Overall x 40.0% Voids
#2	55.65'	2,380 cf	**Cultec R-280** x 56 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
		5,012 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	56.15'	**12.0" Round Culvert** L= 90.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 56.15' / 55.45' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	56.15'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	57.55'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.5' Crest Height
#4	Discarded	55.15'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 39.60 hrs HW=55.65' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.20 cfs @ 12.74 hrs HW=56.99' (Free Discharge)
└─**1=Culvert** (Passes 0.20 cfs of 2.03 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.20 cfs @ 4.07 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-2: 73 Stevens St Rear Recharge System



Summary for Pond POND-3: Maggiore Combined Detention Basin

Inflow Area = 11.446 ac, 73.64% Impervious, Inflow Depth = 4.00" for 10 YR event
Inflow = 45.03 cfs @ 12.13 hrs, Volume= 3.817 af
Outflow = 19.24 cfs @ 12.38 hrs, Volume= 3.812 af, Atten= 57%, Lag= 15.3 min
Primary = 19.24 cfs @ 12.38 hrs, Volume= 3.812 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 33.00' @ 12.38 hrs Surf.Area= 28,873 sf Storage= 53,062 cf

Plug-Flow detention time= 83.1 min calculated for 3.812 af (100% of inflow)
Center-of-Mass det. time= 82.2 min (865.0 - 782.8)

Volume	Invert	Avail.Storage	Storage Description
#1	30.00'	117,074 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

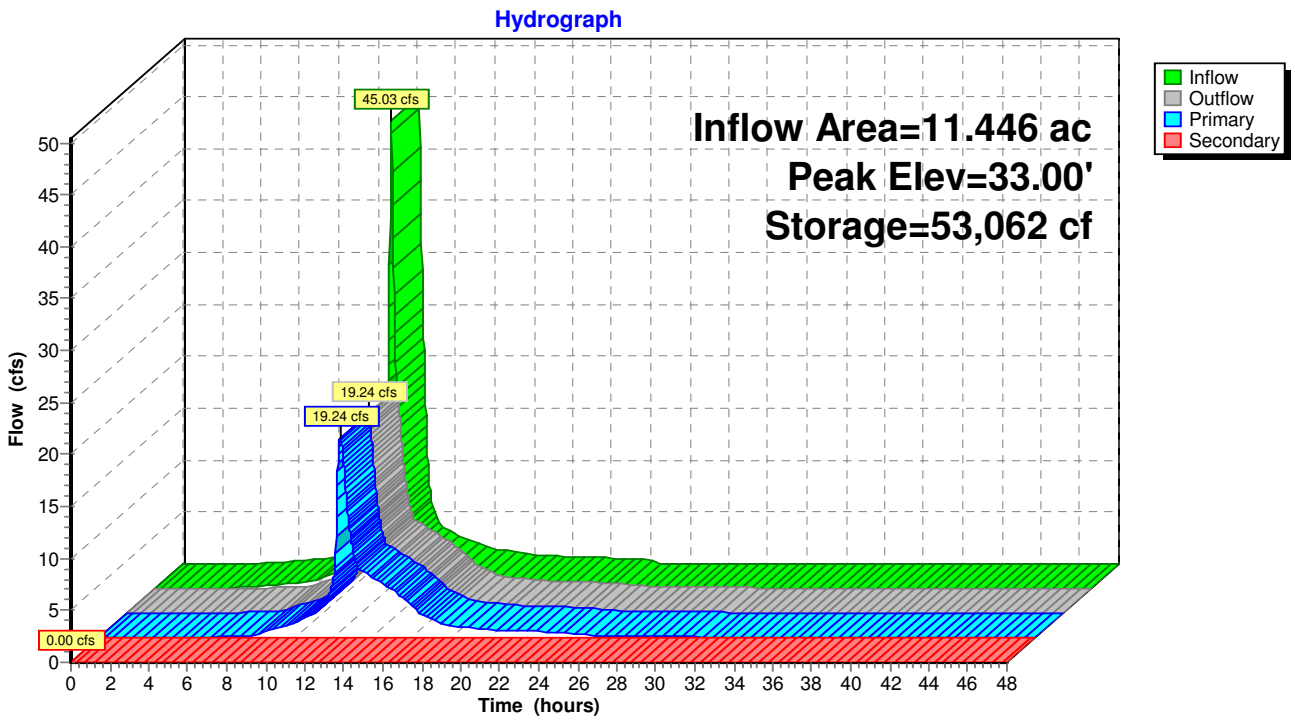
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
30.00	402	0	0
31.00	12,578	6,490	6,490
32.00	25,888	19,233	25,723
33.00	28,878	27,383	53,106
34.00	31,850	30,364	83,470
35.00	35,357	33,604	117,074

Device	Routing	Invert	Outlet Devices
#1	Primary	29.25'	**18.0" Round Culvert X 2.00** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 28.20' / 29.25' S= -0.0210 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	30.14'	**2.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 1	30.64'	**10.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	32.42'	**4.0' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s) 2.0' Crest Height
#5	Secondary	34.25'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=19.23 cfs @ 12.38 hrs HW=33.00' (Free Discharge)
└─**1=Culvert** (Passes 19.23 cfs of 29.47 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.35 cfs @ 8.02 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 7.32 cfs @ 6.71 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Weir Controls 11.57 cfs @ 2.57 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=30.00' (Free Discharge)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-3: Maggiore Combined Detention Basin



Summary for Pond POND-4: Maggiore 1 Recharge System

Inflow Area =	1.223 ac,100.00% Impervious, Inflow Depth = 4.56" for 10 YR event				
Inflow =	5.73 cfs @	12.08 hrs,	Volume=	0.465 af	
Outflow =	0.49 cfs @	12.98 hrs,	Volume=	0.465 af,	Atten= 91%, Lag= 53.5 min
Discarded =	0.22 cfs @	20.48 hrs,	Volume=	0.428 af	
Primary =	0.28 cfs @	12.98 hrs,	Volume=	0.037 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 44.33' @ 12.98 hrs Surf.Area= 11,388 sf Storage= 10,073 cf

Plug-Flow detention time= 384.2 min calculated for 0.465 af (100% of inflow)
Center-of-Mass det. time= 384.2 min (1,132.9 - 748.7)

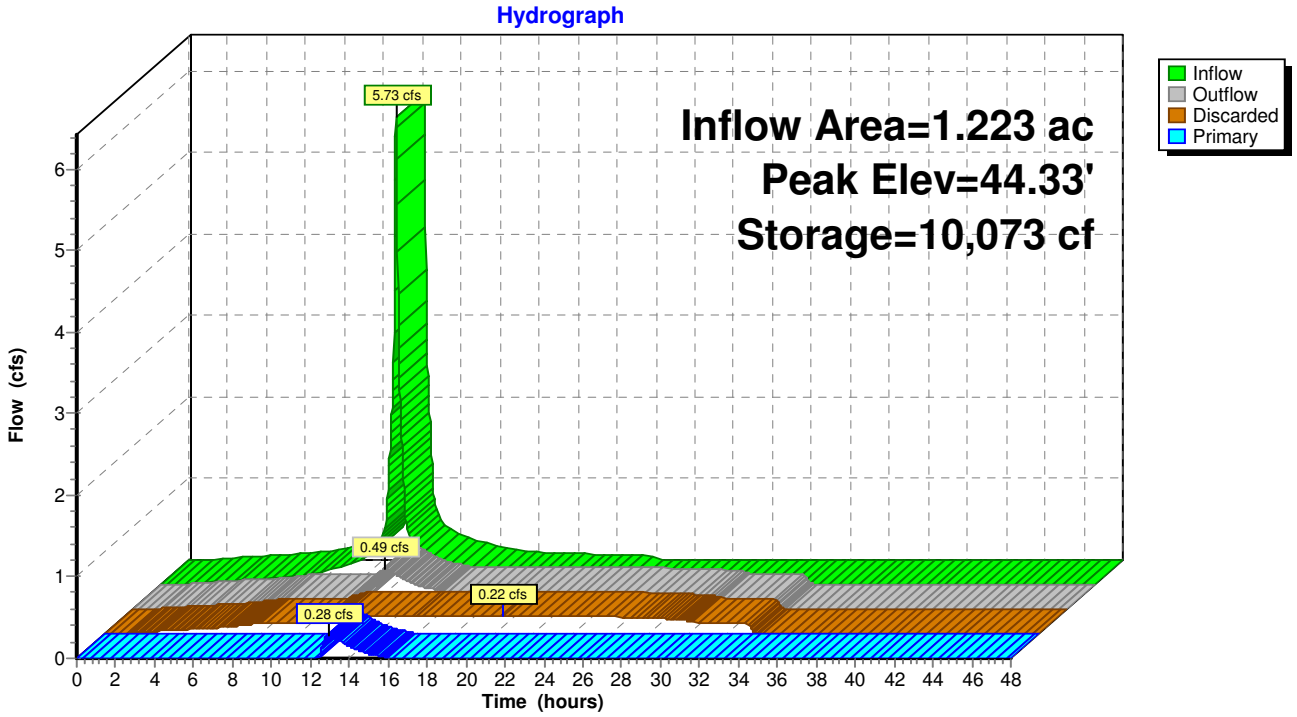
Volume	Invert	Avail.Storage	Storage Description
#1	42.50'	7,420 cf	**53.00'W x 140.00'L x 2.50'H Prismatoid** 18,550 cf Overall x 40.0% Voids
#2	43.00'	6,597 cf	**24.0" Round Pipe Storage** x 15 L= 140.0'
		14,017 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	42.00'	**12.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 42.00' / 41.25' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	44.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.5' Crest Height
#3	Discarded	42.50'	**0.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.22 cfs @ 20.48 hrs HW=44.00' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.22 cfs)

Primary OutFlow Max=0.28 cfs @ 12.98 hrs HW=44.33' (Free Discharge)
└─**1=Culvert** (Passes 0.28 cfs of 5.11 cfs potential flow)
  └─**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.28 cfs @ 0.92 fps)

Pond POND-4: Maggiore 1 Recharge System



Summary for Pond POND-5: Maggiore 1 Detention Basin

Inflow Area = 3.438 ac, 93.38% Impervious, Inflow Depth = 2.92" for 10 YR event
Inflow = 10.20 cfs @ 12.08 hrs, Volume= 0.837 af
Outflow = 6.24 cfs @ 12.19 hrs, Volume= 0.828 af, Atten= 39%, Lag= 6.1 min
Primary = 6.24 cfs @ 12.19 hrs, Volume= 0.828 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 40.59' @ 12.19 hrs Surf.Area= 7,405 sf Storage= 10,162 cf

Plug-Flow detention time= 116.6 min calculated for 0.828 af (99% of inflow)
Center-of-Mass det. time= 109.4 min (875.2 - 765.8)

Volume	Invert	Avail.Storage	Storage Description
#1	38.50'	21,749 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

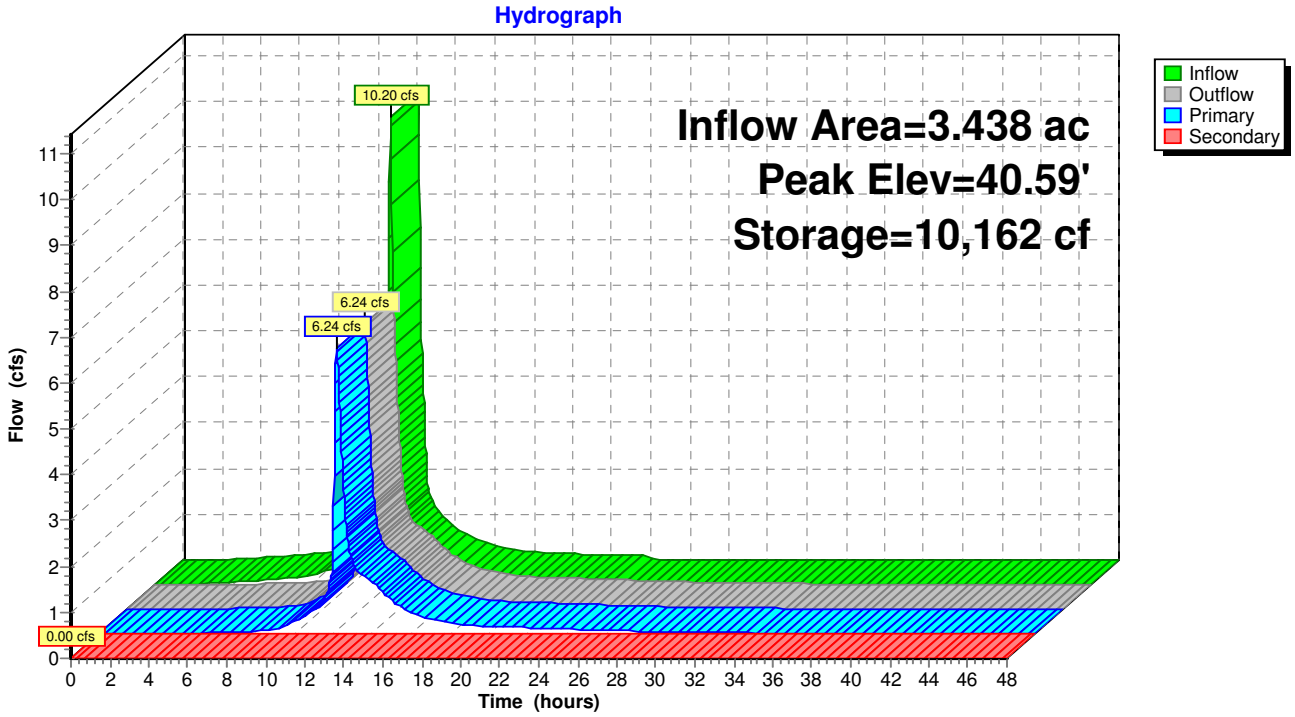
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.50	1,000	0	0
39.00	3,213	1,053	1,053
40.00	6,682	4,948	6,001
41.00	7,905	7,294	13,294
42.00	9,005	8,455	21,749

Device	Routing	Invert	Outlet Devices
#1	Primary	38.50'	**24.0" Round Culvert** L= 20.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.50' / 38.29' S= 0.0105 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	38.74'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	39.24'	**8.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	40.11'	**4.0' long x 1.75' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.7' Crest Height
#5	Secondary	40.95'	**10.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=6.23 cfs @ 12.19 hrs HW=40.59' (Free Discharge)
└─**1=Culvert** (Passes 6.23 cfs of 13.95 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.14 cfs @ 6.40 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 1.69 cfs @ 4.85 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Weir Controls 4.39 cfs @ 2.34 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.50' (Free Discharge)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-5: Maggiore 1 Detention Basin



Summary for Pond POND-6: O'Connell Way Detention Basin

Inflow Area = 6.286 ac, 50.11% Impervious, Inflow Depth = 2.89" for 10 YR event
Inflow = 16.78 cfs @ 12.17 hrs, Volume= 1.513 af
Outflow = 6.26 cfs @ 12.54 hrs, Volume= 1.409 af, Atten= 63%, Lag= 21.9 min
Primary = 6.26 cfs @ 12.54 hrs, Volume= 1.409 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 23.07' @ 12.54 hrs Surf.Area= 27,454 sf Storage= 27,000 cf

Plug-Flow detention time= 177.4 min calculated for 1.408 af (93% of inflow)
Center-of-Mass det. time= 141.5 min (960.2 - 818.6)

Volume	Invert	Avail.Storage	Storage Description
#1	22.00'	149,253 cf	**Custom Stage Data (Prismatic)** Listed below

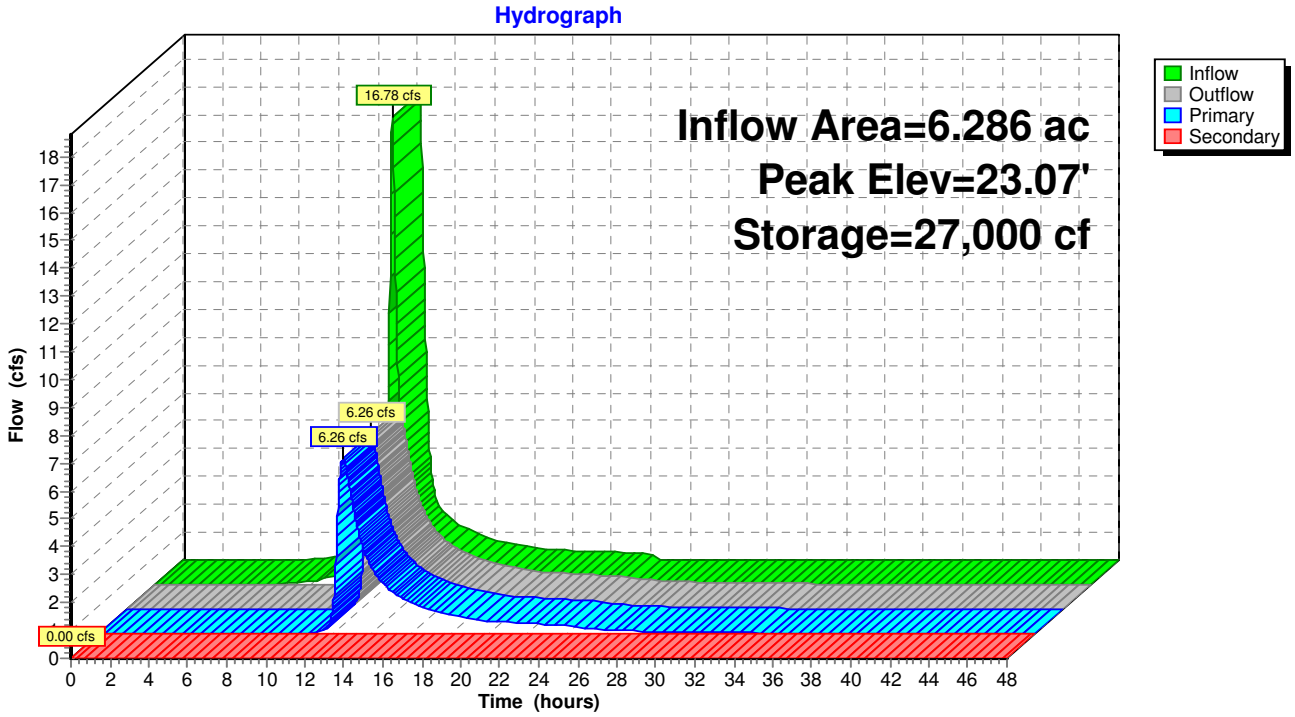
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
22.00	22,688	0	0
23.00	27,133	24,911	24,911
24.00	31,645	29,389	54,300
25.00	36,863	34,254	88,554
26.00	40,469	38,666	127,220
26.50	47,663	22,033	149,253

Device	Routing	Invert	Outlet Devices
#1	Primary	22.15'	**24.0" Round Culvert X 2.00** L= 46.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 22.15' / 22.00' S= 0.0033 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	22.15'	**18.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 1	24.25'	**4.0' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s) 1.0' Crest Height
#4	Secondary	26.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=6.26 cfs @ 12.54 hrs HW=23.07' (Free Discharge)
└─**1=Culvert** (Barrel Controls 6.26 cfs @ 3.25 fps)
  ├─**2=Orifice/Grate** (Passes 6.26 cfs of 7.44 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=22.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-6: O'Connell Way Detention Basin



Summary for Pond POND-7: Existing Detention Basin on 71 Stevens Street

Inflow Area = 2.892 ac, 50.18% Impervious, Inflow Depth = 2.81" for 10 YR event
Inflow = 8.90 cfs @ 12.11 hrs, Volume= 0.677 af
Outflow = 4.38 cfs @ 12.31 hrs, Volume= 0.677 af, Atten= 51%, Lag= 12.0 min
Primary = 4.19 cfs @ 12.31 hrs, Volume= 0.675 af
Secondary = 0.20 cfs @ 12.31 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 55.53' @ 12.31 hrs Surf.Area= 4,824 sf Storage= 6,275 cf

Plug-Flow detention time= 22.2 min calculated for 0.677 af (100% of inflow)
Center-of-Mass det. time= 22.2 min (844.8 - 822.6)

Volume	Invert	Avail.Storage	Storage Description
#1	54.00'	8,617 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

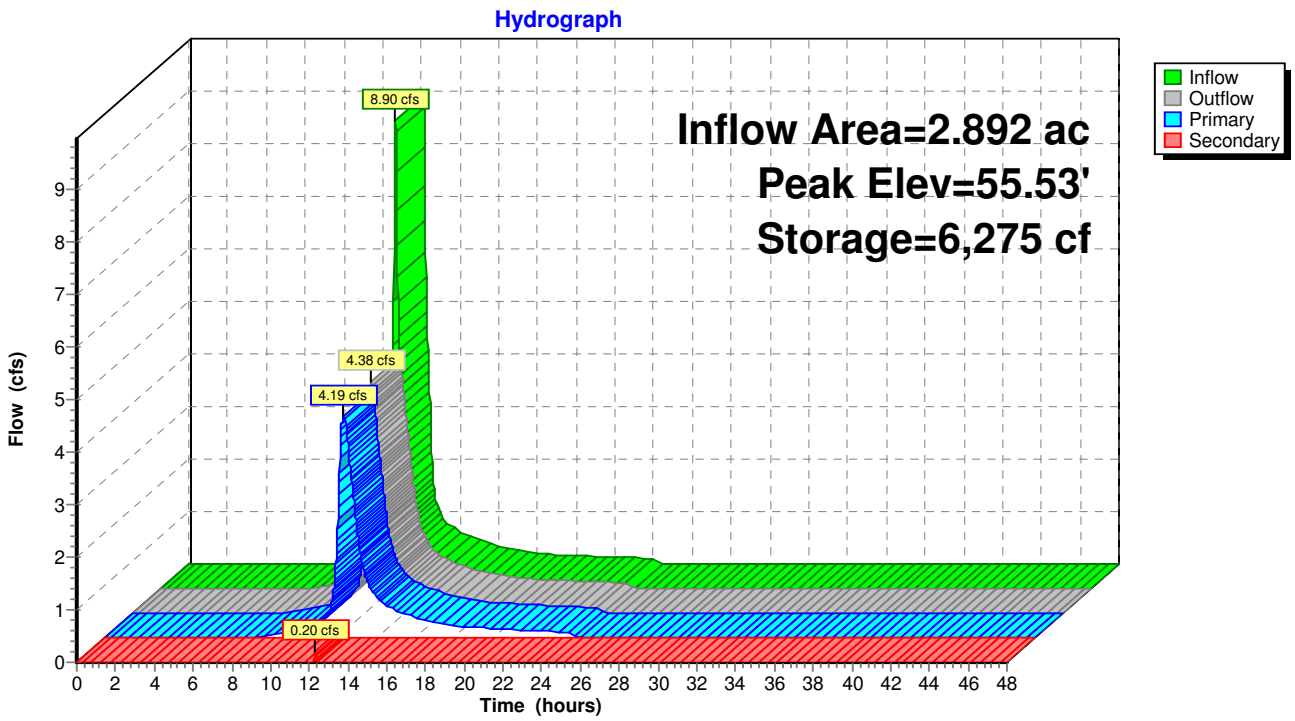
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
54.00	3,306	0	0
55.00	4,342	3,824	3,824
56.00	5,244	4,793	8,617

Device	Routing	Invert	Outlet Devices
#1	Primary	53.81'	**12.0" Round 12" HDPE** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.81' / 53.73' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Secondary	55.50'	**12.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.18 cfs @ 12.31 hrs HW=55.53' (Free Discharge)
└**1=12" HDPE** (Inlet Controls 4.18 cfs @ 5.33 fps)

Secondary OutFlow Max=0.19 cfs @ 12.31 hrs HW=55.53' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.19 cfs @ 0.46 fps)

Pond POND-7: Existing Detention Basin on 71 Stevens Street



Summary for Pond POND-8: Existing Detention Basin on DaRosa Lot

Proposed Detention Basin

Inflow Area =	0.452 ac,	0.00% Impervious,	Inflow Depth =	2.21"	for 10 YR event
Inflow =	1.06 cfs @	12.13 hrs,	Volume=	0.083 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= 0.02 hrs
Peak Elev= 43.40' @ 24.52 hrs Surf.Area= 2,981 sf Storage= 3,617 cf

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

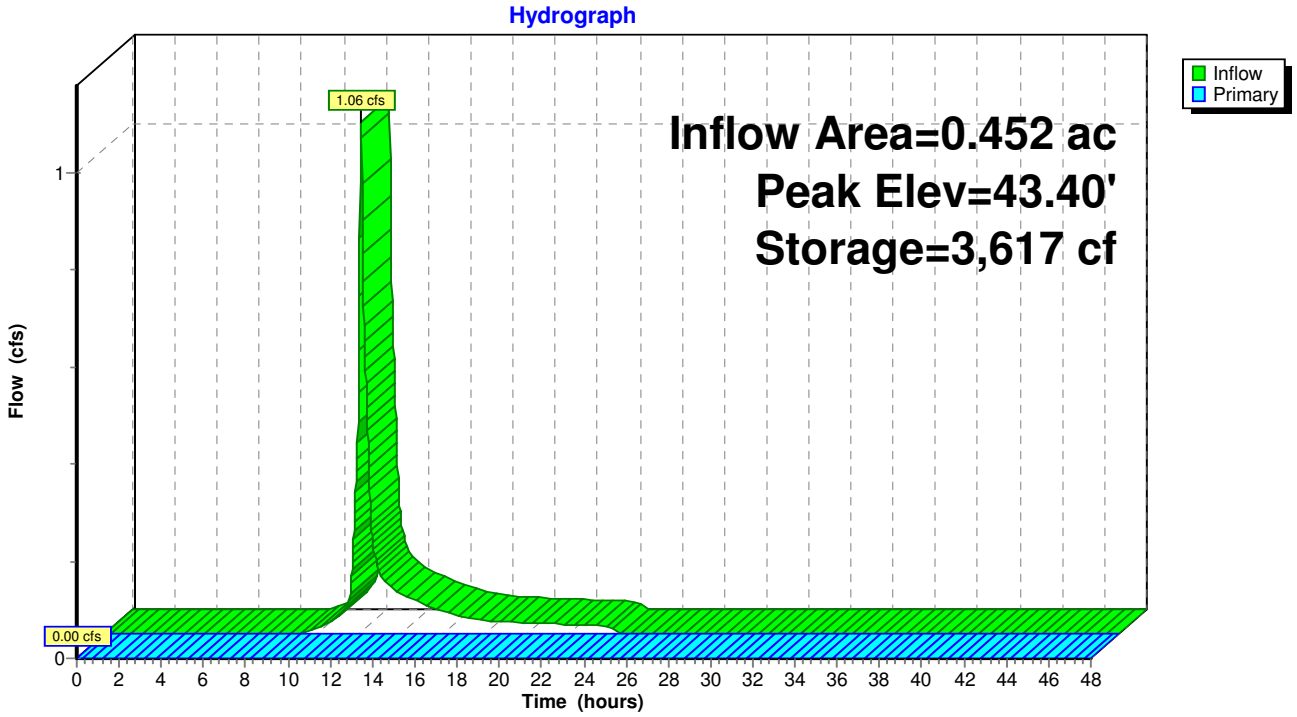
Volume	Invert	Avail.Storage	Storage Description
#1	42.00'	9,217 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
42.00	2,064	0	0
43.00	2,716	2,390	2,390
44.00	3,374	3,045	5,435
45.00	4,189	3,782	9,217

Device	Routing	Invert	Outlet Devices
#1	Primary	44.50'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=42.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-8: Existing Detention Basin on DaRosa Lot



Summary for Pond POND-9: Existing Culvert Crossing at 71 Stevens

Inflow Area = 5.340 ac, 44.13% Impervious, Inflow Depth = 2.73" for 10 YR event
Inflow = 10.17 cfs @ 12.12 hrs, Volume= 1.215 af
Outflow = 10.04 cfs @ 12.14 hrs, Volume= 1.215 af, Atten= 1%, Lag= 1.3 min
Primary = 10.04 cfs @ 12.14 hrs, Volume= 1.215 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 5
Peak Elev= 47.35' @ 12.14 hrs Surf.Area= 772 sf Storage= 723 cf

Plug-Flow detention time= 2.1 min calculated for 1.215 af (100% of inflow)
Center-of-Mass det. time= 2.1 min (838.9 - 836.8)

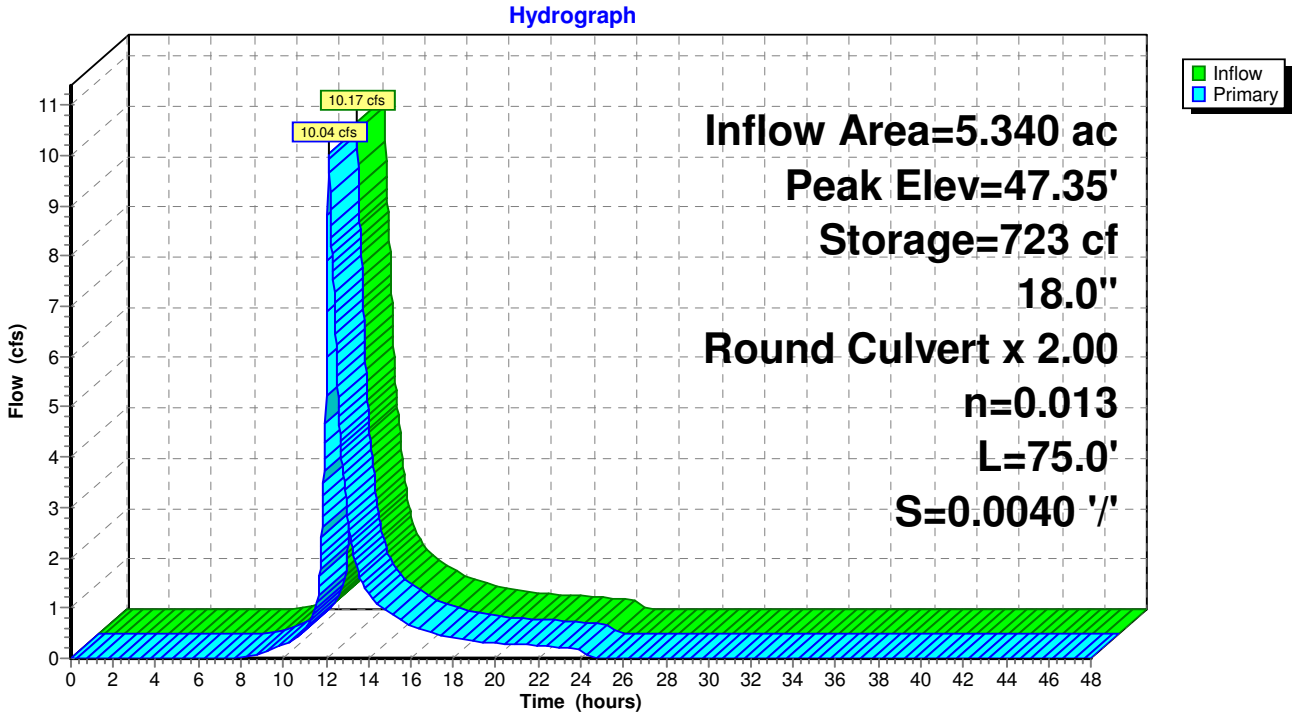
Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	5,400 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
46.00	300	0	0
47.00	650	475	475
48.00	1,000	825	1,300
49.00	1,500	1,250	2,550
50.00	2,000	1,750	4,300
50.50	2,400	1,100	5,400

Device	Routing	Invert	Outlet Devices
#1	Primary	46.00'	**18.0" Round Culvert X 2.00** L= 75.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 46.00' / 45.70' S= 0.0040 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=10.04 cfs @ 12.14 hrs HW=47.35' (Free Discharge)
└**1=Culvert** (Barrel Controls 10.04 cfs @ 3.96 fps)

Pond POND-9: Existing Culvert Crossing at 71 Stevens



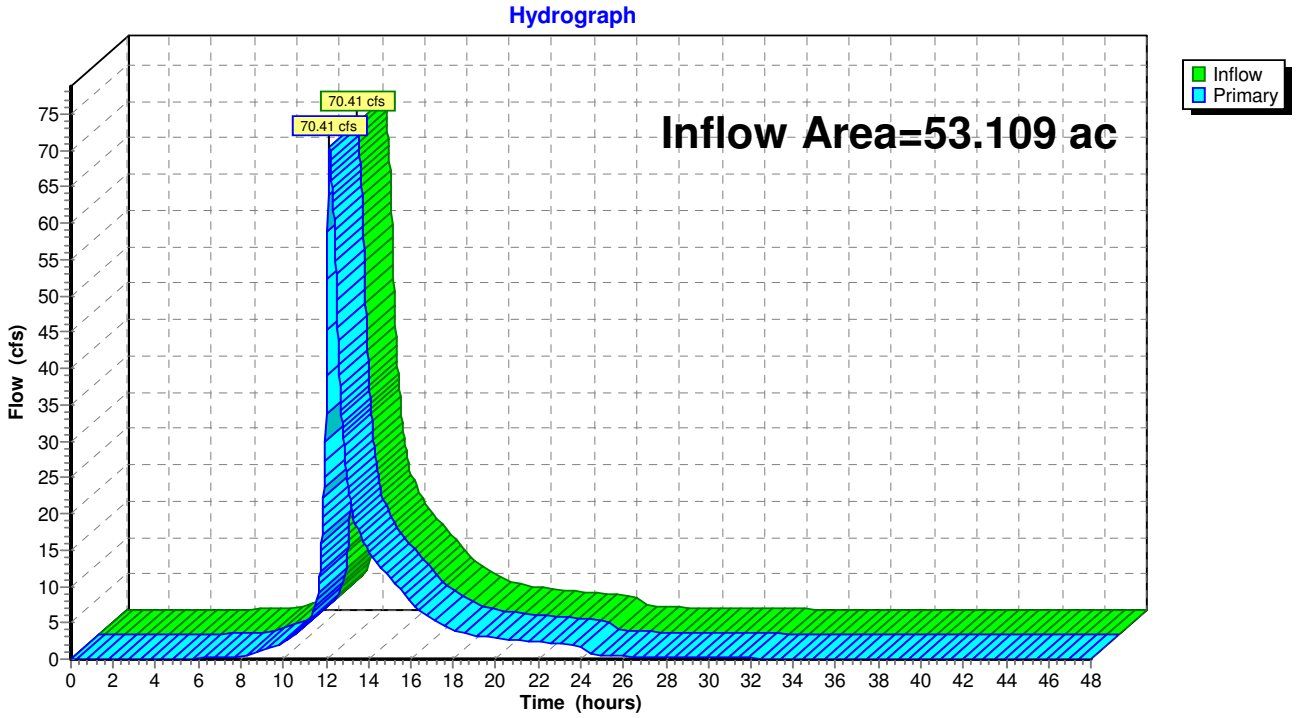
ry for Pond SUM-S: Summation of Analysis Points to Cotley River Wetlands from Southern portion of deve

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 53.109 ac, 36.80% Impervious, Inflow Depth > 2.53" for 10 YR event
Inflow = 70.41 cfs @ 12.17 hrs, Volume= 11.208 af
Primary = 70.41 cfs @ 12.17 hrs, Volume= 11.208 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond SUM-S: Summation of Analysis Points to Cotley River Wetlands from Southern portion of developmen



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PRE-1: Front Area of 73 Runoff Area=29,061 sf 67.72% Impervious Runoff Depth=5.82"
Flow Length=85' Tc=10.5 min CN=90 Runoff=3.71 cfs 0.324 af

Subcatchment PRE-10: Rear of 71 Runoff Area=125,958 sf 50.18% Impervious Runoff Depth=4.81"
Flow Length=335' Tc=7.9 min CN=81 Runoff=15.04 cfs 1.158 af

Subcatchment PRE-11: Unattenuated Area Runoff Area=41,813 sf 3.98% Impervious Runoff Depth=4.26"
Flow Length=395' Tc=8.7 min CN=76 Runoff=4.35 cfs 0.341 af

Subcatchment PRE-12: Unattenuated Area Runoff Area=80,250 sf 5.95% Impervious Runoff Depth=3.83"
Flow Length=410' Tc=8.6 min CN=72 Runoff=7.55 cfs 0.588 af

Subcatchment PRE-13: Existing B&D Runoff Area=118,483 sf 47.33% Impervious Runoff Depth=4.69"
Flow Length=700' Tc=6.0 min CN=80 Runoff=14.81 cfs 1.064 af

Subcatchment PRE-14: Portion of Existing Runoff Area=56,946 sf 16.24% Impervious Runoff Depth=4.47"
Flow Length=630' Tc=6.5 min CN=78 Runoff=6.69 cfs 0.487 af

Subcatchment PRE-15: Existing DaRosa Runoff Area=19,680 sf 0.00% Impervious Runoff Depth=4.04"
Flow Length=215' Tc=8.7 min CN=74 Runoff=1.95 cfs 0.152 af

Subcatchment PRE-16: Portion of Existing Runoff Area=20,900 sf 0.00% Impervious Runoff Depth=4.69"
Flow Length=150' Tc=8.2 min CN=80 Runoff=2.42 cfs 0.188 af

Subcatchment PRE-17: Lot 11 Remaining Runoff Area=58,635 sf 0.00% Impervious Runoff Depth=3.00"
Flow Length=395' Tc=8.8 min CN=64 Runoff=4.24 cfs 0.337 af

Subcatchment PRE-18: Lot 11 Runoff Area=106,859 sf 0.00% Impervious Runoff Depth=2.80"
Flow Length=530' Tc=10.1 min CN=62 Runoff=6.85 cfs 0.573 af

Subcatchment PRE-19: Lot 9 Upland Areas Runoff Area=184,240 sf 0.00% Impervious Runoff Depth=2.51"
Flow Length=540' Tc=14.5 min CN=59 Runoff=9.12 cfs 0.883 af

Subcatchment PRE-2: Rear Area of 73 Runoff Area=19,260 sf 75.97% Impervious Runoff Depth=6.05"
Flow Length=70' Tc=7.1 min CN=92 Runoff=2.80 cfs 0.223 af

Subcatchment PRE-3: Unattenuated Areas Runoff Area=470,600 sf 0.00% Impervious Runoff Depth=3.62"
Flow Length=440' Tc=10.1 min CN=70 Runoff=39.81 cfs 3.258 af

Subcatchment PRE-4: Maggiore 2, Runoff Area=498,594 sf 73.64% Impervious Runoff Depth=6.17"
Flow Length=1,320' Tc=9.5 min CN=93 Runoff=67.77 cfs 5.886 af

Subcatchment PRE-5: Portion of Runoff Area=53,288 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=8.39 cfs 0.689 af

Subcatchment PRE-6: Loading Area of Runoff Area=96,485 sf 89.73% Impervious Runoff Depth=6.52"
Flow Length=975' Tc=6.0 min CN=96 Runoff=15.05 cfs 1.204 af

Subcatchment PRE-7: Unattenuated Areas Runoff Area=52,366 sf 0.00% Impervious Runoff Depth=2.03"
Flow Length=45' Slope=0.0560 '/' Tc=7.2 min CN=54 Runoff=2.53 cfs 0.203 af

Subcatchment PRE-8: O'Connell Way Runoff Area=215,174 sf 63.77% Impervious Runoff Depth=5.37"
Flow Length=2,195' Tc=13.1 min CN=86 Runoff=24.04 cfs 2.209 af

Subcatchment PRE-9: Front of 71 Stevens, Runoff Area=64,847 sf 58.27% Impervious Runoff Depth=4.81"
Flow Length=190' Tc=6.5 min CN=81 Runoff=8.12 cfs 0.596 af

Reach 1R: Grassed Swale Avg. Flow Depth=0.34' Max Vel=2.87 fps Inflow=3.85 cfs 0.372 af
n=0.030 L=540.0' S=0.0185 '/' Capacity=104.91 cfs Outflow=3.59 cfs 0.372 af

Pond AP-1: Wetlands South of O'Connell Way Inflow=121.63 cfs 16.538 af
Primary=121.63 cfs 16.538 af

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11 Inflow=31.01 cfs 2.327 af
Primary=31.01 cfs 2.327 af

Pond AP-3: Existing Culvert Crossing at Crossroads Inflow=6.85 cfs 0.573 af
Primary=6.85 cfs 0.573 af

Pond FE-1: Flared End Outlet Inflow=3.85 cfs 0.372 af
Primary=3.85 cfs 0.372 af

Pond POND-1: 73 Stevens St Front Recharge Peak Elev=59.66' Storage=5,375 cf Inflow=3.71 cfs 0.324 af
Discarded=0.03 cfs 0.078 af Primary=2.93 cfs 0.218 af Outflow=2.94 cfs 0.296 af

Pond POND-2: 73 Stevens St Rear Recharge Peak Elev=57.72' Storage=4,480 cf Inflow=2.80 cfs 0.223 af
Discarded=0.02 cfs 0.068 af Primary=1.22 cfs 0.153 af Outflow=1.24 cfs 0.222 af

Pond POND-3: Maggiore Combined Peak Elev=33.62' Storage=71,631 cf Inflow=67.77 cfs 5.886 af
Primary=32.39 cfs 5.882 af Secondary=0.00 cfs 0.000 af Outflow=32.39 cfs 5.882 af

Pond POND-4: Maggiore 1 Recharge System Peak Elev=44.63' Storage=12,053 cf Inflow=8.39 cfs 0.689 af
Discarded=0.22 cfs 0.479 af Primary=3.05 cfs 0.211 af Outflow=3.25 cfs 0.689 af

Pond POND-5: Maggiore 1 Detention Basin Peak Elev=40.89' Storage=12,466 cf Inflow=15.11 cfs 1.415 af
Primary=11.31 cfs 1.405 af Secondary=0.00 cfs 0.000 af Outflow=11.31 cfs 1.405 af

Pond POND-6: O'Connell Way Detention Peak Elev=23.51' Storage=39,947 cf Inflow=27.95 cfs 2.545 af
Primary=12.62 cfs 2.440 af Secondary=0.00 cfs 0.000 af Outflow=12.62 cfs 2.440 af

Pond POND-7: Existing Detention Basin on Peak Elev=55.90' Storage=8,108 cf Inflow=15.04 cfs 1.158 af
Primary=4.77 cfs 1.005 af Secondary=7.84 cfs 0.153 af Outflow=12.61 cfs 1.158 af

Pond POND-8: Existing Detention Basin on Peak Elev=44.32' Storage=6,629 cf Inflow=1.95 cfs 0.152 af
Outflow=0.00 cfs 0.000 af

Pond POND-9: Existing Culvert Crossing at Peak Elev=48.82' Storage=2,293 cf Inflow=23.20 cfs 2.095 af
18.0" Round Culvert x 2.00 n=0.013 L=75.0' S=0.0040 '/' Outflow=21.33 cfs 2.095 af

Pond SUM-S: Summation of Analysis Points to Cotley River Wetlands Inflow=152.89 cfs 19.438 af
Primary=152.89 cfs 19.438 af

Total Runoff Area = 53.109 ac Runoff Volume = 20.363 af Average Runoff Depth = 4.60"
63.20% Pervious = 33.565 ac 36.80% Impervious = 19.544 ac

Summary for Subcatchment PRE-1: Front Area of 73 Stevens St

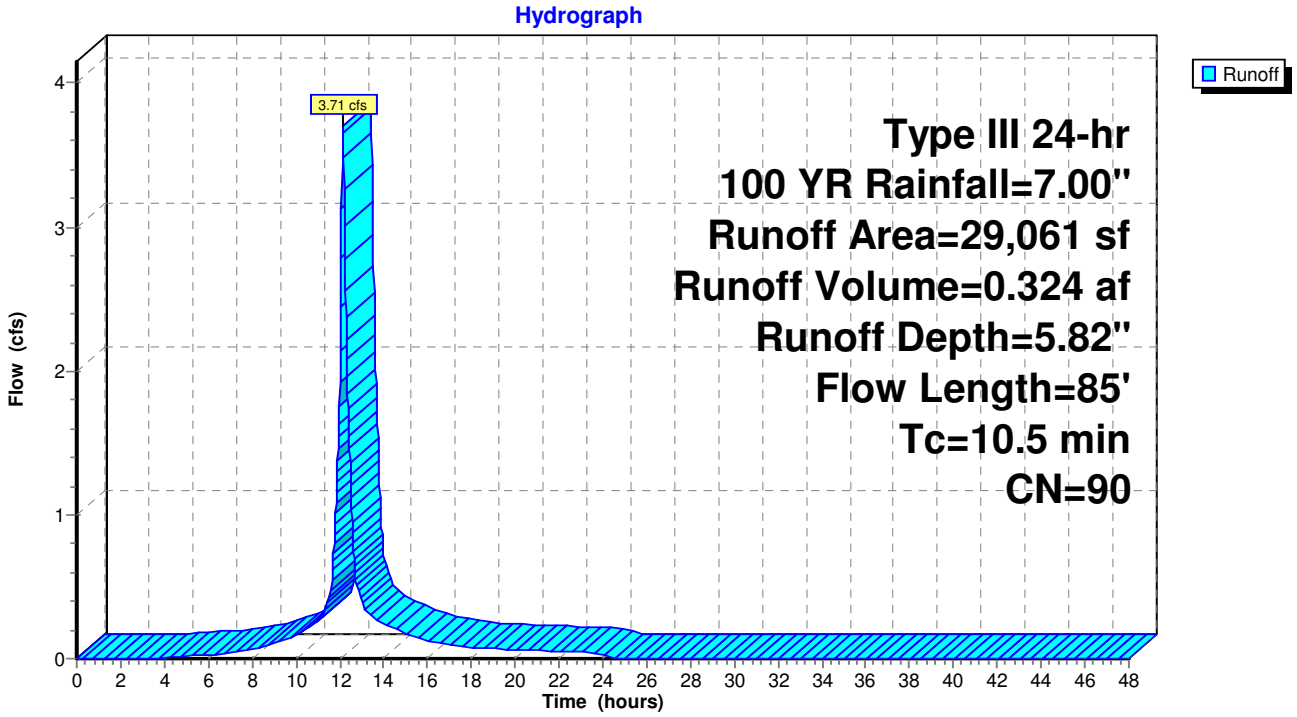
Runoff = 3.71 cfs @ 12.14 hrs, Volume= 0.324 af, Depth= 5.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
19,681	98	Paved parking & roofs
9,380	74	>75% Grass cover, Good, HSG C
29,061	90	Weighted Average
9,380		32.28% Pervious Area
19,681		67.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	50	0.0100	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.2	35	0.0500	3.60		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
10.5	85	Total			

Subcatchment PRE-1: Front Area of 73 Stevens St



Summary for Subcatchment PRE-10: Rear of 71 Stevens Street, Portion of Gravel Area, Half Building

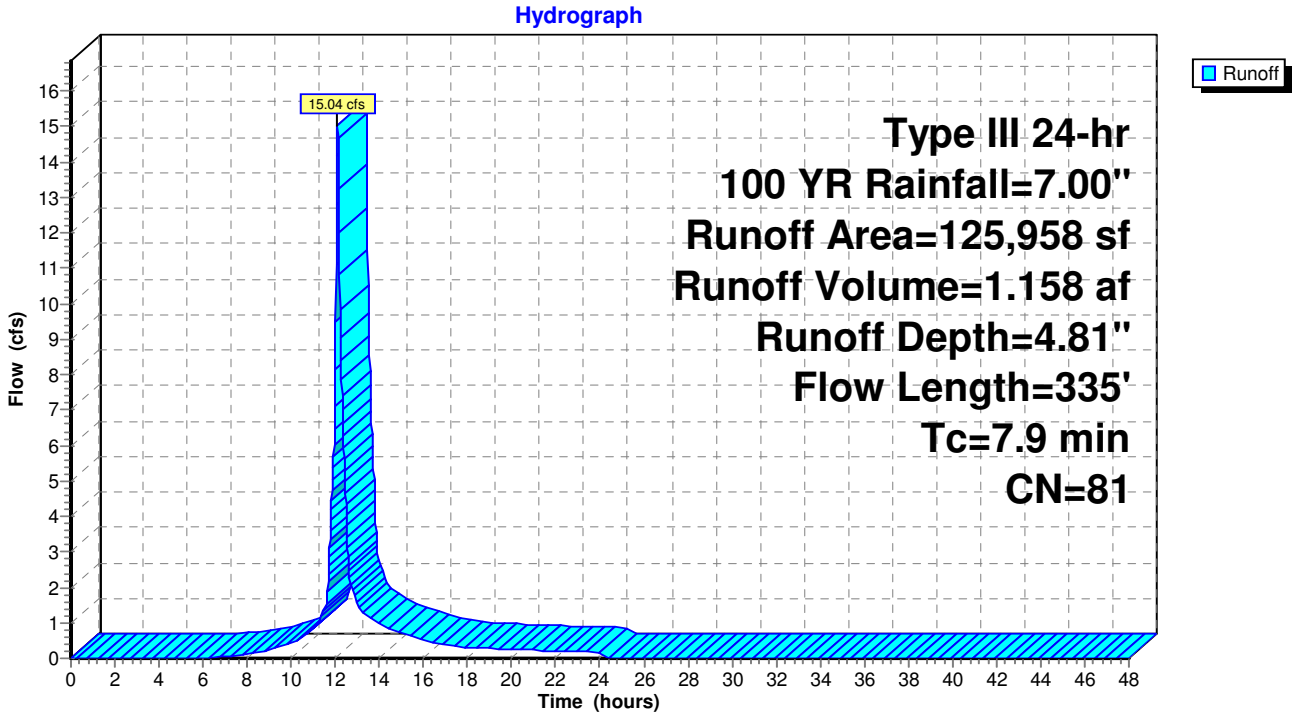
Runoff = 15.04 cfs @ 12.11 hrs, Volume= 1.158 af, Depth= 4.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

	Area (sf)	CN	Description
*	41,109	98	Paved Areas
*	18,846	98	Roof
	5,844	76	Gravel roads, HSG A
	14,995	89	Gravel roads, HSG C
	3,257	98	Water Surface
	19,672	39	>75% Grass cover, Good, HSG A
	18,619	74	>75% Grass cover, Good, HSG C
	3,616	30	Woods, Good, HSG A
	125,958	81	Weighted Average
	62,746		49.82% Pervious Area
	63,212		50.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0110	0.14		**Sheet Flow, 50' down slope (A-B)** Range n= 0.130 P2= 3.50"
1.3	135	0.0110	1.69		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	35	0.0700	4.26		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.4	115	0.0090	4.30	3.38	**Pipe Channel, D-E** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
7.9	335	Total			

Subcatchment PRE-10: Rear of 71 Stevens Street, Portion of Gravel Area, Half Building



Summary for Subcatchment PRE-11: Unattenuated Area to Flared Ends on 71 Stevens St

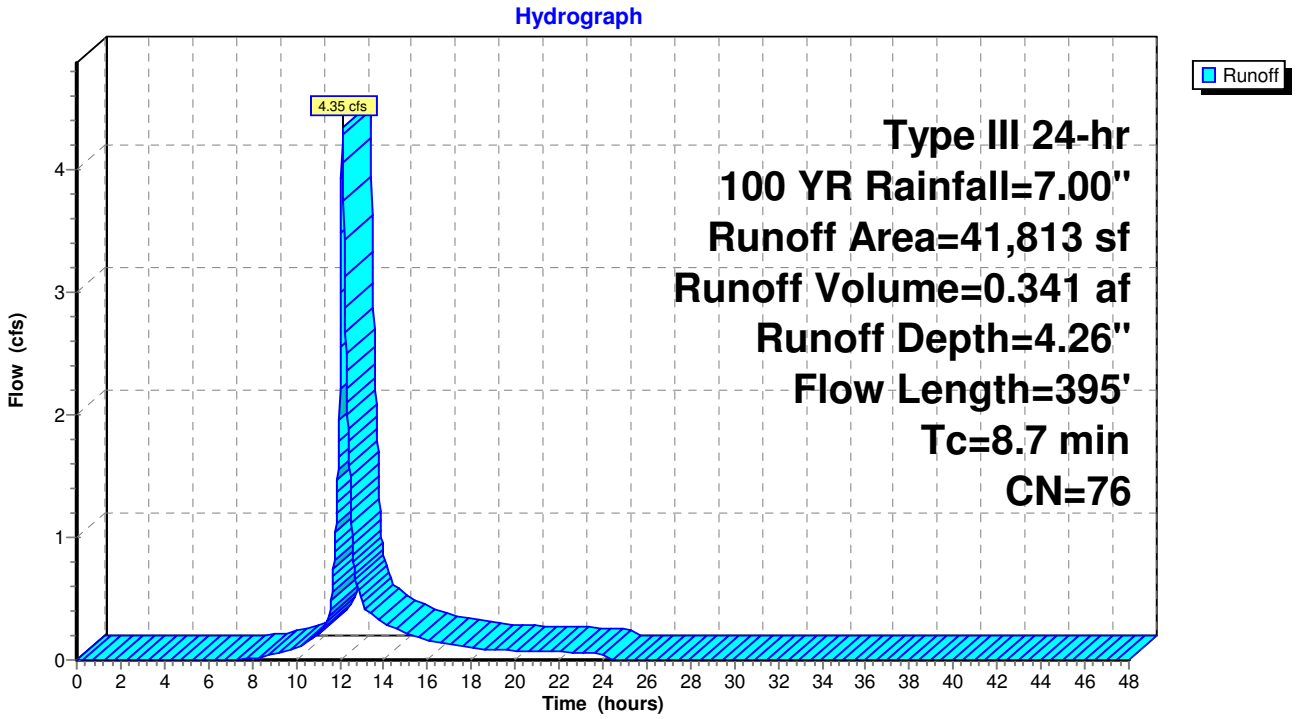
Runoff = 4.35 cfs @ 12.12 hrs, Volume= 0.341 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
1,665	98	Paved parking & roofs
2,206	89	Gravel roads, HSG C
37,942	74	>75% Grass cover, Good, HSG C
41,813	76	Weighted Average
40,148		96.02% Pervious Area
1,665		3.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0110	0.14		**Sheet Flow, A-B** Range n= 0.130 P2= 3.50"
0.5	55	0.0110	1.69		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
2.1	290	0.0210	2.33		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
8.7	395	Total			

Subcatchment PRE-11: Unattenuated Area to Flared Ends on 71 Stevens St



Summary for Subcatchment PRE-12: Unattenuated Area on 71 Stevens St to DaRosa Ditch

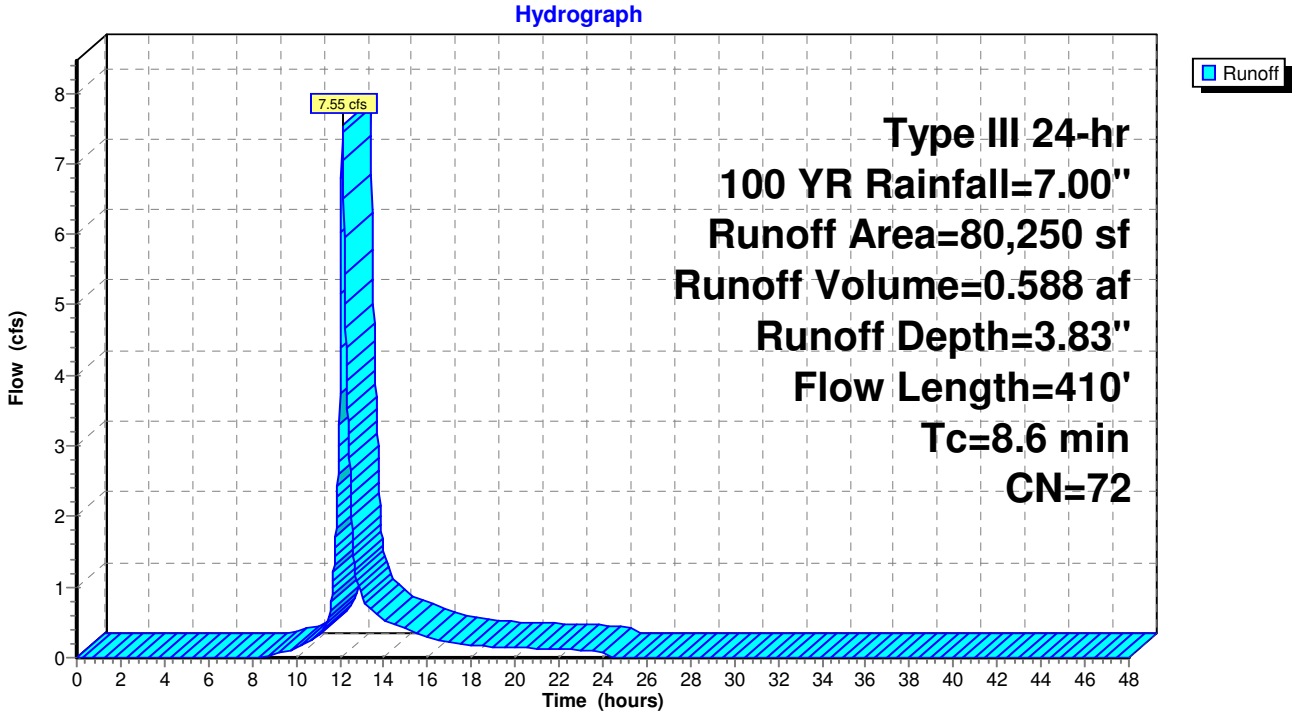
Runoff = 7.55 cfs @ 12.12 hrs, Volume= 0.588 af, Depth= 3.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
4,772	98	Paved parking & roofs
6,028	39	>75% Grass cover, Good, HSG A
67,592	74	>75% Grass cover, Good, HSG C
1,858	30	Woods, Good, HSG A
80,250	72	Weighted Average
75,478		94.05% Pervious Area
4,772		5.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	50	0.0110	0.14		**Sheet Flow, A-B** Range n= 0.130 P2= 3.50"
2.5	360	0.0220	2.39		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.6	410	Total			

Subcatchment PRE-12: Unattenuated Area on 71 Stevens St to DaRosa Ditch



Summary for Subcatchment PRE-13: Existing B&D Construction Area Unattenuated to Wetland

Existing B&D Construction Lot

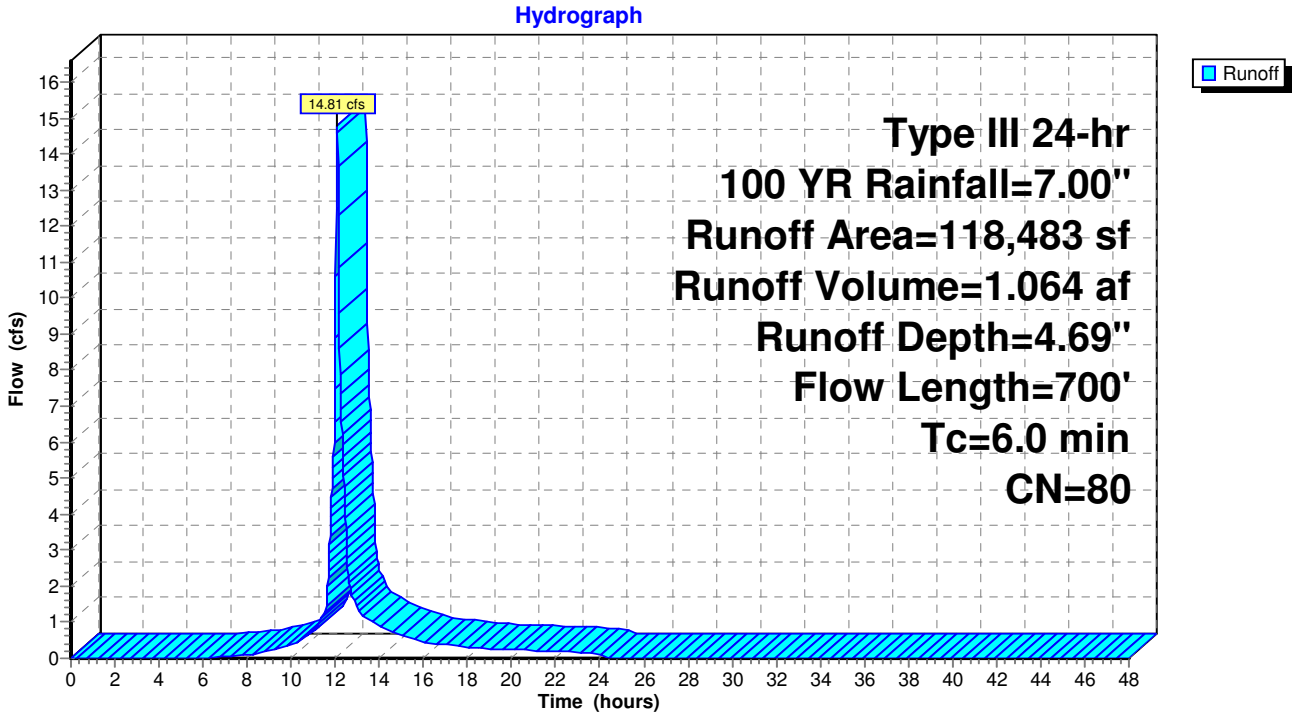
Runoff = 14.81 cfs @ 12.09 hrs, Volume= 1.064 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
56,082	98	Paved parking & roofs
3,884	89	Gravel roads, HSG C
19,480	39	>75% Grass cover, Good, HSG A
39,037	74	>75% Grass cover, Good, HSG C
118,483	80	Weighted Average
62,401		52.67% Pervious Area
56,082		47.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.25		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.50"
1.3	320	0.0400	4.06		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
1.0	330	0.0100	5.36	4.21	**Pipe Channel, C-D** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
3.0	700	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PRE-13: Existing B&D Construction Area Unattenuated to Wetland



Summary for Subcatchment PRE-14: Portion of Existing DaRosa Lot to Existing Stream

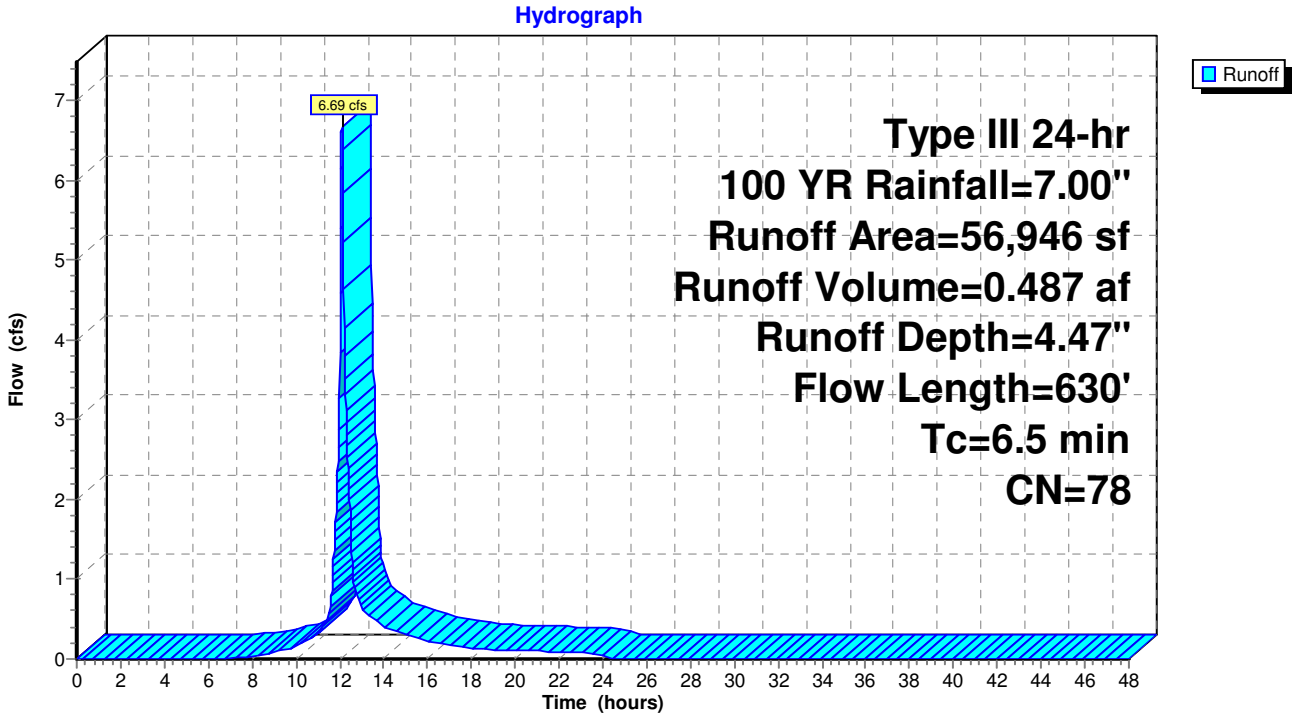
Runoff = 6.69 cfs @ 12.09 hrs, Volume= 0.487 af, Depth= 4.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
9,246	98	Paved parking & roofs
45,102	74	>75% Grass cover, Good, HSG C
367	80	>75% Grass cover, Good, HSG D
2,231	70	Woods, Good, HSG C
56,946	78	Weighted Average
47,700		83.76% Pervious Area
9,246		16.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	40	0.0500	0.15		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.2	210	0.0400	3.00		**Shallow Concentrated Flow, B-C** Grassed Waterway Kv= 15.0 fps
0.8	380	0.0200	8.41	14.86	**Pipe Channel, C-D** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
6.5	630	Total			

Subcatchment PRE-14: Portion of Existing DaRosa Lot to Existing Stream



Summary for Subcatchment PRE-15: Existing DaRosa Lot to Existing Detention Basin

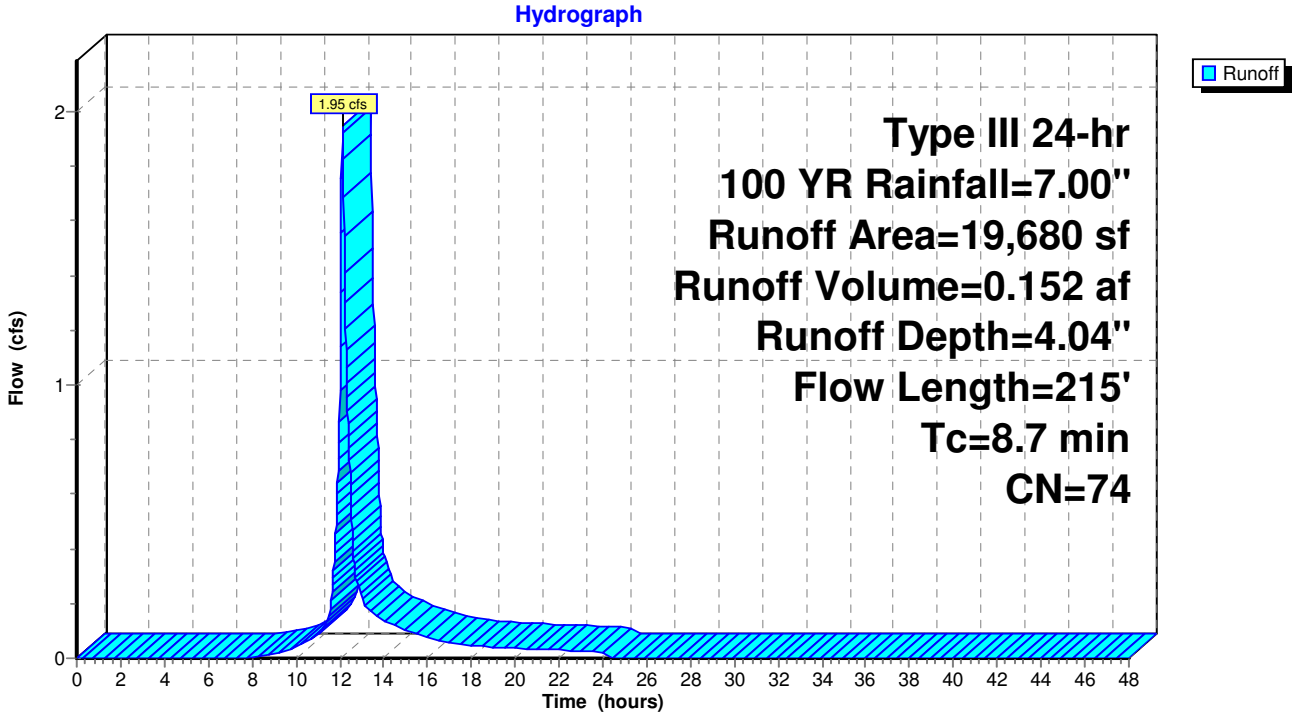
Runoff = 1.95 cfs @ 12.12 hrs, Volume= 0.152 af, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
19,500	74	>75% Grass cover, Good, HSG C
180	70	Woods, Good, HSG C
19,680	74	Weighted Average
19,680		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.9	165	0.0390	3.18		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.7	215	Total			

Subcatchment PRE-15: Existing DaRosa Lot to Existing Detention Basin



Summary for Subcatchment PRE-16: Portion of Existing Lot 11 to Existing Stream

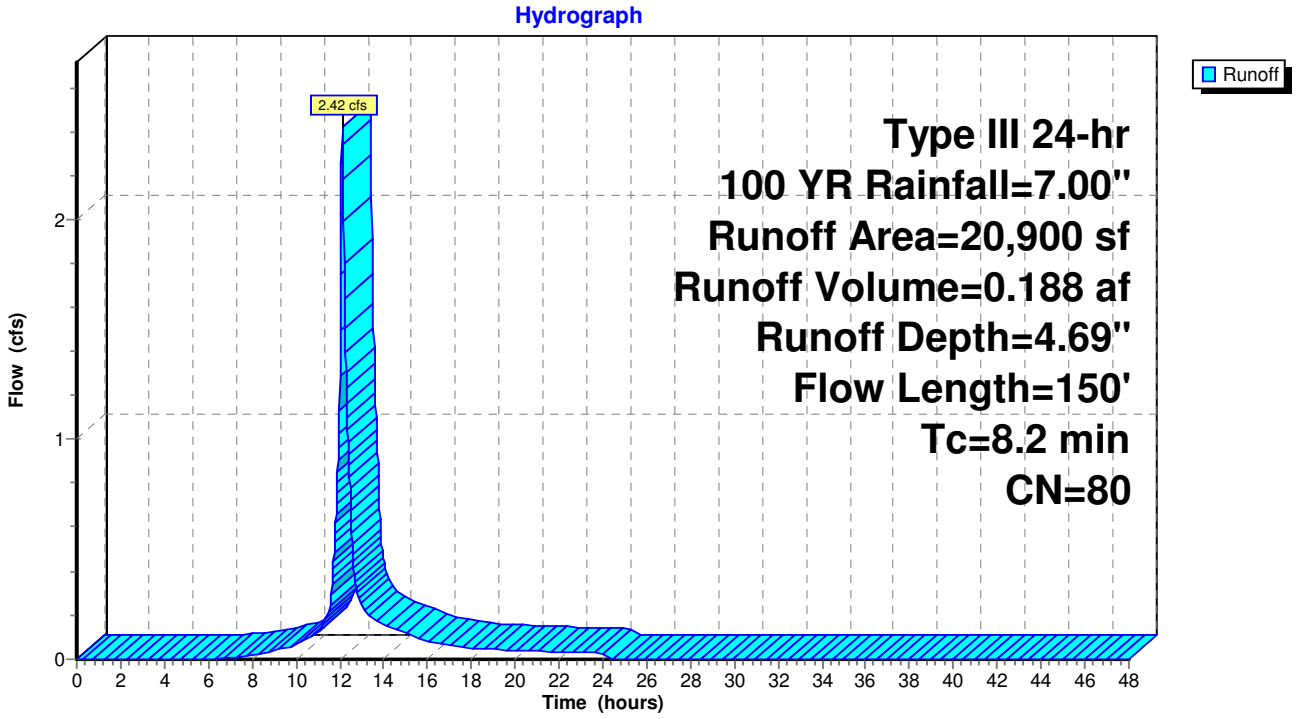
Runoff = 2.42 cfs @ 12.12 hrs, Volume= 0.188 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
20,900	80	>75% Grass cover, Good, HSG D
20,900		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.4	100	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.2	150	Total			

Subcatchment PRE-16: Portion of Existing Lot 11 to Existing Stream



Summary for Subcatchment PRE-17: Lot 11 Remaining Area to Swale

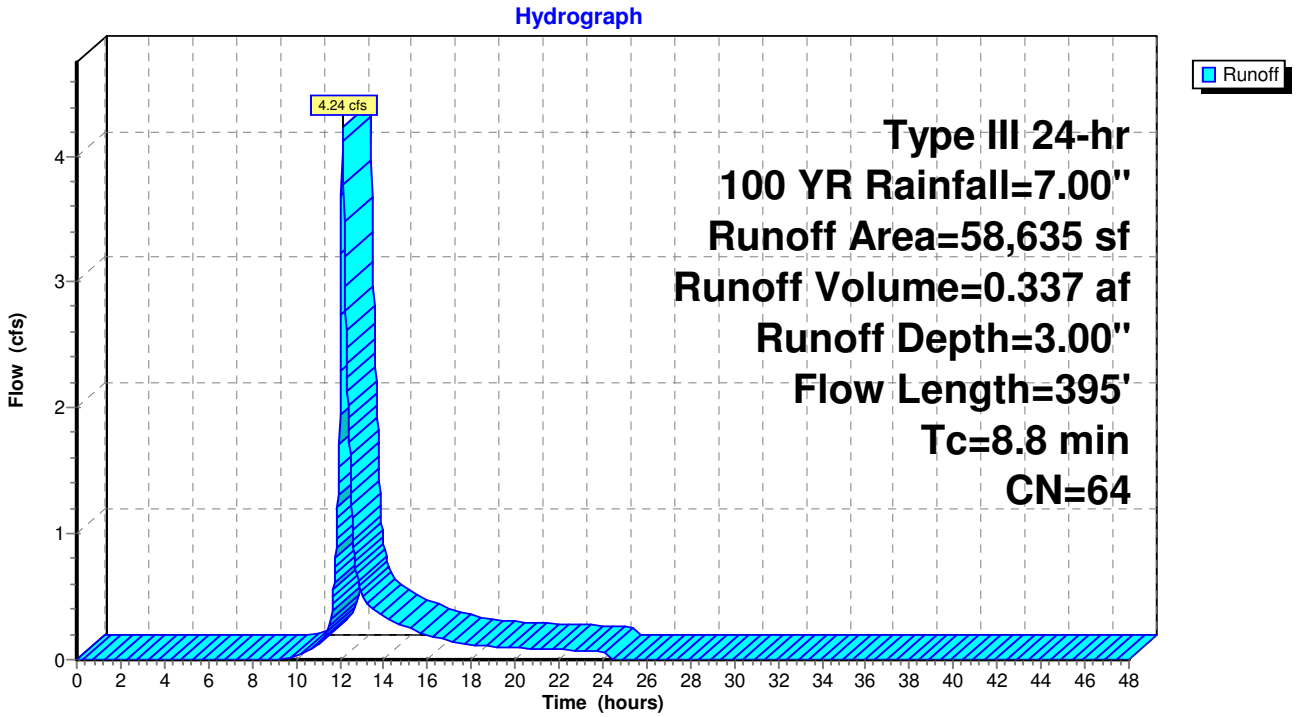
Runoff = 4.24 cfs @ 12.13 hrs, Volume= 0.337 af, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
318	39	>75% Grass cover, Good, HSG A
47,126	61	>75% Grass cover, Good, HSG B
6,212	80	>75% Grass cover, Good, HSG D
1,095	55	Woods, Good, HSG B
3,884	77	Woods, Good, HSG D
58,635	64	Weighted Average
58,635		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0300	0.13		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.2	205	0.0290	2.74		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.9	140	0.0290	2.55		**Shallow Concentrated Flow, C-D** Grassed Waterway Kv= 15.0 fps
8.8	395	Total			

Subcatchment PRE-17: Lot 11 Remaining Area to Swale



Summary for Subcatchment PRE-18: Lot 11 Unattenuated to Wetland System Through Stream

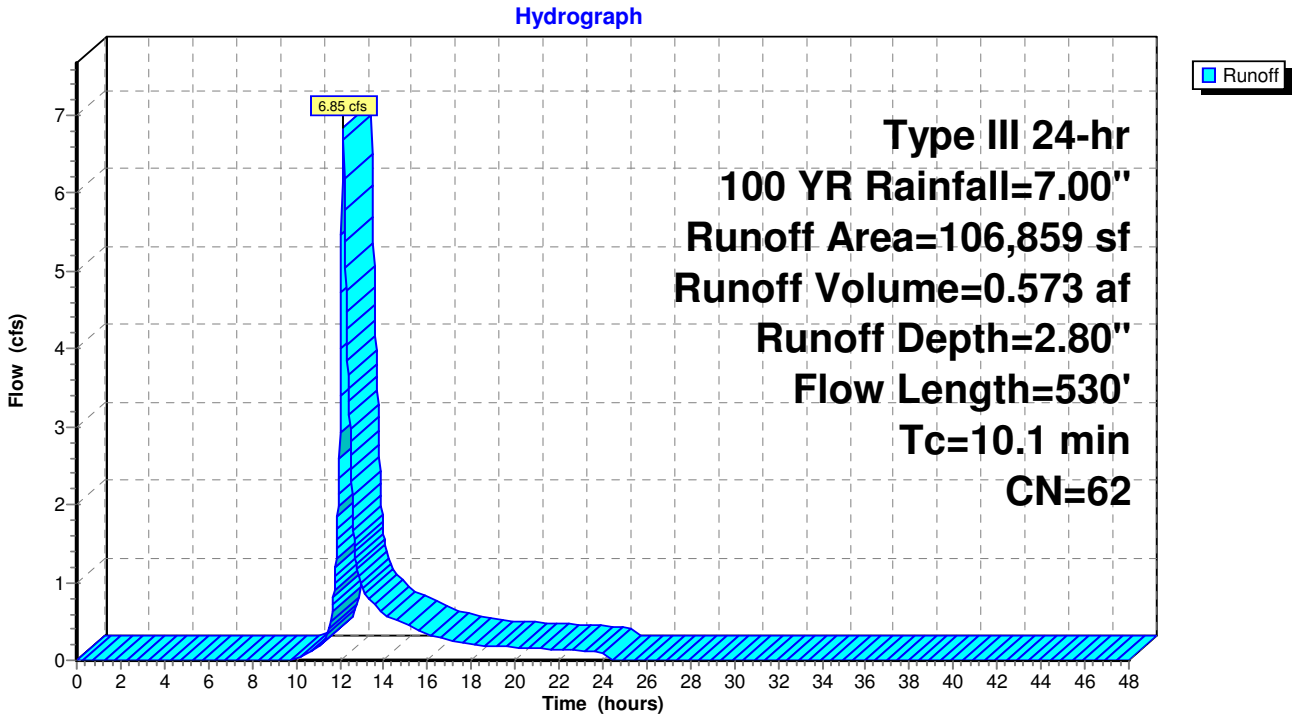
Runoff = 6.85 cfs @ 12.15 hrs, Volume= 0.573 af, Depth= 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
102,707	61	>75% Grass cover, Good, HSG B
3,076	80	>75% Grass cover, Good, HSG D
848	55	Woods, Good, HSG B
228	77	Woods, Good, HSG D
106,859	62	Weighted Average
106,859		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0300	0.13		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
3.4	480	0.0210	2.33		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
10.1	530	Total			

Subcatchment PRE-18: Lot 11 Unattenuated to Wetland System Through Stream



Summary for Subcatchment PRE-19: Lot 9 Upland Areas

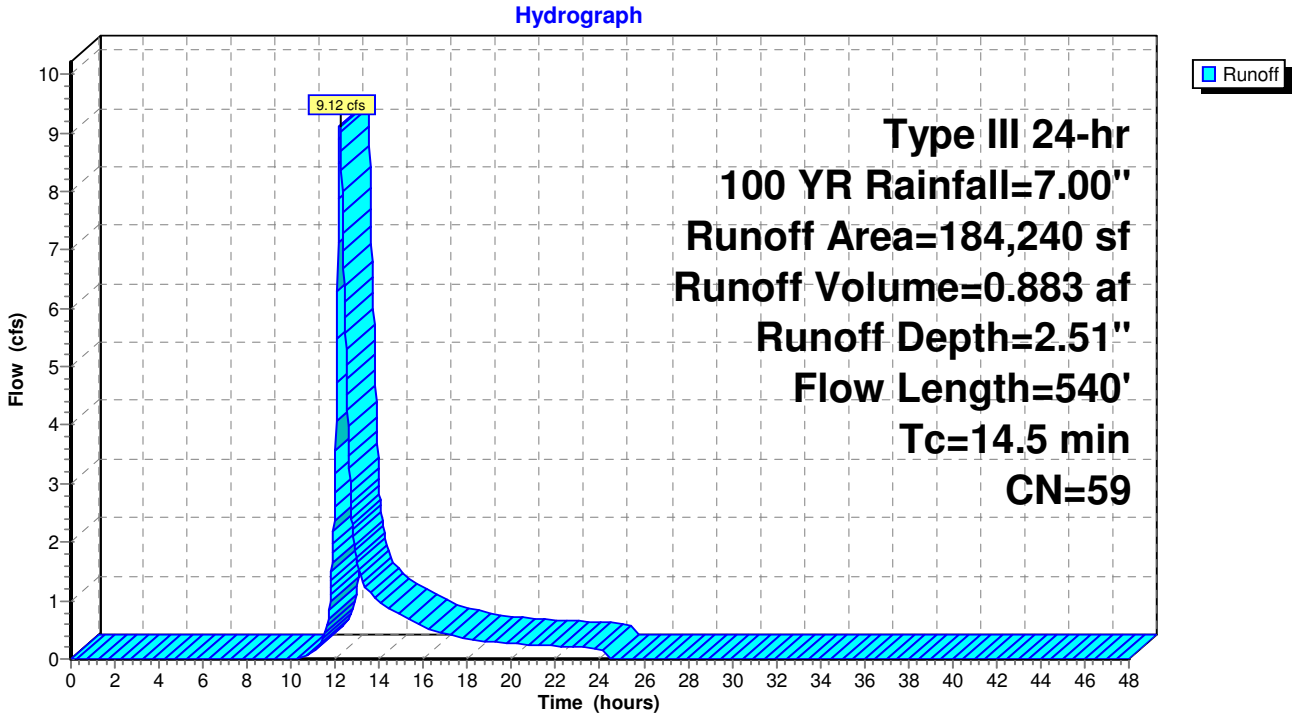
Runoff = 9.12 cfs @ 12.21 hrs, Volume= 0.883 af, Depth= 2.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
39,080	30	Meadow, non-grazed, HSG A
96,780	71	Meadow, non-grazed, HSG C
4,760	78	Meadow, non-grazed, HSG D
19,930	30	Woods, Good, HSG A
3,730	70	Woods, Good, HSG C
19,960	77	Woods, Good, HSG D
184,240	59	Weighted Average
184,240		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0200	0.17		**Sheet Flow, A-B** Range n= 0.130 P2= 3.50"
7.8	365	0.0123	0.78		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
1.9	125	0.0248	1.10		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
14.5	540	Total			

Subcatchment PRE-19: Lot 9 Upland Areas



Summary for Subcatchment PRE-2: Rear Area of 73 Stevens St

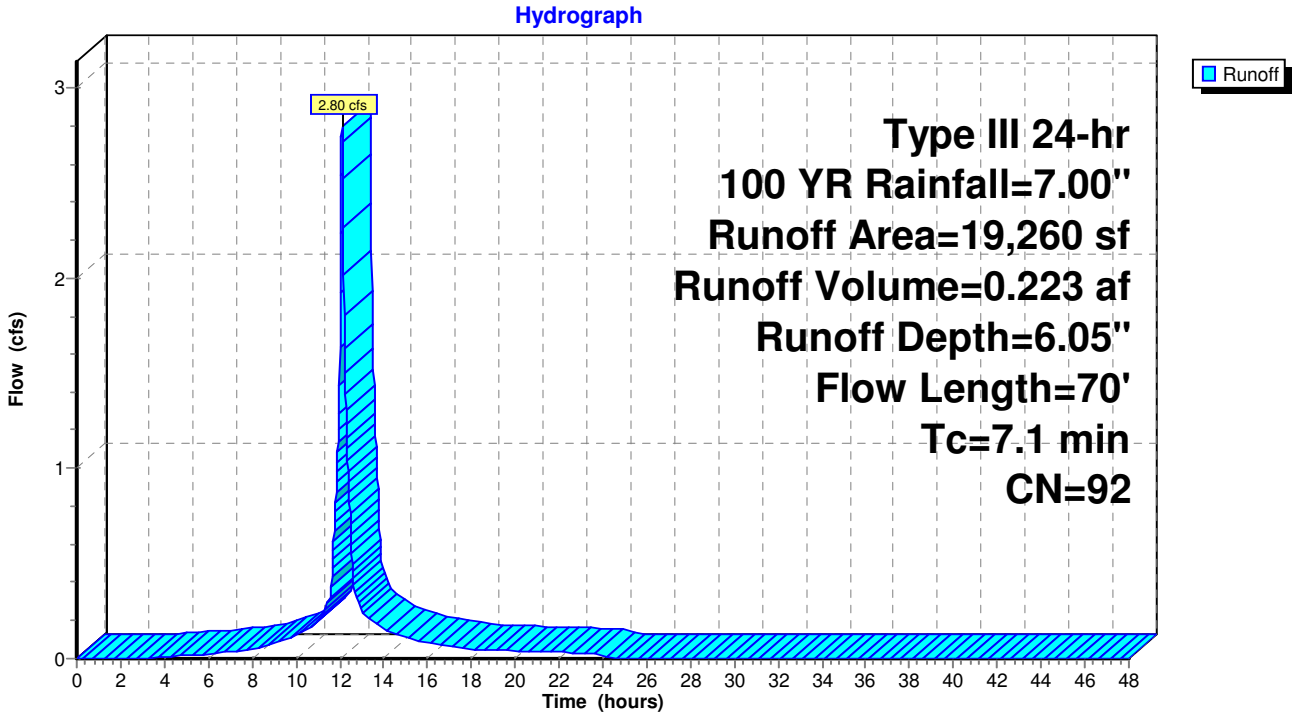
Runoff = 2.80 cfs @ 12.10 hrs, Volume= 0.223 af, Depth= 6.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
14,632	98	Paved parking & roofs
4,628	74	>75% Grass cover, Good, HSG C
19,260	92	Weighted Average
4,628		24.03% Pervious Area
14,632		75.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	20	0.0050	0.05		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.5	50	0.0080	1.82		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
7.1	70	Total			

Subcatchment PRE-2: Rear Area of 73 Stevens St



Summary for Subcatchment PRE-3: Unattenuated Areas to Wetlands Associated with Cotley River

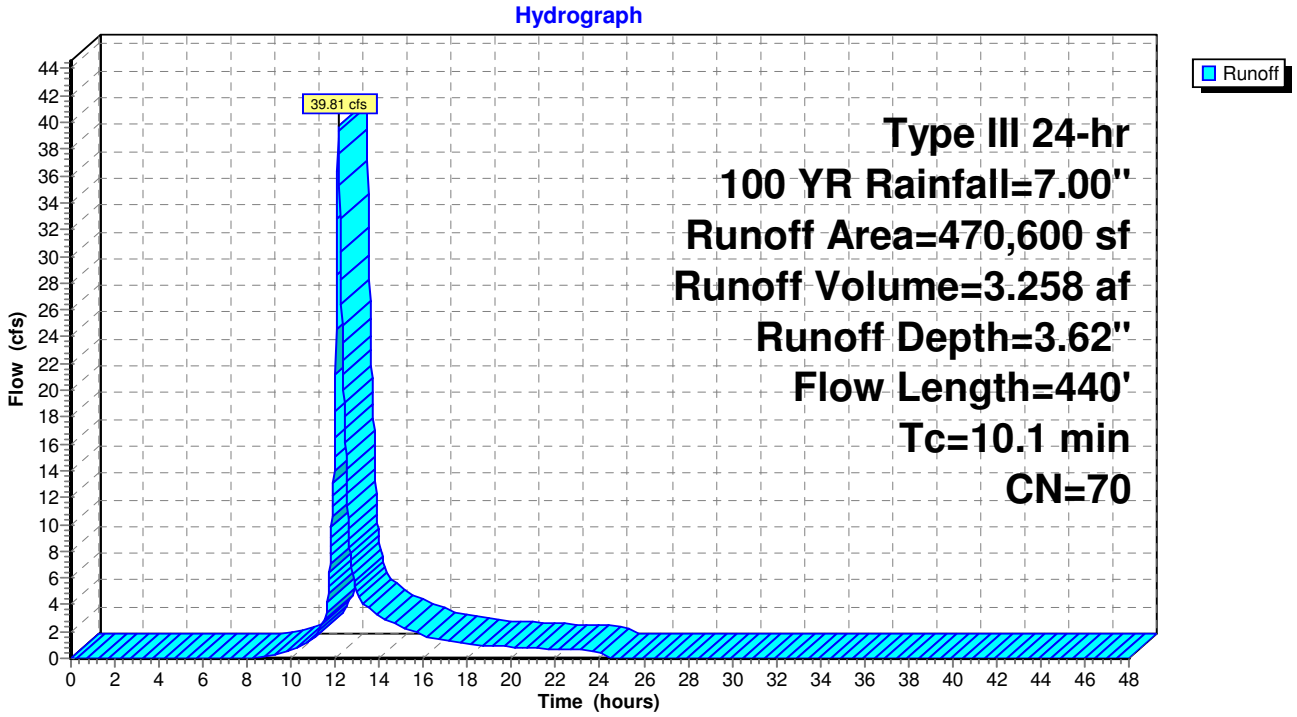
Runoff = 39.81 cfs @ 12.14 hrs, Volume= 3.258 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
13,744	61	>75% Grass cover, Good, HSG B
167,771	74	>75% Grass cover, Good, HSG C
472	80	>75% Grass cover, Good, HSG D
52,648	55	Woods, Good, HSG B
235,170	70	Woods, Good, HSG C
795	77	Woods, Good, HSG D
470,600	70	Weighted Average
470,600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.3	80	0.0560	3.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	60	0.1800	6.83		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
1.9	250	0.0190	2.22		**Shallow Concentrated Flow, D-E** Unpaved Kv= 16.1 fps
10.1	440	Total			

Subcatchment PRE-3: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment PRE-4: Maggiore 2, Common Driveway and Parking Areas

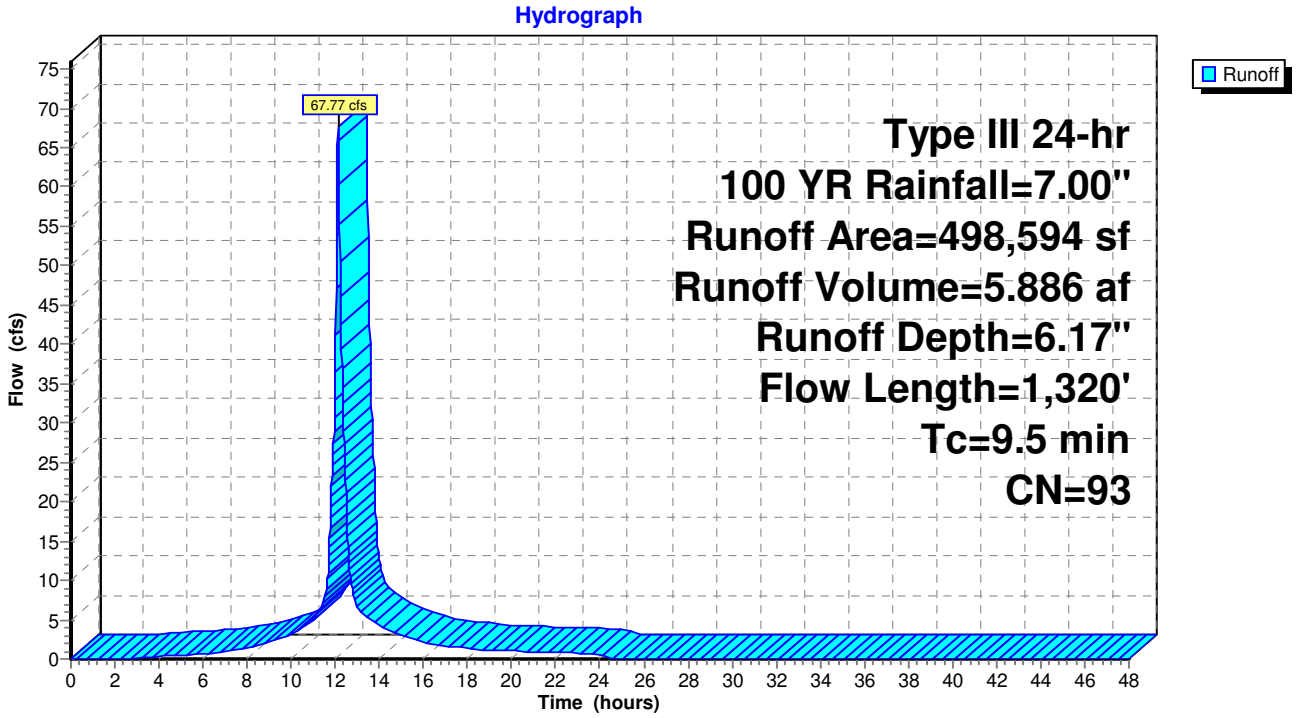
Runoff = 67.77 cfs @ 12.13 hrs, Volume= 5.886 af, Depth= 6.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
341,295	98	Paved parking & roofs
60,601	89	Gravel roads, HSG C
25,888	98	Water Surface
70,810	74	>75% Grass cover, Good, HSG C
498,594	93	Weighted Average
131,411		26.36% Pervious Area
367,183		73.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0400	0.14		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.6	270	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
2.0	1,000	0.0100	8.36	41.02	**Pipe Channel, C-D** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013 Concrete pipe, bends & connections
9.5	1,320	Total			

Subcatchment PRE-4: Maggiore 2, Common Driveway and Parking Areas



Summary for Subcatchment PRE-5: Portion of Maggiore 1

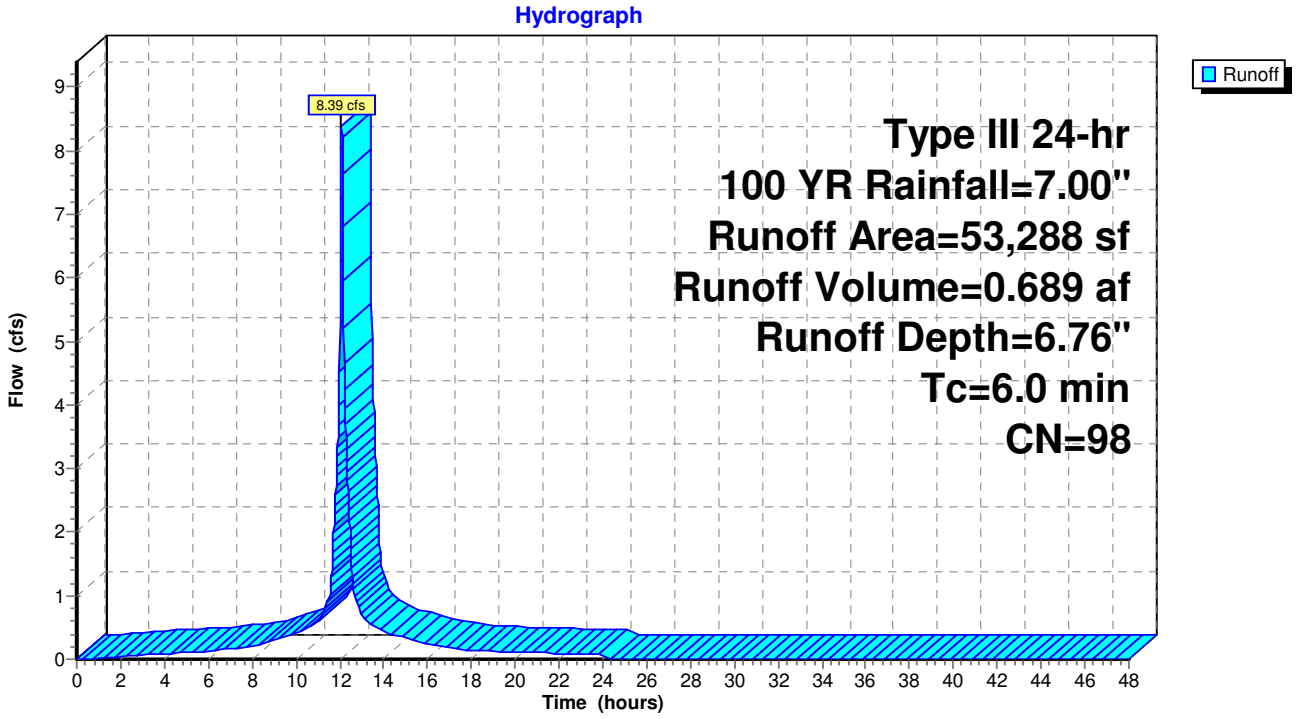
Runoff = 8.39 cfs @ 12.08 hrs, Volume= 0.689 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
53,288	98	Paved parking & roofs
53,288		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment PRE-5: Portion of Maggiore 1



Summary for Subcatchment PRE-6: Loading Area of Maggiore 1

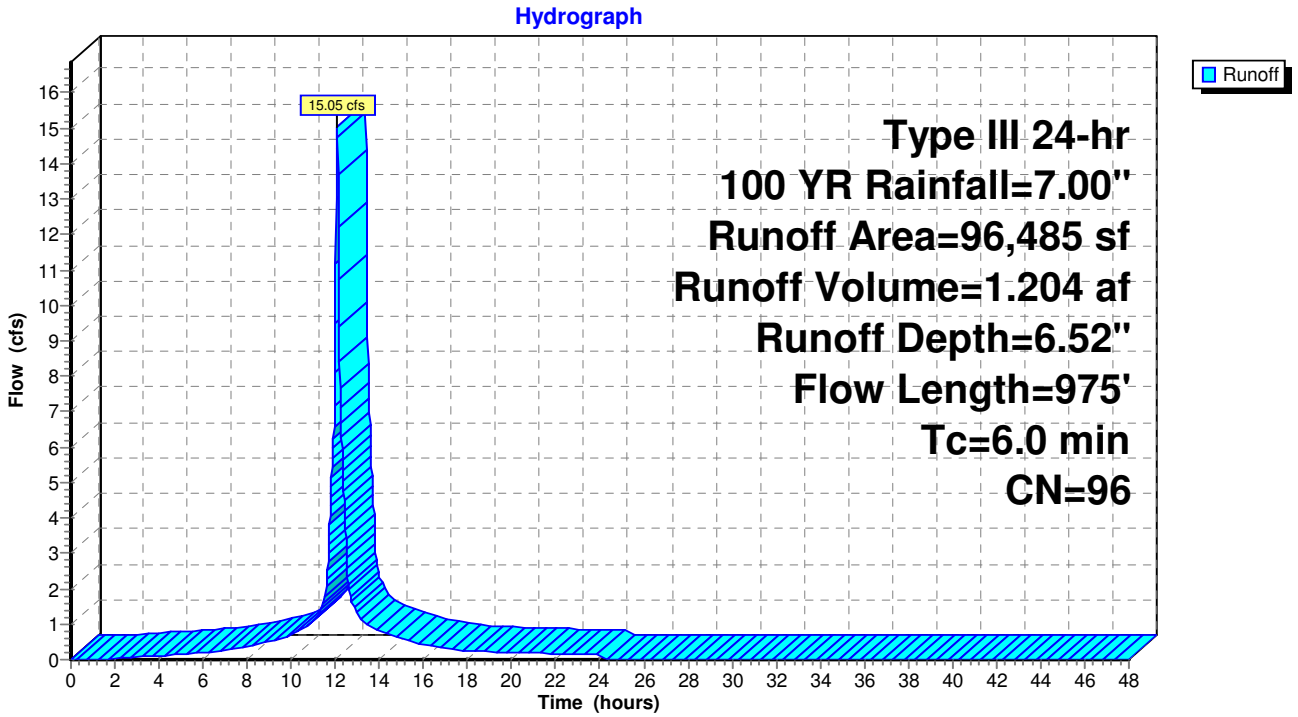
Runoff = 15.05 cfs @ 12.08 hrs, Volume= 1.204 af, Depth= 6.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
79,890	98	Paved parking & roofs
6,682	98	Water Surface
9,913	74	>75% Grass cover, Good, HSG C
96,485	96	Weighted Average
9,913		10.27% Pervious Area
86,572		89.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.25		**Sheet Flow, A-B** Smooth surfaces n= 0.011 P2= 3.50"
2.0	300	0.0150	2.49		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
1.9	625	0.0060	5.44	9.62	**Pipe Channel, C-D** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
4.6	975	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PRE-6: Loading Area of Maggiore 1



Summary for Subcatchment PRE-7: Unattenuated Areas to Wetlands Associated with Cotley River

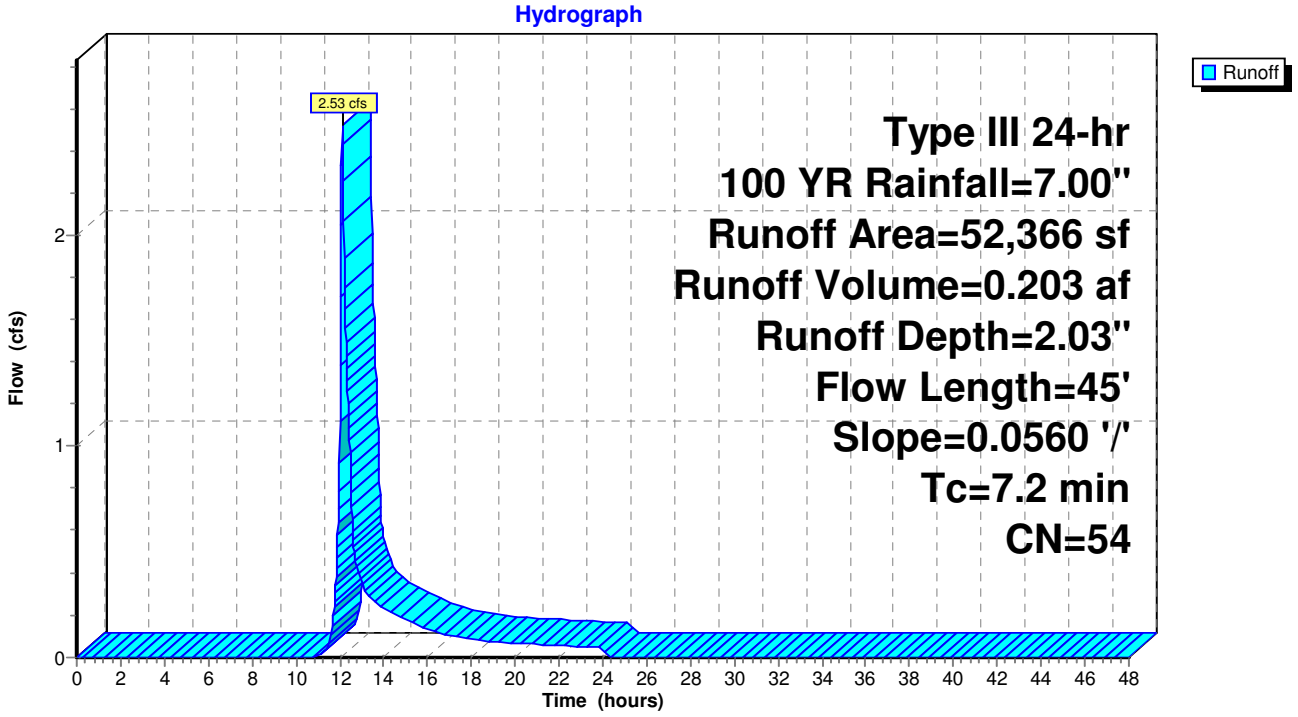
Runoff = 2.53 cfs @ 12.11 hrs, Volume= 0.203 af, Depth= 2.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
18,717	39	>75% Grass cover, Good, HSG A
11,926	61	>75% Grass cover, Good, HSG B
7,879	80	>75% Grass cover, Good, HSG D
6,196	30	Woods, Good, HSG A
432	55	Woods, Good, HSG B
7,216	77	Woods, Good, HSG D
52,366	54	Weighted Average
52,366		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	45	0.0560	0.10		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.50"

Subcatchment PRE-7: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment PRE-8: O'Connell Way

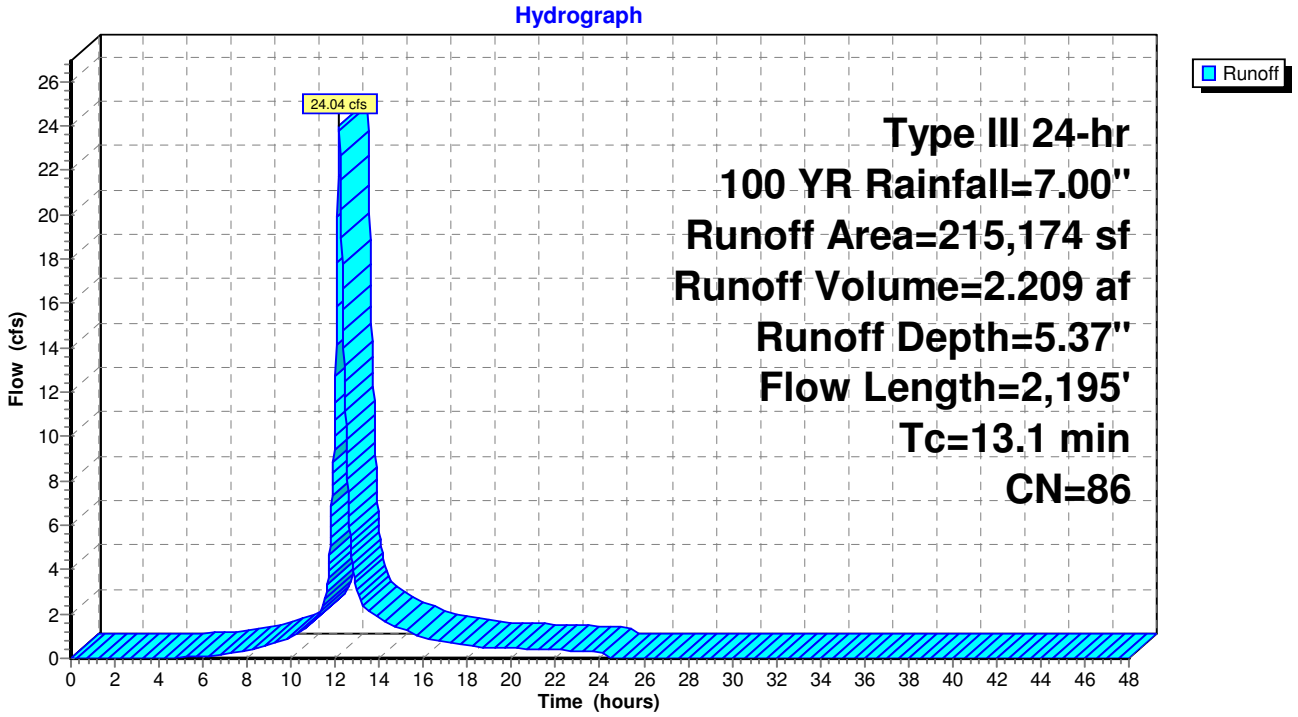
Runoff = 24.04 cfs @ 12.17 hrs, Volume= 2.209 af, Depth= 5.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
110,196	98	Paved parking & roofs
27,017	98	Water Surface
8,285	39	>75% Grass cover, Good, HSG A
31,759	61	>75% Grass cover, Good, HSG B
33,571	74	>75% Grass cover, Good, HSG C
4,346	80	>75% Grass cover, Good, HSG D
215,174	86	Weighted Average
77,961		36.23% Pervious Area
137,213		63.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	65	0.0460	0.16		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.3	230	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
4.9	1,900	0.0080	6.44	20.23	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
13.1	2,195	Total			

Subcatchment PRE-8: O'Connell Way



Summary for Subcatchment PRE-9: Front of 71 Stevens, Parking and Half Building

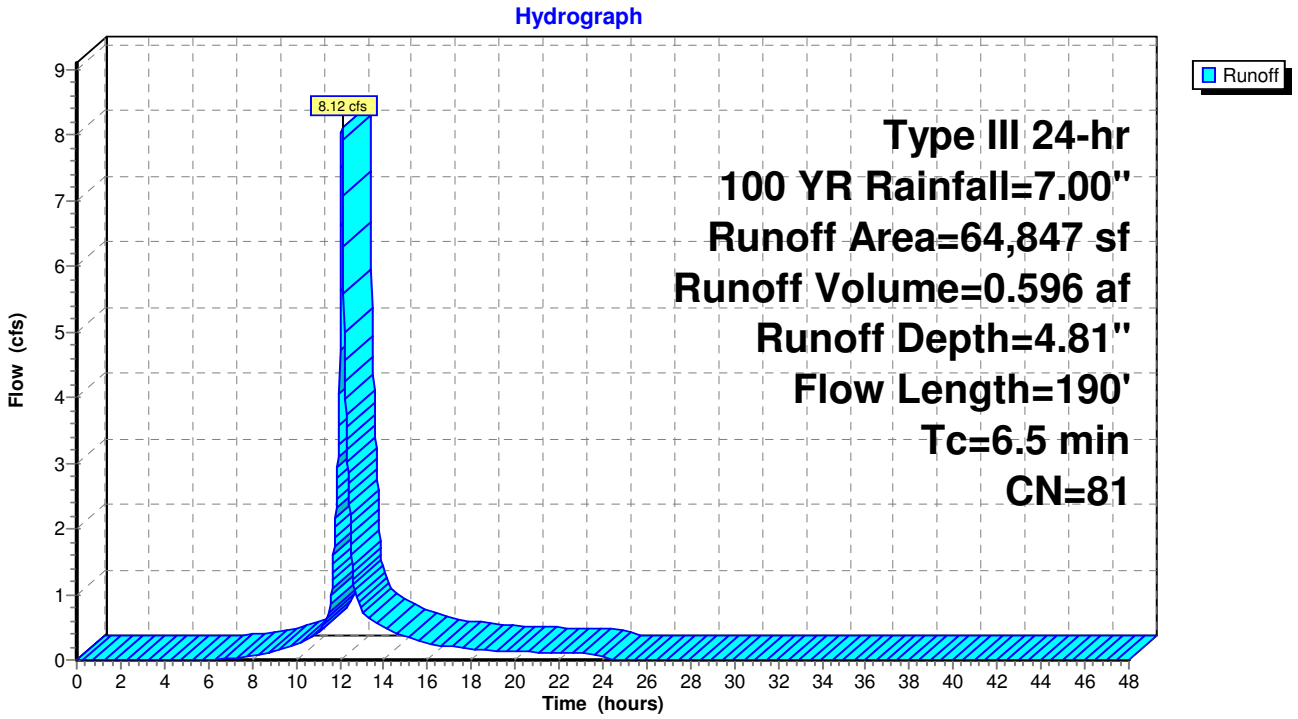
Runoff = 8.12 cfs @ 12.09 hrs, Volume= 0.596 af, Depth= 4.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

	Area (sf)	CN	Description
*	37,786	98	Paved Parking and New Driveway/Sidewalks
	12,548	39	>75% Grass cover, Good, HSG A
	14,513	74	>75% Grass cover, Good, HSG C
	64,847	81	Weighted Average
	27,061		41.73% Pervious Area
	37,786		58.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0400	0.14		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
0.2	50	0.0700	4.26		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.4	90	0.0400	4.06		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
6.5	190	Total			

Subcatchment PRE-9: Front of 71 Stevens, Parking and Half Building



Summary for Reach 1R: Grassed Swale

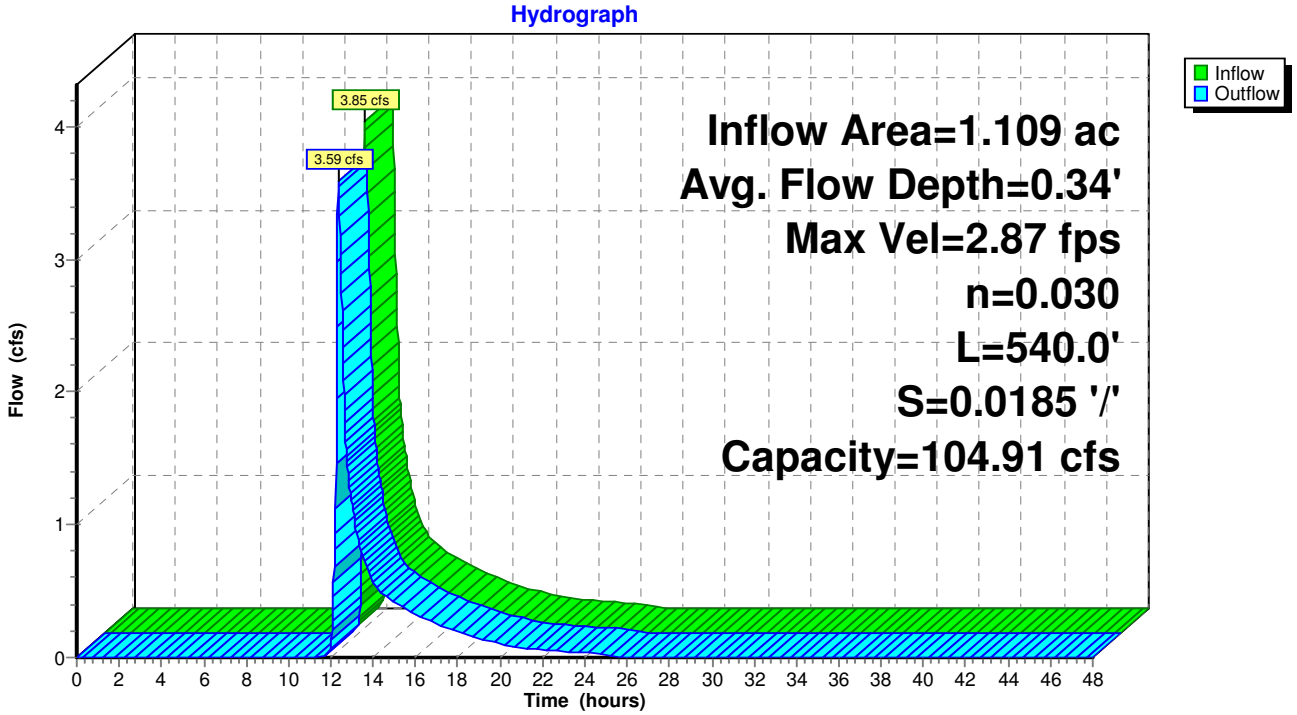
Inflow Area = 1.109 ac, 71.01% Impervious, Inflow Depth = 4.02" for 100 YR event
Inflow = 3.85 cfs @ 12.26 hrs, Volume= 0.372 af
Outflow = 3.59 cfs @ 12.36 hrs, Volume= 0.372 af, Atten= 7%, Lag= 6.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 2.87 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 0.98 fps, Avg. Travel Time= 9.2 min

Peak Storage= 678 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 104.91 cfs

3.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 540.0' Slope= 0.0185 '/'
Inlet Invert= 49.00', Outlet Invert= 39.00'

Reach 1R: Grassed Swale



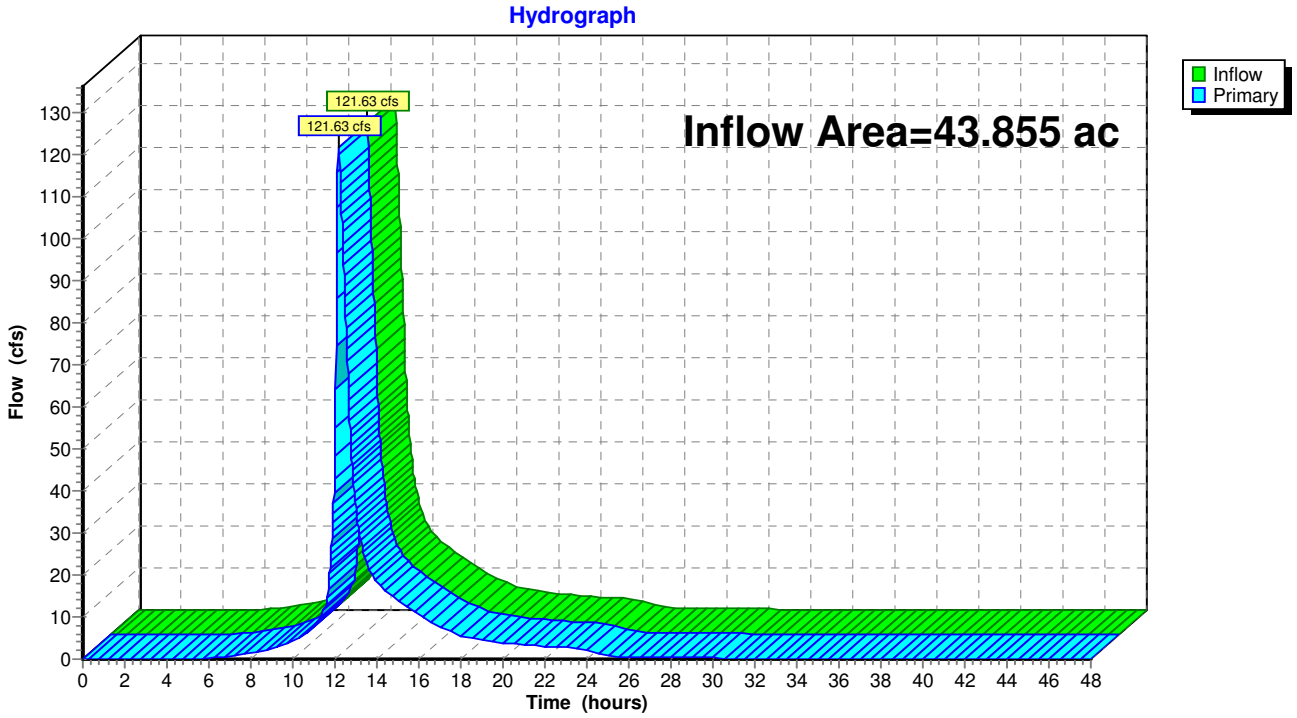
Summary for Pond AP-1: Wetlands South of O'Connell Way

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 43.855 ac, 40.90% Impervious, Inflow Depth = 4.53" for 100 YR event
Inflow = 121.63 cfs @ 12.18 hrs, Volume= 16.538 af
Primary = 121.63 cfs @ 12.18 hrs, Volume= 16.538 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-1: Wetlands South of O'Connell Way



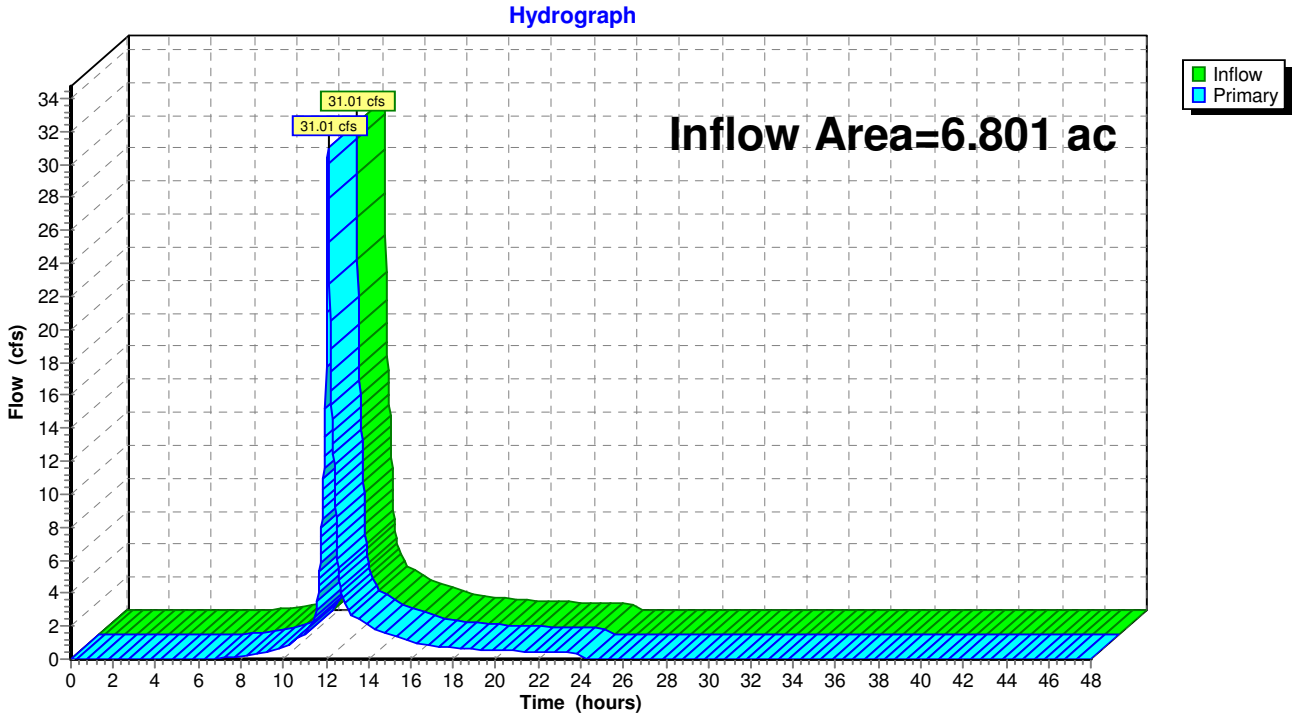
Summary for Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 6.801 ac, 23.66% Impervious, Inflow Depth = 4.11" for 100 YR event
Inflow = 31.01 cfs @ 12.10 hrs, Volume= 2.327 af
Primary = 31.01 cfs @ 12.10 hrs, Volume= 2.327 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11



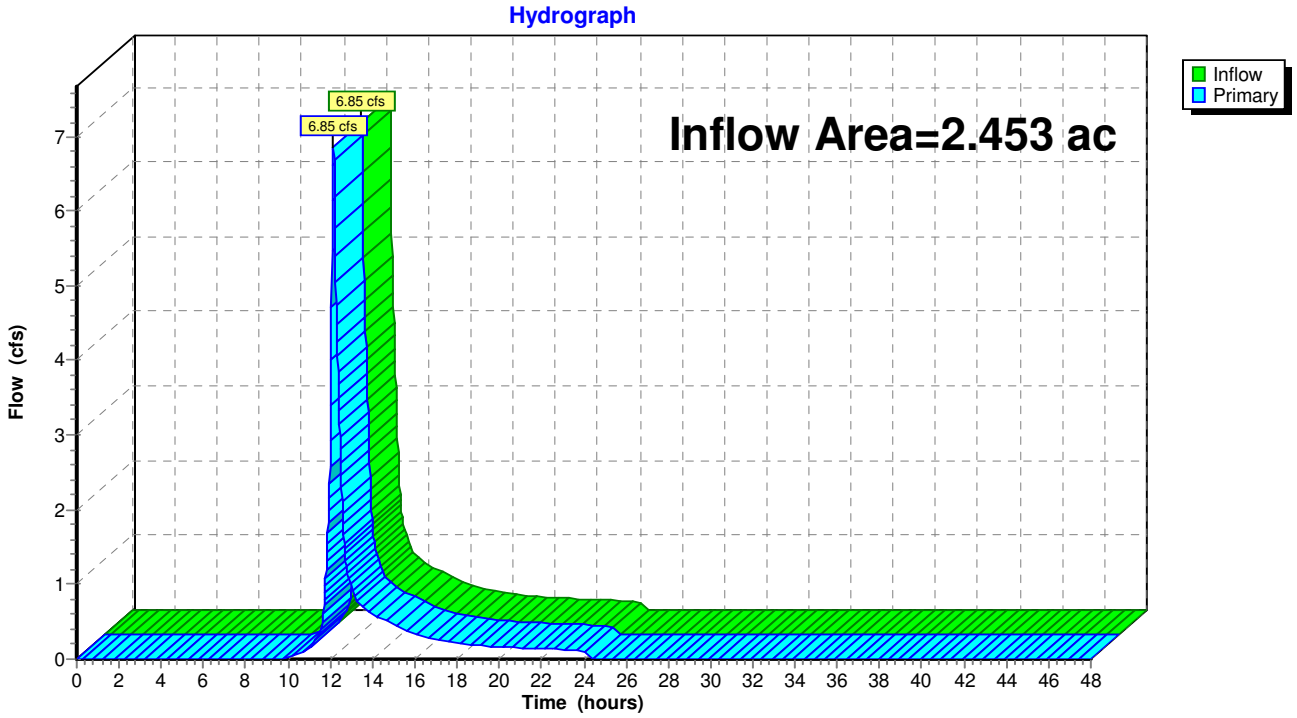
Summary for Pond AP-3: Existing Culvert Crossing at Crossroads

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.453 ac, 0.00% Impervious, Inflow Depth = 2.80" for 100 YR event
Inflow = 6.85 cfs @ 12.15 hrs, Volume= 0.573 af
Primary = 6.85 cfs @ 12.15 hrs, Volume= 0.573 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-3: Existing Culvert Crossing at Crossroads



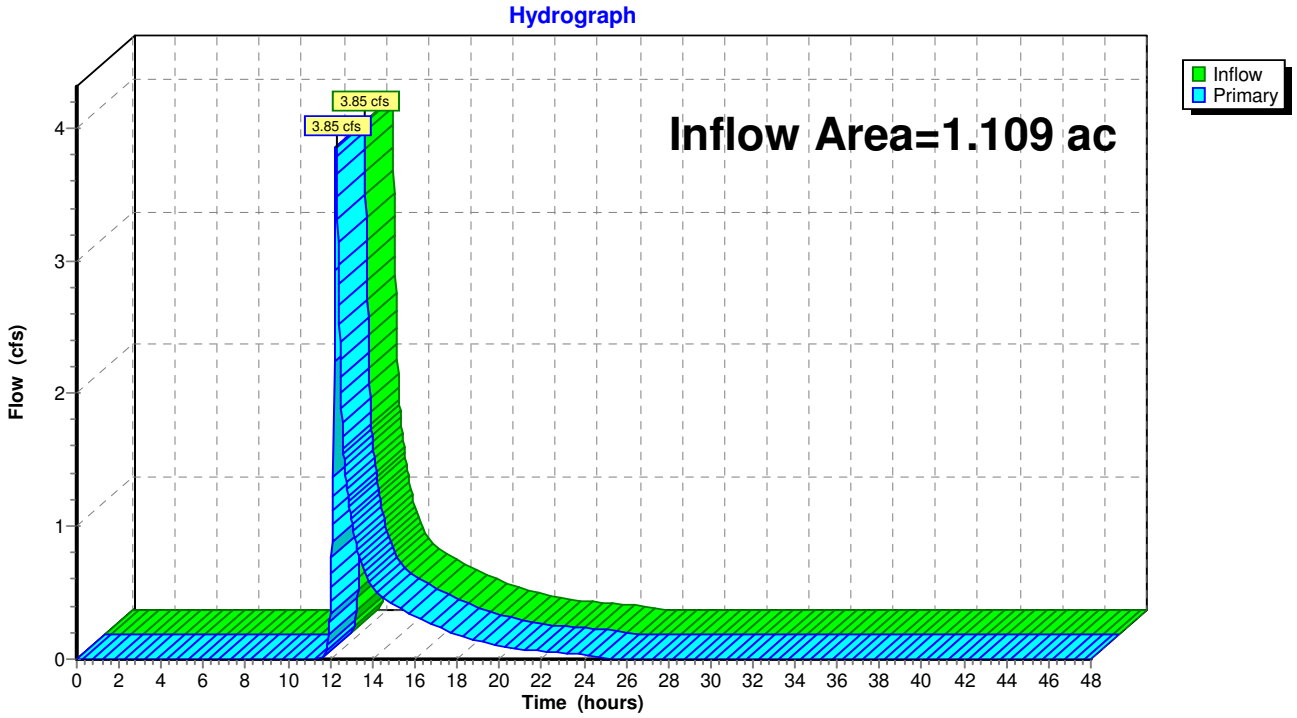
Summary for Pond FE-1: Flared End Outlet

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.109 ac, 71.01% Impervious, Inflow Depth = 4.02" for 100 YR event
Inflow = 3.85 cfs @ 12.26 hrs, Volume= 0.372 af
Primary = 3.85 cfs @ 12.26 hrs, Volume= 0.372 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond FE-1: Flared End Outlet



Summary for Pond POND-1: 73 Stevens St Front Recharge System

Inflow Area =	0.667 ac, 67.72% Impervious, Inflow Depth = 5.82" for 100 YR event				
Inflow =	3.71 cfs @	12.14 hrs,	Volume=	0.324 af	
Outflow =	2.94 cfs @	12.23 hrs,	Volume=	0.296 af,	Atten= 21%, Lag= 5.3 min
Discarded =	0.03 cfs @	9.50 hrs,	Volume=	0.078 af	
Primary =	2.93 cfs @	12.23 hrs,	Volume=	0.218 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 59.66' @ 12.23 hrs Surf.Area= 2,575 sf Storage= 5,375 cf

Plug-Flow detention time= 328.0 min calculated for 0.296 af (91% of inflow)
Center-of-Mass det. time= 284.3 min (1,068.3 - 784.1)

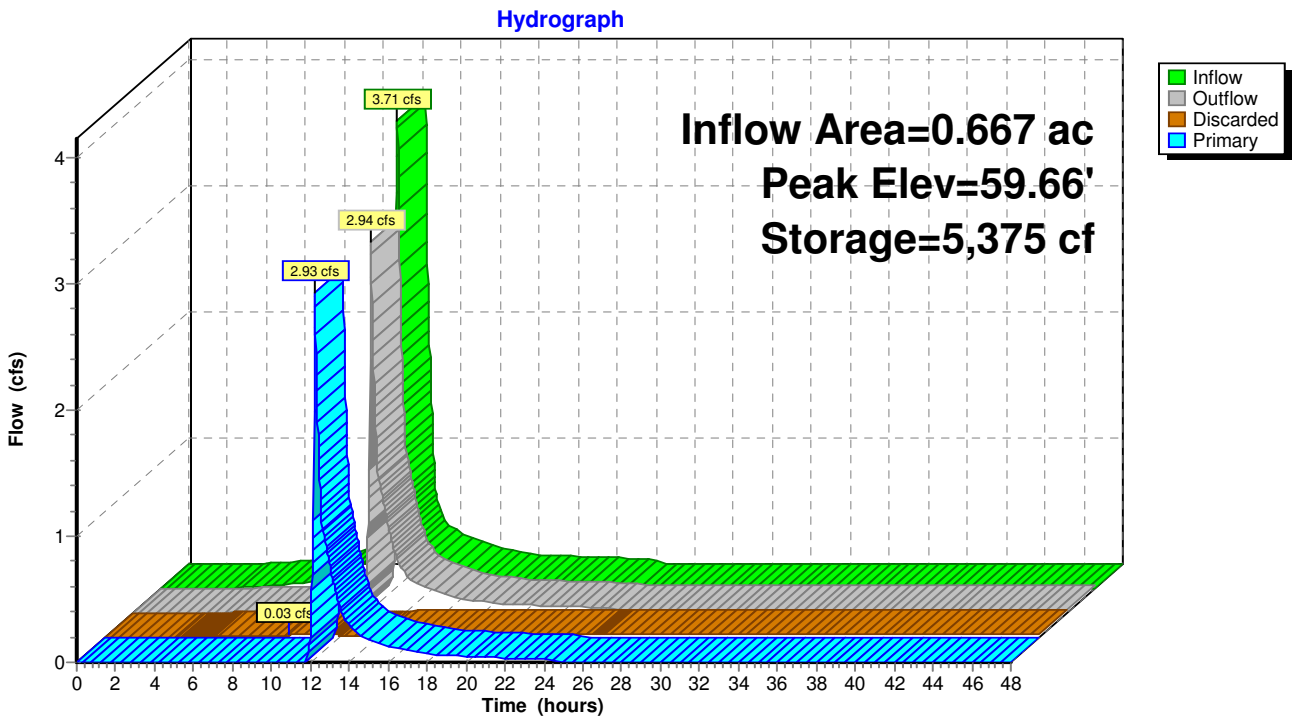
Volume	Invert	Avail.Storage	Storage Description
#1	56.90'	3,284 cf	**23.25'W x 110.00'L x 3.21'H Prismatoid** 8,210 cf Overall x 40.0% Voids
#2	56.40'	2,550 cf	**Cultec R-280** x 60 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
		5,834 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	57.90'	**12.0" Round Culvert** L= 175.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 57.90' / 56.15' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	57.90'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	59.40'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.5' Crest Height
#4	Discarded	56.40'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 9.50 hrs HW=56.90' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=2.89 cfs @ 12.23 hrs HW=59.66' (Free Discharge)
└─**1=Culvert** (Passes 2.89 cfs of 3.77 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.16 cfs @ 5.91 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 1.73 cfs @ 1.70 fps)

Pond POND-1: 73 Stevens St Front Recharge System



Summary for Pond POND-2: 73 Stevens St Rear Recharge System

Inflow Area =	0.442 ac, 75.97% Impervious, Inflow Depth = 6.05" for 100 YR event				
Inflow =	2.80 cfs @	12.10 hrs,	Volume=	0.223 af	
Outflow =	1.24 cfs @	12.30 hrs,	Volume=	0.222 af,	Atten= 56%, Lag= 12.2 min
Discarded =	0.02 cfs @	40.42 hrs,	Volume=	0.068 af	
Primary =	1.22 cfs @	12.30 hrs,	Volume=	0.153 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 57.72' @ 12.30 hrs Surf.Area= 2,229 sf Storage= 4,480 cf

Plug-Flow detention time= 335.4 min calculated for 0.222 af (99% of inflow)
Center-of-Mass det. time= 331.5 min (1,105.3 - 773.7)

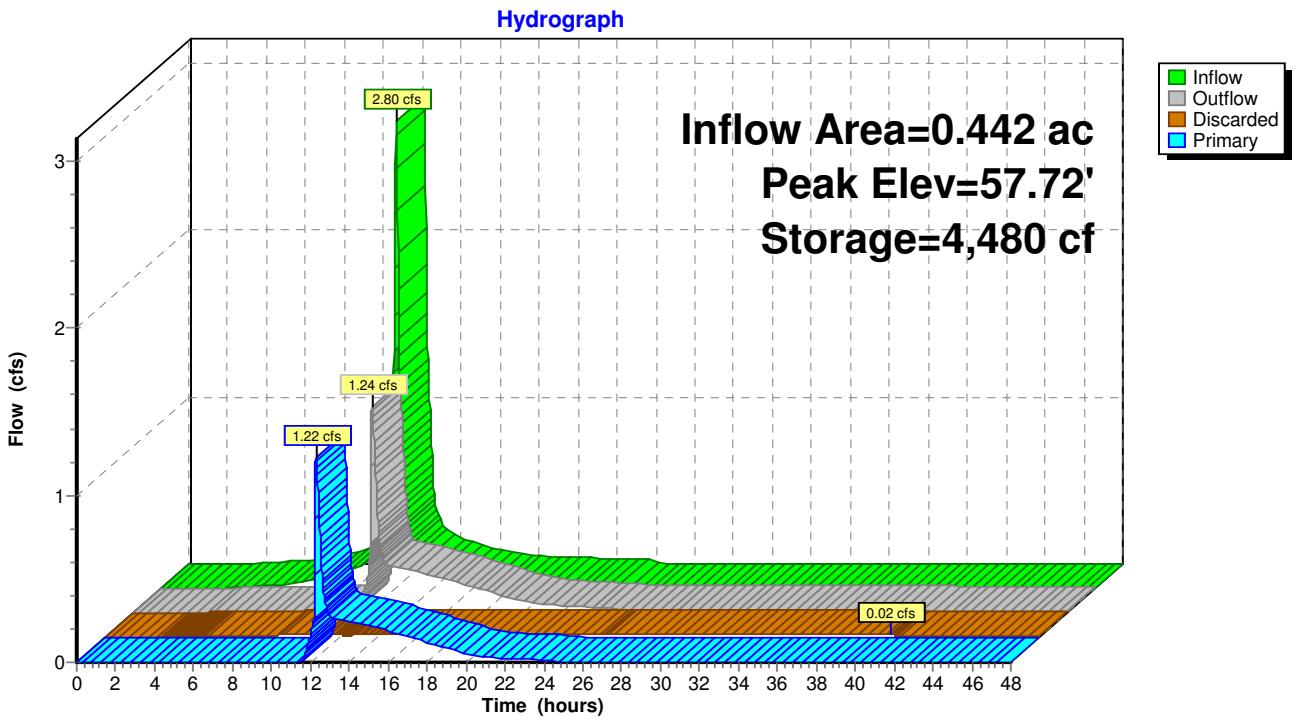
Volume	Invert	Avail.Storage	Storage Description
#1	55.15'	2,632 cf	**10.25'W x 200.00'L x 3.21'H Prismatoid** 6,581 cf Overall x 40.0% Voids
#2	55.65'	2,380 cf	**Cultec R-280** x 56 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
		5,012 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	56.15'	**12.0" Round Culvert** L= 90.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 56.15' / 55.45' S= 0.0078 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	56.15'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	57.55'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.5' Crest Height
#4	Discarded	55.15'	**0.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.02 cfs @ 40.42 hrs HW=55.65' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=1.22 cfs @ 12.30 hrs HW=57.72' (Free Discharge)
└─**1=Culvert** (Passes 1.22 cfs of 3.42 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.28 cfs @ 5.79 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.94 cfs @ 1.37 fps)

Pond POND-2: 73 Stevens St Rear Recharge System



Summary for Pond POND-3: Maggiore Combined Detention Basin

Inflow Area = 11.446 ac, 73.64% Impervious, Inflow Depth = 6.17" for 100 YR event
Inflow = 67.77 cfs @ 12.13 hrs, Volume= 5.886 af
Outflow = 32.39 cfs @ 12.34 hrs, Volume= 5.882 af, Atten= 52%, Lag= 12.9 min
Primary = 32.39 cfs @ 12.34 hrs, Volume= 5.882 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 33.62' @ 12.34 hrs Surf.Area= 30,725 sf Storage= 71,631 cf

Plug-Flow detention time= 70.0 min calculated for 5.880 af (100% of inflow)
Center-of-Mass det. time= 69.9 min (841.9 - 772.0)

Volume	Invert	Avail.Storage	Storage Description
#1	30.00'	117,074 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

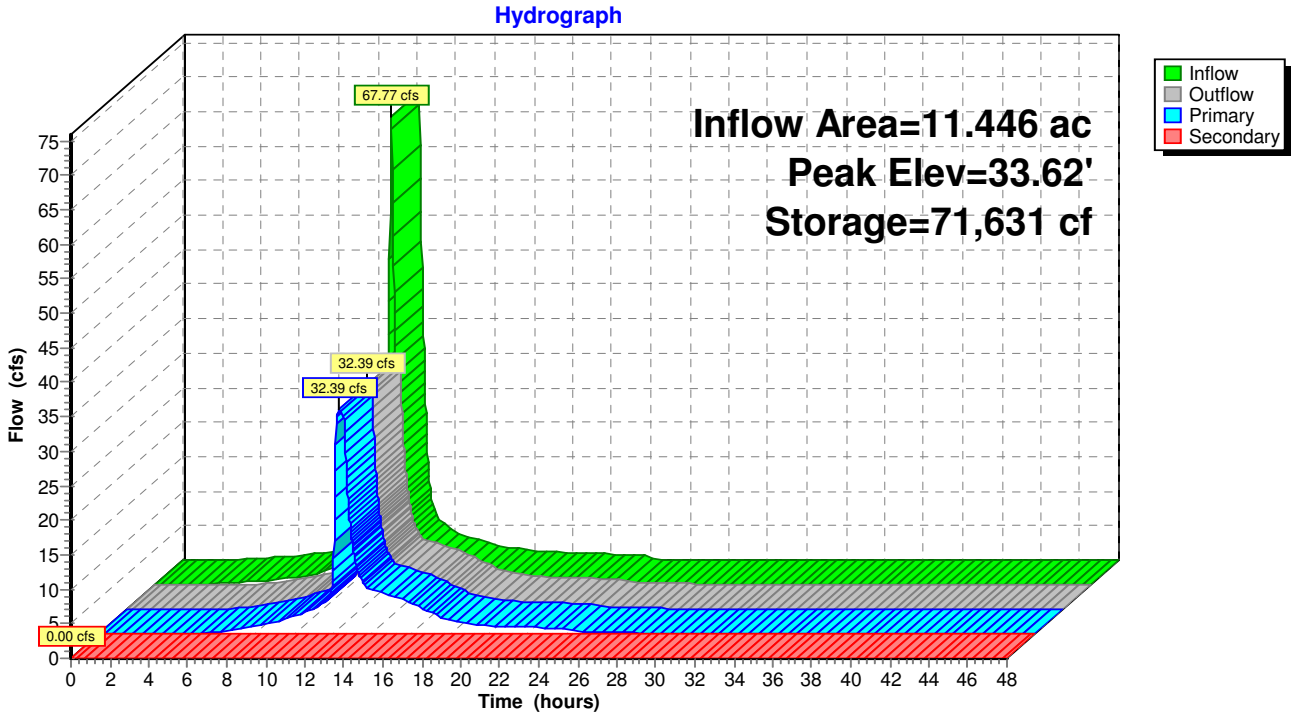
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
30.00	402	0	0
31.00	12,578	6,490	6,490
32.00	25,888	19,233	25,723
33.00	28,878	27,383	53,106
34.00	31,850	30,364	83,470
35.00	35,357	33,604	117,074

Device	Routing	Invert	Outlet Devices
#1	Primary	29.25'	**18.0" Round Culvert X 2.00** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 28.20' / 29.25' S= -0.0210 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	30.14'	**2.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 1	30.64'	**10.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	32.42'	**4.0' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s) 2.0' Crest Height
#5	Secondary	34.25'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=32.38 cfs @ 12.34 hrs HW=33.62' (Free Discharge)
└─**1=Culvert** (Inlet Controls 32.38 cfs @ 9.16 fps)
  ├─**2=Orifice/Grate** (Passes < 0.39 cfs potential flow)
  ├─**3=Orifice/Grate** (Passes < 8.41 cfs potential flow)
  └─**4=Sharp-Crested Rectangular Weir** (Passes < 34.76 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=30.00' (Free Discharge)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-3: Maggiore Combined Detention Basin



Summary for Pond POND-4: Maggiore 1 Recharge System

Inflow Area =	1.223 ac,100.00% Impervious, Inflow Depth = 6.76" for 100 YR event				
Inflow =	8.39 cfs @	12.08 hrs,	Volume=	0.689 af	
Outflow =	3.25 cfs @	12.31 hrs,	Volume=	0.689 af,	Atten= 61%, Lag= 13.4 min
Discarded =	0.22 cfs @	22.48 hrs,	Volume=	0.479 af	
Primary =	3.05 cfs @	12.31 hrs,	Volume=	0.211 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 44.63' @ 12.31 hrs Surf.Area= 10,696 sf Storage= 12,053 cf

Plug-Flow detention time= 305.6 min calculated for 0.689 af (100% of inflow)
Center-of-Mass det. time= 305.7 min (1,048.7 - 743.0)

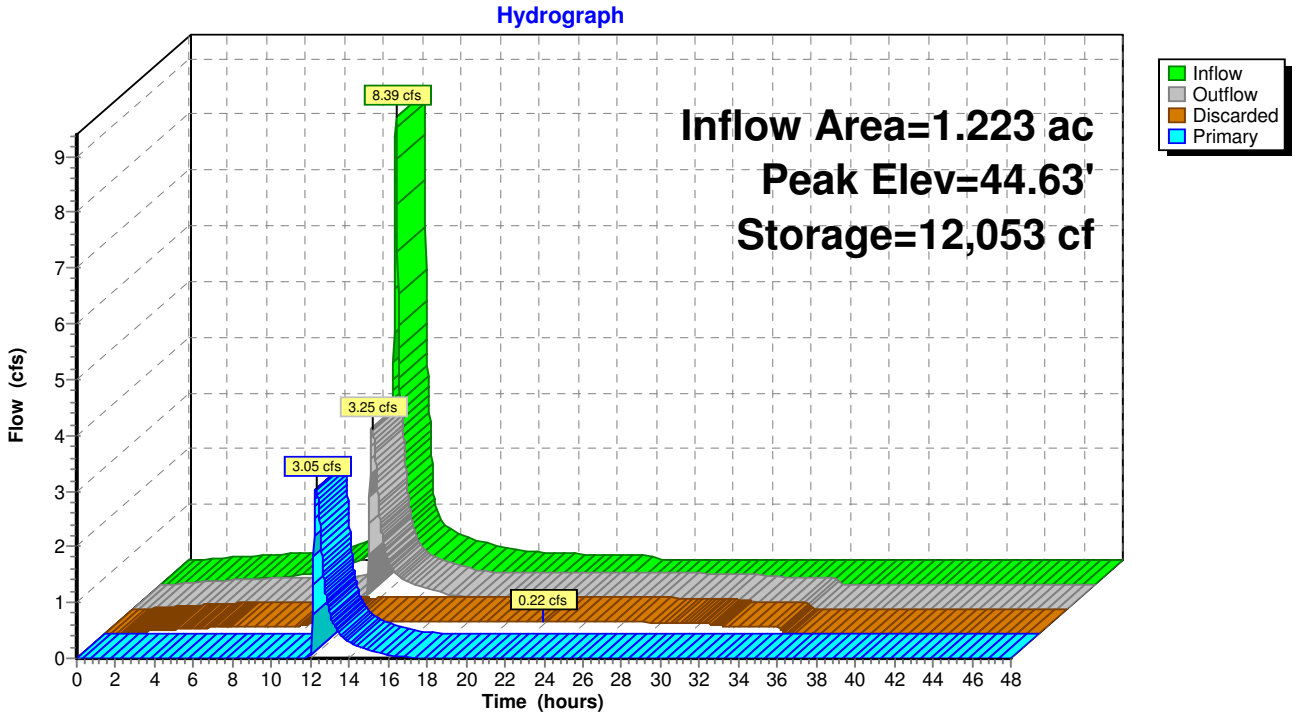
Volume	Invert	Avail.Storage	Storage Description
#1	42.50'	7,420 cf	**53.00'W x 140.00'L x 2.50'H Prismatoid** 18,550 cf Overall x 40.0% Voids
#2	43.00'	6,597 cf	**24.0" Round Pipe Storage** x 15 L= 140.0'
		14,017 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	42.00'	**12.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 42.00' / 41.25' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	44.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.5' Crest Height
#3	Discarded	42.50'	**0.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.22 cfs @ 22.48 hrs HW=44.00' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.22 cfs)

Primary OutFlow Max=3.04 cfs @ 12.31 hrs HW=44.63' (Free Discharge)
└─**1=Culvert** (Passes 3.04 cfs of 5.51 cfs potential flow)
  └─**2=Sharp-Crested Rectangular Weir** (Weir Controls 3.04 cfs @ 2.07 fps)

Pond POND-4: Maggiore 1 Recharge System



Summary for Pond POND-5: Maggiore 1 Detention Basin

Inflow Area = 3.438 ac, 93.38% Impervious, Inflow Depth = 4.94" for 100 YR event
Inflow = 15.11 cfs @ 12.09 hrs, Volume= 1.415 af
Outflow = 11.31 cfs @ 12.19 hrs, Volume= 1.405 af, Atten= 25%, Lag= 6.0 min
Primary = 11.31 cfs @ 12.19 hrs, Volume= 1.405 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 40.89' @ 12.19 hrs Surf.Area= 7,776 sf Storage= 12,466 cf

Plug-Flow detention time= 83.8 min calculated for 1.405 af (99% of inflow)
Center-of-Mass det. time= 80.0 min (838.9 - 758.9)

Volume	Invert	Avail.Storage	Storage Description
#1	38.50'	21,749 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

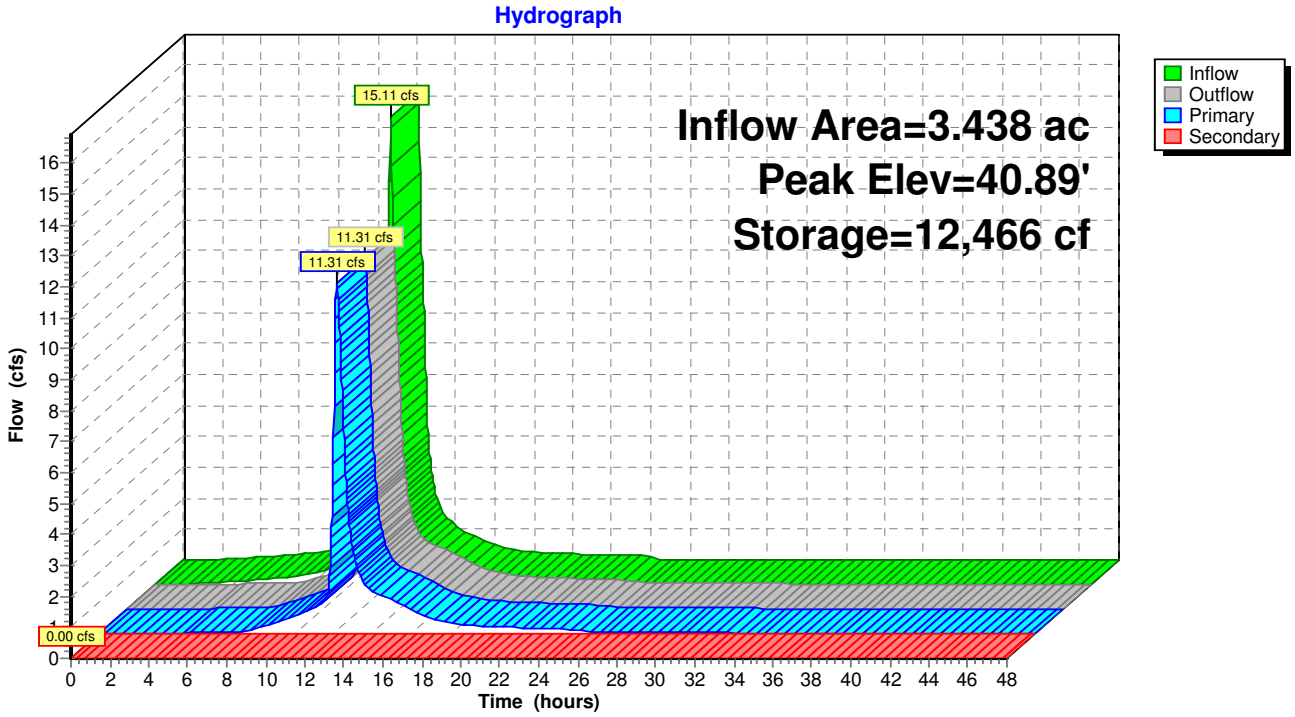
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.50	1,000	0	0
39.00	3,213	1,053	1,053
40.00	6,682	4,948	6,001
41.00	7,905	7,294	13,294
42.00	9,005	8,455	21,749

Device	Routing	Invert	Outlet Devices
#1	Primary	38.50'	**24.0" Round Culvert** L= 20.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 38.50' / 38.29' S= 0.0105 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	38.74'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	39.24'	**8.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	40.11'	**4.0' long x 1.75' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.7' Crest Height
#5	Secondary	40.95'	**10.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=11.29 cfs @ 12.19 hrs HW=40.89' (Free Discharge)
└─**1=Culvert** (Passes 11.29 cfs of 16.46 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.15 cfs @ 6.93 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 1.93 cfs @ 5.53 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Weir Controls 9.20 cfs @ 3.06 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.50' (Free Discharge)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-5: Maggiore 1 Detention Basin



Summary for Pond POND-6: O'Connell Way Detention Basin

Inflow Area = 6.286 ac, 50.11% Impervious, Inflow Depth = 4.86" for 100 YR event
Inflow = 27.95 cfs @ 12.17 hrs, Volume= 2.545 af
Outflow = 12.62 cfs @ 12.46 hrs, Volume= 2.440 af, Atten= 55%, Lag= 17.8 min
Primary = 12.62 cfs @ 12.46 hrs, Volume= 2.440 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 23.51' @ 12.46 hrs Surf.Area= 29,442 sf Storage= 39,947 cf

Plug-Flow detention time= 133.9 min calculated for 2.440 af (96% of inflow)
Center-of-Mass det. time= 110.3 min (915.5 - 805.2)

Volume	Invert	Avail.Storage	Storage Description
#1	22.00'	149,253 cf	**Custom Stage Data (Prismatic)** Listed below

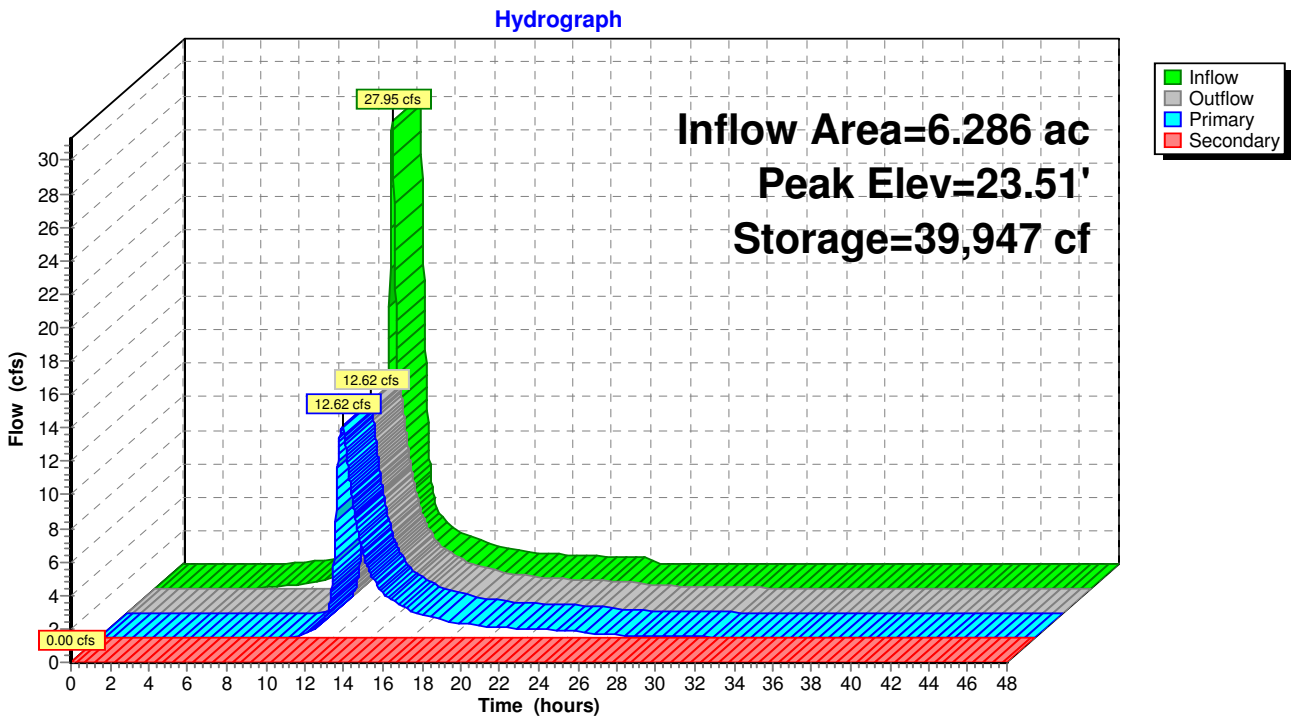
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
22.00	22,688	0	0
23.00	27,133	24,911	24,911
24.00	31,645	29,389	54,300
25.00	36,863	34,254	88,554
26.00	40,469	38,666	127,220
26.50	47,663	22,033	149,253

Device	Routing	Invert	Outlet Devices
#1	Primary	22.15'	**24.0" Round Culvert X 2.00** L= 46.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 22.15' / 22.00' S= 0.0033 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	22.15'	**18.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 1	24.25'	**4.0' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s) 1.0' Crest Height
#4	Secondary	26.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=12.62 cfs @ 12.46 hrs HW=23.51' (Free Discharge)
└─**1=Culvert** (Barrel Controls 12.62 cfs @ 3.91 fps)
  ├─**2=Orifice/Grate** (Passes 12.62 cfs of 13.39 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=22.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-6: O'Connell Way Detention Basin



Summary for Pond POND-7: Existing Detention Basin on 71 Stevens Street

Inflow Area = 2.892 ac, 50.18% Impervious, Inflow Depth = 4.81" for 100 YR event
Inflow = 15.04 cfs @ 12.11 hrs, Volume= 1.158 af
Outflow = 12.61 cfs @ 12.17 hrs, Volume= 1.158 af, Atten= 16%, Lag= 3.6 min
Primary = 4.77 cfs @ 12.17 hrs, Volume= 1.005 af
Secondary = 7.84 cfs @ 12.17 hrs, Volume= 0.153 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 55.90' @ 12.17 hrs Surf.Area= 5,156 sf Storage= 8,108 cf

Plug-Flow detention time= 20.7 min calculated for 1.157 af (100% of inflow)
Center-of-Mass det. time= 20.7 min (828.0 - 807.3)

Volume	Invert	Avail.Storage	Storage Description
#1	54.00'	8,617 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

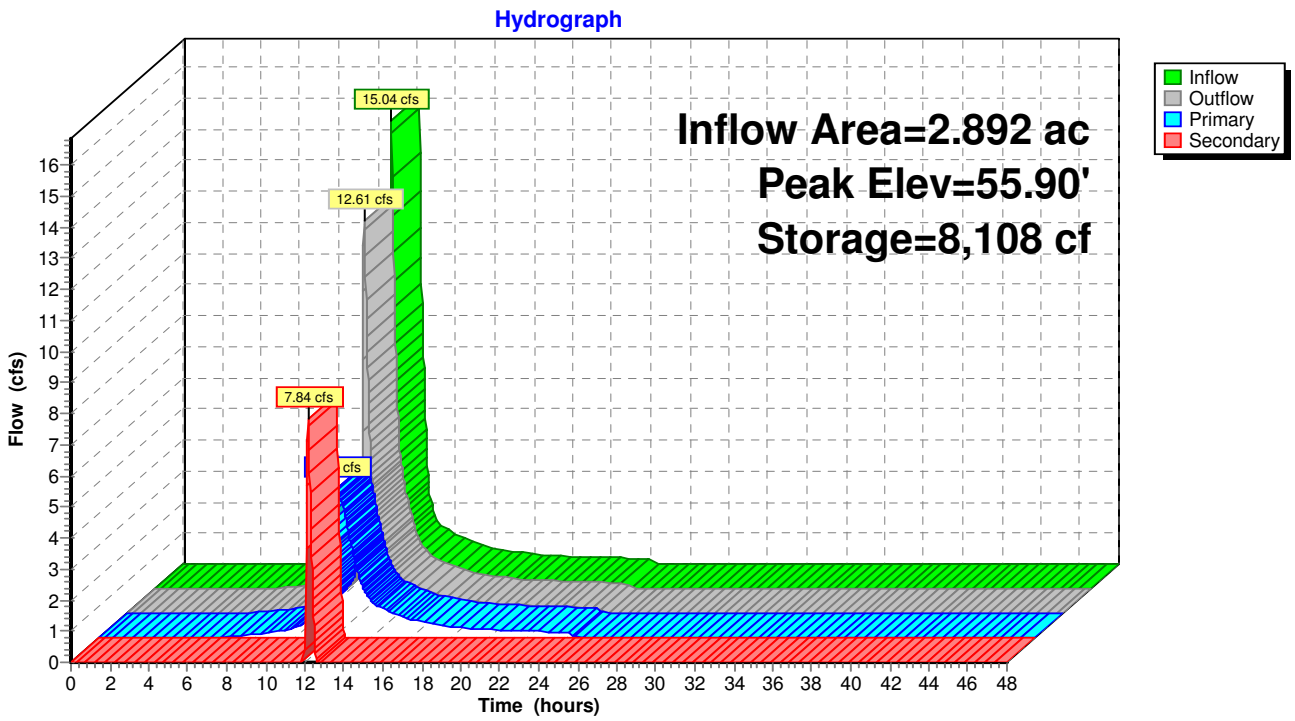
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
54.00	3,306	0	0
55.00	4,342	3,824	3,824
56.00	5,244	4,793	8,617

Device	Routing	Invert	Outlet Devices
#1	Primary	53.81'	**12.0" Round 12" HDPE** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.81' / 53.73' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Secondary	55.50'	**12.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.77 cfs @ 12.17 hrs HW=55.90' (Free Discharge)
└**1=12" HDPE** (Inlet Controls 4.77 cfs @ 6.07 fps)

Secondary OutFlow Max=7.78 cfs @ 12.17 hrs HW=55.90' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 7.78 cfs @ 1.62 fps)

Pond POND-7: Existing Detention Basin on 71 Stevens Street



Summary for Pond POND-8: Existing Detention Basin on DaRosa Lot

Proposed Detention Basin

Inflow Area =	0.452 ac,	0.00% Impervious,	Inflow Depth =	4.04"	for 100 YR event
Inflow =	1.95 cfs @	12.12 hrs,	Volume=	0.152 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= 0.02 hrs
Peak Elev= 44.32' @ 24.52 hrs Surf.Area= 3,631 sf Storage= 6,629 cf

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

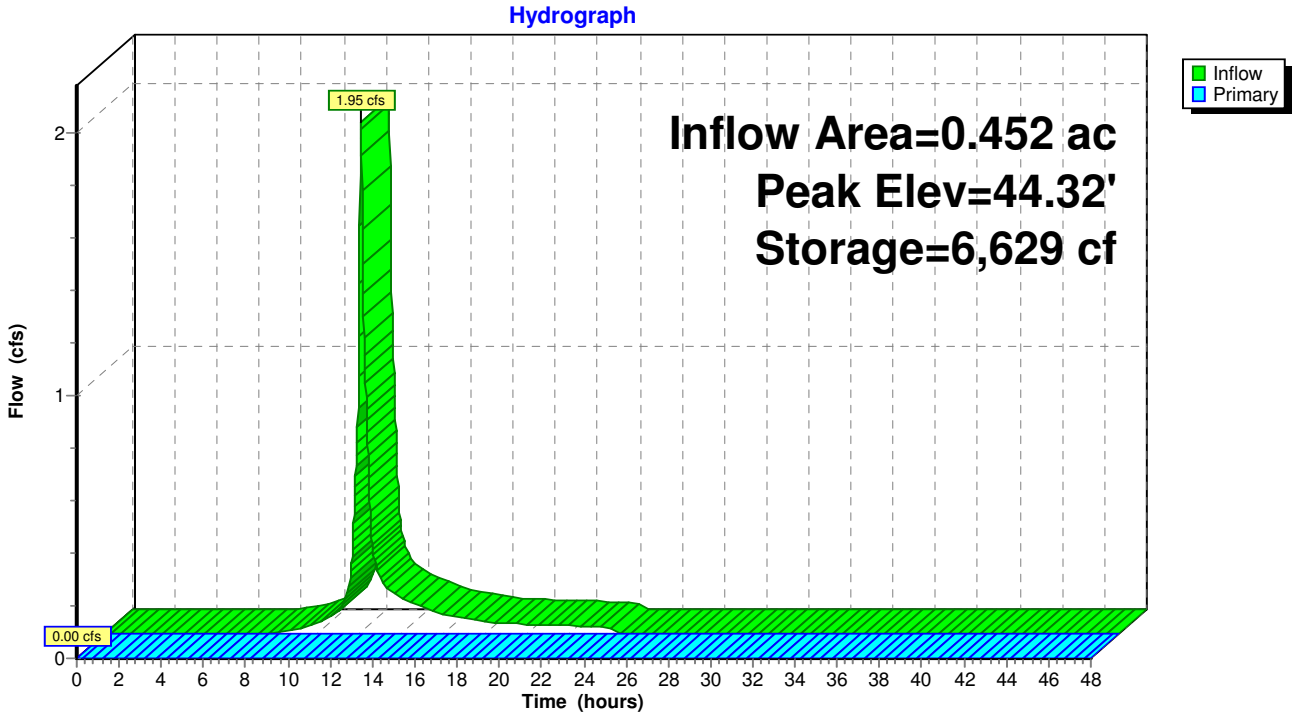
Volume	Invert	Avail.Storage	Storage Description
#1	42.00'	9,217 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
42.00	2,064	0	0
43.00	2,716	2,390	2,390
44.00	3,374	3,045	5,435
45.00	4,189	3,782	9,217

Device	Routing	Invert	Outlet Devices
#1	Primary	44.50'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=42.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-8: Existing Detention Basin on DaRosa Lot



Summary for Pond POND-9: Existing Culvert Crossing at 71 Stevens

Inflow Area = 5.340 ac, 44.13% Impervious, Inflow Depth = 4.71" for 100 YR event
Inflow = 23.20 cfs @ 12.14 hrs, Volume= 2.095 af
Outflow = 21.33 cfs @ 12.19 hrs, Volume= 2.095 af, Atten= 8%, Lag= 2.7 min
Primary = 21.33 cfs @ 12.19 hrs, Volume= 2.095 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 5
Peak Elev= 48.82' @ 12.19 hrs Surf.Area= 1,412 sf Storage= 2,293 cf

Plug-Flow detention time= 1.8 min calculated for 2.094 af (100% of inflow)
Center-of-Mass det. time= 1.9 min (822.3 - 820.4)

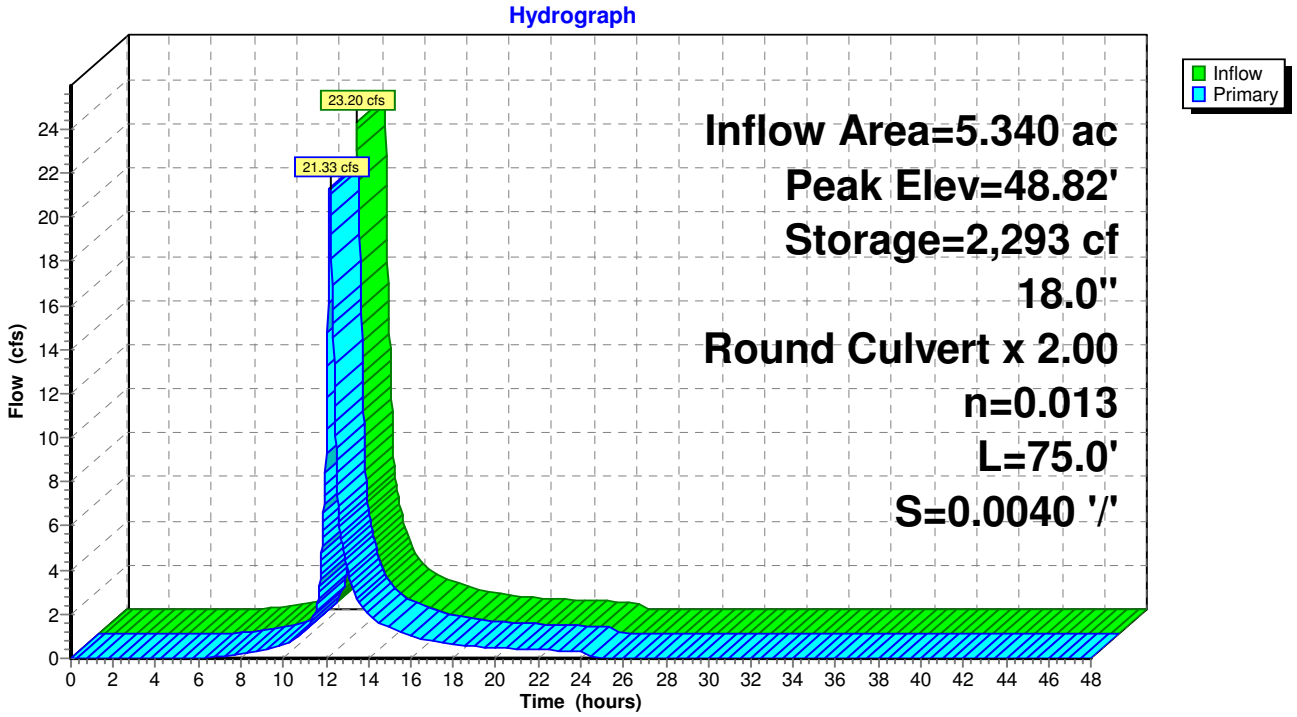
Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	5,400 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
46.00	300	0	0
47.00	650	475	475
48.00	1,000	825	1,300
49.00	1,500	1,250	2,550
50.00	2,000	1,750	4,300
50.50	2,400	1,100	5,400

Device	Routing	Invert	Outlet Devices
#1	Primary	46.00'	**18.0" Round Culvert X 2.00** L= 75.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 46.00' / 45.70' S= 0.0040 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf

Primary OutFlow Max=21.27 cfs @ 12.19 hrs HW=48.81' (Free Discharge)
└**1=Culvert** (Barrel Controls 21.27 cfs @ 6.02 fps)

Pond POND-9: Existing Culvert Crossing at 71 Stevens



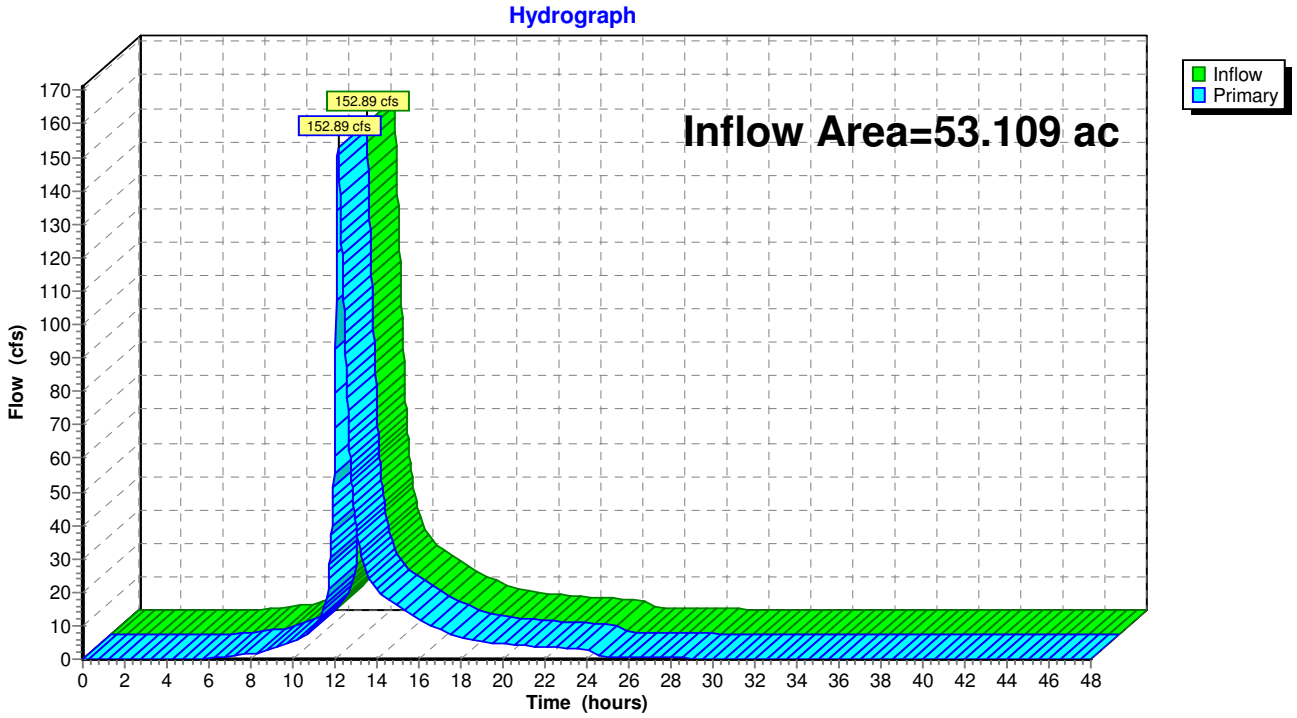
ry for Pond SUM-S: Summation of Analysis Points to Cotley River Wetlands from Southern portion of deve

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 53.109 ac, 36.80% Impervious, Inflow Depth = 4.39" for 100 YR event
Inflow = 152.89 cfs @ 12.16 hrs, Volume= 19.438 af
Primary = 152.89 cfs @ 12.16 hrs, Volume= 19.438 af, Atten= 0%, Lag= 0.0 min

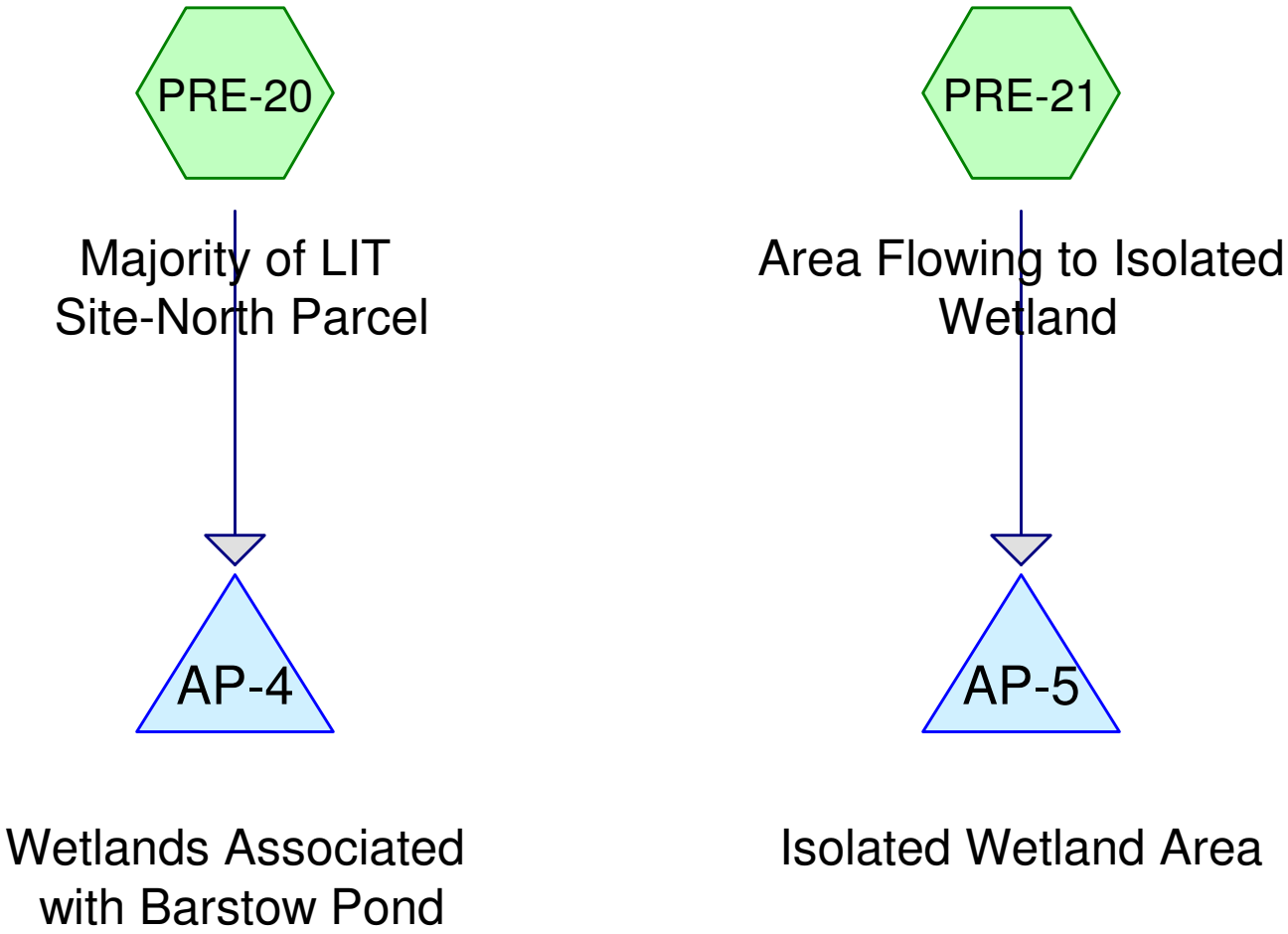
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

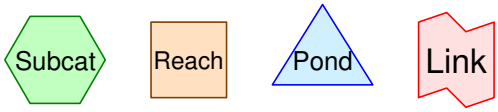
Pond SUM-S: Summation of Analysis Points to Cotley River Wetlands from Southern portion of developmen



Section 3

Pre Development Hydrologic Analysis
LIT Site-North Parcel





Routing Diagram for 1905-Pre-Development-LIT Site-North-FEIS
Prepared by Field Engineering Co. Inc., Printed 4/10/2014
HydroCAD® 10.00 s/n 01897 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
5.651	71	Meadow, non-grazed, HSG C (PRE-20)
0.192	98	Water Surface (PRE-21)
23.845	70	Woods, Good, HSG C (PRE-20, PRE-21)
29.688	**70**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PRE-20: Majority of LIT Runoff Area=1,230,725 sf 0.00% Impervious Runoff Depth=1.01"
Tc=20.0 min CN=70 Runoff=20.59 cfs 2.374 af

Subcatchment PRE-21: Area Flowing to Runoff Area=62,469 sf 13.40% Impervious Runoff Depth=1.24"
Tc=10.0 min CN=74 Runoff=1.74 cfs 0.148 af

Pond AP-4: Wetlands Associated with Barstow Pond Inflow=20.59 cfs 2.374 af
Primary=20.59 cfs 2.374 af

Pond AP-5: Isolated Wetland Area Inflow=1.74 cfs 0.148 af
Primary=1.74 cfs 0.148 af

Total Runoff Area = 29.688 ac Runoff Volume = 2.522 af Average Runoff Depth = 1.02"
99.35% Pervious = 29.496 ac 0.65% Impervious = 0.192 ac

Summary for Subcatchment PRE-20: Majority of LIT Site-North Parcel

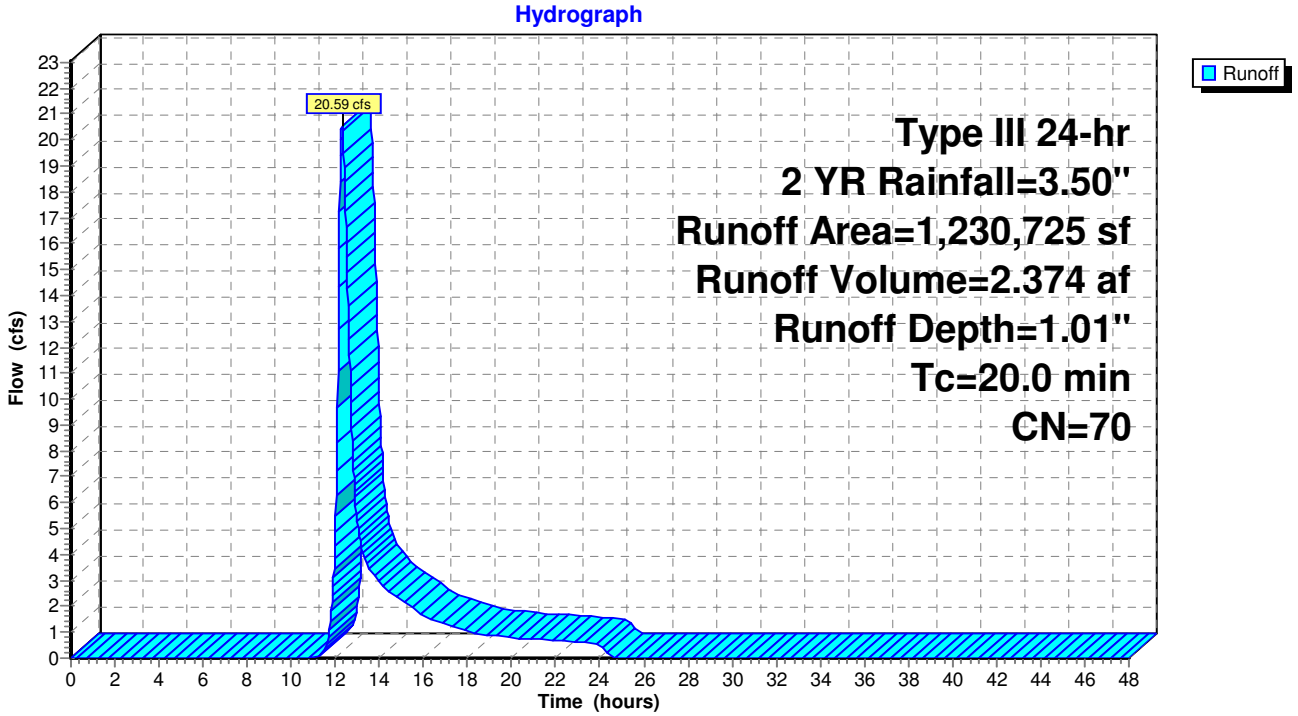
Runoff = 20.59 cfs @ 12.30 hrs, Volume= 2.374 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
246,145	71	Meadow, non-grazed, HSG C
984,580	70	Woods, Good, HSG C
1,230,725	70	Weighted Average
1,230,725		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment PRE-20: Majority of LIT Site-North Parcel



Summary for Subcatchment PRE-21: Area Flowing to Isolated Wetland

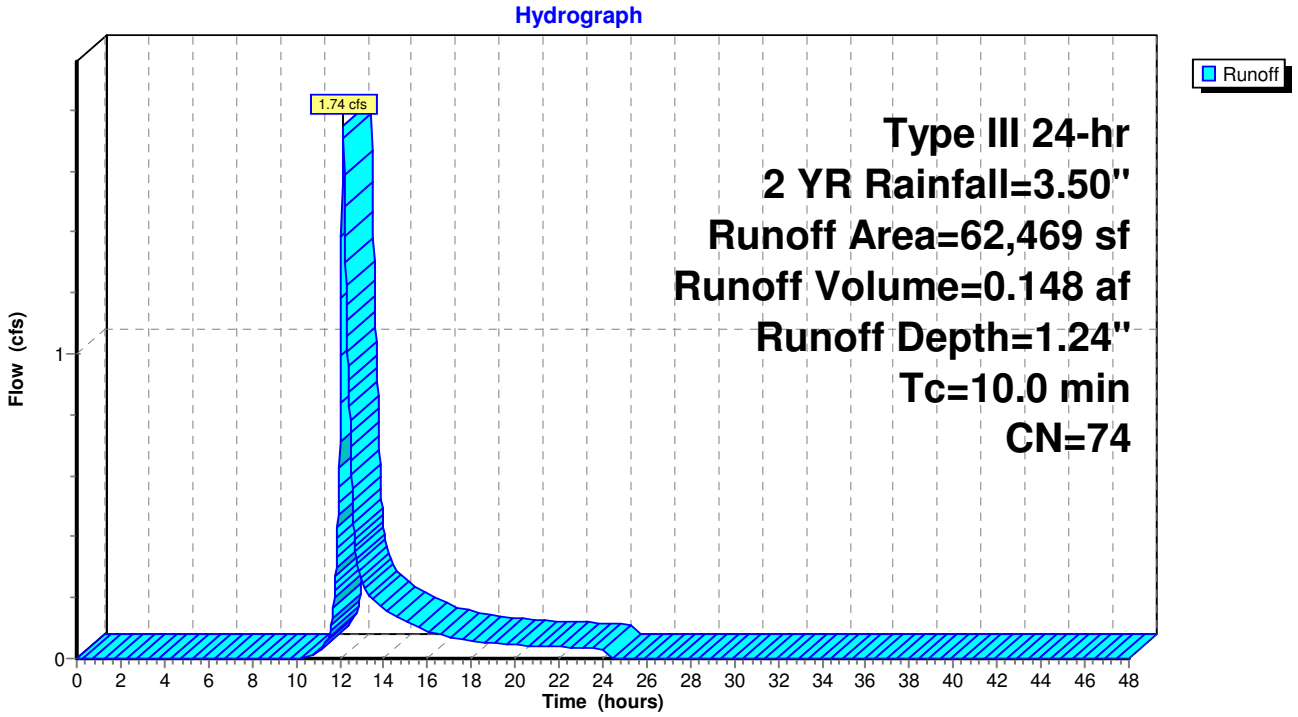
Runoff = 1.74 cfs @ 12.15 hrs, Volume= 0.148 af, Depth= 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
8,370	98	Water Surface
54,099	70	Woods, Good, HSG C
62,469	74	Weighted Average
54,099		86.60% Pervious Area
8,370		13.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment PRE-21: Area Flowing to Isolated Wetland



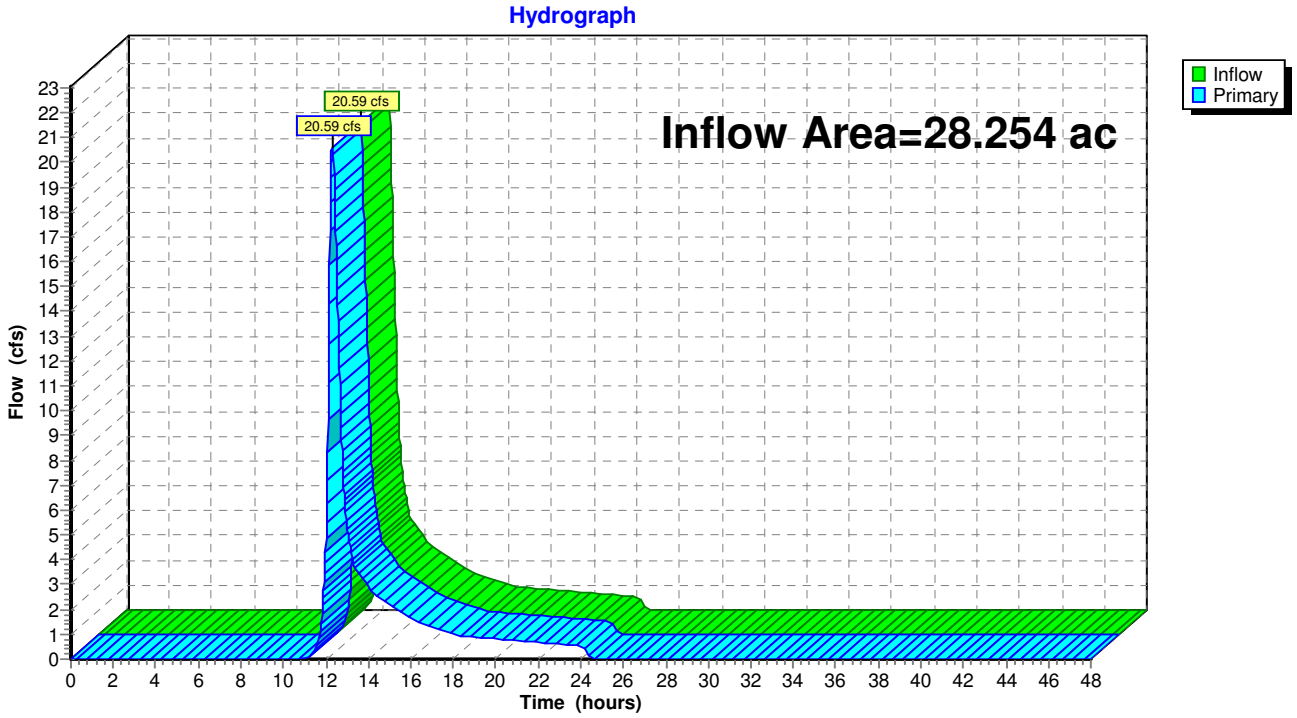
Summary for Pond AP-4: Wetlands Associated with Barstow Pond

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 28.254 ac, 0.00% Impervious, Inflow Depth = 1.01" for 2 YR event
Inflow = 20.59 cfs @ 12.30 hrs, Volume= 2.374 af
Primary = 20.59 cfs @ 12.30 hrs, Volume= 2.374 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

Pond AP-4: Wetlands Associated with Barstow Pond



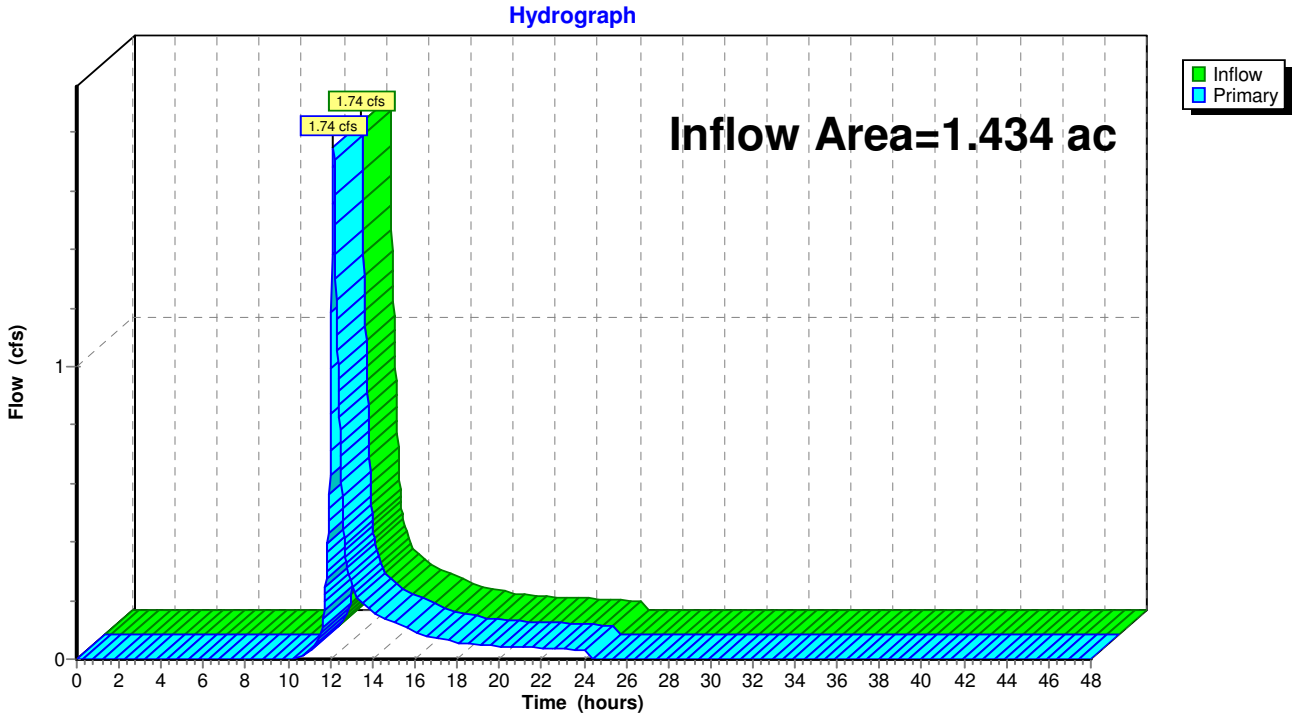
Summary for Pond AP-5: Isolated Wetland Area

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.434 ac, 13.40% Impervious, Inflow Depth = 1.24" for 2 YR event
Inflow = 1.74 cfs @ 12.15 hrs, Volume= 0.148 af
Primary = 1.74 cfs @ 12.15 hrs, Volume= 0.148 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

Pond AP-5: Isolated Wetland Area



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PRE-20: Majority of LIT Runoff Area=1,230,725 sf 0.00% Impervious Runoff Depth=1.89"
Tc=20.0 min CN=70 Runoff=41.05 cfs 4.448 af

Subcatchment PRE-21: Area Flowing to Runoff Area=62,469 sf 13.40% Impervious Runoff Depth=2.21"
Tc=10.0 min CN=74 Runoff=3.21 cfs 0.264 af

Pond AP-4: Wetlands Associated with Barstow Pond Inflow=41.05 cfs 4.448 af
Primary=41.05 cfs 4.448 af

Pond AP-5: Isolated Wetland Area Inflow=3.21 cfs 0.264 af
Primary=3.21 cfs 0.264 af

Total Runoff Area = 29.688 ac Runoff Volume = 4.712 af Average Runoff Depth = 1.90"
99.35% Pervious = 29.496 ac 0.65% Impervious = 0.192 ac

Summary for Subcatchment PRE-20: Majority of LIT Site-North Parcel

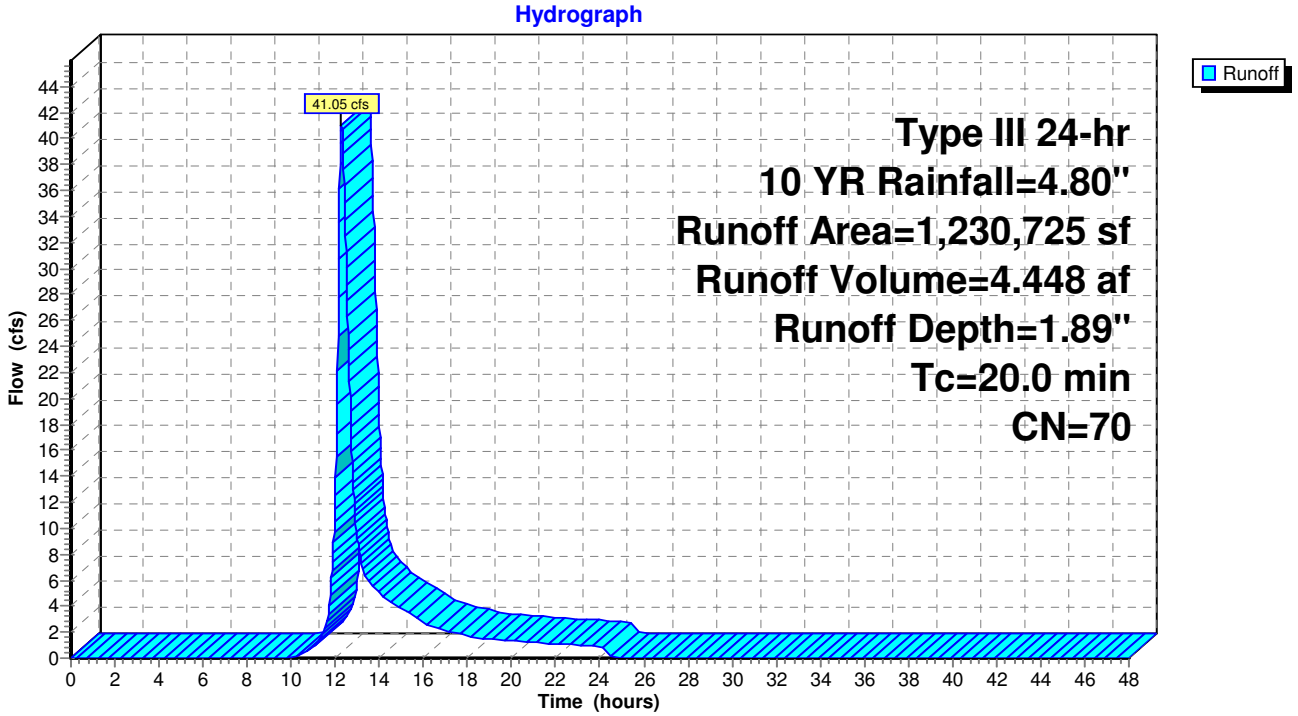
Runoff = 41.05 cfs @ 12.29 hrs, Volume= 4.448 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
246,145	71	Meadow, non-grazed, HSG C
984,580	70	Woods, Good, HSG C
1,230,725	70	Weighted Average
1,230,725		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment PRE-20: Majority of LIT Site-North Parcel



Summary for Subcatchment PRE-21: Area Flowing to Isolated Wetland

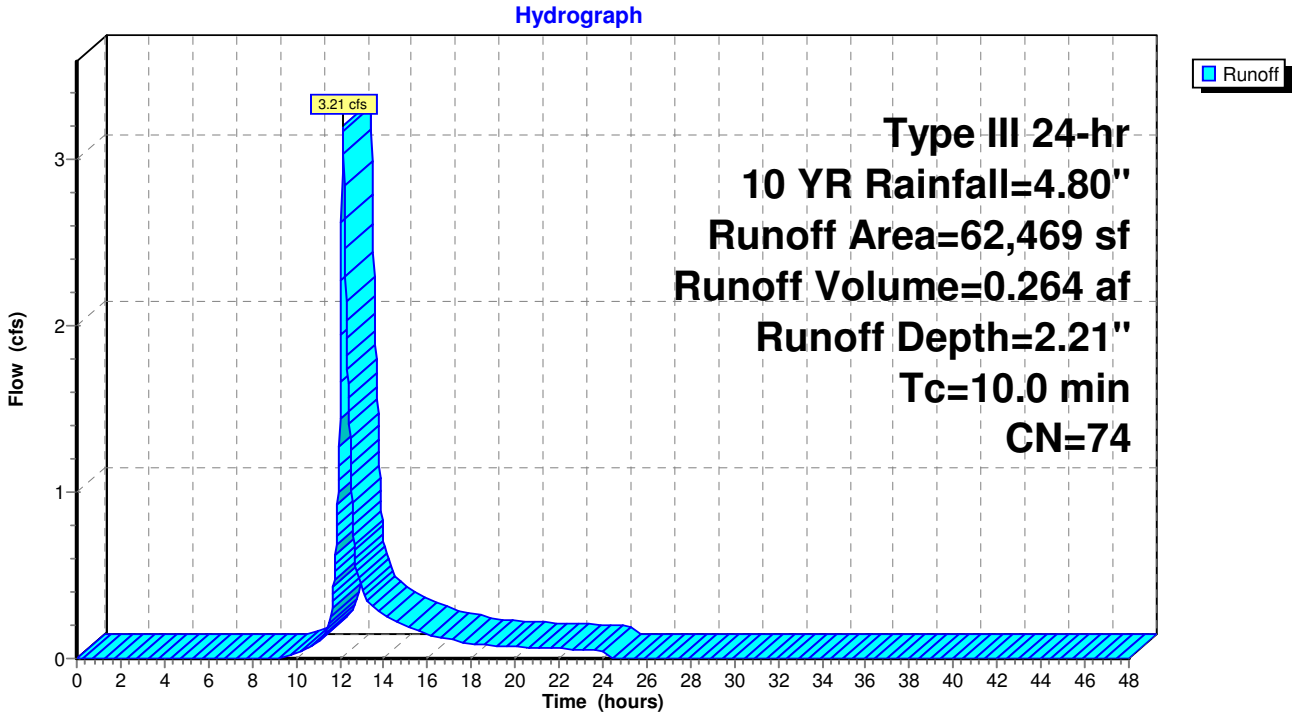
Runoff = 3.21 cfs @ 12.14 hrs, Volume= 0.264 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
8,370	98	Water Surface
54,099	70	Woods, Good, HSG C
62,469	74	Weighted Average
54,099		86.60% Pervious Area
8,370		13.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment PRE-21: Area Flowing to Isolated Wetland



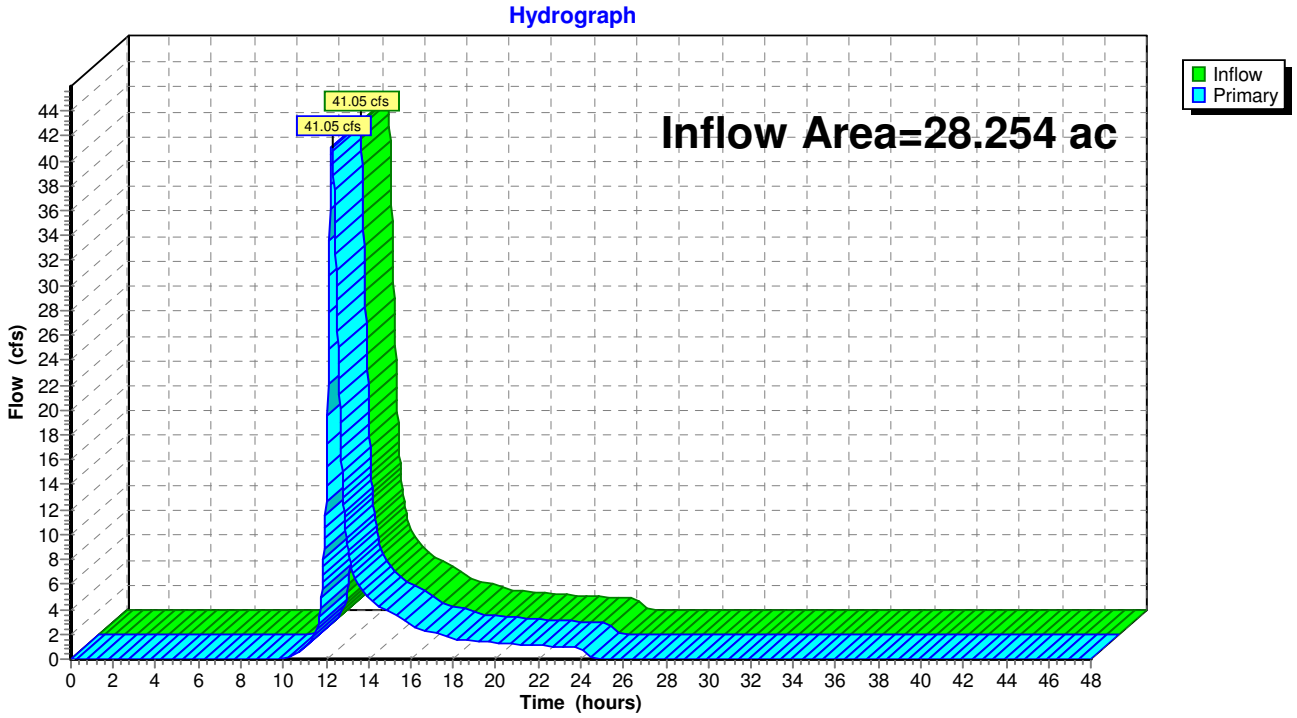
Summary for Pond AP-4: Wetlands Associated with Barstow Pond

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 28.254 ac, 0.00% Impervious, Inflow Depth = 1.89" for 10 YR event
Inflow = 41.05 cfs @ 12.29 hrs, Volume= 4.448 af
Primary = 41.05 cfs @ 12.29 hrs, Volume= 4.448 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

Pond AP-4: Wetlands Associated with Barstow Pond



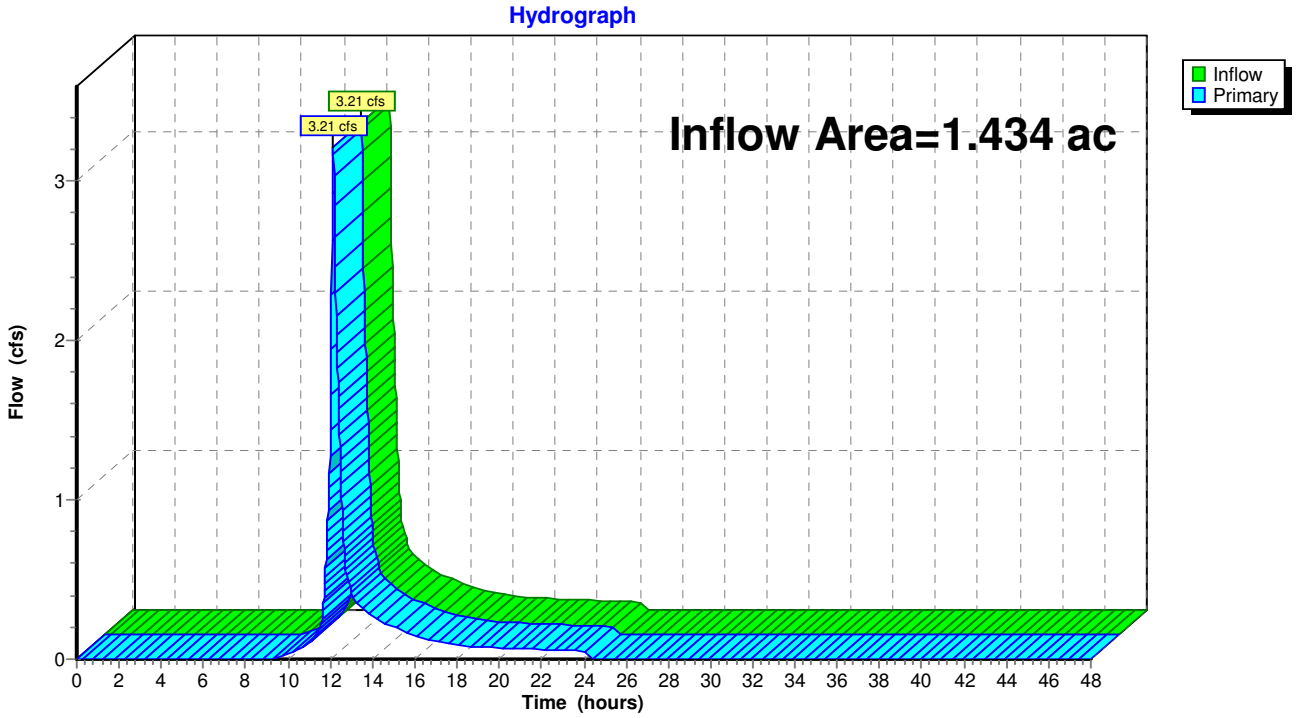
Summary for Pond AP-5: Isolated Wetland Area

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.434 ac, 13.40% Impervious, Inflow Depth = 2.21" for 10 YR event
Inflow = 3.21 cfs @ 12.14 hrs, Volume= 0.264 af
Primary = 3.21 cfs @ 12.14 hrs, Volume= 0.264 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

Pond AP-5: Isolated Wetland Area



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PRE-20: Majority of LIT Runoff Area=1,230,725 sf 0.00% Impervious Runoff Depth=3.62"
Tc=20.0 min CN=70 Runoff=80.63 cfs 8.519 af

Subcatchment PRE-21: Area Flowing to Runoff Area=62,469 sf 13.40% Impervious Runoff Depth=4.04"
Tc=10.0 min CN=74 Runoff=5.93 cfs 0.483 af

Pond AP-4: Wetlands Associated with Barstow Pond Inflow=80.63 cfs 8.519 af
Primary=80.63 cfs 8.519 af

Pond AP-5: Isolated Wetland Area Inflow=5.93 cfs 0.483 af
Primary=5.93 cfs 0.483 af

Total Runoff Area = 29.688 ac Runoff Volume = 9.002 af Average Runoff Depth = 3.64"
99.35% Pervious = 29.496 ac 0.65% Impervious = 0.192 ac

Summary for Subcatchment PRE-20: Majority of LIT Site-North Parcel

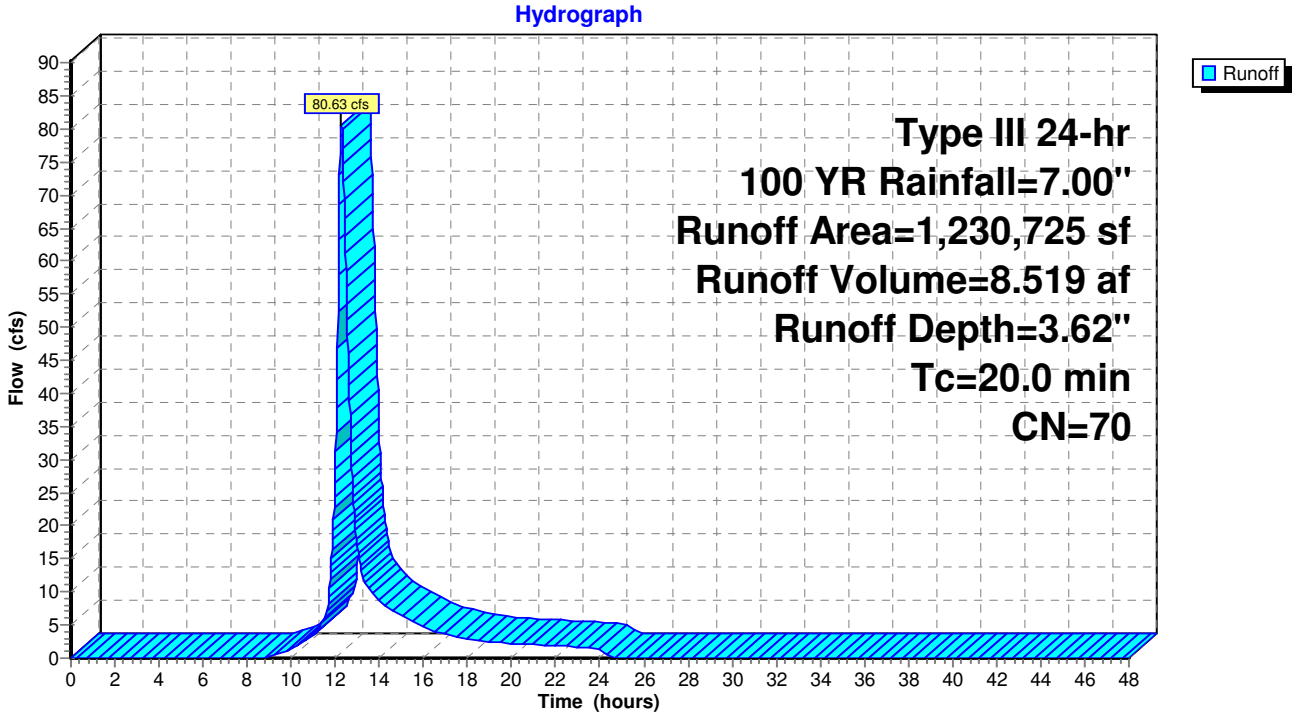
Runoff = 80.63 cfs @ 12.28 hrs, Volume= 8.519 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
246,145	71	Meadow, non-grazed, HSG C
984,580	70	Woods, Good, HSG C
1,230,725	70	Weighted Average
1,230,725		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment PRE-20: Majority of LIT Site-North Parcel



Summary for Subcatchment PRE-21: Area Flowing to Isolated Wetland

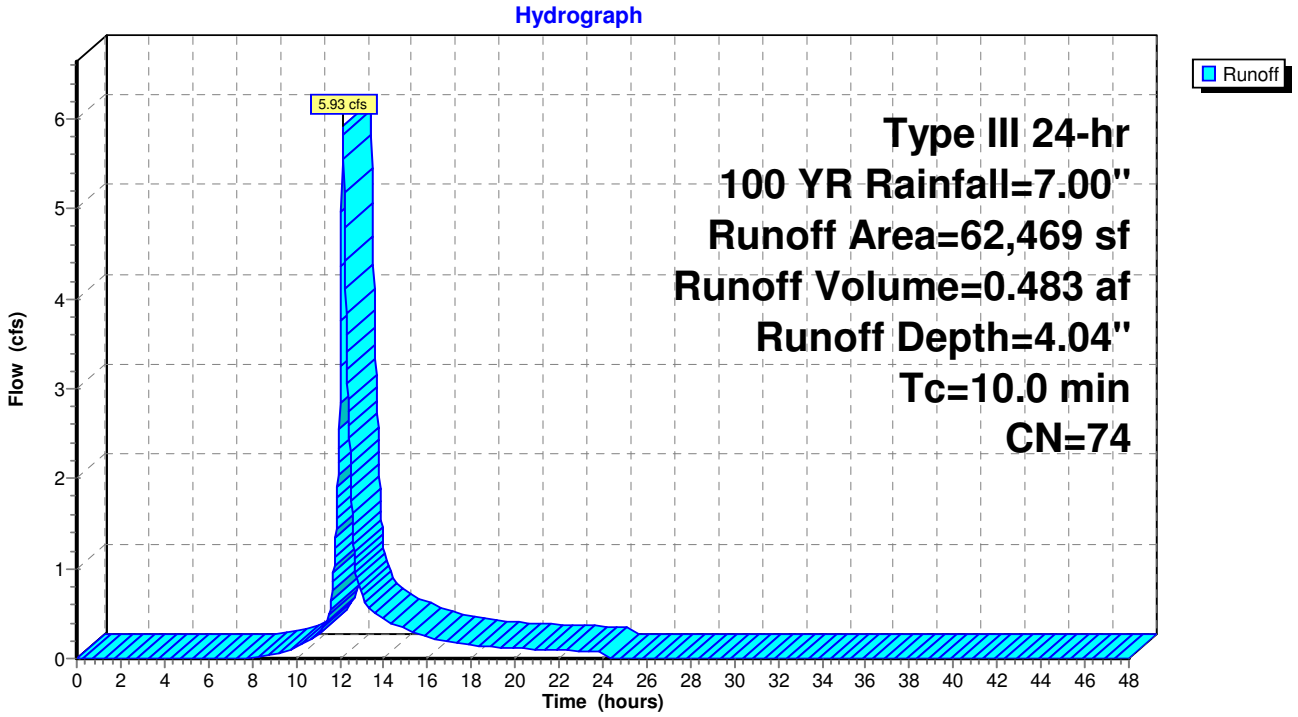
Runoff = 5.93 cfs @ 12.14 hrs, Volume= 0.483 af, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
8,370	98	Water Surface
54,099	70	Woods, Good, HSG C
62,469	74	Weighted Average
54,099		86.60% Pervious Area
8,370		13.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment PRE-21: Area Flowing to Isolated Wetland



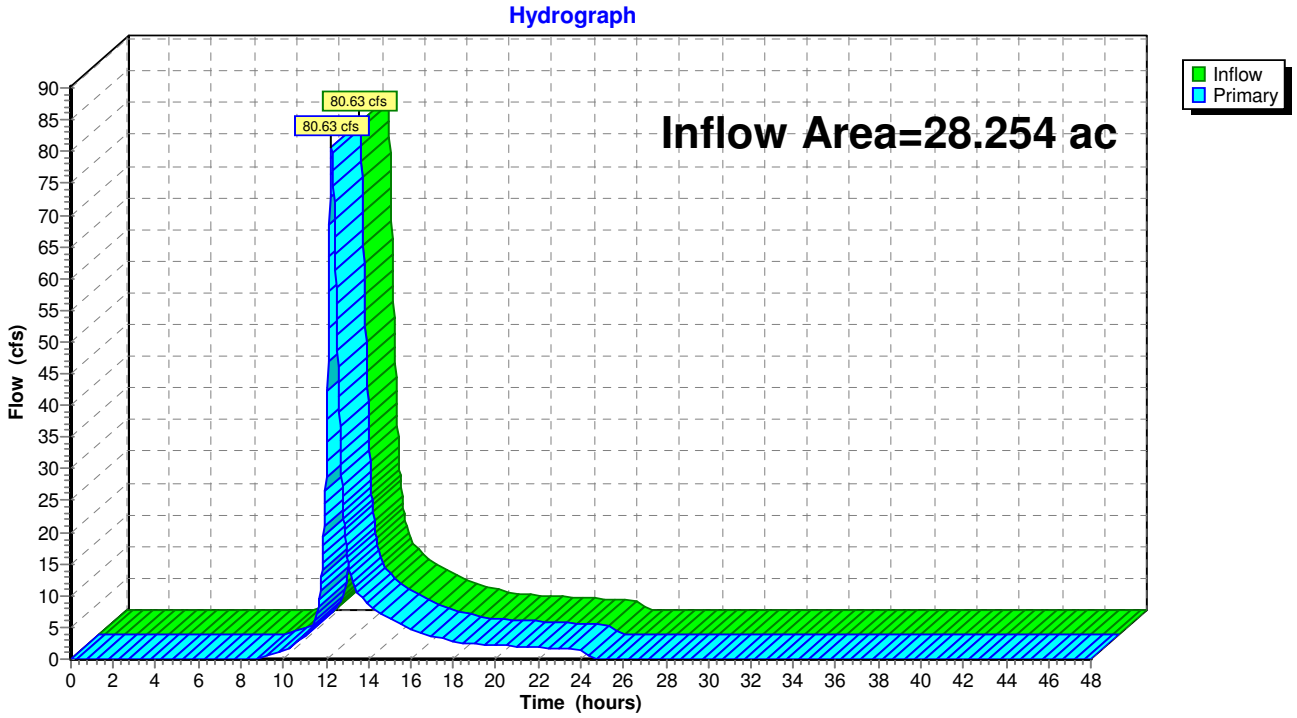
Summary for Pond AP-4: Wetlands Associated with Barstow Pond

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 28.254 ac, 0.00% Impervious, Inflow Depth = 3.62" for 100 YR event
Inflow = 80.63 cfs @ 12.28 hrs, Volume= 8.519 af
Primary = 80.63 cfs @ 12.28 hrs, Volume= 8.519 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

Pond AP-4: Wetlands Associated with Barstow Pond



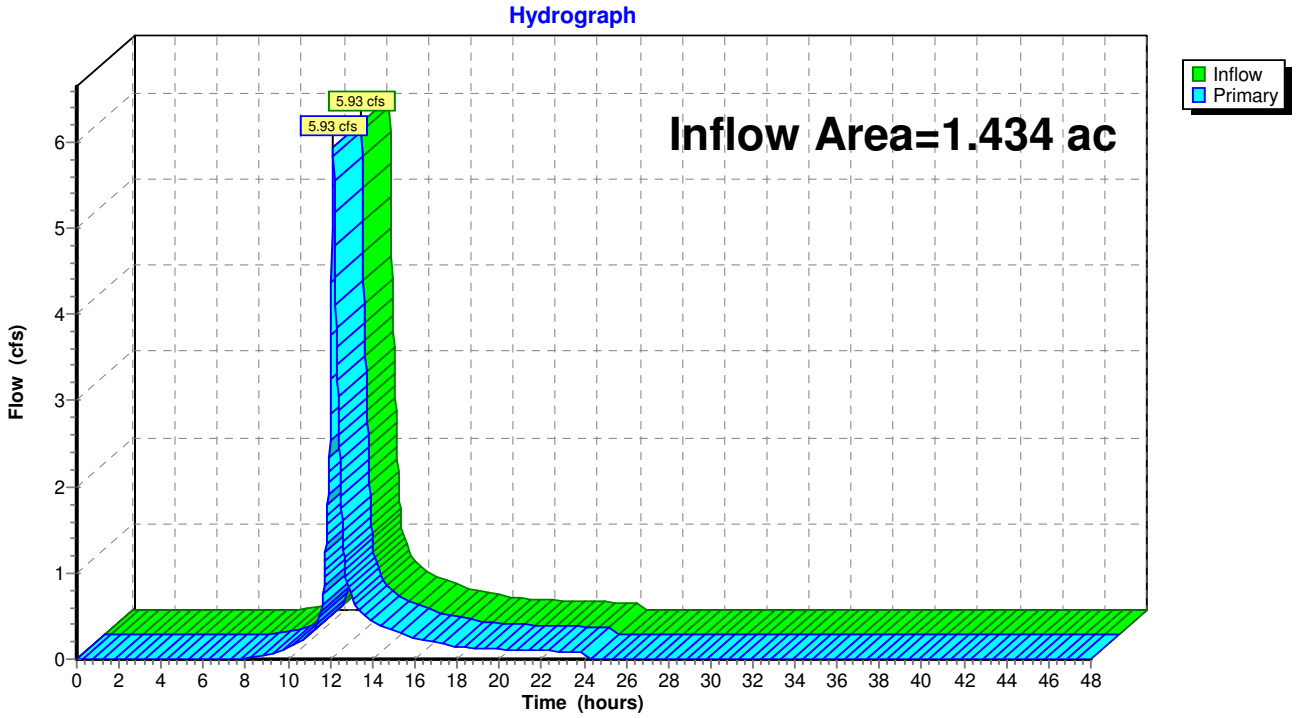
Summary for Pond AP-5: Isolated Wetland Area

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.434 ac, 13.40% Impervious, Inflow Depth = 4.04" for 100 YR event
Inflow = 5.93 cfs @ 12.14 hrs, Volume= 0.483 af
Primary = 5.93 cfs @ 12.14 hrs, Volume= 0.483 af, Atten= 0%, Lag= 0.0 min

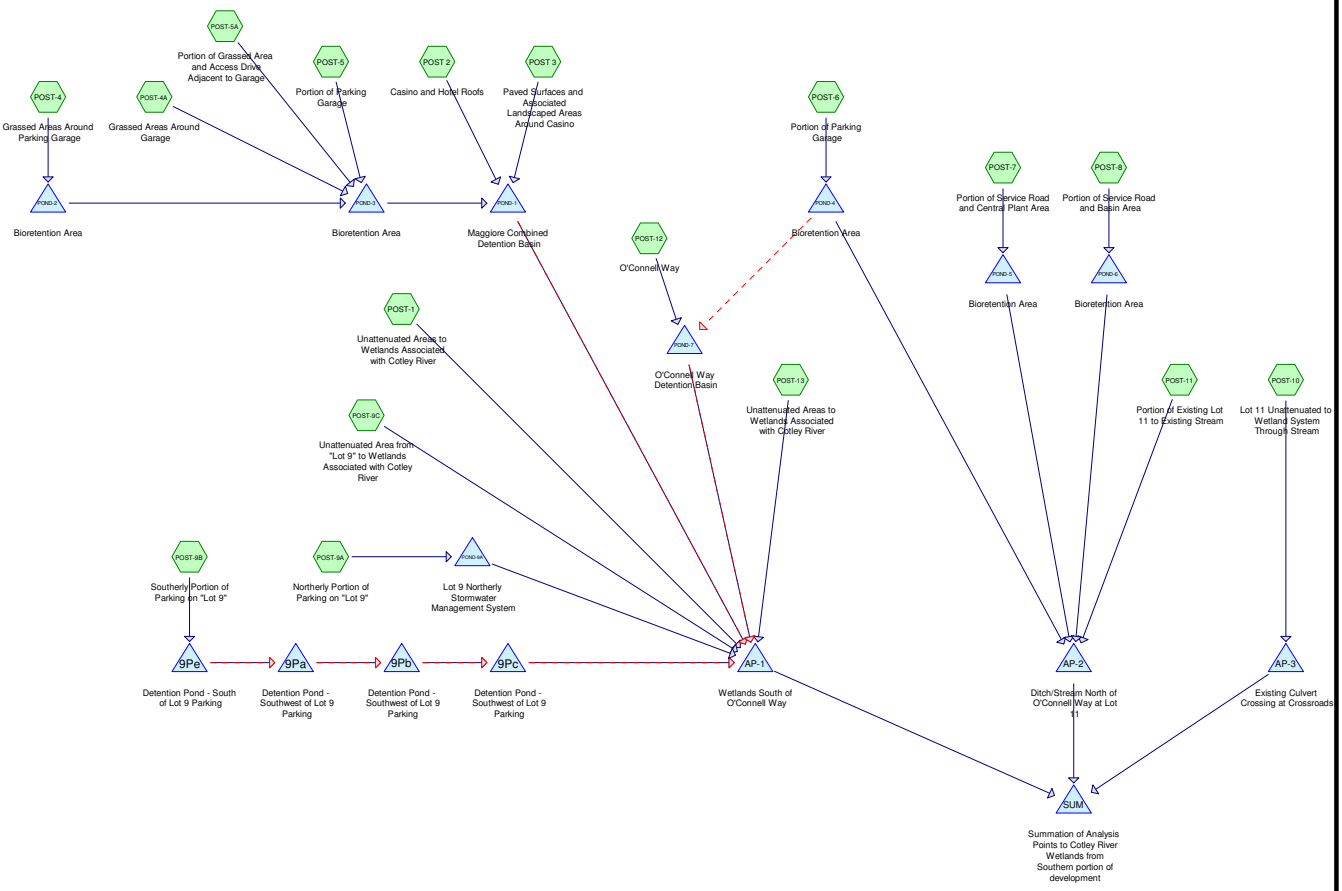
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

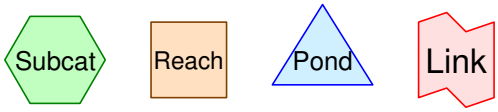
Pond AP-5: Isolated Wetland Area



Section 4

Post Development Hydrologic Analysis
LIT Site-South Parcel





Routing Diagram for 1905-Post-Development-LIT Site-South-FEIS
Prepared by Field Engineering Co. Inc., Printed 4/14/2014
HydroCAD® 10.00 s/n 01897 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.687	39	>75% Grass cover, Good, HSG A (POST-12, POST-13, POST-9C)
2.653	61	>75% Grass cover, Good, HSG B (POST-1, POST-10, POST-12, POST-13)
9.966	74	>75% Grass cover, Good, HSG C (POST 3, POST-1, POST-12, POST-4, POST-4A, POST-5A, POST-6, POST-7, POST-8)
1.601	80	>75% Grass cover, Good, HSG D (POST-1, POST-10, POST-11, POST-12, POST-13, POST-9C)
0.092	30	Meadow, non-grazed, HSG A (POST-9C)
0.138	78	Meadow, non-grazed, HSG D (POST-9C)
22.138	98	Paved parking & roofs (POST 2, POST 3, POST-12, POST-9A, POST-9B)
8.055	98	Paved parking, HSG C (POST-5, POST-5A, POST-6, POST-7, POST-8)
0.033	98	Unconnected pavement, HSG C (POST-4A)
0.508	98	Water Surface (POST-12)
0.692	98	Water Surface, HSG C (POST 3)
0.349	30	Woods, Good, HSG A (POST-13, POST-9C)
1.056	55	Woods, Good, HSG B (POST-1, POST-13)
4.497	70	Woods, Good, HSG C (POST-1, POST-10, POST-9C)
0.737	77	Woods, Good, HSG D (POST-1, POST-10, POST-13)
53.202	**86**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment POST 2: Casino and Runoff Area=446,687 sf 100.00% Impervious Runoff Depth=3.27"
Tc=6.0 min CN=98 Runoff=34.86 cfs 2.791 af

Subcatchment POST 3: Paved Surfaces Runoff Area=394,235 sf 70.88% Impervious Runoff Depth=2.54"
Tc=6.0 min CN=91 Runoff=26.36 cfs 1.917 af

Subcatchment POST-1: Unattenuated Runoff Area=371,335 sf 0.00% Impervious Runoff Depth=1.01"
Tc=10.0 min CN=70 Runoff=8.05 cfs 0.716 af

Subcatchment POST-10: Lot 11 Runoff Area=58,321 sf 0.00% Impervious Runoff Depth=0.71"
Tc=6.0 min CN=64 Runoff=0.90 cfs 0.079 af

Subcatchment POST-11: Portion of Existing Runoff Area=16,084 sf 0.00% Impervious Runoff Depth=1.64"
Tc=6.0 min CN=80 Runoff=0.70 cfs 0.050 af

Subcatchment POST-12: O'Connell Way Runoff Area=241,140 sf 69.51% Impervious Runoff Depth=2.18"
Flow Length=2,195' Tc=13.1 min CN=87 Runoff=11.25 cfs 1.007 af

Subcatchment POST-13: Unattenuated Runoff Area=49,358 sf 0.00% Impervious Runoff Depth=0.35"
Tc=10.0 min CN=55 Runoff=0.18 cfs 0.033 af

Subcatchment POST-4: Grassed Areas Runoff Area=40,262 sf 0.00% Impervious Runoff Depth=1.24"
Tc=10.0 min CN=74 Runoff=1.12 cfs 0.096 af

Subcatchment POST-4A: Grassed Areas Runoff Area=22,803 sf 6.22% Impervious Runoff Depth=1.30"
Tc=6.0 min CN=75 Runoff=0.77 cfs 0.057 af

Subcatchment POST-5: Portion of Runoff Area=110,956 sf 100.00% Impervious Runoff Depth=3.27"
Tc=6.0 min CN=98 Runoff=8.66 cfs 0.693 af

Subcatchment POST-5A: Portion of Runoff Area=36,782 sf 66.62% Impervious Runoff Depth=2.45"
Tc=6.0 min CN=90 Runoff=2.38 cfs 0.172 af

Subcatchment POST-6: Portion of Runoff Area=183,629 sf 93.31% Impervious Runoff Depth=3.05"
Tc=6.0 min CN=96 Runoff=13.91 cfs 1.070 af

Subcatchment POST-7: Portion of Service Runoff Area=88,786 sf 34.67% Impervious Runoff Depth=1.78"
Tc=6.0 min CN=82 Runoff=4.25 cfs 0.303 af

Subcatchment POST-8: Portion of Service Runoff Area=41,710 sf 31.81% Impervious Runoff Depth=1.78"
Tc=6.0 min CN=82 Runoff=2.00 cfs 0.142 af

Subcatchment POST-9A: Northerly Runoff Area=63,780 sf 100.00% Impervious Runoff Depth=3.27"
Tc=6.0 min CN=98 Runoff=4.98 cfs 0.399 af

Subcatchment POST-9B: Southerly Runoff Area=59,094 sf 100.00% Impervious Runoff Depth=3.27"
Tc=6.0 min CN=98 Runoff=4.61 cfs 0.369 af

Subcatchment POST-9C: Unattenuated Runoff Area=92,500 sf 0.00% Impervious Runoff Depth=0.85"
Tc=10.0 min CN=67 Runoff=1.60 cfs 0.150 af

Pond 9Pa: Detention Pond - Southwest of Lot Peak Elev=26.81' Storage=3,679 cf Inflow=2.89 cfs 0.327 af
Primary=1.66 cfs 0.308 af Secondary=0.00 cfs 0.000 af Outflow=1.66 cfs 0.308 af

Pond 9Pb: Detention Pond - Southwest of Lot Peak Elev=25.54' Storage=2,306 cf Inflow=1.66 cfs 0.308 af
Primary=1.41 cfs 0.293 af Secondary=0.00 cfs 0.000 af Outflow=1.41 cfs 0.293 af

Pond 9Pc: Detention Pond - Southwest of Lot Peak Elev=24.81' Storage=2,591 cf Inflow=1.41 cfs 0.293 af
Primary=0.71 cfs 0.239 af Secondary=0.68 cfs 0.037 af Outflow=1.38 cfs 0.275 af

Pond 9Pe: Detention Pond - South of Lot 9 Peak Elev=30.66' Storage=4,675 cf Inflow=4.61 cfs 0.369 af
Primary=2.89 cfs 0.327 af Secondary=0.00 cfs 0.000 af Outflow=2.89 cfs 0.327 af

Pond AP-1: Wetlands South of O'Connell Way Inflow=23.71 cfs 6.135 af
Primary=23.71 cfs 6.135 af

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11 Inflow=7.26 cfs 0.494 af
Primary=7.26 cfs 0.494 af

Pond AP-3: Existing Culvert Crossing at Crossroads Inflow=0.90 cfs 0.079 af
Primary=0.90 cfs 0.079 af

Pond POND-1: Maggiore Combined Peak Elev=33.21' Storage=110,799 cf Inflow=70.83 cfs 5.476 af
Primary=15.86 cfs 4.925 af Secondary=0.00 cfs 0.000 af Outflow=15.86 cfs 4.925 af

Pond POND-2: Bioretention Area Peak Elev=52.22' Storage=1,161 cf Inflow=1.12 cfs 0.096 af
Discarded=0.13 cfs 0.070 af Primary=0.22 cfs 0.025 af Outflow=0.35 cfs 0.096 af

Pond POND-3: Bioretention Area Peak Elev=49.64' Storage=4,096 cf Inflow=11.83 cfs 0.948 af
Discarded=0.10 cfs 0.180 af Primary=10.46 cfs 0.768 af Outflow=10.56 cfs 0.948 af

Pond POND-4: Bioretention Area Peak Elev=48.97' Storage=3,515 cf Inflow=13.91 cfs 1.070 af
Discarded=0.10 cfs 0.182 af Primary=6.58 cfs 0.444 af Secondary=6.58 cfs 0.444 af Outflow=13.25 cfs 1.070 af

Pond POND-5: Bioretention Area Peak Elev=41.98' Storage=8,548 cf Inflow=4.25 cfs 0.303 af
Discarded=0.12 cfs 0.303 af Primary=0.00 cfs 0.000 af Outflow=0.12 cfs 0.303 af

Pond POND-6: Bioretention Area Peak Elev=39.96' Storage=6,196 cf Inflow=2.00 cfs 0.142 af
Outflow=0.00 cfs 0.000 af

Pond POND-7: O'Connell Way Detention Peak Elev=24.20' Storage=63,199 cf Inflow=16.95 cfs 1.451 af
Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Pond POND-9A: Lot 9 Northerly Stormwater Peak Elev=0.96' Storage=0.155 af Inflow=4.98 cfs 0.399 af
Discarded=0.28 cfs 0.363 af Primary=0.35 cfs 0.035 af Outflow=0.62 cfs 0.399 af

Pond SUM: Summation of Analysis Points to Cotley River Wetlands from Inflow=30.83 cfs 6.708 af
Primary=30.83 cfs 6.708 af

Total Runoff Area = 53.202 ac Runoff Volume = 10.043 af Average Runoff Depth = 2.27"
40.93% Pervious = 21.776 ac 59.07% Impervious = 31.426 ac

Summary for Subcatchment POST 2: Casino and Hotel Roofs

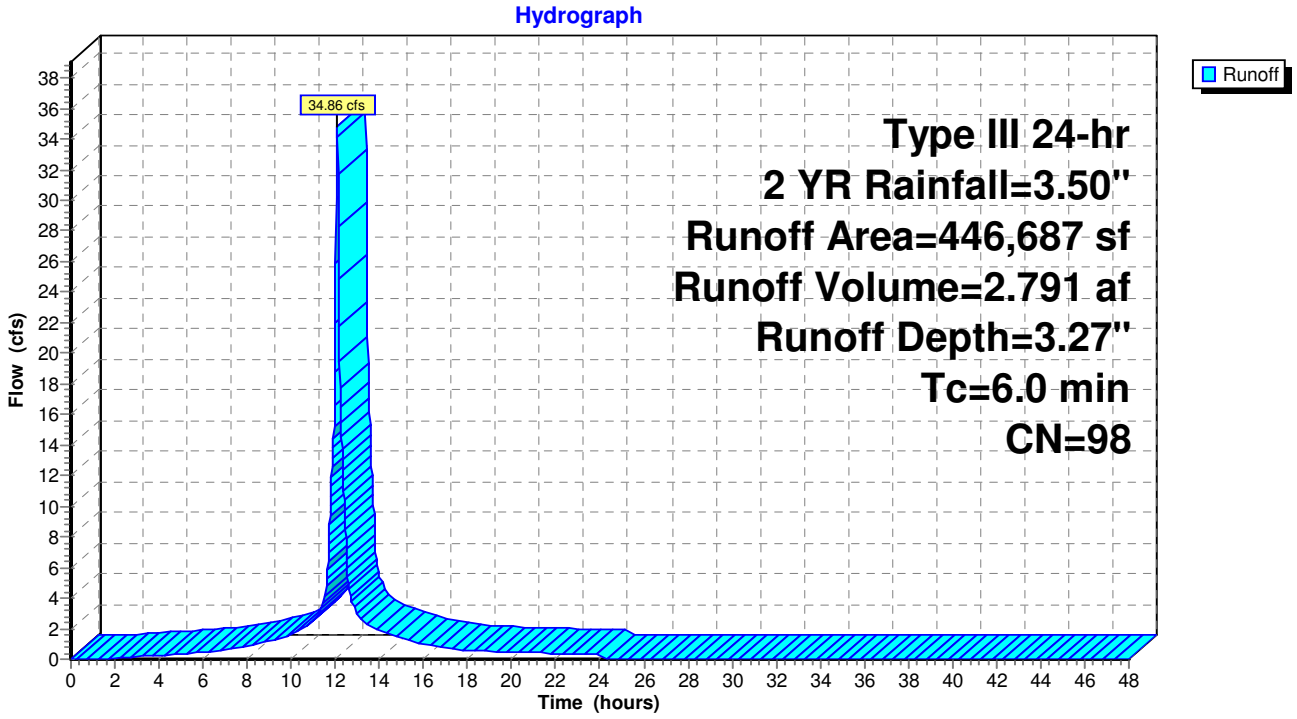
Runoff = 34.86 cfs @ 12.08 hrs, Volume= 2.791 af, Depth= 3.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
446,687	98	Paved parking & roofs
446,687		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST 2: Casino and Hotel Roofs



Summary for Subcatchment POST 3: Paved Surfaces and Associated Landscaped Areas Around Casino

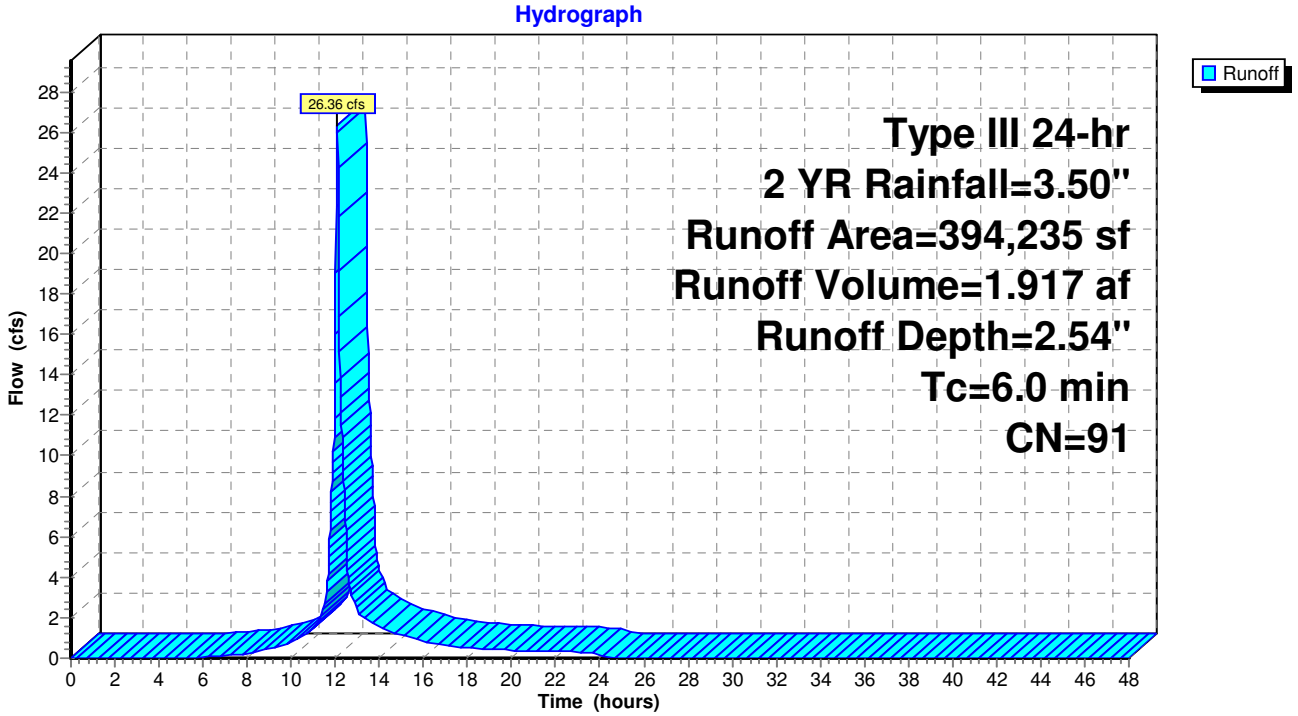
Runoff = 26.36 cfs @ 12.09 hrs, Volume= 1.917 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
249,275	98	Paved parking & roofs
114,800	74	>75% Grass cover, Good, HSG C
30,160	98	Water Surface, HSG C
394,235	91	Weighted Average
114,800		29.12% Pervious Area
279,435		70.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST 3: Paved Surfaces and Associated Landscaped Areas Around Casino



Summary for Subcatchment POST-1: Unattenuated Areas to Wetlands Associated with Cotley River

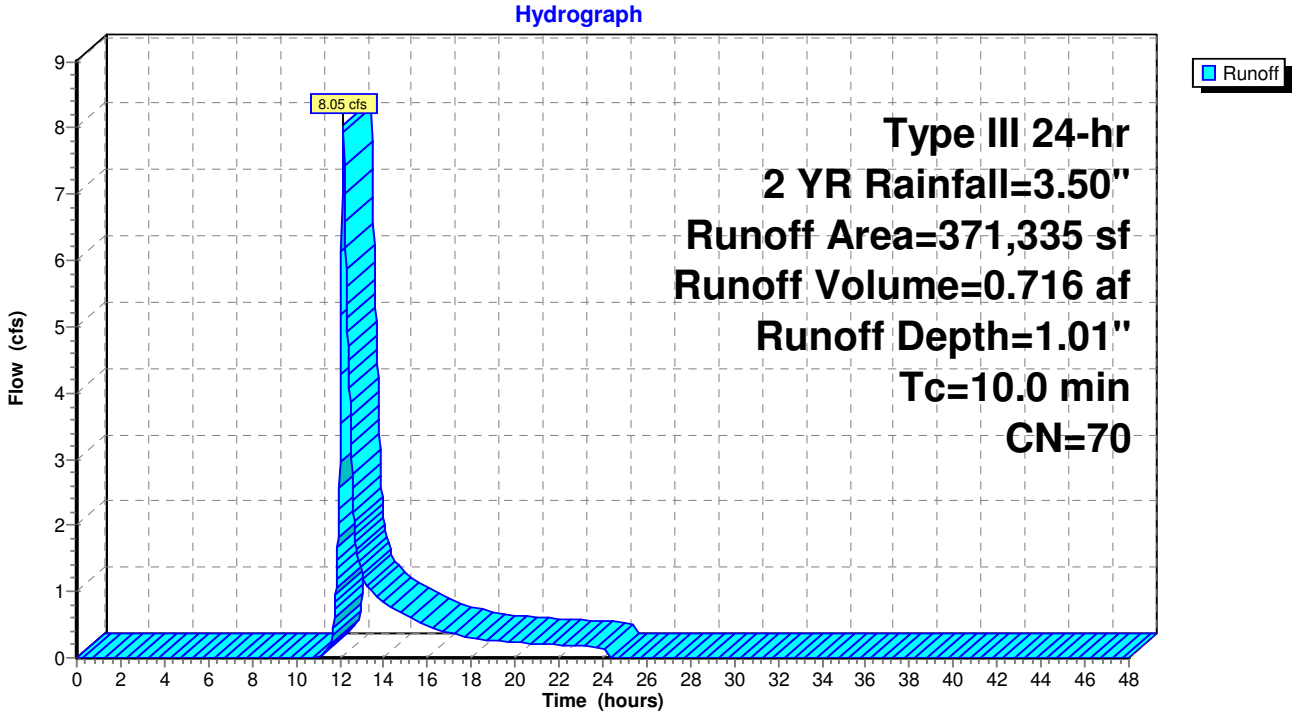
Runoff = 8.05 cfs @ 12.15 hrs, Volume= 0.716 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
11,864	61	>75% Grass cover, Good, HSG B
132,465	74	>75% Grass cover, Good, HSG C
456	80	>75% Grass cover, Good, HSG D
45,589	55	Woods, Good, HSG B
158,052	70	Woods, Good, HSG C
22,909	77	Woods, Good, HSG D
371,335	70	Weighted Average
371,335		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-1: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment POST-10: Lot 11 Unattenuated to Wetland System Through Stream

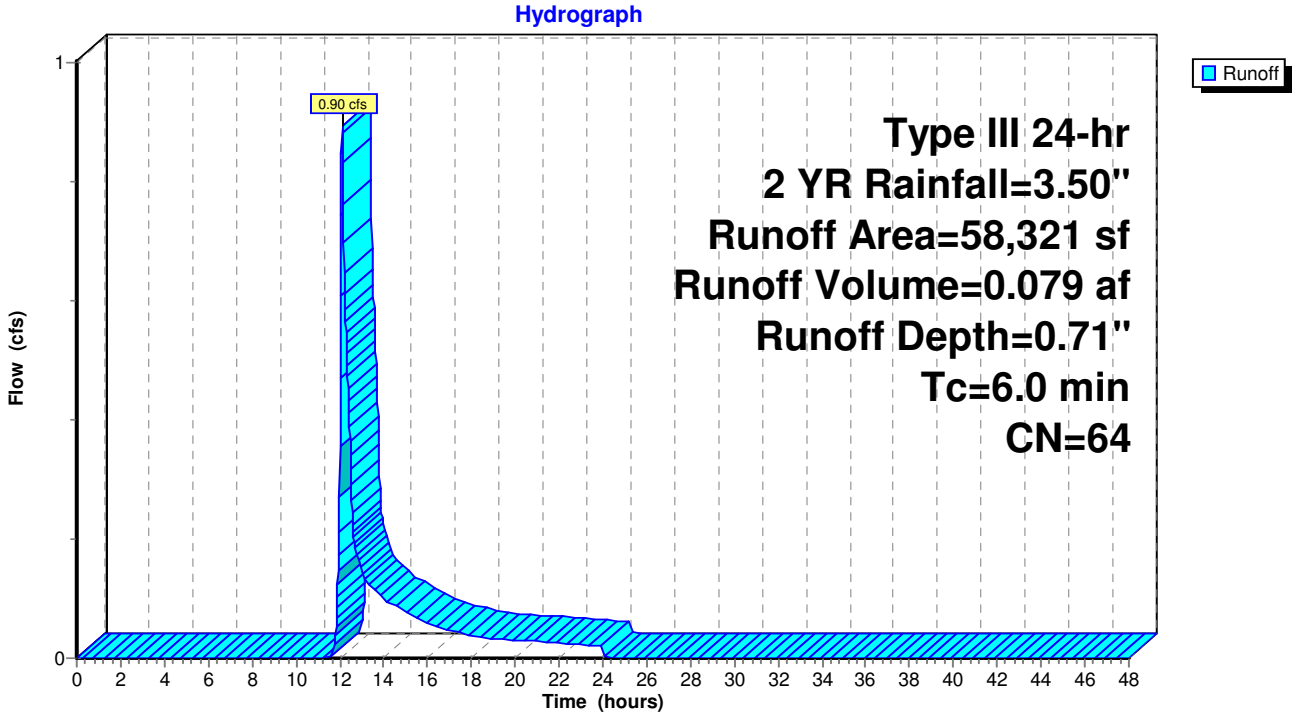
Runoff = 0.90 cfs @ 12.11 hrs, Volume= 0.079 af, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
48,048	61	>75% Grass cover, Good, HSG B
6,493	80	>75% Grass cover, Good, HSG D
1,821	70	Woods, Good, HSG C
1,959	77	Woods, Good, HSG D
58,321	64	Weighted Average
58,321		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-10: Lot 11 Unattenuated to Wetland System Through Stream



Summary for Subcatchment POST-11: Portion of Existing Lot 11 to Existing Stream

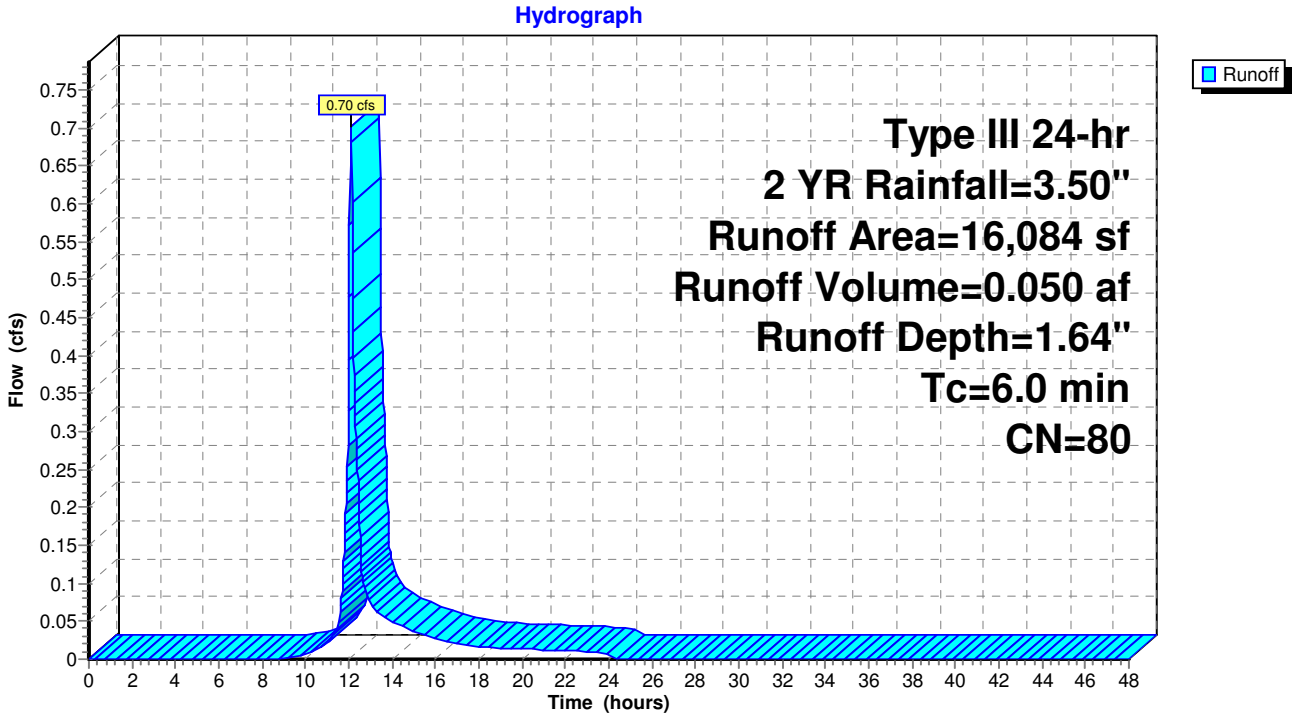
Runoff = 0.70 cfs @ 12.09 hrs, Volume= 0.050 af, Depth= 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
16,084	80	>75% Grass cover, Good, HSG D
16,084		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-11: Portion of Existing Lot 11 to Existing Stream



Summary for Subcatchment POST-12: O'Connell Way

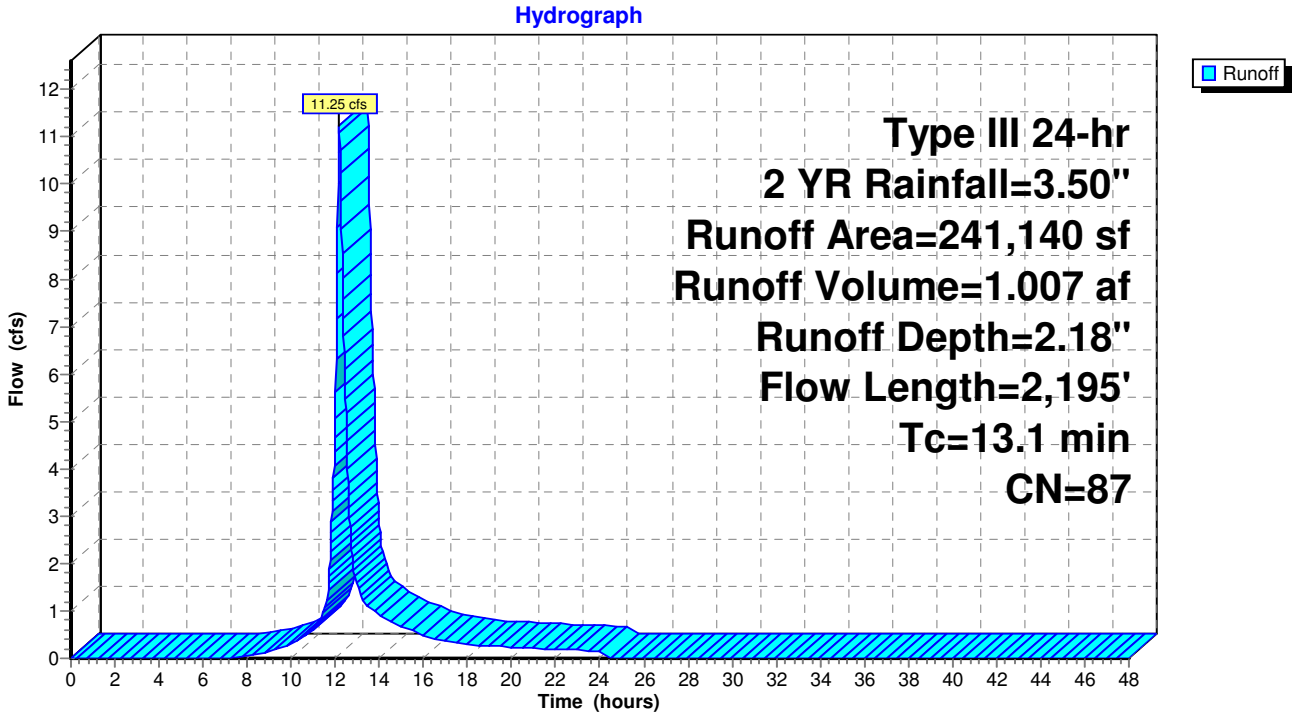
Runoff = 11.25 cfs @ 12.18 hrs, Volume= 1.007 af, Depth= 2.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
145,476	98	Paved parking & roofs
22,143	98	Water Surface
9,233	39	>75% Grass cover, Good, HSG A
43,746	61	>75% Grass cover, Good, HSG B
14,196	74	>75% Grass cover, Good, HSG C
6,346	80	>75% Grass cover, Good, HSG D
241,140	87	Weighted Average
73,521		30.49% Pervious Area
167,619		69.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	65	0.0460	0.16		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.3	230	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
4.9	1,900	0.0080	6.44	20.23	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
13.1	2,195	Total			

Subcatchment POST-12: O'Connell Way



Summary for Subcatchment POST-13: Unattenuated Areas to Wetlands Associated with Cotley River

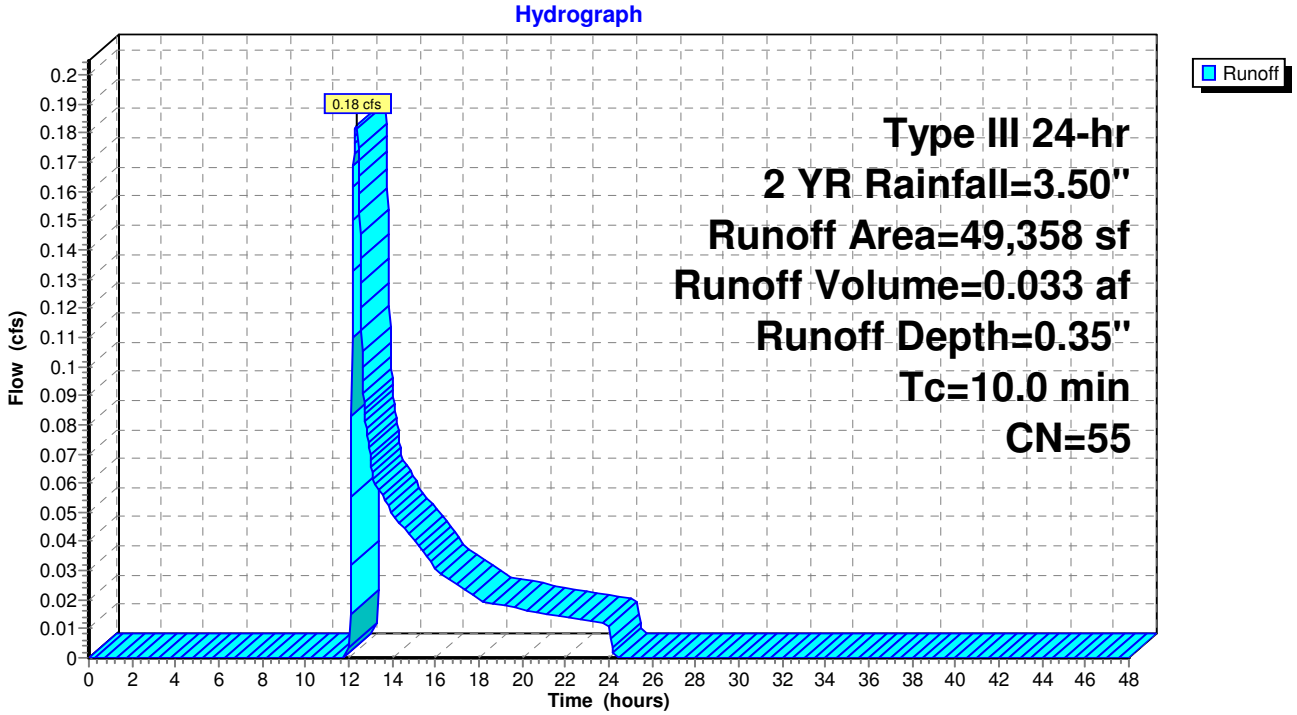
Runoff = 0.18 cfs @ 12.34 hrs, Volume= 0.033 af, Depth= 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
15,709	39	>75% Grass cover, Good, HSG A
11,926	61	>75% Grass cover, Good, HSG B
7,879	80	>75% Grass cover, Good, HSG D
6,196	30	Woods, Good, HSG A
432	55	Woods, Good, HSG B
7,216	77	Woods, Good, HSG D
49,358	55	Weighted Average
49,358		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-13: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment POST-4: Grassed Areas Around Parking Garage

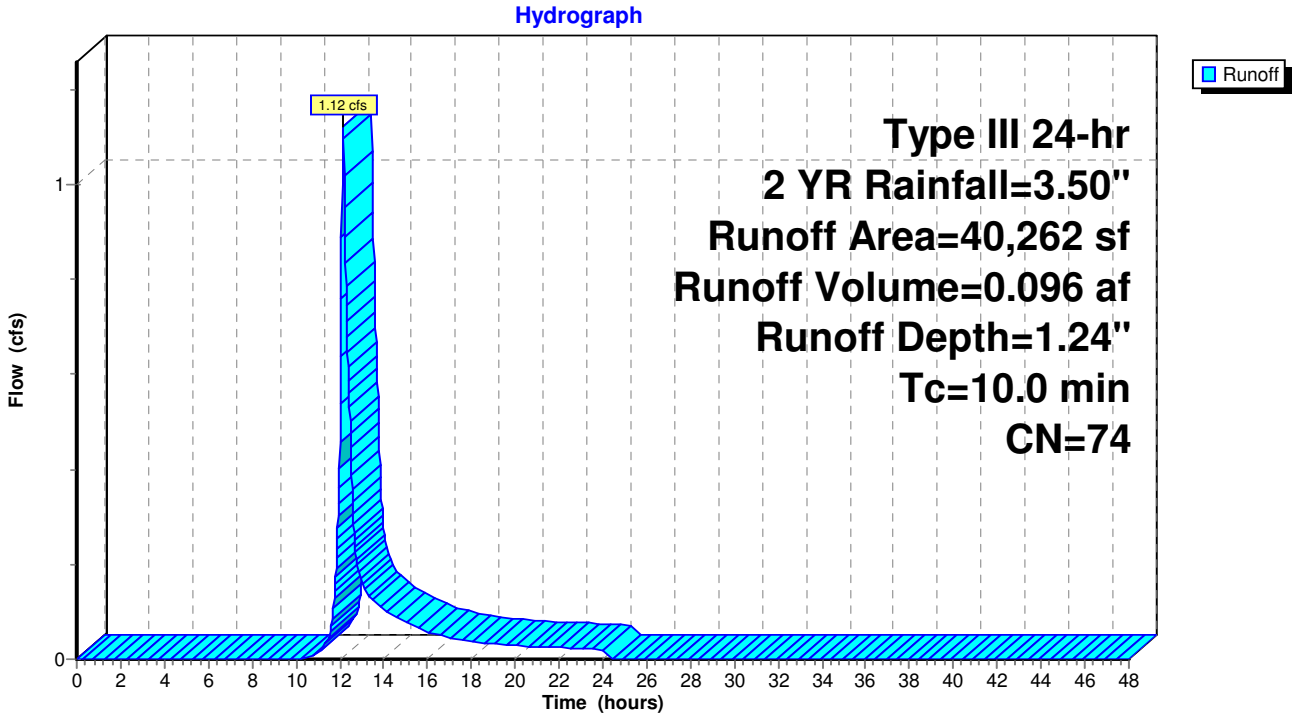
Runoff = 1.12 cfs @ 12.15 hrs, Volume= 0.096 af, Depth= 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
40,262	74	>75% Grass cover, Good, HSG C
40,262		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-4: Grassed Areas Around Parking Garage



Summary for Subcatchment POST-4A: Grassed Areas Around Garage

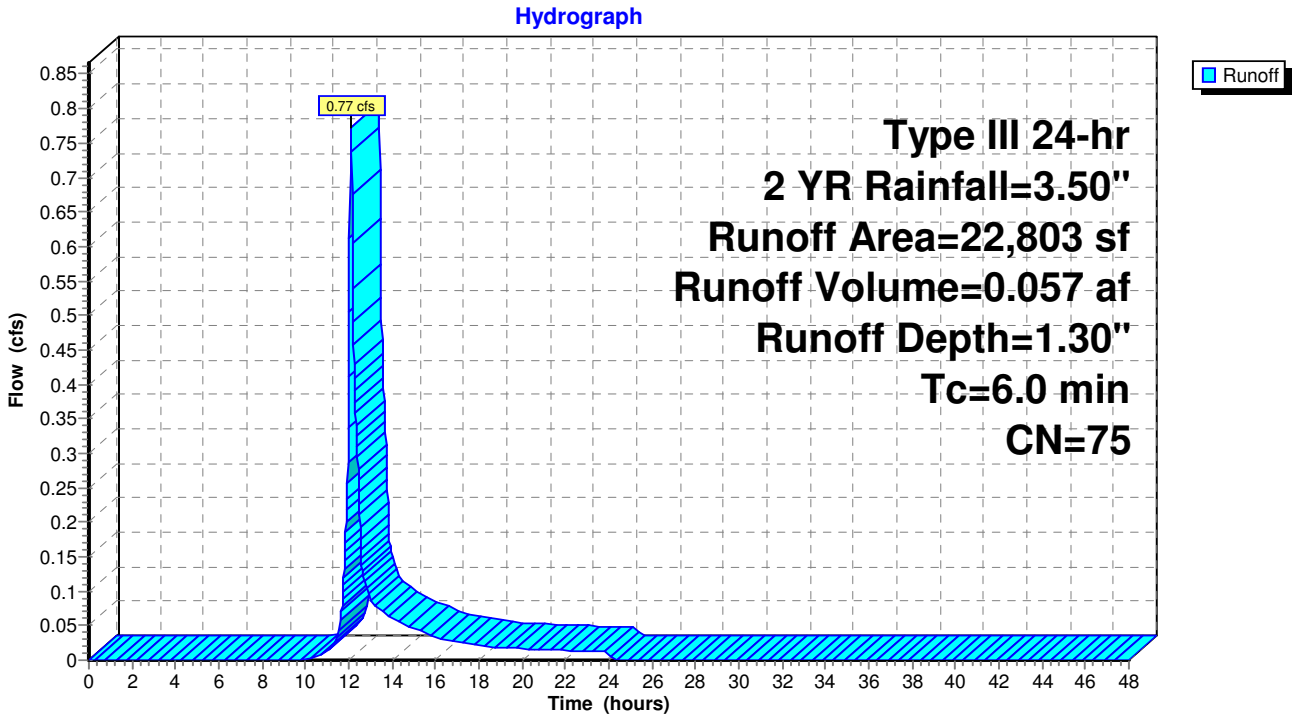
Runoff = 0.77 cfs @ 12.09 hrs, Volume= 0.057 af, Depth= 1.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
21,385	74	>75% Grass cover, Good, HSG C
1,418	98	Unconnected pavement, HSG C
22,803	75	Weighted Average
21,385		93.78% Pervious Area
1,418		6.22% Impervious Area
1,418		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-4A: Grassed Areas Around Garage



Summary for Subcatchment POST-5: Portion of Parking Garage

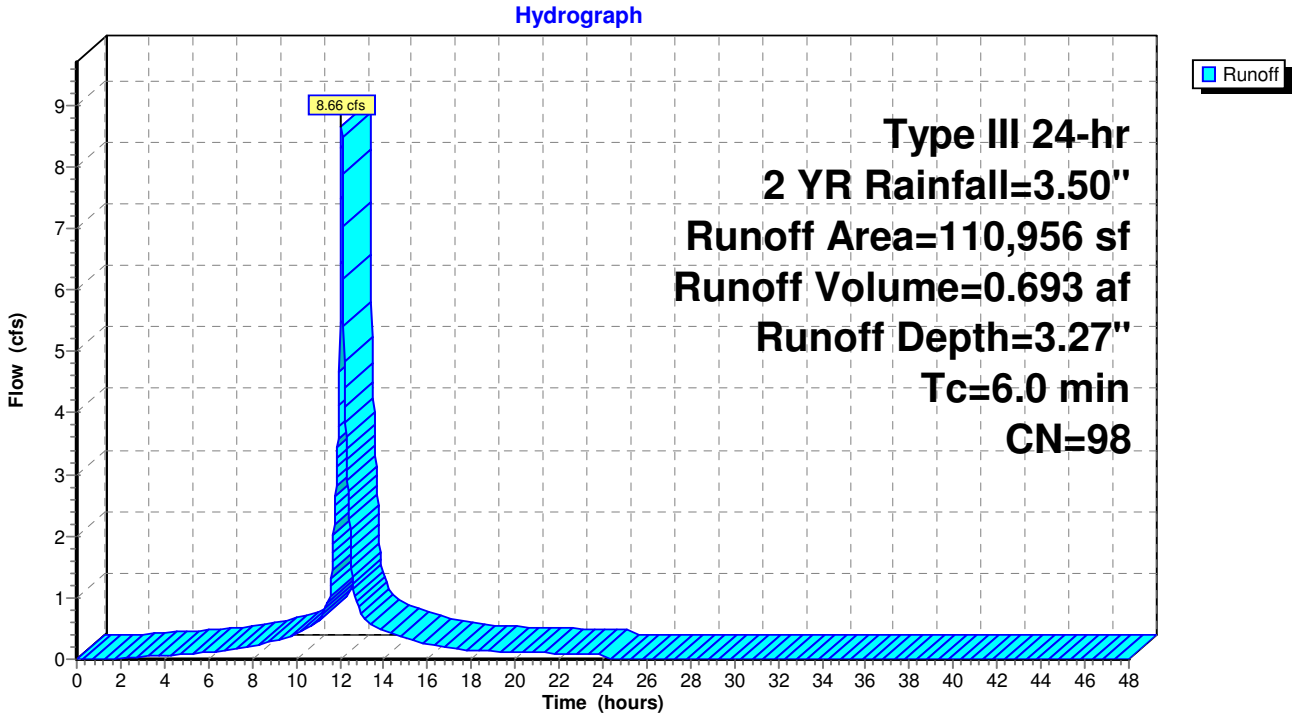
Runoff = 8.66 cfs @ 12.08 hrs, Volume= 0.693 af, Depth= 3.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
110,956	98	Paved parking, HSG C
110,956		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-5: Portion of Parking Garage



Summary for Subcatchment POST-5A: Portion of Grassed Area and Access Drive Adjacent to Garage

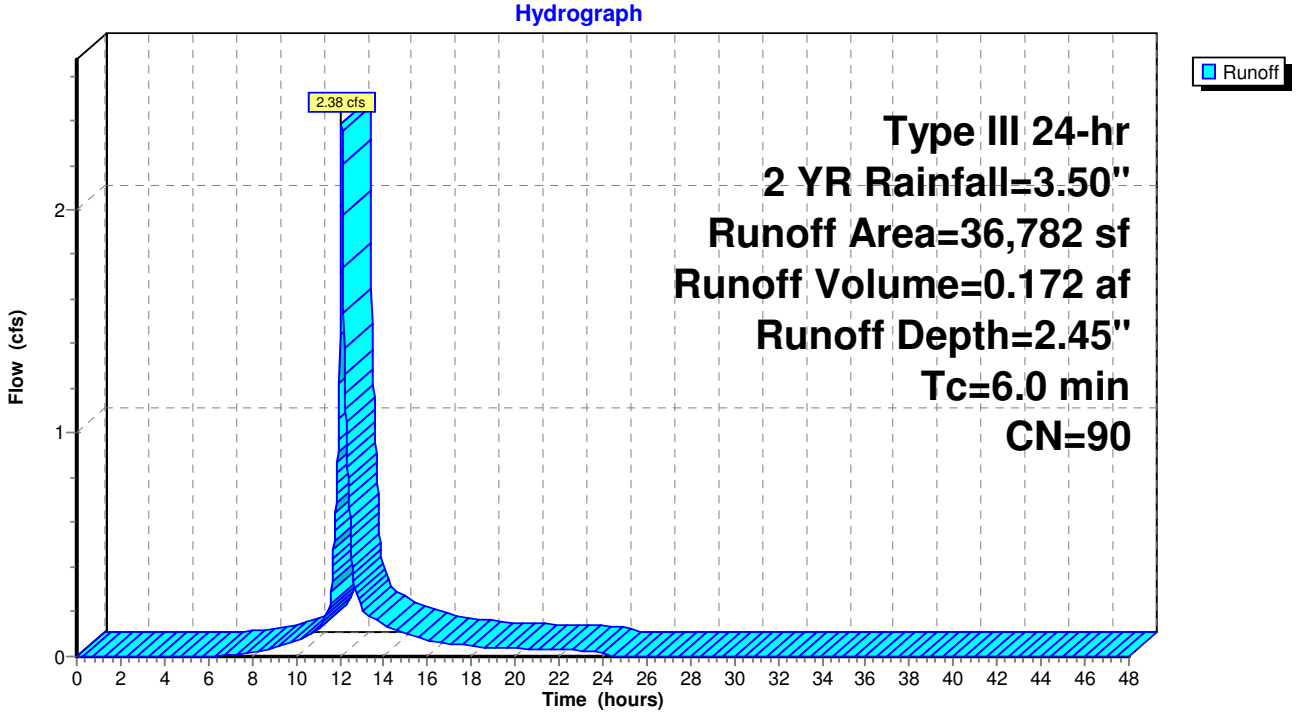
Runoff = 2.38 cfs @ 12.09 hrs, Volume= 0.172 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
24,506	98	Paved parking, HSG C
12,276	74	>75% Grass cover, Good, HSG C
36,782	90	Weighted Average
12,276		33.38% Pervious Area
24,506		66.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-5A: Portion of Grassed Area and Access Drive Adjacent to Garage



Summary for Subcatchment POST-6: Portion of Parking Garage

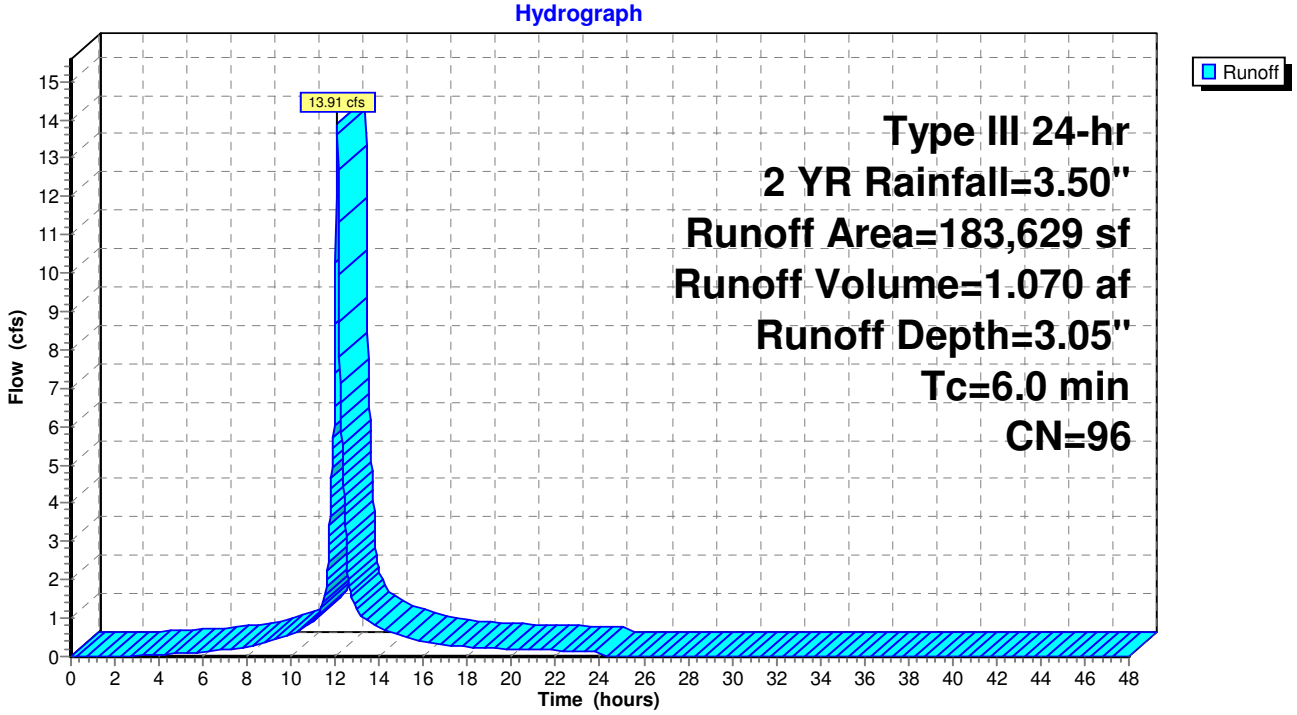
Runoff = 13.91 cfs @ 12.08 hrs, Volume= 1.070 af, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
171,350	98	Paved parking, HSG C
12,279	74	>75% Grass cover, Good, HSG C
183,629	96	Weighted Average
12,279		6.69% Pervious Area
171,350		93.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-6: Portion of Parking Garage



Summary for Subcatchment POST-7: Portion of Service Road and Central Plant Area

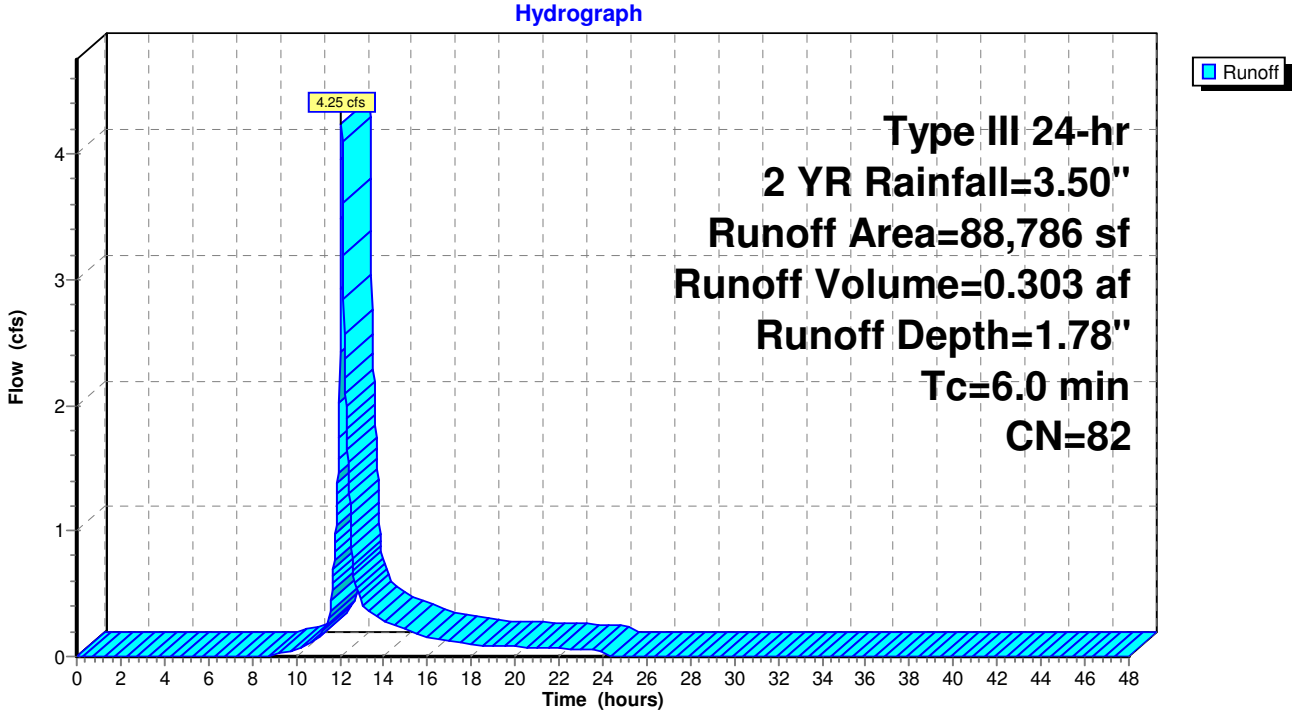
Runoff = 4.25 cfs @ 12.09 hrs, Volume= 0.303 af, Depth= 1.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
58,002	74	>75% Grass cover, Good, HSG C
30,784	98	Paved parking, HSG C
88,786	82	Weighted Average
58,002		65.33% Pervious Area
30,784		34.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-7: Portion of Service Road and Central Plant Area



Summary for Subcatchment POST-8: Portion of Service Road and Basin Area

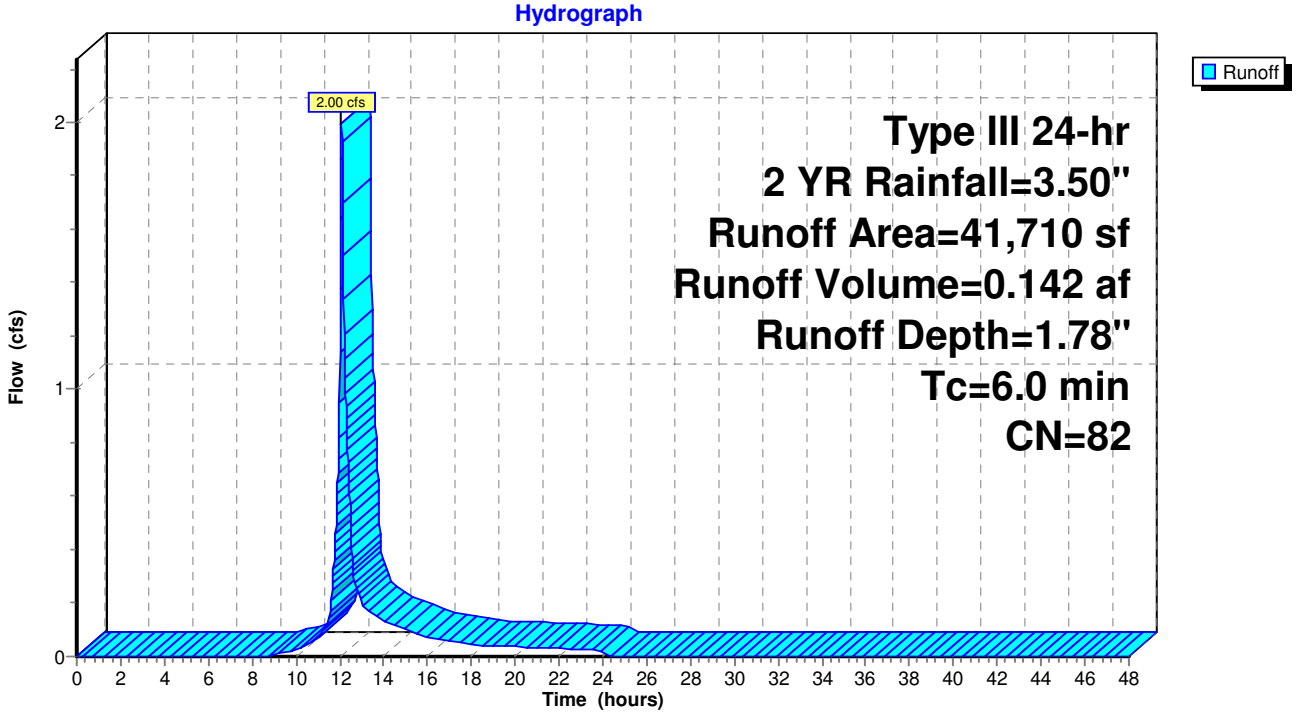
Runoff = 2.00 cfs @ 12.09 hrs, Volume= 0.142 af, Depth= 1.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
13,269	98	Paved parking, HSG C
28,441	74	>75% Grass cover, Good, HSG C
41,710	82	Weighted Average
28,441		68.19% Pervious Area
13,269		31.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-8: Portion of Service Road and Basin Area



Summary for Subcatchment POST-9A: Northerly Portion of Parking on "Lot 9"

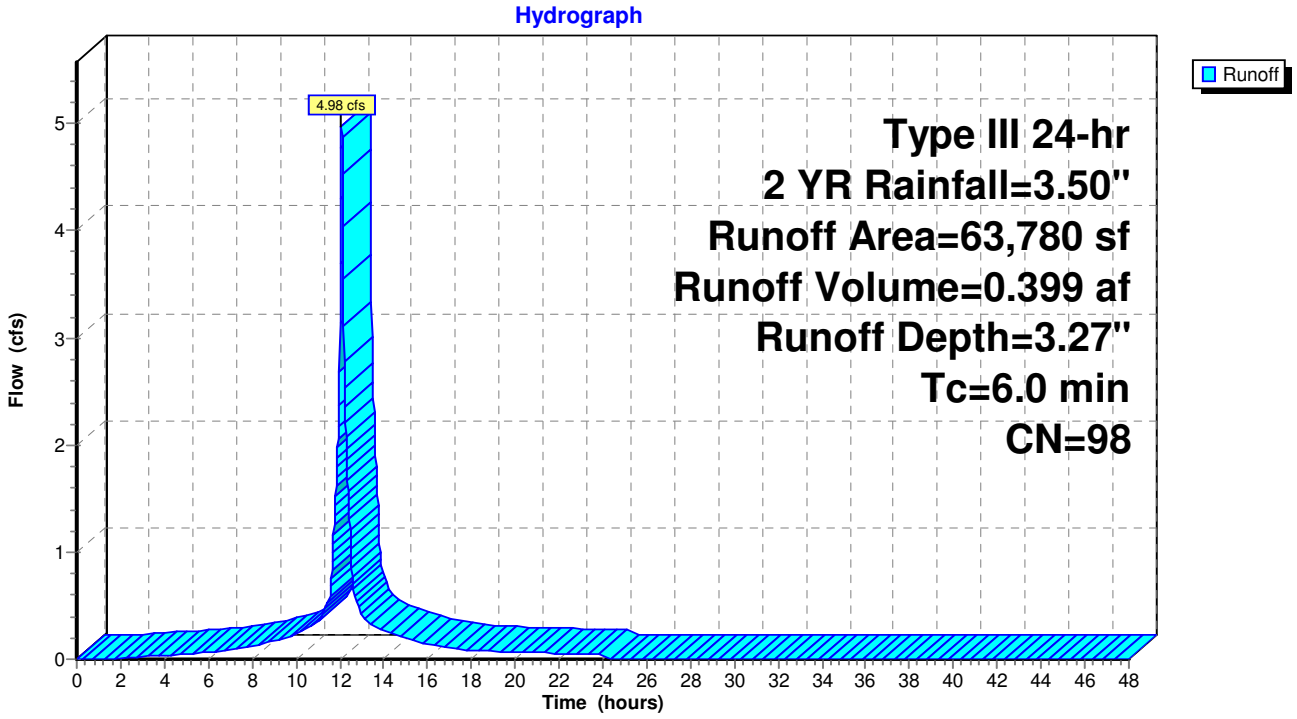
Runoff = 4.98 cfs @ 12.08 hrs, Volume= 0.399 af, Depth= 3.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
63,780	98	Paved parking & roofs
63,780		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-9A: Northerly Portion of Parking on "Lot 9"



Summary for Subcatchment POST-9B: Southerly Portion of Parking on "Lot 9"

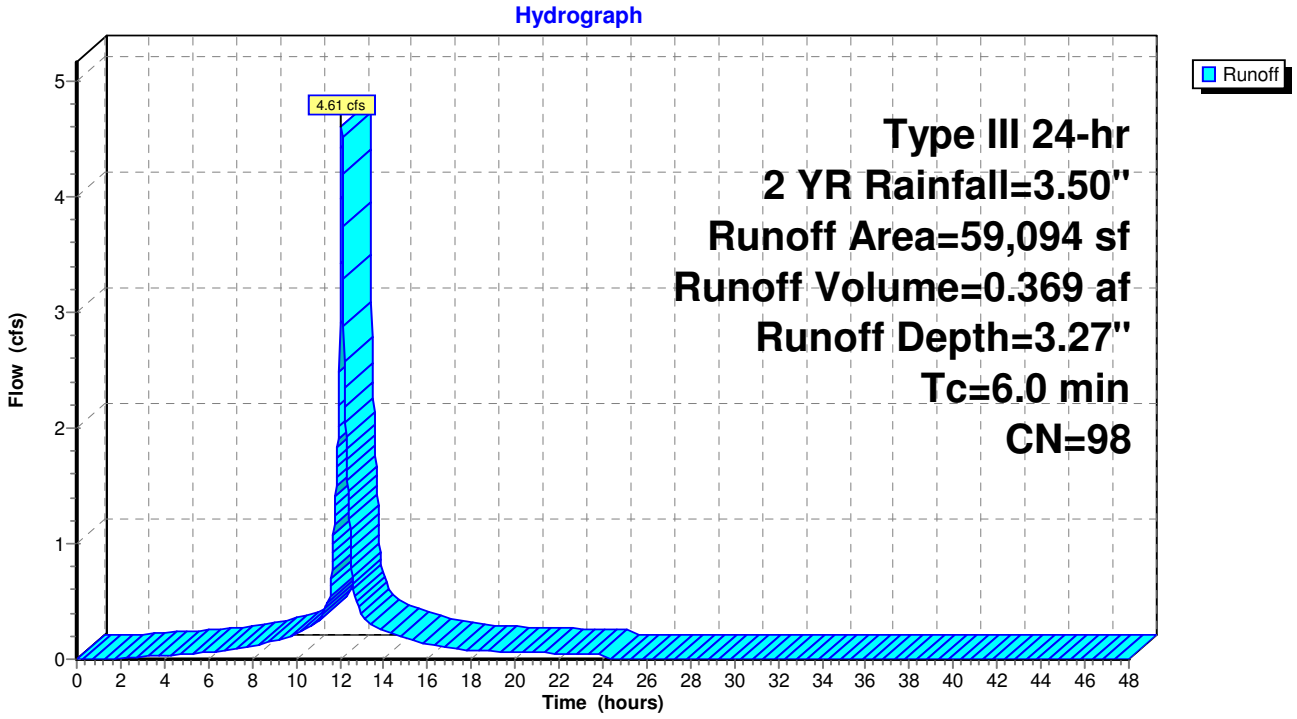
Runoff = 4.61 cfs @ 12.08 hrs, Volume= 0.369 af, Depth= 3.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
59,094	98	Paved parking & roofs
59,094		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-9B: Southerly Portion of Parking on "Lot 9"



mmary for Subcatchment POST-9C: Unattenuated Area from "Lot 9" to Wetlands Associated with Cotley Ri

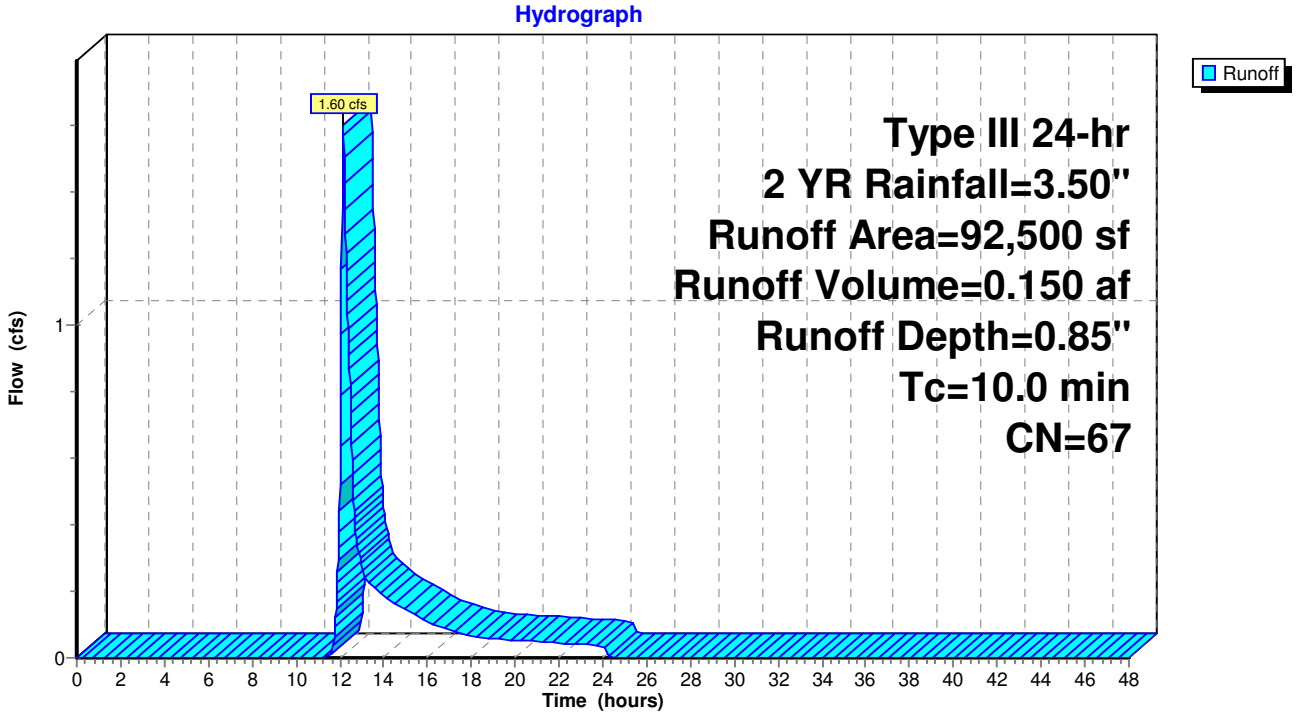
Runoff = 1.60 cfs @ 12.16 hrs, Volume= 0.150 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
4,000	30	Meadow, non-grazed, HSG A
6,000	78	Meadow, non-grazed, HSG D
9,000	30	Woods, Good, HSG A
36,000	70	Woods, Good, HSG C
5,000	39	>75% Grass cover, Good, HSG A
32,500	80	>75% Grass cover, Good, HSG D
92,500	67	Weighted Average
92,500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-9C: Unattenuated Area from "Lot 9" to Wetlands Associated with Cotley River



Summary for Pond 9Pa: Detention Pond - Southwest of Lot 9 Parking

Inflow Area = 1.357 ac,100.00% Impervious, Inflow Depth = 2.89" for 2 YR event
Inflow = 2.89 cfs @ 12.18 hrs, Volume= 0.327 af
Outflow = 1.66 cfs @ 12.53 hrs, Volume= 0.308 af, Atten= 43%, Lag= 20.9 min
Primary = 1.66 cfs @ 12.53 hrs, Volume= 0.308 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 26.81' @ 12.53 hrs Surf.Area= 2,687 sf Storage= 3,679 cf
Flood Elev= 29.00' Surf.Area= 5,450 sf Storage= 12,595 cf

Plug-Flow detention time= 83.9 min calculated for 0.308 af (94% of inflow)
Center-of-Mass det. time= 46.7 min (884.7 - 838.0)

Volume	Invert	Avail.Storage	Storage Description
#1	25.00'	12,595 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

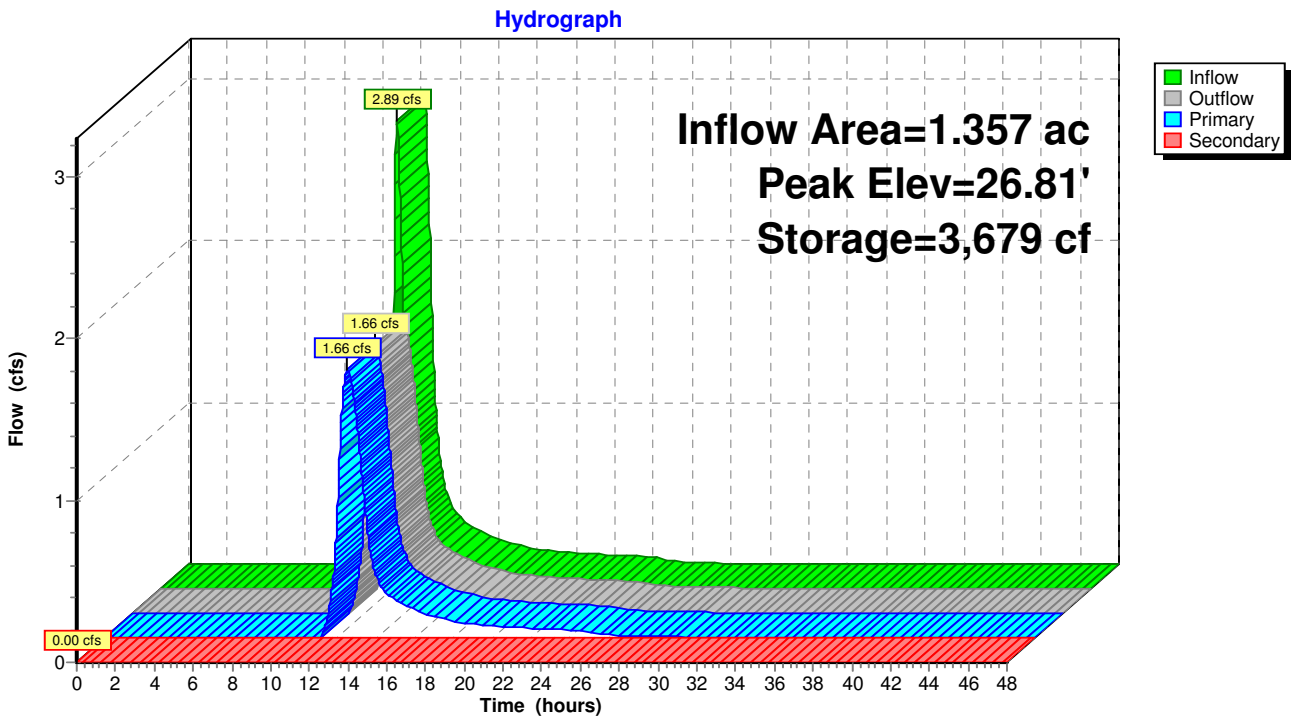
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
25.00	1,420	0	0
26.00	2,080	1,750	1,750
27.00	2,830	2,455	4,205
28.00	4,250	3,540	7,745
29.00	5,450	4,850	12,595

Device	Routing	Invert	Outlet Devices
#1	Primary	25.50'	**8.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 25.50' / 25.00' S= 0.0250 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Secondary	28.50'	**10.0' long x 4.0' 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 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=1.66 cfs @ 12.53 hrs HW=26.81' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.66 cfs @ 4.76 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=25.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9Pa: Detention Pond - Southwest of Lot 9 Parking



Summary for Pond 9Pb: Detention Pond - Southwest of Lot 9 Parking

[79] Warning: Submerged Pond 9Pa Primary device # 1 INLET by 0.04'

Inflow Area =	1.357 ac,100.00% Impervious, Inflow Depth > 2.73" for 2 YR event			
Inflow =	1.66 cfs @ 12.53 hrs, Volume=	0.308 af		
Outflow =	1.41 cfs @ 12.93 hrs, Volume=	0.293 af, Atten= 15%, Lag= 23.8 min		
Primary =	1.41 cfs @ 12.93 hrs, Volume=	0.293 af		
Secondary =	0.00 cfs @ 0.00 hrs, Volume=	0.000 af		

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 25.54' @ 12.93 hrs Surf.Area= 1,842 sf Storage= 2,306 cf
Flood Elev= 27.00' Surf.Area= 2,560 sf Storage= 5,510 cf

Plug-Flow detention time= 71.9 min calculated for 0.293 af (95% of inflow)
Center-of-Mass det. time= 35.3 min (920.0 - 884.7)

Volume	Invert	Avail.Storage	Storage Description
#1	24.00'	5,510 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

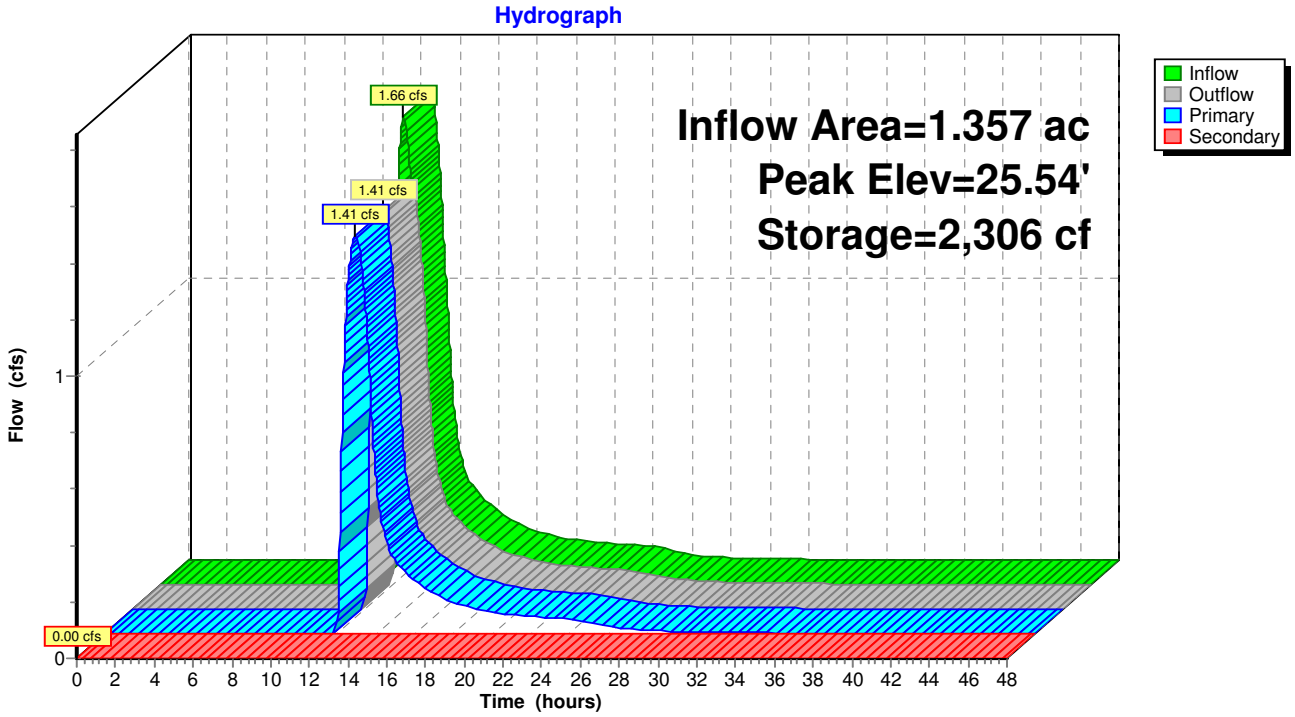
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
24.00	1,160	0	0
25.00	1,600	1,380	1,380
26.00	2,050	1,825	3,205
27.00	2,560	2,305	5,510

Device	Routing	Invert	Outlet Devices
#1	Primary	24.50'	**8.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.50' / 24.00' S= 0.0250 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Secondary	26.50'	**10.0' long x 4.0' 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 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=1.41 cfs @ 12.93 hrs HW=25.54' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.41 cfs @ 4.04 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=24.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9Pb: Detention Pond - Southwest of Lot 9 Parking



Summary for Pond 9Pc: Detention Pond - Southwest of Lot 9 Parking

[79] Warning: Submerged Pond 9Pb Primary device # 1 INLET by 0.31'

Inflow Area = 1.357 ac,100.00% Impervious, Inflow Depth > 2.60" for 2 YR event
Inflow = 1.41 cfs @ 12.93 hrs, Volume= 0.293 af
Outflow = 1.38 cfs @ 13.09 hrs, Volume= 0.275 af, Atten= 2%, Lag= 10.0 min
Primary = 0.71 cfs @ 13.09 hrs, Volume= 0.239 af
Secondary = 0.68 cfs @ 13.09 hrs, Volume= 0.037 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 24.81' @ 13.09 hrs Surf.Area= 2,600 sf Storage= 2,591 cf
Flood Elev= 25.00' Surf.Area= 2,760 sf Storage= 3,103 cf

Plug-Flow detention time= 102.0 min calculated for 0.275 af (94% of inflow)
Center-of-Mass det. time= 54.7 min (974.7 - 920.0)

Volume	Invert	Avail.Storage	Storage Description
#1	23.50'	3,103 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

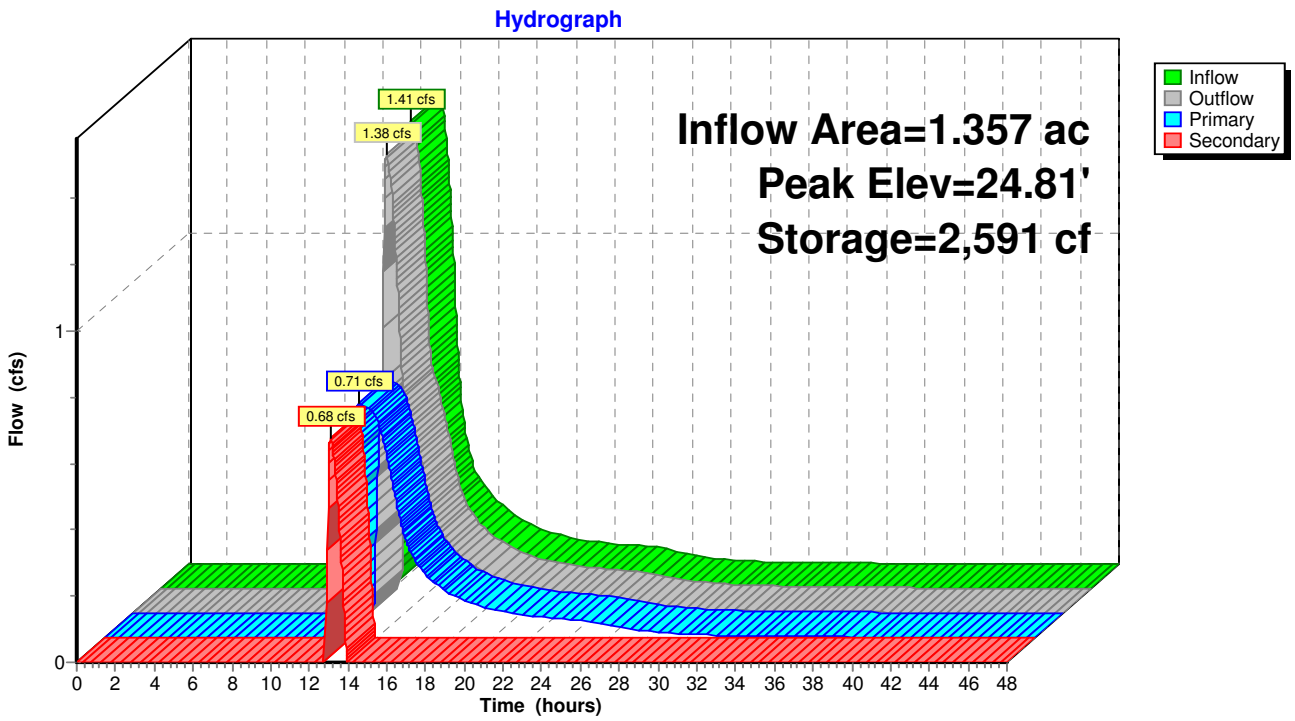
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
23.50	1,130	0	0
24.00	1,920	763	763
25.00	2,760	2,340	3,103

Device	Routing	Invert	Outlet Devices
#1	Primary	24.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	24.75'	**20.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.71 cfs @ 13.09 hrs HW=24.81' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.71 cfs @ 3.60 fps)

Secondary OutFlow Max=0.67 cfs @ 13.09 hrs HW=24.81' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.67 cfs @ 0.57 fps)

Pond 9Pc: Detention Pond - Southwest of Lot 9 Parking



Summary for Pond 9Pe: Detention Pond - South of Lot 9 Parking

Inflow Area = 1.357 ac,100.00% Impervious, Inflow Depth = 3.27" for 2 YR event
Inflow = 4.61 cfs @ 12.08 hrs, Volume= 0.369 af
Outflow = 2.89 cfs @ 12.18 hrs, Volume= 0.327 af, Atten= 37%, Lag= 5.8 min
Primary = 2.89 cfs @ 12.18 hrs, Volume= 0.327 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 30.66' @ 12.18 hrs Surf.Area= 3,620 sf Storage= 4,675 cf
Flood Elev= 32.00' Surf.Area= 4,940 sf Storage= 10,445 cf

Plug-Flow detention time= 137.9 min calculated for 0.327 af (89% of inflow)
Center-of-Mass det. time= 83.4 min (838.0 - 754.6)

Volume	Invert	Avail.Storage	Storage Description
#1	29.00'	10,445 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

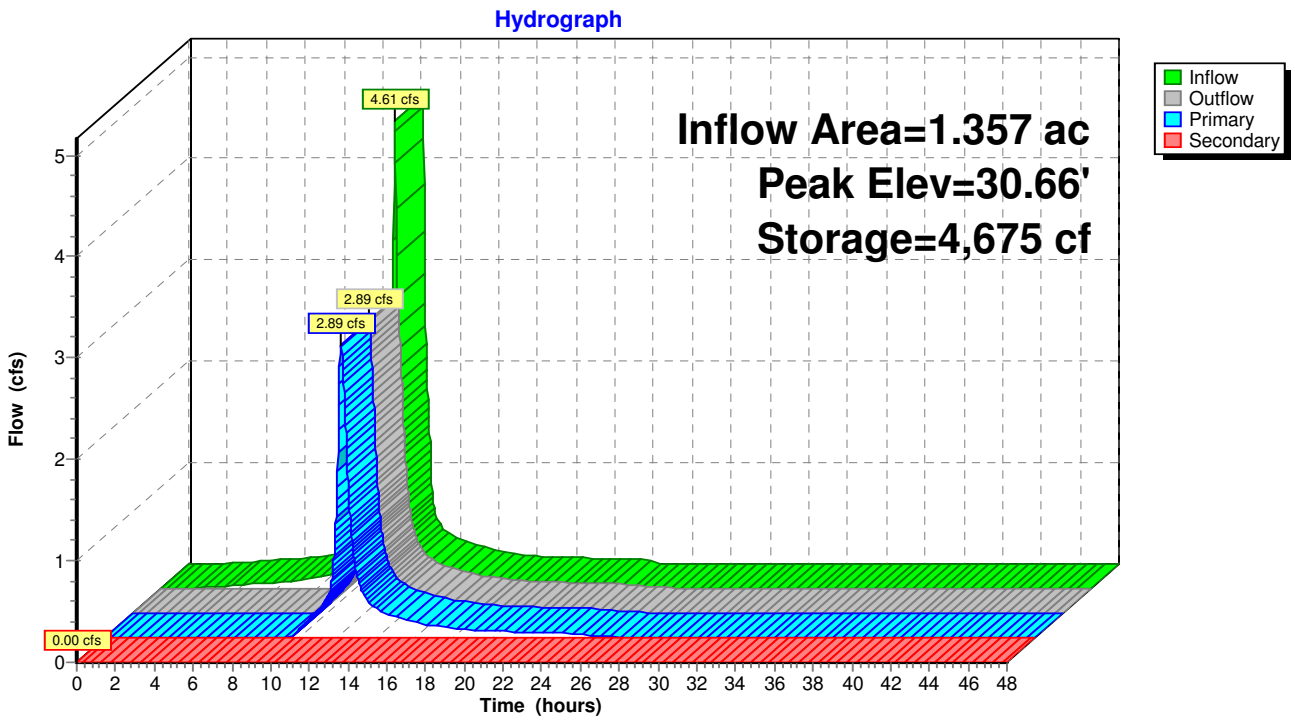
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
29.00	2,210	0	0
30.00	2,860	2,535	2,535
31.00	4,010	3,435	5,970
32.00	4,940	4,475	10,445

Device	Routing	Invert	Outlet Devices
#1	Primary	29.75'	**15.0" Round Culvert** L= 94.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 29.75' / 29.00' S= 0.0080 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Secondary	31.70'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.89 cfs @ 12.18 hrs HW=30.66' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.89 cfs @ 4.22 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=29.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9Pe: Detention Pond - South of Lot 9 Parking



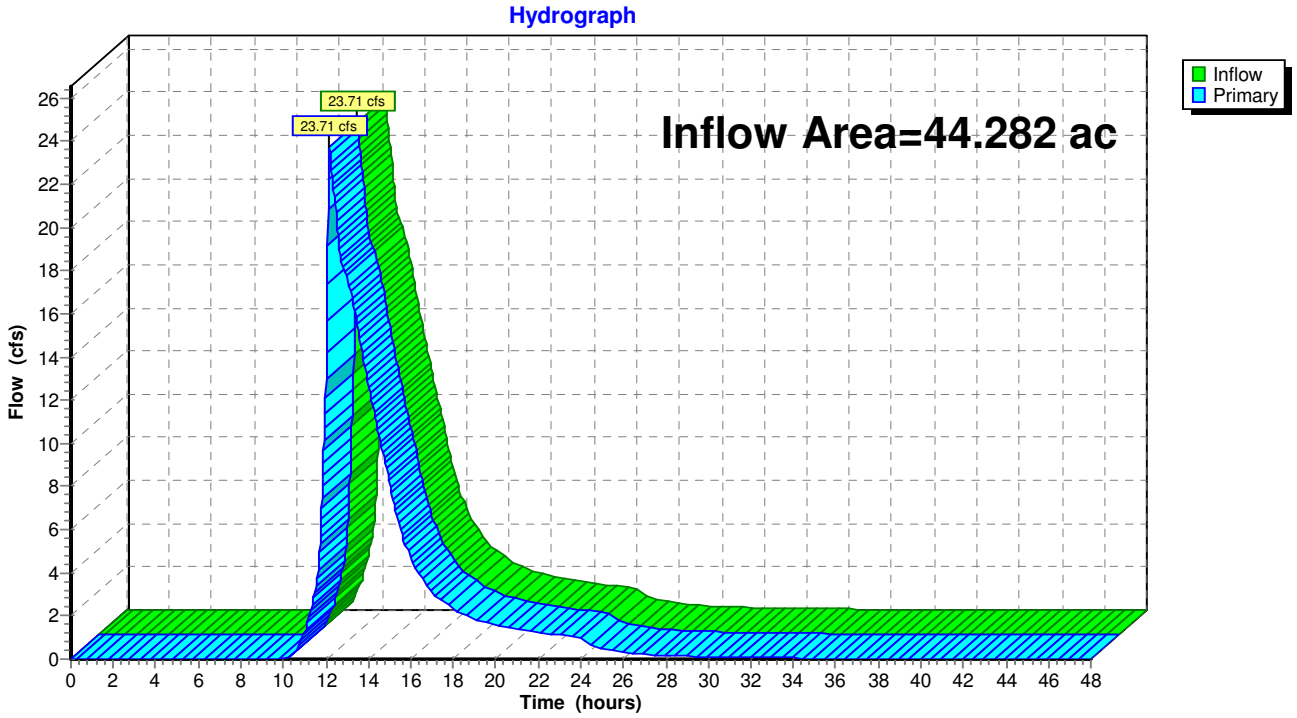
Summary for Pond AP-1: Wetlands South of O'Connell Way

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 44.282 ac, 59.80% Impervious, Inflow Depth > 1.66" for 2 YR event
Inflow = 23.71 cfs @ 12.18 hrs, Volume= 6.135 af
Primary = 23.71 cfs @ 12.18 hrs, Volume= 6.135 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-1: Wetlands South of O'Connell Way



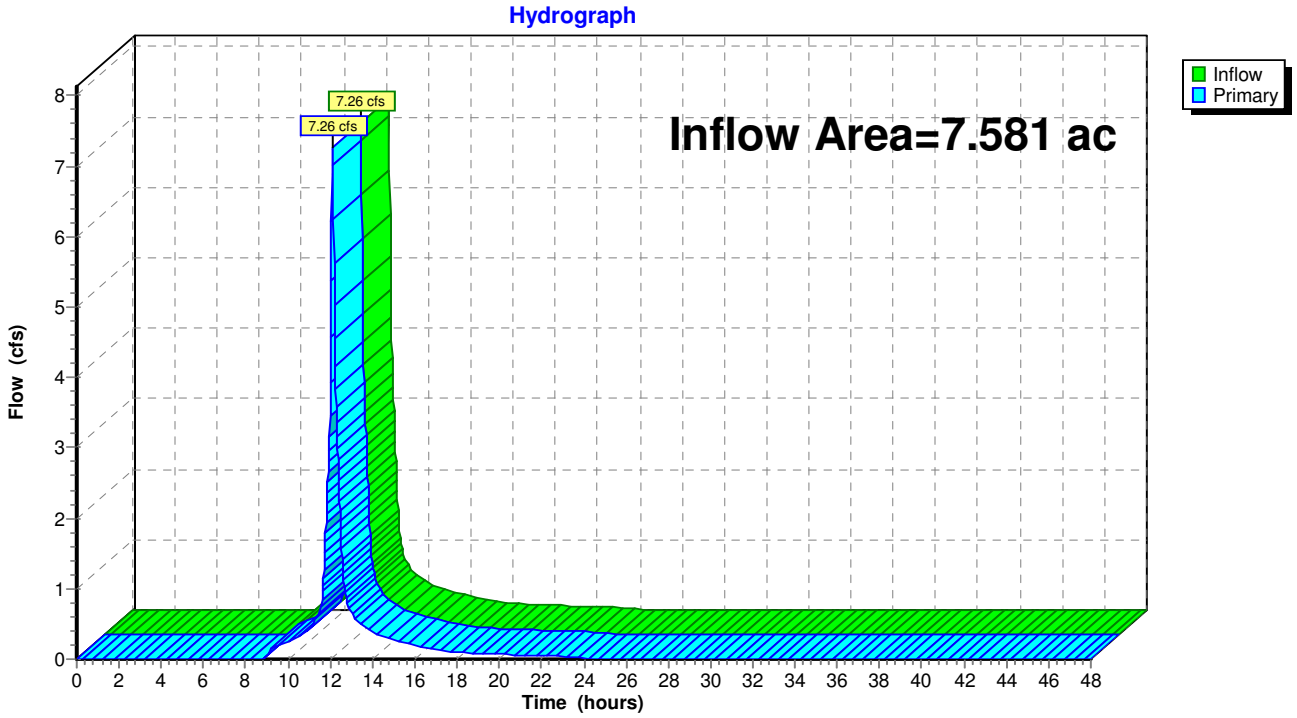
Summary for Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =	7.581 ac,	65.23% Impervious,	Inflow Depth =	0.78"	for 2 YR event
Inflow =	7.26 cfs @	12.11 hrs,	Volume=	0.494 af	
Primary =	7.26 cfs @	12.11 hrs,	Volume=	0.494 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11



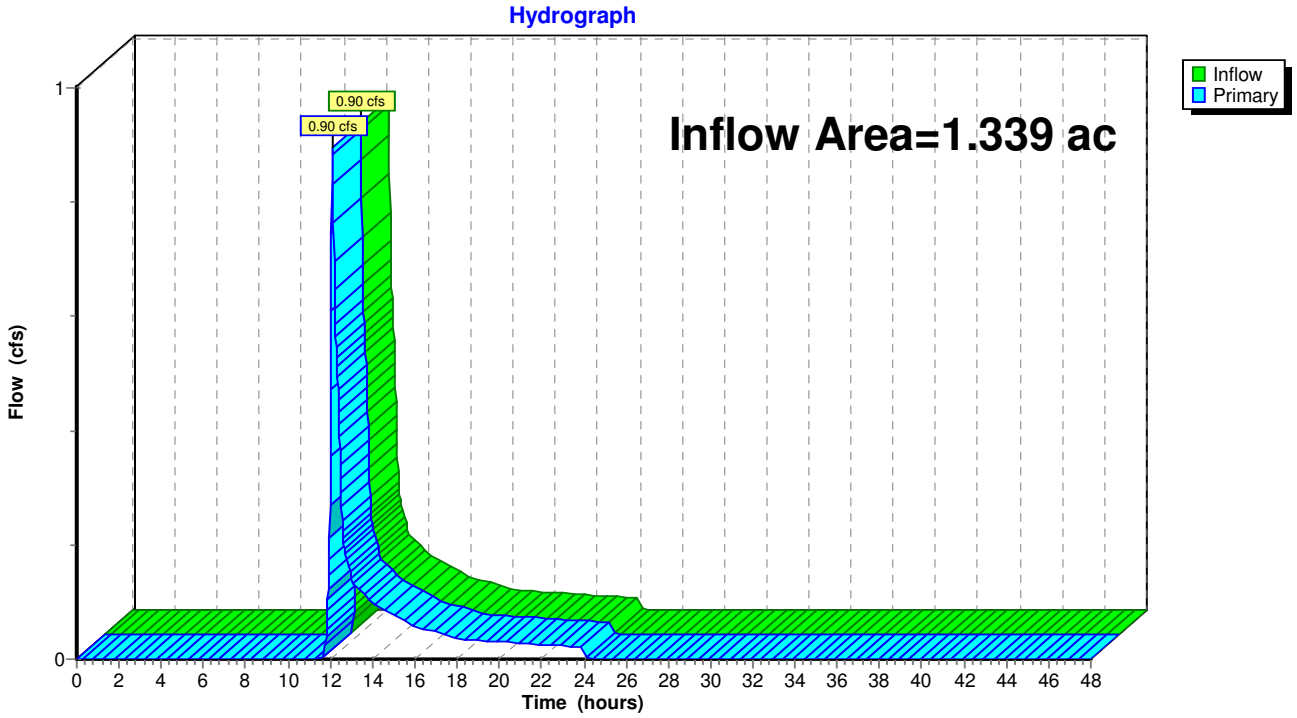
Summary for Pond AP-3: Existing Culvert Crossing at Crossroads

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.339 ac, 0.00% Impervious, Inflow Depth = 0.71" for 2 YR event
Inflow = 0.90 cfs @ 12.11 hrs, Volume= 0.079 af
Primary = 0.90 cfs @ 12.11 hrs, Volume= 0.079 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-3: Existing Culvert Crossing at Crossroads



Summary for Pond POND-1: Maggiore Combined Detention Basin

Inflow Area = 24.144 ac, 82.06% Impervious, Inflow Depth = 2.72" for 2 YR event
Inflow = 70.83 cfs @ 12.09 hrs, Volume= 5.476 af
Outflow = 15.86 cfs @ 12.51 hrs, Volume= 4.925 af, Atten= 78%, Lag= 25.1 min
Primary = 15.86 cfs @ 12.51 hrs, Volume= 4.925 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 33.21' @ 12.51 hrs Surf.Area= 39,069 sf Storage= 110,799 cf

Plug-Flow detention time= 175.4 min calculated for 4.923 af (90% of inflow)
Center-of-Mass det. time= 128.0 min (902.1 - 774.1)

Volume	Invert	Avail.Storage	Storage Description
#1	30.00'	185,603 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

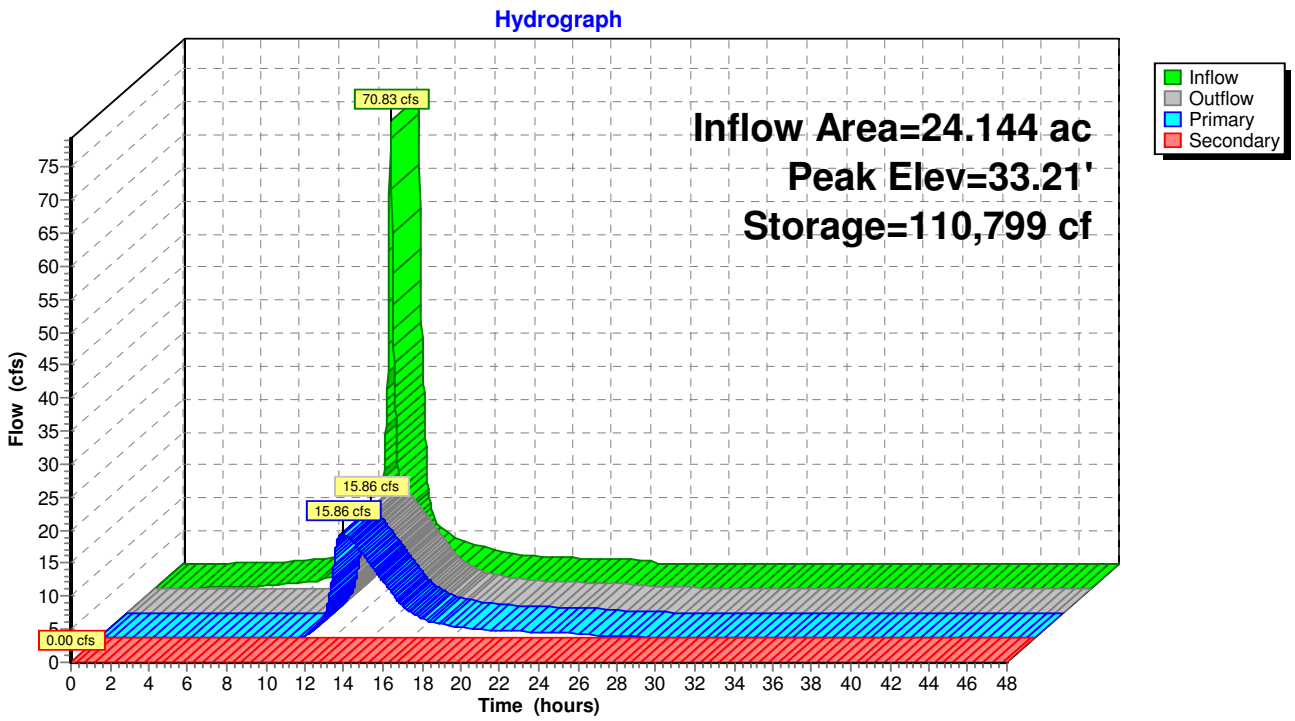
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
30.00	30,160	0	0
31.00	32,879	31,520	31,520
32.00	35,649	34,264	65,784
33.00	38,477	37,063	102,847
34.00	41,364	39,921	142,767
35.00	44,308	42,836	185,603

Device	Routing	Invert	Outlet Devices
#1	Primary	30.00'	**18.0" Round Culvert X 3.00** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 30.00' / 29.25' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	30.75'	**12.0" Vert. Orifice/Grate X 3.00** C= 0.600
#3	Device 1	33.25'	**4.0' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 2.0' Crest Height
#4	Secondary	34.25'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=15.86 cfs @ 12.51 hrs HW=33.20' (Free Discharge)
└─**1=Culvert** (Passes 15.86 cfs of 39.99 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 15.86 cfs @ 6.73 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=30.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-1: Maggiore Combined Detention Basin



Summary for Pond POND-2: Bioretention Area

Inflow Area =	0.924 ac,	0.00% Impervious,	Inflow Depth =	1.24"	for 2 YR event
Inflow =	1.12 cfs @	12.15 hrs,	Volume=	0.096 af	
Outflow =	0.35 cfs @	12.57 hrs,	Volume=	0.096 af,	Atten= 69%, Lag= 25.1 min
Discarded =	0.13 cfs @	12.57 hrs,	Volume=	0.070 af	
Primary =	0.22 cfs @	12.57 hrs,	Volume=	0.025 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 52.22' @ 12.57 hrs Surf.Area= 5,502 sf Storage= 1,161 cf
Flood Elev= 54.00' Surf.Area= 7,638 sf Storage= 12,871 cf

Plug-Flow detention time= 39.8 min calculated for 0.096 af (100% of inflow)
Center-of-Mass det. time= 39.7 min (900.0 - 860.3)

Volume	Invert	Avail.Storage	Storage Description
#1	52.00'	12,871 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

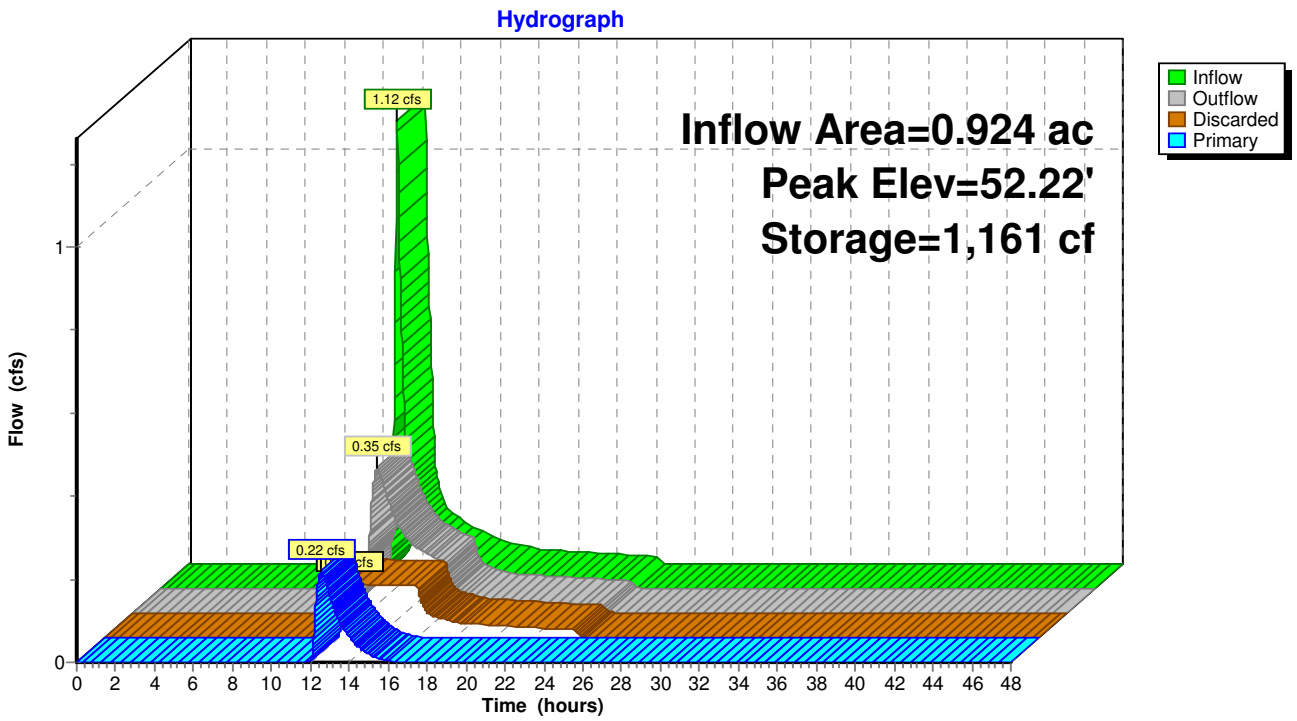
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.00	5,246	0	0
53.00	6,429	5,838	5,838
54.00	7,638	7,034	12,871

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**18.0" Round Headwall** L= 534.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.00' / 49.17' S= 0.0053 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Discarded	52.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.13 cfs @ 12.57 hrs HW=52.22' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.13 cfs)

Primary OutFlow Max=0.22 cfs @ 12.57 hrs HW=52.22' (Free Discharge)
└**1=Headwall** (Barrel Controls 0.22 cfs @ 2.13 fps)

Pond POND-2: Bioretention Area



Summary for Pond POND-3: Bioretention Area

[79] Warning: Submerged Pond POND-2 Primary device # 1 OUTLET by 0.47'

Inflow Area =	4.839 ac,	64.93% Impervious,	Inflow Depth =	2.35"	for 2 YR event
Inflow =	11.83 cfs @	12.08 hrs,	Volume=	0.948 af	
Outflow =	10.56 cfs @	12.13 hrs,	Volume=	0.948 af,	Atten= 11%, Lag= 2.4 min
Discarded =	0.10 cfs @	12.13 hrs,	Volume=	0.180 af	
Primary =	10.46 cfs @	12.13 hrs,	Volume=	0.768 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4
Peak Elev= 49.64' @ 12.13 hrs Surf.Area= 4,249 sf Storage= 4,096 cf
Flood Elev= 51.00' Surf.Area= 5,289 sf Storage= 10,704 cf

Plug-Flow detention time= 52.0 min calculated for 0.947 af (100% of inflow)
Center-of-Mass det. time= 52.1 min (822.5 - 770.5)

Volume	Invert	Avail.Storage	Storage Description
#1	48.50'	10,704 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

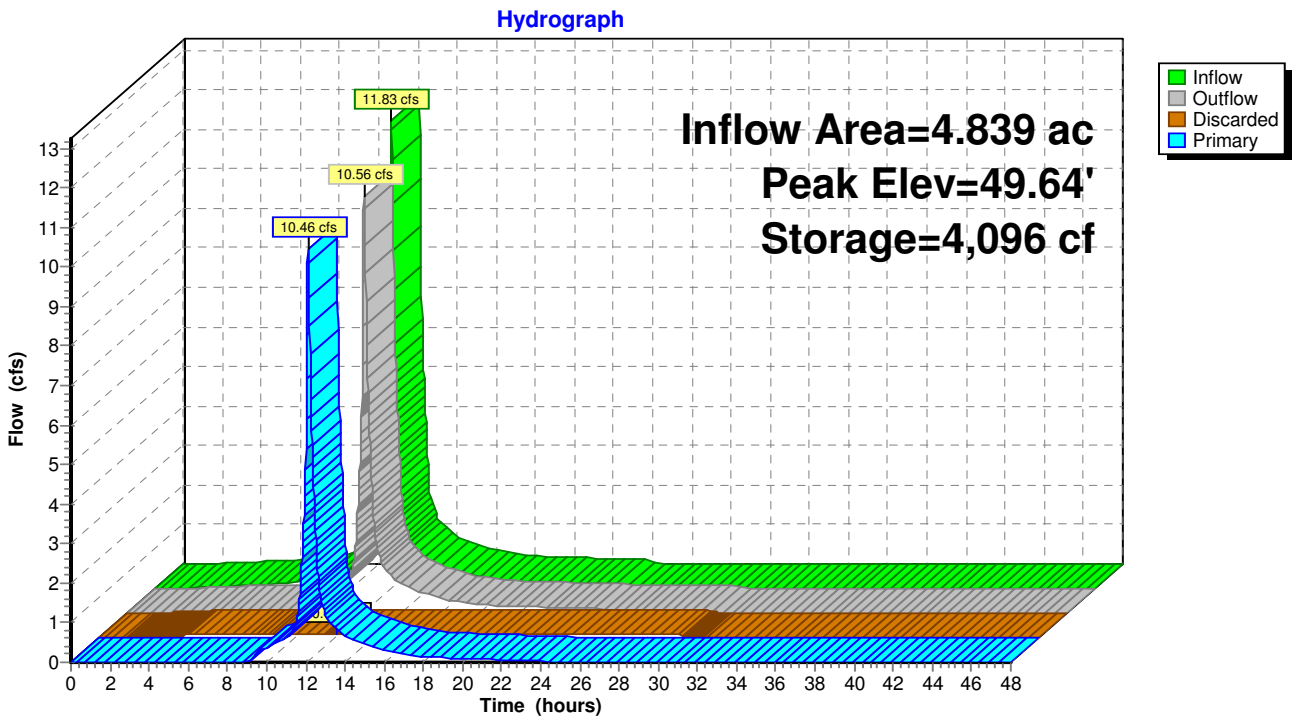
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.50	3,056	0	0
49.00	3,475	1,633	1,633
50.00	4,689	4,082	5,715
51.00	5,289	4,989	10,704

Device	Routing	Invert	Outlet Devices
#1	Primary	45.50'	**18.0" Round Culvert** L= 114.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.50' / 44.36' S= 0.0100 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	49.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	48.50'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.10 cfs @ 12.13 hrs HW=49.64' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=10.42 cfs @ 12.13 hrs HW=49.64' (Free Discharge)
└─**1=Culvert** (Passes 10.42 cfs of 15.66 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 10.42 cfs @ 2.61 fps)

Pond POND-3: Bioretention Area



Summary for Pond POND-4: Bioretention Area

Inflow Area =	4.216 ac, 93.31% Impervious, Inflow Depth = 3.05" for 2 YR event				
Inflow =	13.91 cfs @	12.08 hrs,	Volume=	1.070 af	
Outflow =	13.25 cfs @	12.11 hrs,	Volume=	1.070 af,	Atten= 5%, Lag= 1.6 min
Discarded =	0.10 cfs @	12.11 hrs,	Volume=	0.182 af	
Primary =	6.58 cfs @	12.11 hrs,	Volume=	0.444 af	
Secondary =	6.58 cfs @	12.11 hrs,	Volume=	0.444 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 48.97' @ 12.11 hrs Surf.Area= 4,099 sf Storage= 3,515 cf
Flood Elev= 49.50' Surf.Area= 5,417 sf Storage= 6,033 cf

Plug-Flow detention time= 46.1 min calculated for 1.069 af (100% of inflow)
Center-of-Mass det. time= 46.3 min (817.8 - 771.5)

Volume	Invert	Avail.Storage	Storage Description
#1	48.00'	6,033 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.00	3,163	0	0
49.00	4,130	3,647	3,647
49.50	5,417	2,387	6,033

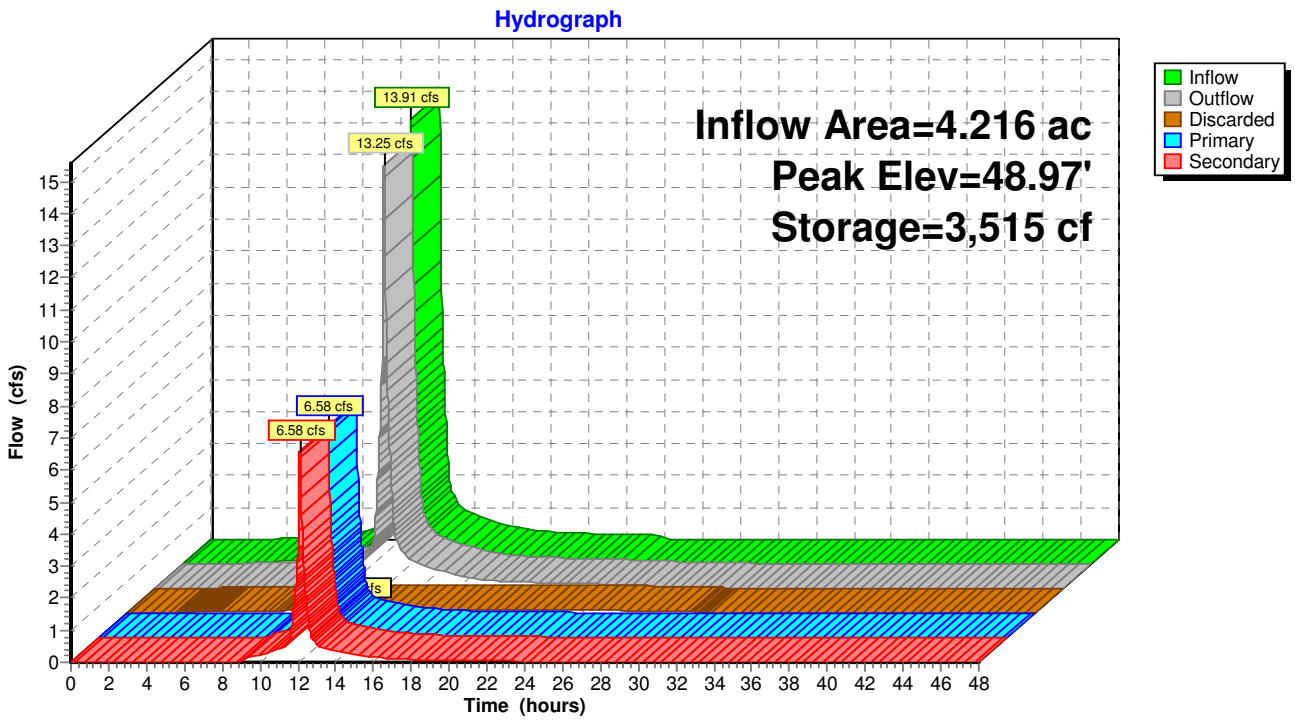
Device	Routing	Invert	Outlet Devices
#1	Primary	45.00'	**18.0" Round Culvert** L= 154.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.00' / 42.96' S= 0.0132 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	45.00'	**18.0" Round Culvert** L= 154.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.00' / 42.96' S= 0.0132 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 1	48.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	48.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	48.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.10 cfs @ 12.11 hrs HW=48.97' (Free Discharge)
└─**5=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=6.53 cfs @ 12.11 hrs HW=48.97' (Free Discharge)
└─**1=Culvert** (Passes 6.53 cfs of 15.26 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 6.53 cfs @ 2.23 fps)

Secondary OutFlow Max=6.53 cfs @ 12.11 hrs HW=48.97' (Free Discharge)
└─**2=Culvert** (Passes 6.53 cfs of 15.26 cfs potential flow)
  └─**4=Orifice/Grate** (Weir Controls 6.53 cfs @ 2.23 fps)

Pond POND-4: Bioretention Area



Summary for Pond POND-5: Bioretention Area

Inflow Area = 2.038 ac, 34.67% Impervious, Inflow Depth = 1.78" for 2 YR event
Inflow = 4.25 cfs @ 12.09 hrs, Volume= 0.303 af
Outflow = 0.12 cfs @ 17.12 hrs, Volume= 0.303 af, Atten= 97%, Lag= 301.6 min
Discarded = 0.12 cfs @ 17.12 hrs, Volume= 0.303 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 41.98' @ 17.12 hrs Surf.Area= 5,106 sf Storage= 8,548 cf

Plug-Flow detention time= 770.3 min calculated for 0.303 af (100% of inflow)
Center-of-Mass det. time= 770.3 min (1,602.3 - 832.0)

Volume	Invert	Avail.Storage	Storage Description
#1	40.00'	27,603 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

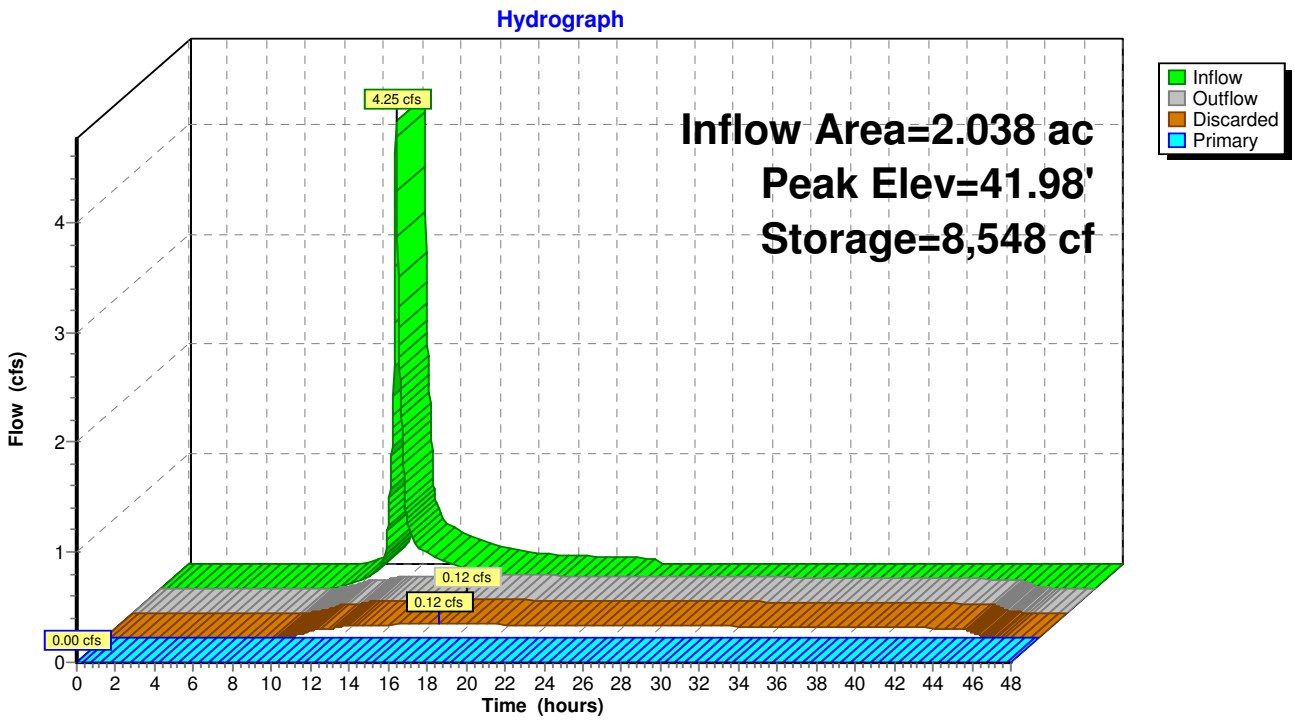
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
40.00	3,535	0	0
45.00	7,506	27,603	27,603

Device	Routing	Invert	Outlet Devices
#1	Device 2	43.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	36.20'	**12.0" Round Culvert** L= 81.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 36.20' / 35.39' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Discarded	40.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.12 cfs @ 17.12 hrs HW=41.98' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=40.00' (Free Discharge)
└─**2=Culvert** (Passes 0.00 cfs of 5.42 cfs potential flow)
  └─**1=Orifice/Grate** (Controls 0.00 cfs)

Pond POND-5: Bioretention Area



Summary for Pond POND-6: Bioretention Area

Inflow Area = 0.958 ac, 31.81% Impervious, Inflow Depth = 1.78" for 2 YR event
Inflow = 2.00 cfs @ 12.09 hrs, Volume= 0.142 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= 0.02 hrs
Peak Elev= 39.96' @ 24.36 hrs Surf.Area= 4,022 sf Storage= 6,196 cf

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

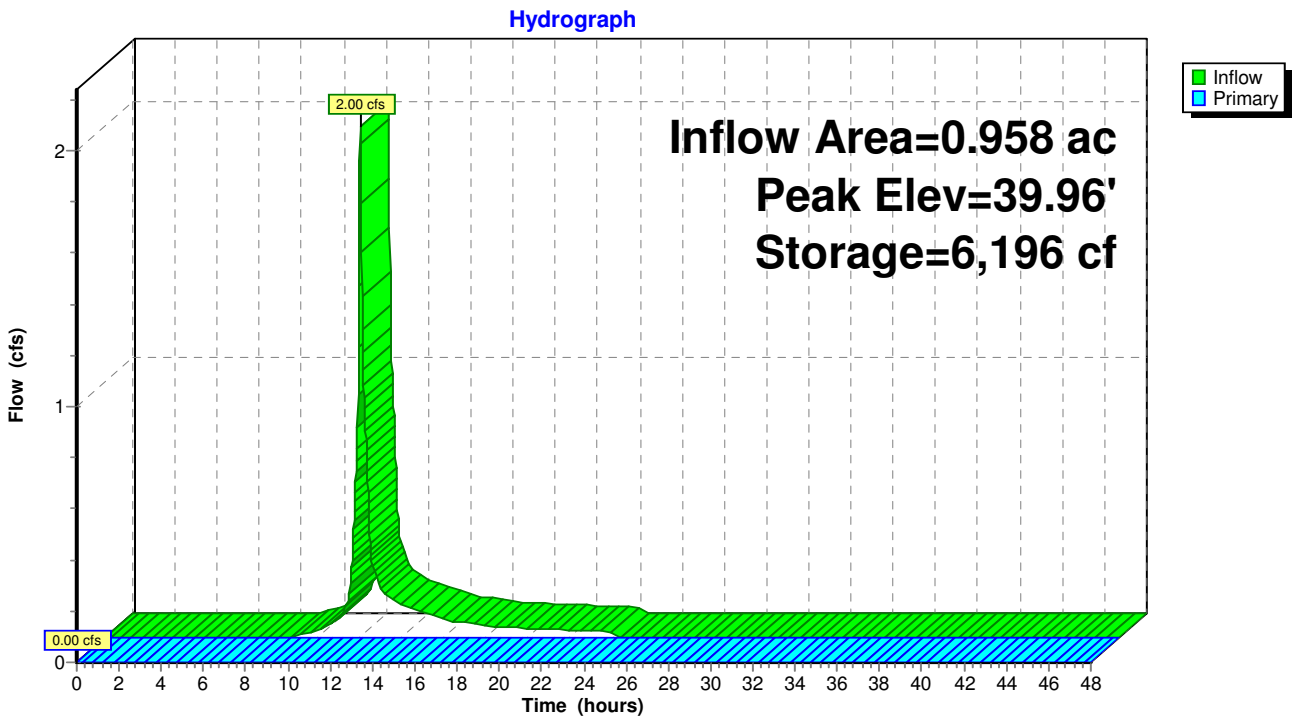
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	41,832 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	2,362	0	0
39.00	3,160	2,761	2,761
40.00	4,061	3,611	6,372
45.00	10,123	35,460	41,832

Device	Routing	Invert	Outlet Devices
#1	Primary	35.20'	**18.0" Round Culvert** L= 78.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 35.20' / 34.42' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Device 1	43.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
└─**1=Culvert** (Passes 0.00 cfs of 9.62 cfs potential flow)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond POND-6: Bioretention Area



Summary for Pond POND-7: O'Connell Way Detention Basin

Inflow Area = 5.536 ac, 69.51% Impervious, Inflow Depth = 3.15" for 2 YR event
Inflow = 16.95 cfs @ 12.15 hrs, Volume= 1.451 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
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 24.20' @ 24.76 hrs Surf.Area= 30,079 sf Storage= 63,199 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	21.50'	173,855 cf	**Custom Stage Data (Prismatic)** Listed below

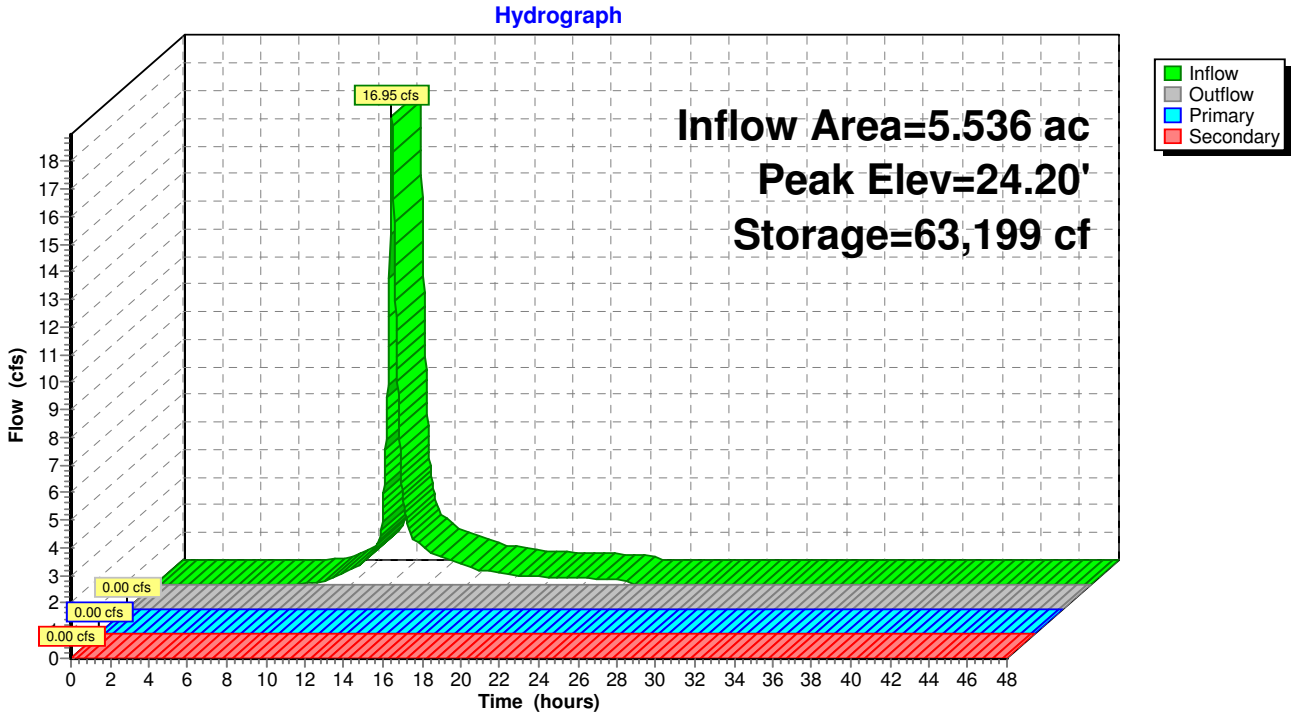
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
21.50	2,384	0	0
22.00	22,143	6,132	6,132
24.00	28,209	50,352	56,484
25.00	37,334	32,772	89,255
26.00	42,638	39,986	129,241
27.00	46,589	44,614	173,855

Device	Routing	Invert	Outlet Devices
#1	Primary	22.15'	**24.0" Round Culvert X 2.00** L= 46.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 22.15' / 22.00' S= 0.0033 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	25.75'	**4.0' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s) 1.0' Crest Height
#3	Secondary	26.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=21.50' (Free Discharge)
└─**1=Culvert** (Controls 0.00 cfs)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=21.50' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-7: O'Connell Way Detention Basin



Summary for Pond POND-9A: Lot 9 Northerly Stormwater Management System

Inflow Area = 1.464 ac,100.00% Impervious, Inflow Depth = 3.27" for 2 YR event
Inflow = 4.98 cfs @ 12.08 hrs, Volume= 0.399 af
Outflow = 0.62 cfs @ 12.63 hrs, Volume= 0.399 af, Atten= 87%, Lag= 32.7 min
Discarded = 0.28 cfs @ 10.52 hrs, Volume= 0.363 af
Primary = 0.35 cfs @ 12.63 hrs, Volume= 0.035 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 0.96' @ 12.63 hrs Surf.Area= 0.270 ac Storage= 0.155 af

Plug-Flow detention time= 160.5 min calculated for 0.398 af (100% of inflow)
Center-of-Mass det. time= 160.5 min (915.0 - 754.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.164 af	**28.33'W x 415.00'L x 2.04'H Field A** 0.551 af Overall - 0.141 af Embedded = 0.410 af x 40.0% Voids
#2A	0.50'	0.141 af	**Cultec C-100** x 440 Inside #1 Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap Row Length Adjustment= +0.50' x 1.86 sf x 8 rows
		0.305 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	0.83'	**6.0" Round Culvert X 7.00** L= 70.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 0.83' / 0.00' S= 0.0119 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.28 cfs @ 10.52 hrs HW=0.02' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=0.35 cfs @ 12.63 hrs HW=0.96' (Free Discharge)
└**2=Culvert** (Barrel Controls 0.35 cfs @ 1.83 fps)

Pond POND-9A: Lot 9 Northerly Stormwater Management System - Chamber Wizard Field A

Chamber Model = Cultec C-100
Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf
Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap
Row Length Adjustment= +0.50' x 1.86 sf x 8 rows

36.0" Wide + 4.0" Spacing = 40.0" C-C Row Spacing

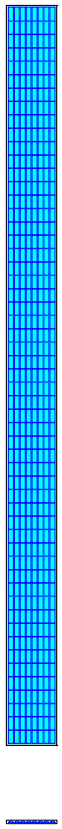
55 Chambers/Row x 7.50' Long +0.50' Row Adjustment = 413.00' Row Length +12.0" End Stone x 2 = 415.00' Base Length
8 Rows x 36.0" Wide + 4.0" Spacing x 7 + 12.0" Side Stone x 2 = 28.33' Base Width
6.0" Base + 12.5" Chamber Height + 6.0" Cover = 2.04' Field Height

440 Chambers x 14.0 cf +0.50' Row Adjustment x 1.86 sf x 8 Rows = 6,150.4 cf Chamber Storage

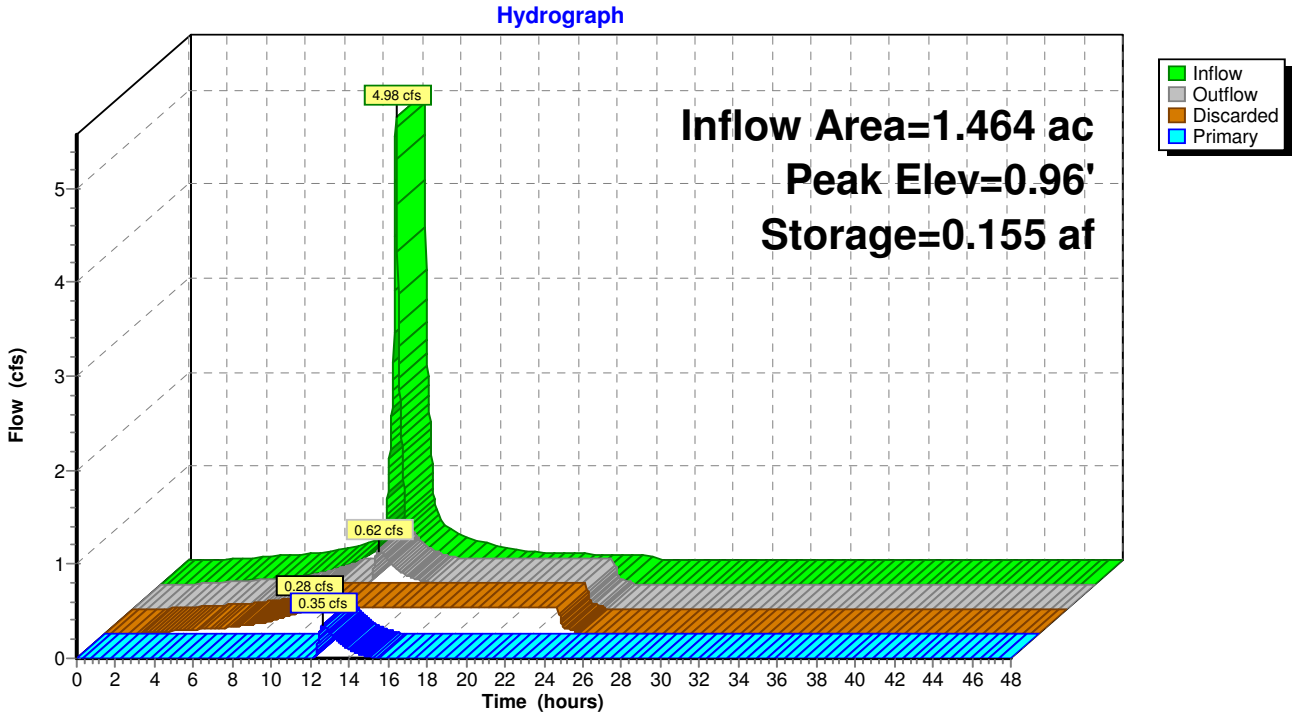
24,006.6 cf Field - 6,150.4 cf Chambers = 17,856.2 cf Stone x 40.0% Voids = 7,142.5 cf Stone Storage

Chamber Storage + Stone Storage = 13,292.9 cf = 0.305 af
Overall Storage Efficiency = 55.4%

440 Chambers
889.1 cy Field
661.3 cy Stone



Pond POND-9A: Lot 9 Northerly Stormwater Management System



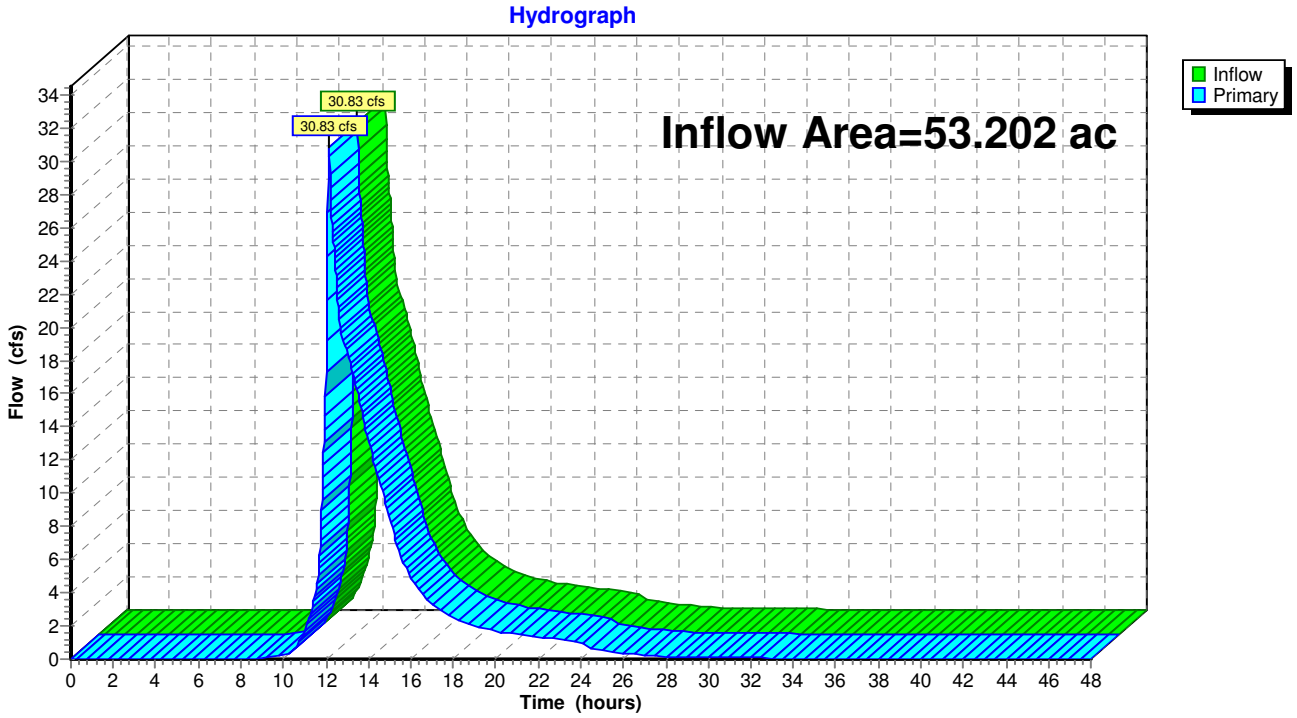
ary for Pond SUM: Summation of Analysis Points to Cotley River Wetlands from Southern portion of develo

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 53.202 ac, 59.07% Impervious, Inflow Depth > 1.51" for 2 YR event
Inflow = 30.83 cfs @ 12.15 hrs, Volume= 6.708 af
Primary = 30.83 cfs @ 12.15 hrs, Volume= 6.708 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond SUM: Summation of Analysis Points to Cotley River Wetlands from Southern portion of development



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment POST 2: Casino and Runoff Area=446,687 sf 100.00% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=98 Runoff=48.06 cfs 3.900 af

Subcatchment POST 3: Paved Surfaces Runoff Area=394,235 sf 70.88% Impervious Runoff Depth=3.79"
Tc=6.0 min CN=91 Runoff=38.53 cfs 2.857 af

Subcatchment POST-1: Unattenuated Runoff Area=371,335 sf 0.00% Impervious Runoff Depth=1.89"
Tc=10.0 min CN=70 Runoff=16.07 cfs 1.342 af

Subcatchment POST-10: Lot 11 Runoff Area=58,321 sf 0.00% Impervious Runoff Depth=1.45"
Tc=6.0 min CN=64 Runoff=2.12 cfs 0.162 af

Subcatchment POST-11: Portion of Existing Runoff Area=16,084 sf 0.00% Impervious Runoff Depth=2.72"
Tc=6.0 min CN=80 Runoff=1.18 cfs 0.084 af

Subcatchment POST-12: O'Connell Way Runoff Area=241,140 sf 69.51% Impervious Runoff Depth=3.38"
Flow Length=2,195' Tc=13.1 min CN=87 Runoff=17.23 cfs 1.559 af

Subcatchment POST-13: Unattenuated Runoff Area=49,358 sf 0.00% Impervious Runoff Depth=0.88"
Tc=10.0 min CN=55 Runoff=0.78 cfs 0.083 af

Subcatchment POST-4: Grassed Areas Runoff Area=40,262 sf 0.00% Impervious Runoff Depth=2.21"
Tc=10.0 min CN=74 Runoff=2.07 cfs 0.170 af

Subcatchment POST-4A: Grassed Areas Runoff Area=22,803 sf 6.22% Impervious Runoff Depth=2.29"
Tc=6.0 min CN=75 Runoff=1.39 cfs 0.100 af

Subcatchment POST-5: Portion of Runoff Area=110,956 sf 100.00% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=98 Runoff=11.94 cfs 0.969 af

Subcatchment POST-5A: Portion of Runoff Area=36,782 sf 66.62% Impervious Runoff Depth=3.68"
Tc=6.0 min CN=90 Runoff=3.52 cfs 0.259 af

Subcatchment POST-6: Portion of Runoff Area=183,629 sf 93.31% Impervious Runoff Depth=4.33"
Tc=6.0 min CN=96 Runoff=19.41 cfs 1.522 af

Subcatchment POST-7: Portion of Service Runoff Area=88,786 sf 34.67% Impervious Runoff Depth=2.90"
Tc=6.0 min CN=82 Runoff=6.91 cfs 0.493 af

Subcatchment POST-8: Portion of Service Runoff Area=41,710 sf 31.81% Impervious Runoff Depth=2.90"
Tc=6.0 min CN=82 Runoff=3.25 cfs 0.231 af

Subcatchment POST-9A: Northerly Runoff Area=63,780 sf 100.00% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=98 Runoff=6.86 cfs 0.557 af

Subcatchment POST-9B: Southerly Runoff Area=59,094 sf 100.00% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=98 Runoff=6.36 cfs 0.516 af

Subcatchment POST-9C: Unattenuated Runoff Area=92,500 sf 0.00% Impervious Runoff Depth=1.67"
Tc=10.0 min CN=67 Runoff=3.46 cfs 0.295 af

Pond 9Pa: Detention Pond - Southwest of Lot Peak Elev=27.33' Storage=5,211 cf Inflow=4.00 cfs 0.474 af
Primary=2.06 cfs 0.455 af Secondary=0.00 cfs 0.000 af Outflow=2.06 cfs 0.455 af

Pond 9Pb: Detention Pond - Southwest of Lot Peak Elev=25.91' Storage=3,026 cf Inflow=2.06 cfs 0.455 af
Primary=1.75 cfs 0.440 af Secondary=0.00 cfs 0.000 af Outflow=1.75 cfs 0.440 af

Pond 9Pc: Detention Pond - Southwest of Lot Peak Elev=24.83' Storage=2,641 cf Inflow=1.75 cfs 0.440 af
Primary=0.72 cfs 0.309 af Secondary=1.03 cfs 0.112 af Outflow=1.74 cfs 0.422 af

Pond 9Pe: Detention Pond - South of Lot 9 Peak Elev=30.88' Storage=5,502 cf Inflow=6.36 cfs 0.516 af
Primary=4.00 cfs 0.474 af Secondary=0.00 cfs 0.000 af Outflow=4.00 cfs 0.474 af

Pond AP-1: Wetlands South of O'Connell Way Inflow=52.25 cfs 9.700 af
Primary=52.25 cfs 9.700 af

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11 Inflow=10.39 cfs 0.773 af
Primary=10.39 cfs 0.773 af

Pond AP-3: Existing Culvert Crossing at Crossroads Inflow=2.12 cfs 0.162 af
Primary=2.12 cfs 0.162 af

Pond POND-1: Maggiore Combined Peak Elev=33.87' Storage=137,237 cf Inflow=100.00 cfs 7.970 af
Primary=37.42 cfs 7.419 af Secondary=0.00 cfs 0.000 af Outflow=37.42 cfs 7.419 af

Pond POND-2: Bioretention Area Peak Elev=52.37' Storage=2,041 cf Inflow=2.07 cfs 0.170 af
Discarded=0.13 cfs 0.095 af Primary=0.67 cfs 0.075 af Outflow=0.81 cfs 0.170 af

Pond POND-3: Bioretention Area Peak Elev=49.86' Storage=5,091 cf Inflow=16.97 cfs 1.402 af
Discarded=0.11 cfs 0.189 af Primary=14.07 cfs 1.213 af Outflow=14.17 cfs 1.402 af

Pond POND-4: Bioretention Area Peak Elev=49.09' Storage=4,017 cf Inflow=19.41 cfs 1.522 af
Discarded=0.10 cfs 0.190 af Primary=9.25 cfs 0.666 af Secondary=9.25 cfs 0.666 af Outflow=18.60 cfs 1.522 af

Pond POND-5: Bioretention Area Peak Elev=43.05' Storage=14,486 cf Inflow=6.91 cfs 0.493 af
Discarded=0.14 cfs 0.394 af Primary=0.12 cfs 0.024 af Outflow=0.26 cfs 0.418 af

Pond POND-6: Bioretention Area Peak Elev=40.81' Storage=10,082 cf Inflow=3.25 cfs 0.231 af
Outflow=0.00 cfs 0.000 af

Pond POND-7: O'Connell Way Detention Peak Elev=25.19' Storage=96,917 cf Inflow=25.20 cfs 2.225 af
Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Pond POND-9A: Lot 9 Northerly Stormwater Peak Elev=1.15' Storage=0.193 af Inflow=6.86 cfs 0.557 af
Discarded=0.28 cfs 0.418 af Primary=1.80 cfs 0.139 af Outflow=2.07 cfs 0.557 af

Pond SUM: Summation of Analysis Points to Cotley River Wetlands from Inflow=58.51 cfs 10.635 af
Primary=58.51 cfs 10.635 af

Total Runoff Area = 53.202 ac Runoff Volume = 15.098 af Average Runoff Depth = 3.41"
40.93% Pervious = 21.776 ac 59.07% Impervious = 31.426 ac

Summary for Subcatchment POST 2: Casino and Hotel Roofs

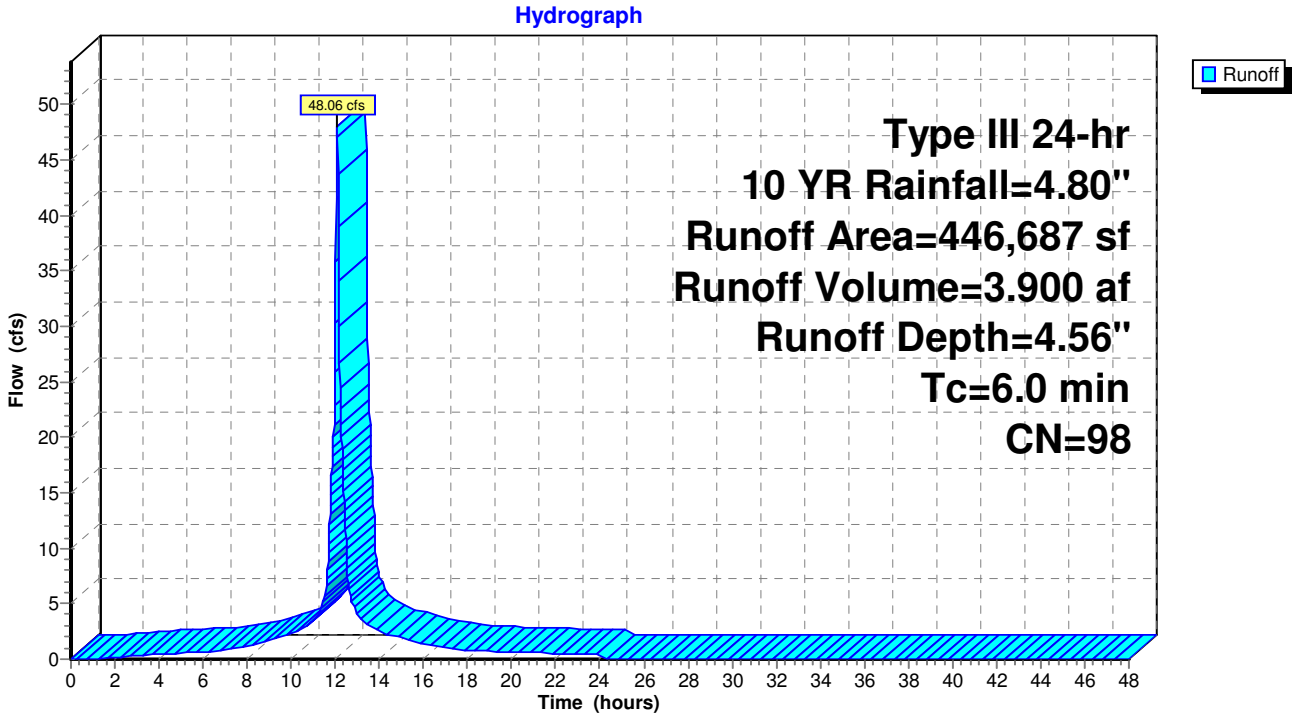
Runoff = 48.06 cfs @ 12.08 hrs, Volume= 3.900 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
446,687	98	Paved parking & roofs
446,687		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST 2: Casino and Hotel Roofs



Summary for Subcatchment POST 3: Paved Surfaces and Associated Landscaped Areas Around Casino

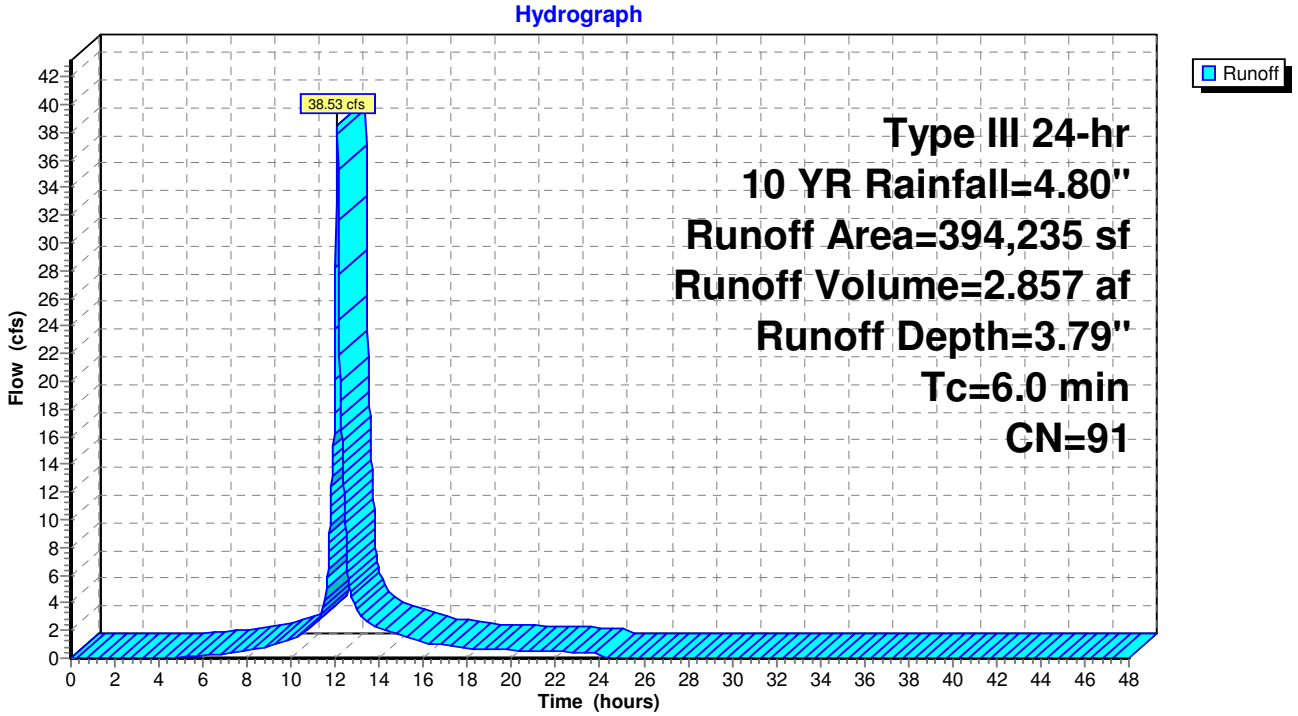
Runoff = 38.53 cfs @ 12.08 hrs, Volume= 2.857 af, Depth= 3.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
249,275	98	Paved parking & roofs
114,800	74	>75% Grass cover, Good, HSG C
30,160	98	Water Surface, HSG C
394,235	91	Weighted Average
114,800		29.12% Pervious Area
279,435		70.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST 3: Paved Surfaces and Associated Landscaped Areas Around Casino



Summary for Subcatchment POST-1: Unattenuated Areas to Wetlands Associated with Cotley River

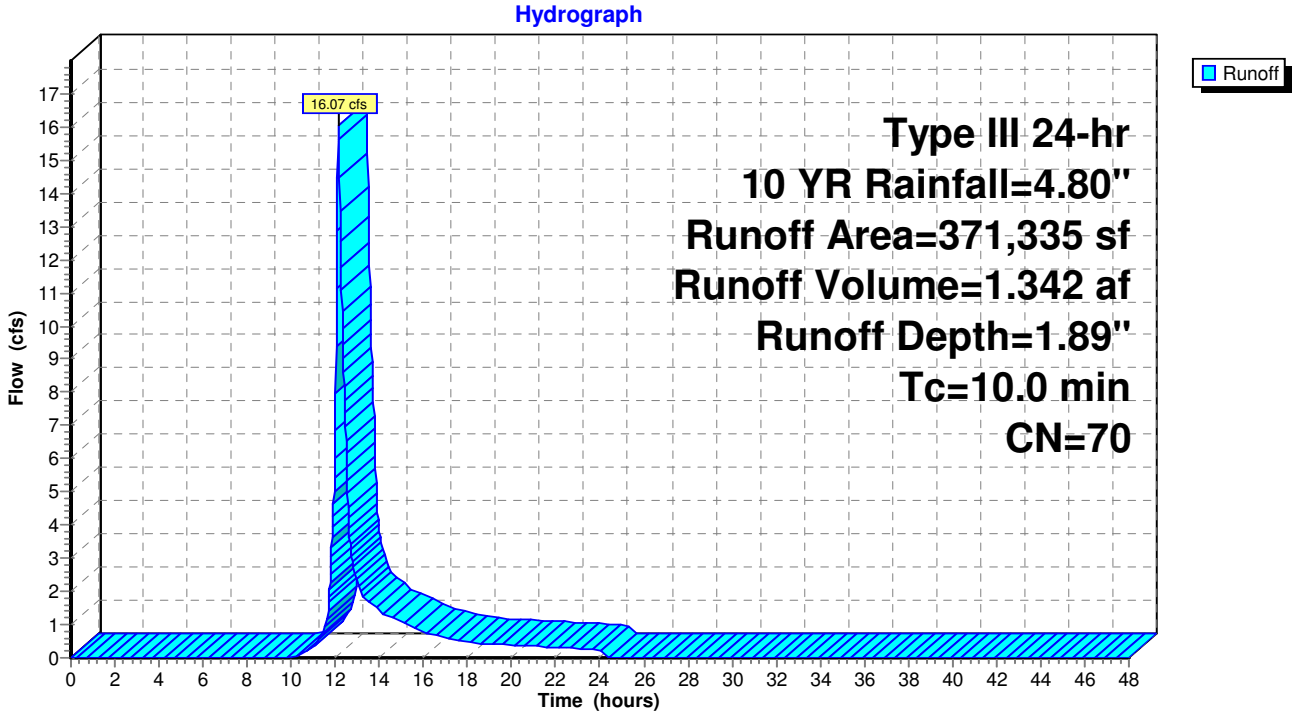
Runoff = 16.07 cfs @ 12.15 hrs, Volume= 1.342 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
11,864	61	>75% Grass cover, Good, HSG B
132,465	74	>75% Grass cover, Good, HSG C
456	80	>75% Grass cover, Good, HSG D
45,589	55	Woods, Good, HSG B
158,052	70	Woods, Good, HSG C
22,909	77	Woods, Good, HSG D
371,335	70	Weighted Average
371,335		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-1: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment POST-10: Lot 11 Unattenuated to Wetland System Through Stream

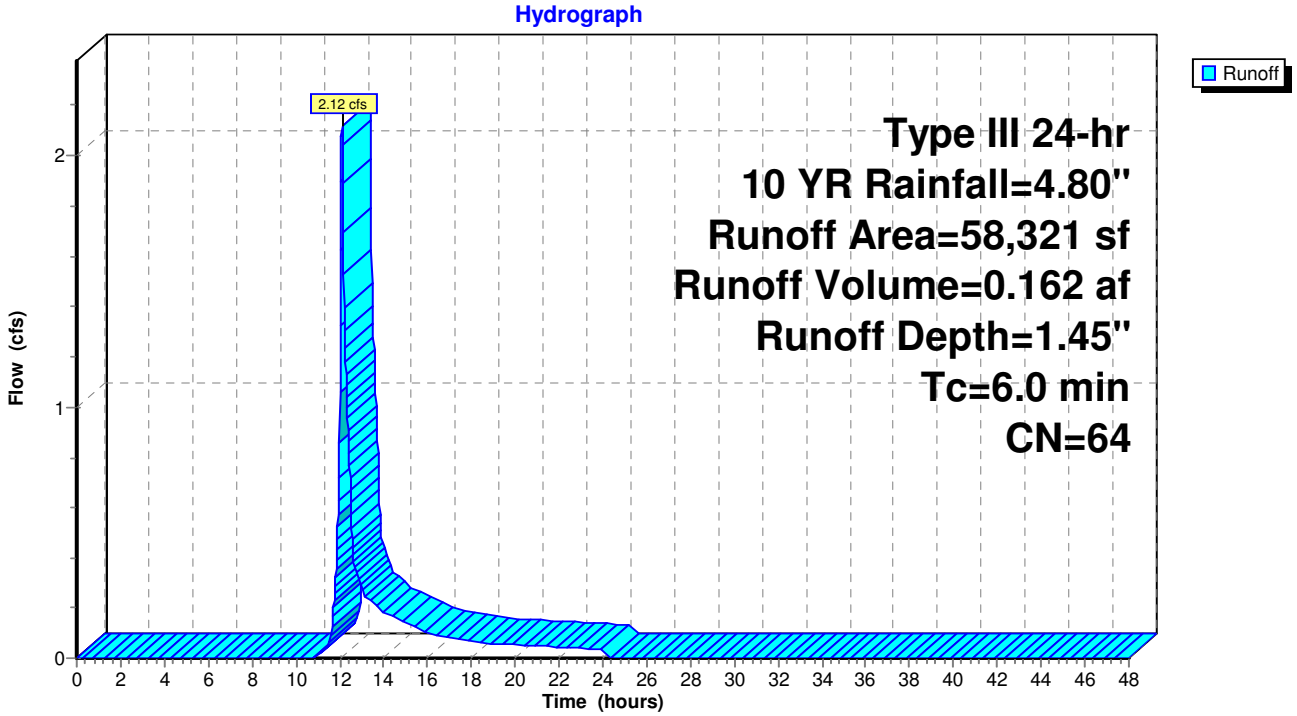
Runoff = 2.12 cfs @ 12.10 hrs, Volume= 0.162 af, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
48,048	61	>75% Grass cover, Good, HSG B
6,493	80	>75% Grass cover, Good, HSG D
1,821	70	Woods, Good, HSG C
1,959	77	Woods, Good, HSG D
58,321	64	Weighted Average
58,321		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-10: Lot 11 Unattenuated to Wetland System Through Stream



Summary for Subcatchment POST-11: Portion of Existing Lot 11 to Existing Stream

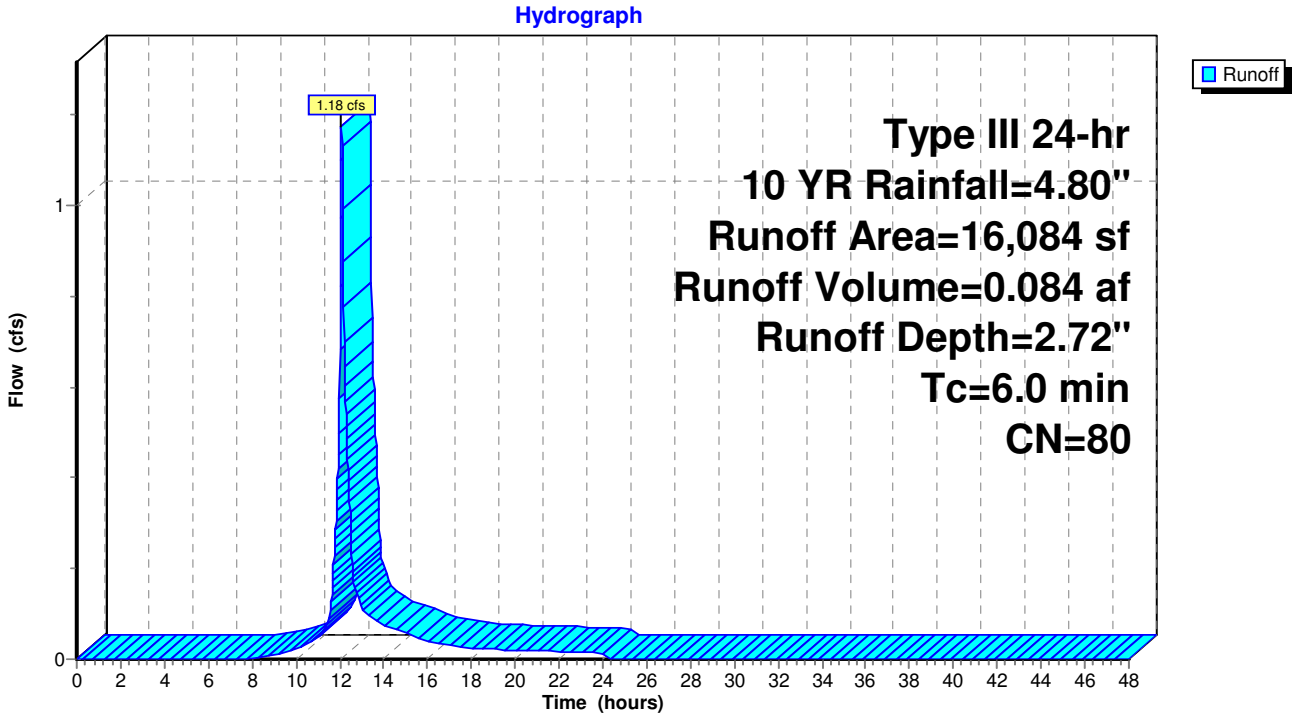
Runoff = 1.18 cfs @ 12.09 hrs, Volume= 0.084 af, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
16,084	80	>75% Grass cover, Good, HSG D
16,084		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-11: Portion of Existing Lot 11 to Existing Stream



Summary for Subcatchment POST-12: O'Connell Way

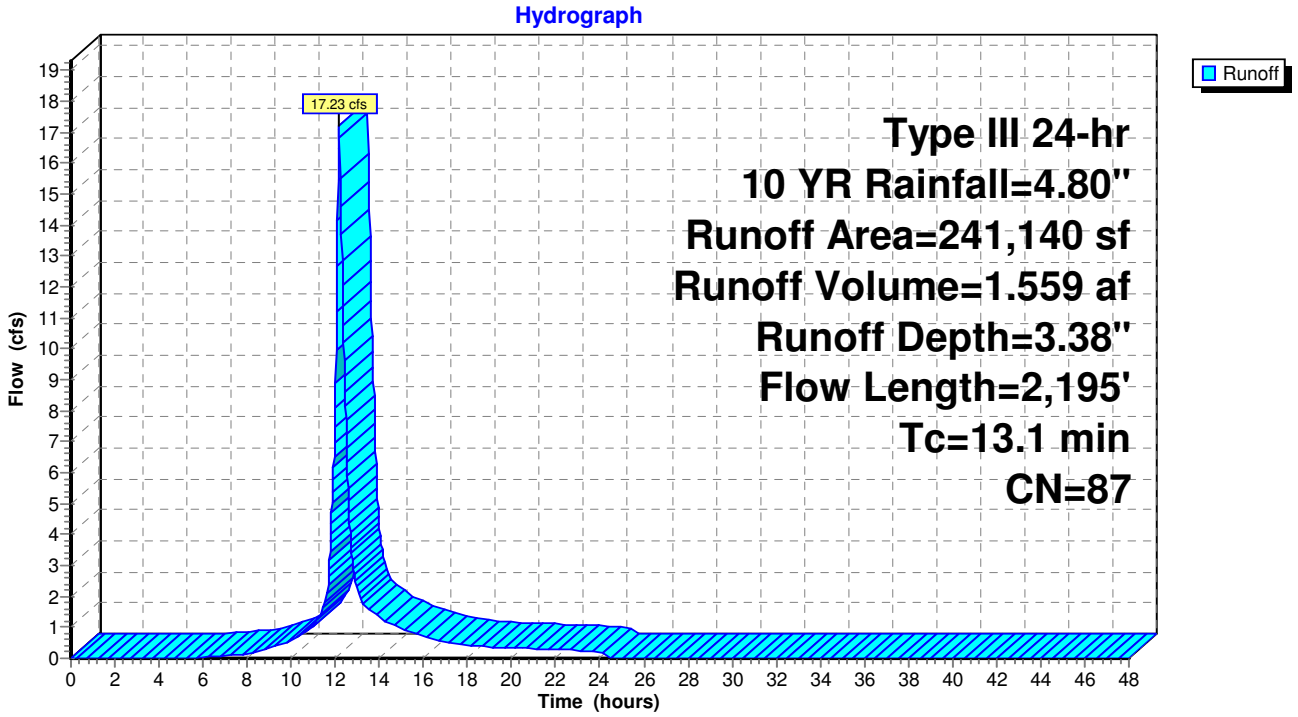
Runoff = 17.23 cfs @ 12.18 hrs, Volume= 1.559 af, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
145,476	98	Paved parking & roofs
22,143	98	Water Surface
9,233	39	>75% Grass cover, Good, HSG A
43,746	61	>75% Grass cover, Good, HSG B
14,196	74	>75% Grass cover, Good, HSG C
6,346	80	>75% Grass cover, Good, HSG D
241,140	87	Weighted Average
73,521		30.49% Pervious Area
167,619		69.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	65	0.0460	0.16		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.3	230	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
4.9	1,900	0.0080	6.44	20.23	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
13.1	2,195	Total			

Subcatchment POST-12: O'Connell Way



Summary for Subcatchment POST-13: Unattenuated Areas to Wetlands Associated with Cotley River

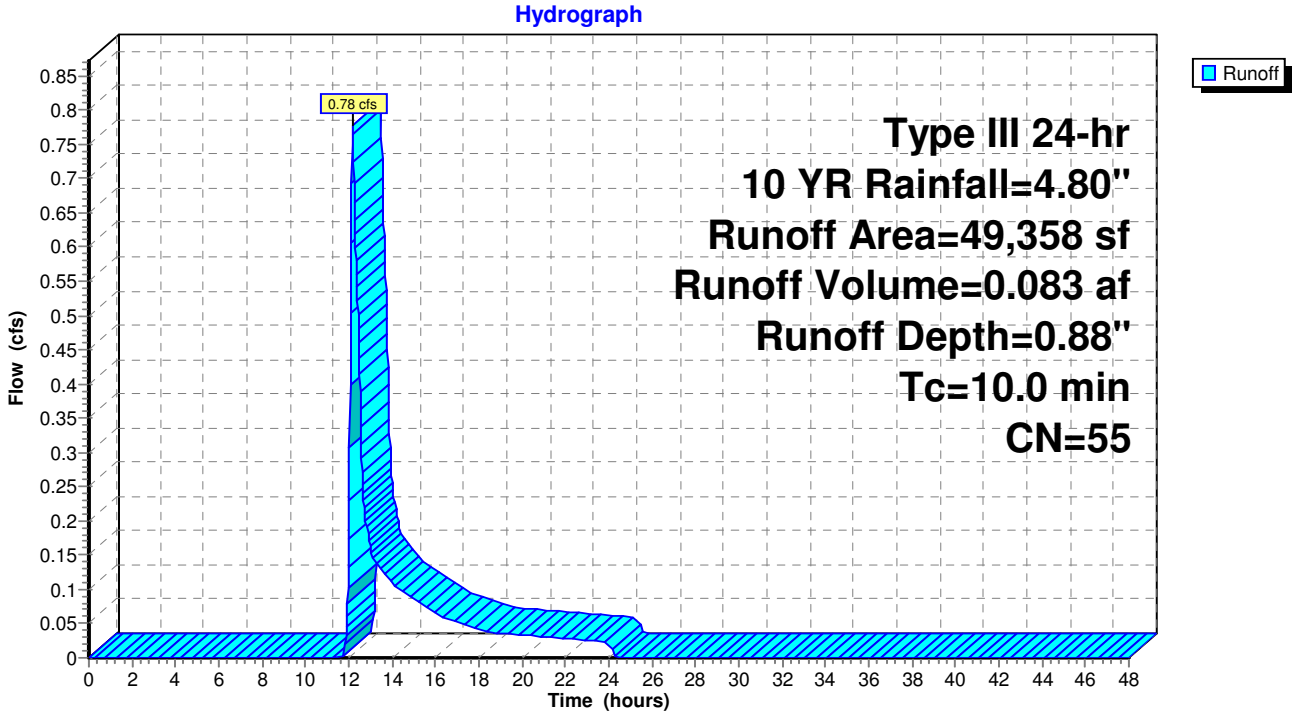
Runoff = 0.78 cfs @ 12.17 hrs, Volume= 0.083 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
15,709	39	>75% Grass cover, Good, HSG A
11,926	61	>75% Grass cover, Good, HSG B
7,879	80	>75% Grass cover, Good, HSG D
6,196	30	Woods, Good, HSG A
432	55	Woods, Good, HSG B
7,216	77	Woods, Good, HSG D
49,358	55	Weighted Average
49,358		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-13: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment POST-4: Grassed Areas Around Parking Garage

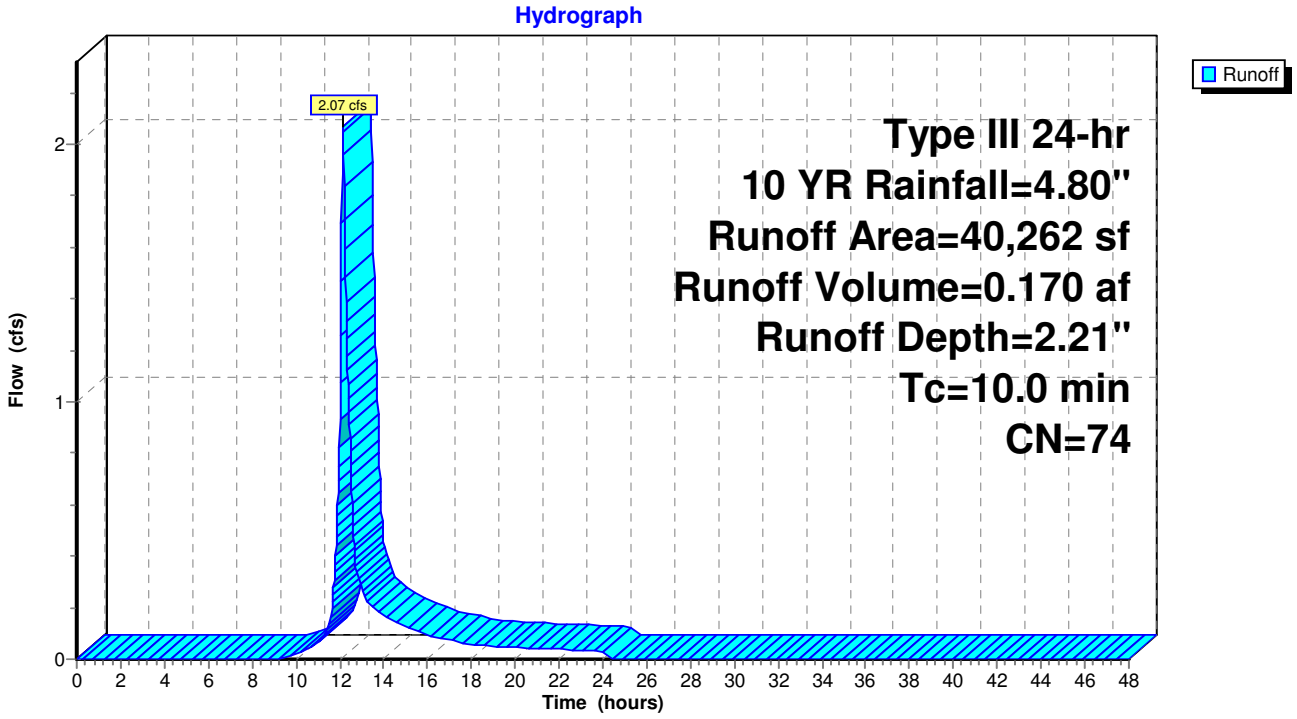
Runoff = 2.07 cfs @ 12.14 hrs, Volume= 0.170 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
40,262	74	>75% Grass cover, Good, HSG C
40,262		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-4: Grassed Areas Around Parking Garage



Summary for Subcatchment POST-4A: Grassed Areas Around Garage

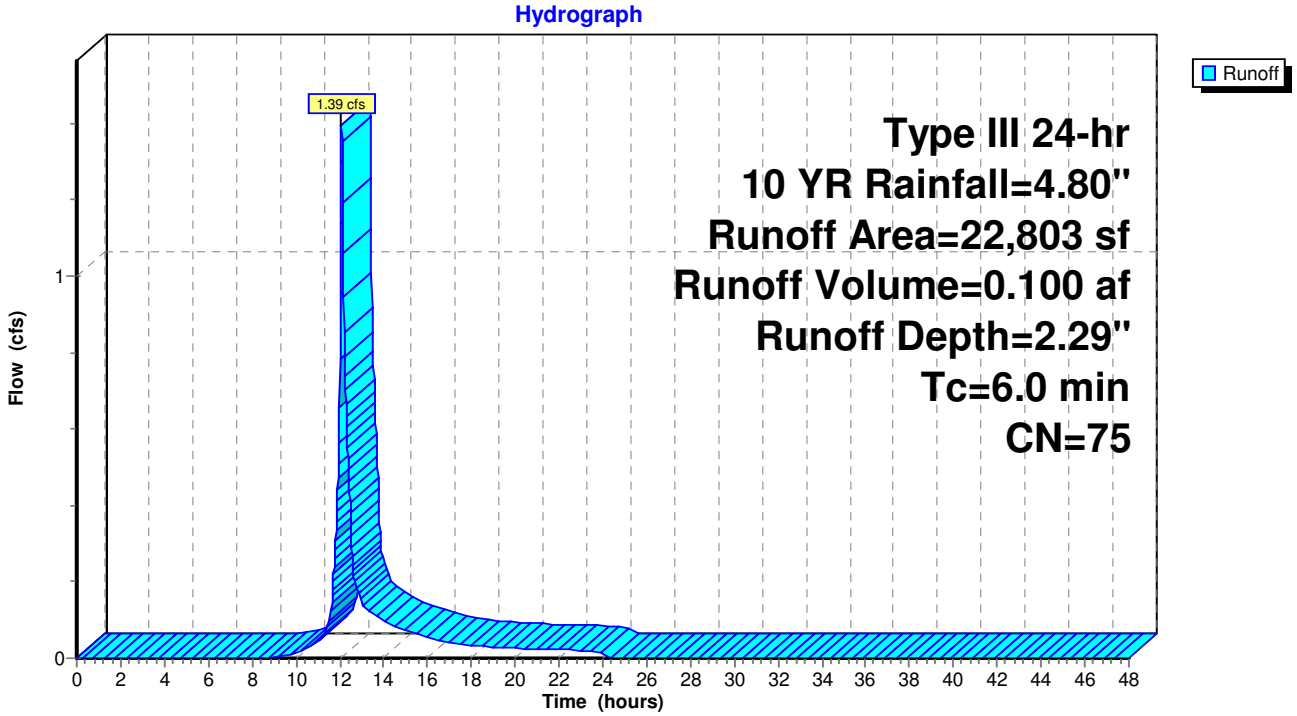
Runoff = 1.39 cfs @ 12.09 hrs, Volume= 0.100 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
21,385	74	>75% Grass cover, Good, HSG C
1,418	98	Unconnected pavement, HSG C
22,803	75	Weighted Average
21,385		93.78% Pervious Area
1,418		6.22% Impervious Area
1,418		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-4A: Grassed Areas Around Garage



Summary for Subcatchment POST-5: Portion of Parking Garage

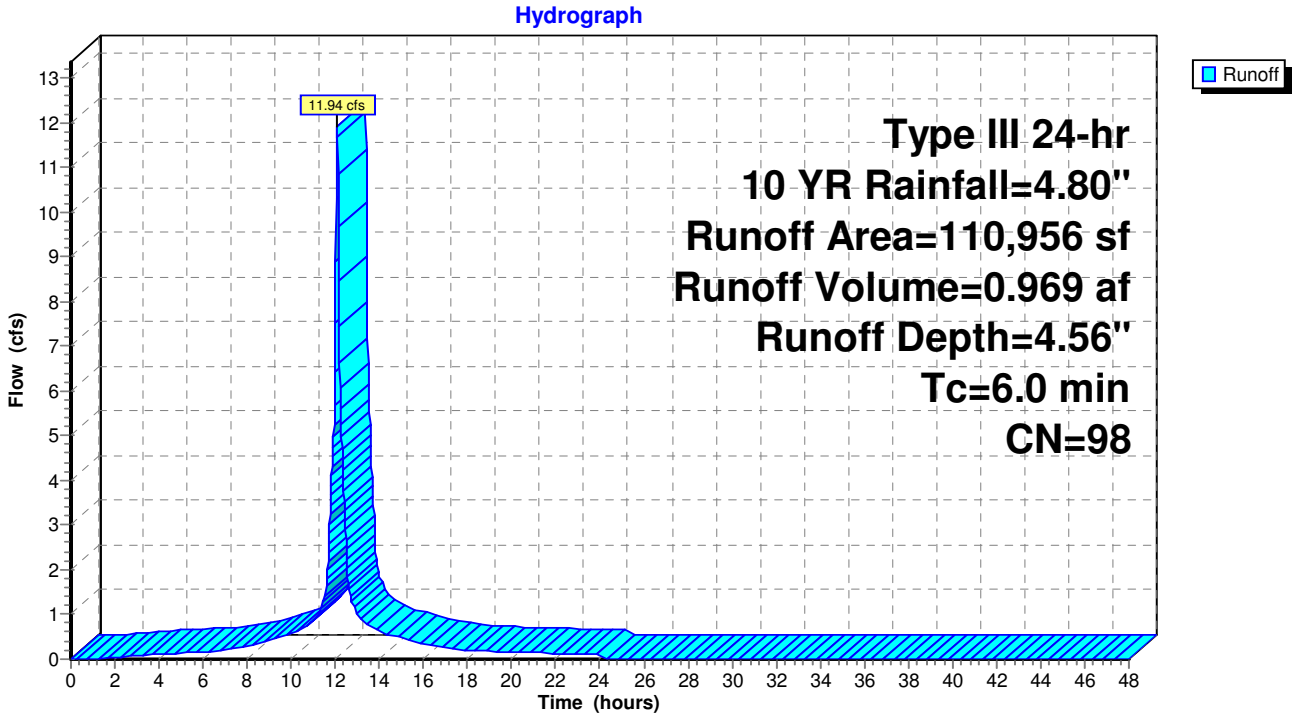
Runoff = 11.94 cfs @ 12.08 hrs, Volume= 0.969 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
110,956	98	Paved parking, HSG C
110,956		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-5: Portion of Parking Garage



Summary for Subcatchment POST-5A: Portion of Grassed Area and Access Drive Adjacent to Garage

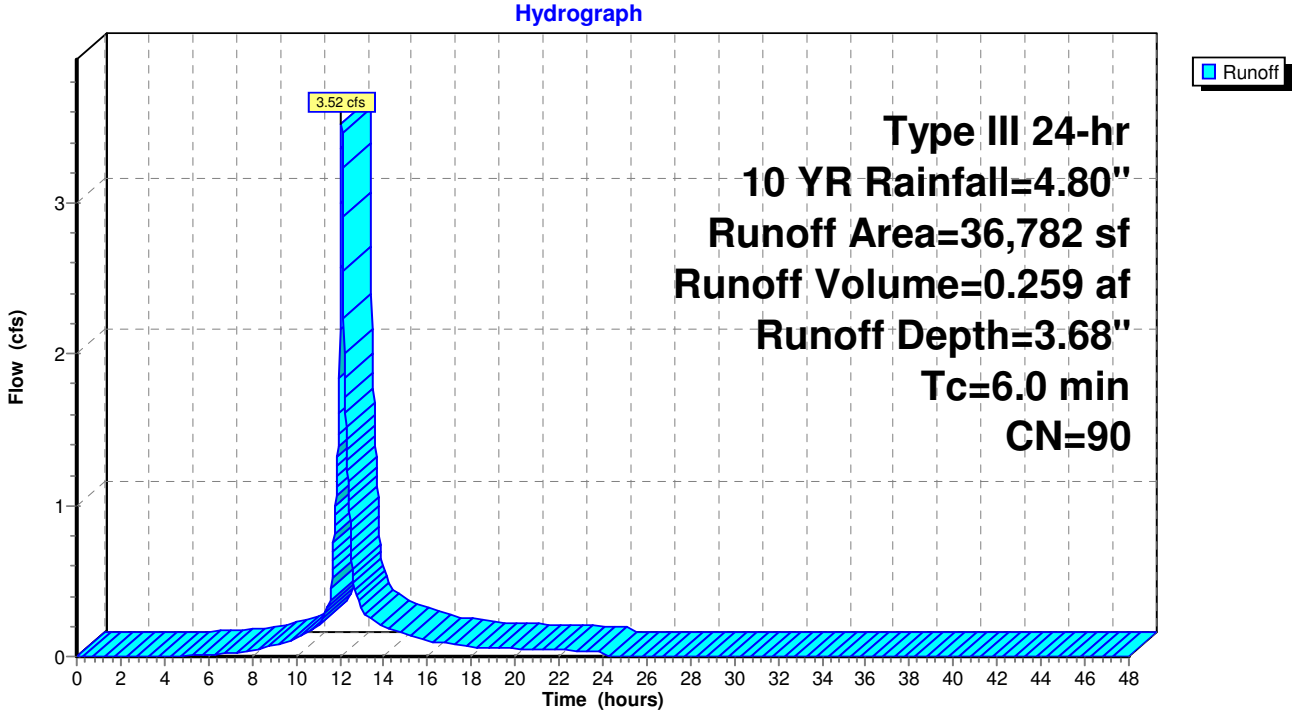
Runoff = 3.52 cfs @ 12.09 hrs, Volume= 0.259 af, Depth= 3.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
24,506	98	Paved parking, HSG C
12,276	74	>75% Grass cover, Good, HSG C
36,782	90	Weighted Average
12,276		33.38% Pervious Area
24,506		66.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-5A: Portion of Grassed Area and Access Drive Adjacent to Garage



Summary for Subcatchment POST-6: Portion of Parking Garage

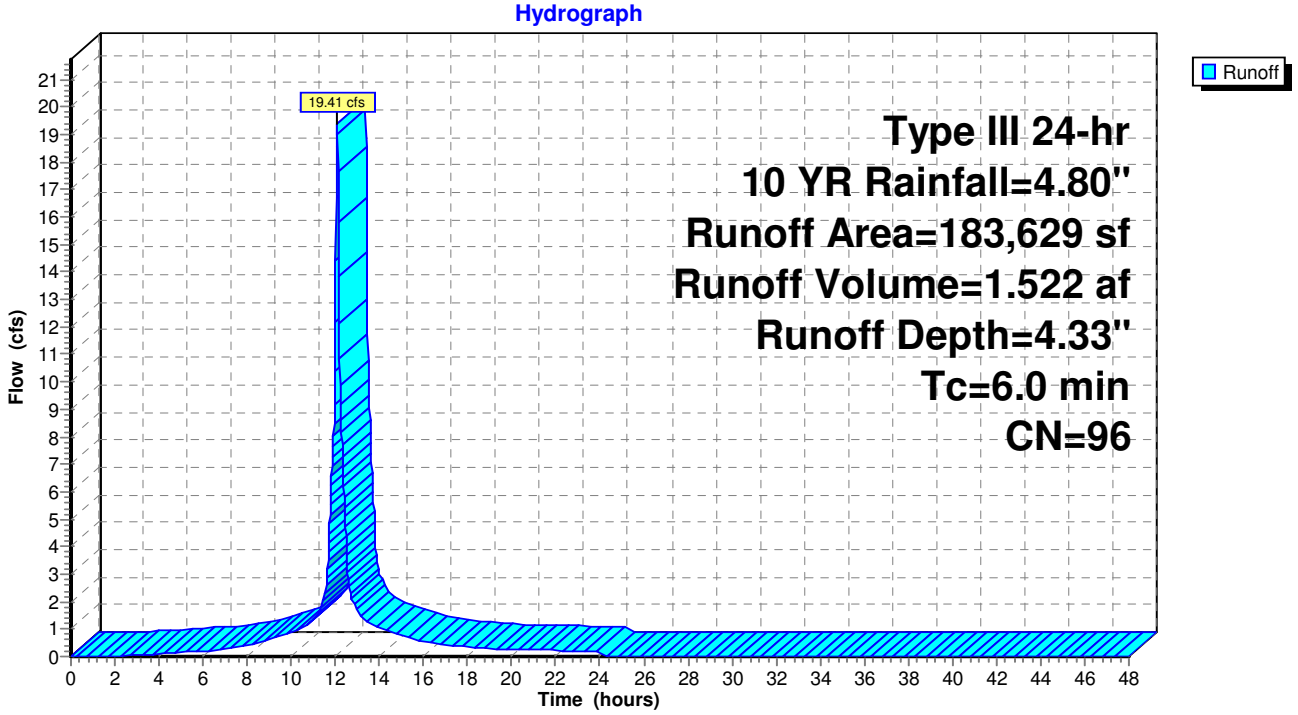
Runoff = 19.41 cfs @ 12.08 hrs, Volume= 1.522 af, Depth= 4.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
171,350	98	Paved parking, HSG C
12,279	74	>75% Grass cover, Good, HSG C
183,629	96	Weighted Average
12,279		6.69% Pervious Area
171,350		93.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-6: Portion of Parking Garage



Summary for Subcatchment POST-7: Portion of Service Road and Central Plant Area

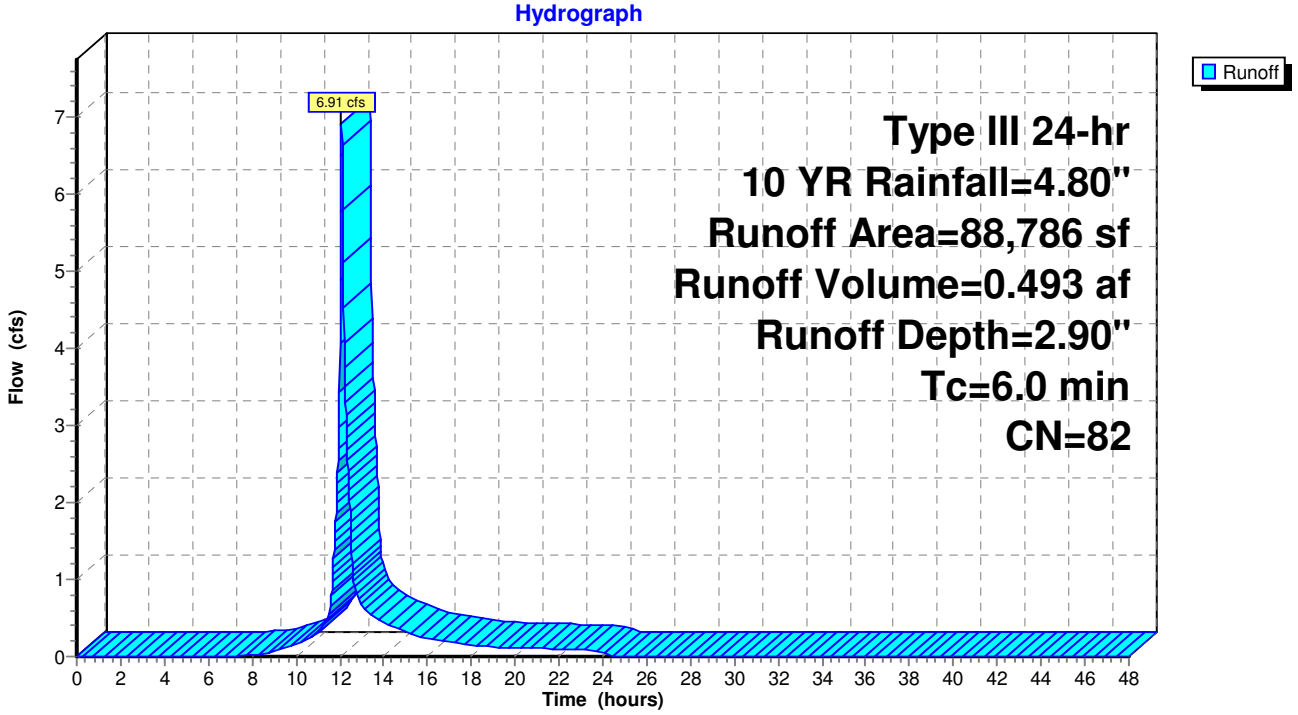
Runoff = 6.91 cfs @ 12.09 hrs, Volume= 0.493 af, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
58,002	74	>75% Grass cover, Good, HSG C
30,784	98	Paved parking, HSG C
88,786	82	Weighted Average
58,002		65.33% Pervious Area
30,784		34.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-7: Portion of Service Road and Central Plant Area



Summary for Subcatchment POST-8: Portion of Service Road and Basin Area

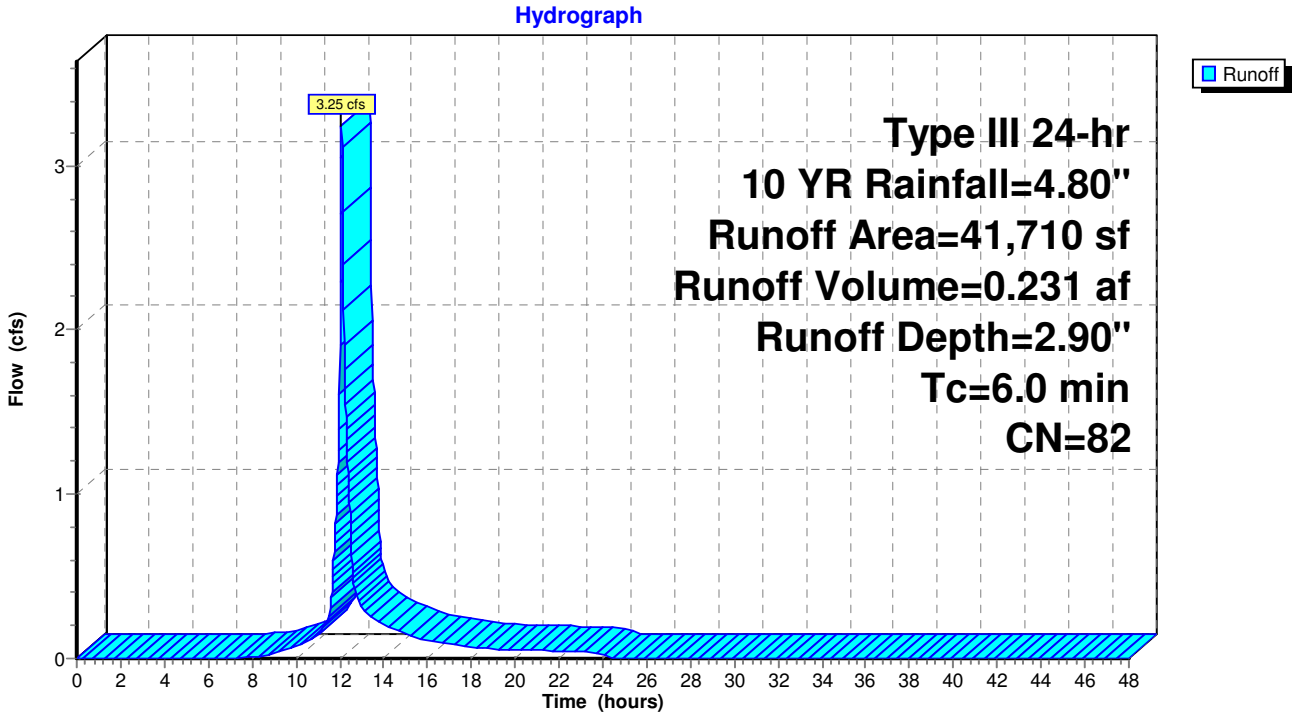
Runoff = 3.25 cfs @ 12.09 hrs, Volume= 0.231 af, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
13,269	98	Paved parking, HSG C
28,441	74	>75% Grass cover, Good, HSG C
41,710	82	Weighted Average
28,441		68.19% Pervious Area
13,269		31.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-8: Portion of Service Road and Basin Area



Summary for Subcatchment POST-9A: Northerly Portion of Parking on "Lot 9"

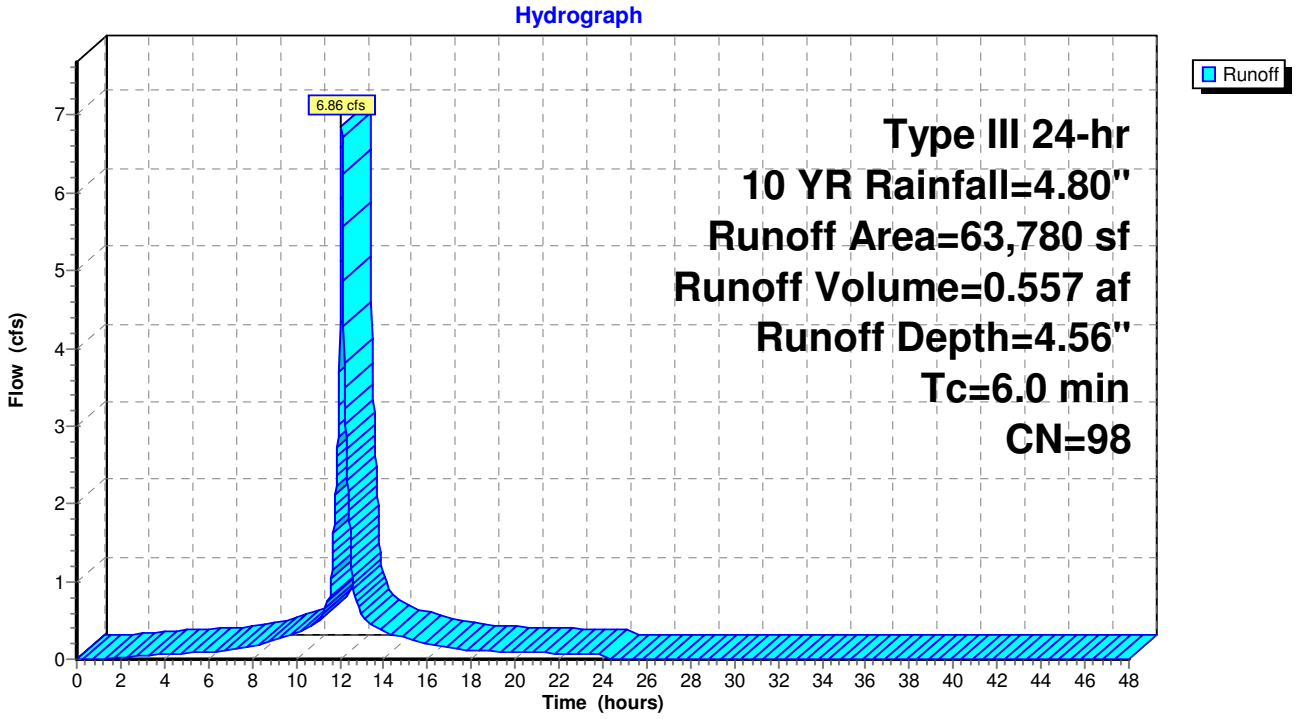
Runoff = 6.86 cfs @ 12.08 hrs, Volume= 0.557 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
63,780	98	Paved parking & roofs
63,780		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-9A: Northerly Portion of Parking on "Lot 9"



Summary for Subcatchment POST-9B: Southerly Portion of Parking on "Lot 9"

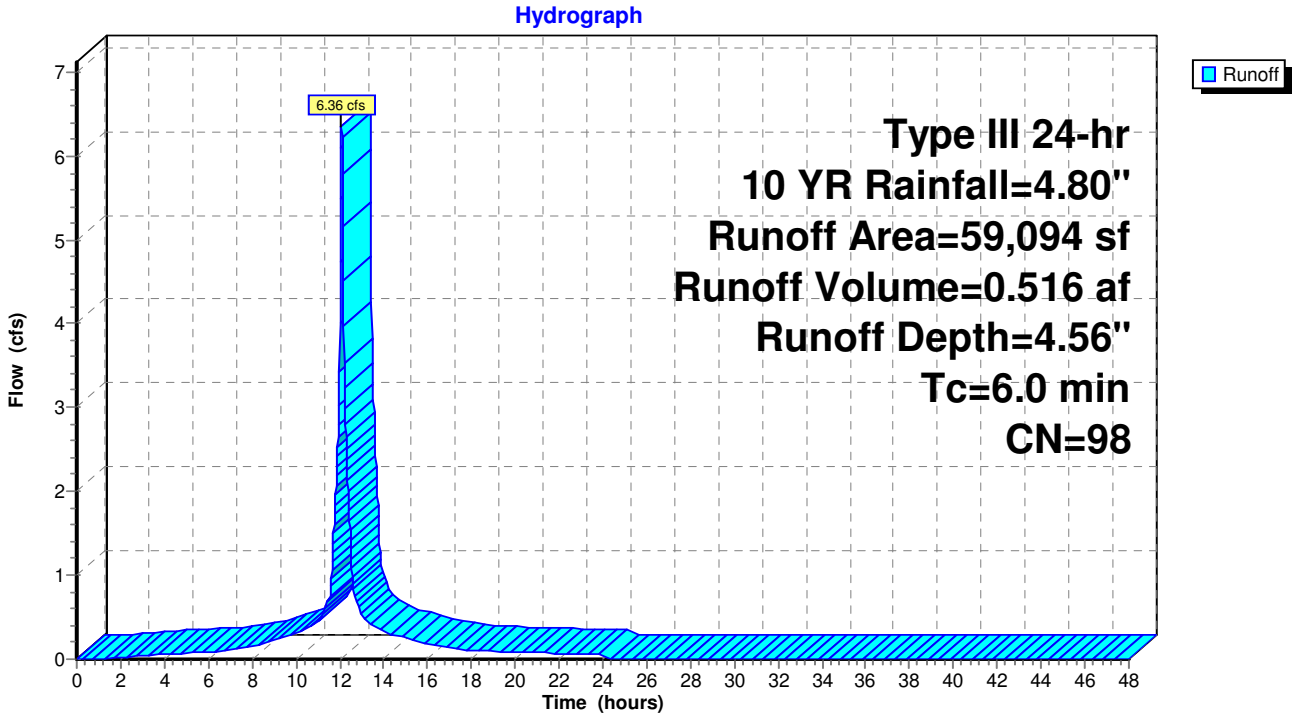
Runoff = 6.36 cfs @ 12.08 hrs, Volume= 0.516 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
59,094	98	Paved parking & roofs
59,094		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-9B: Southerly Portion of Parking on "Lot 9"



mmary for Subcatchment POST-9C: Unattenuated Area from "Lot 9" to Wetlands Associated with Cotley Ri

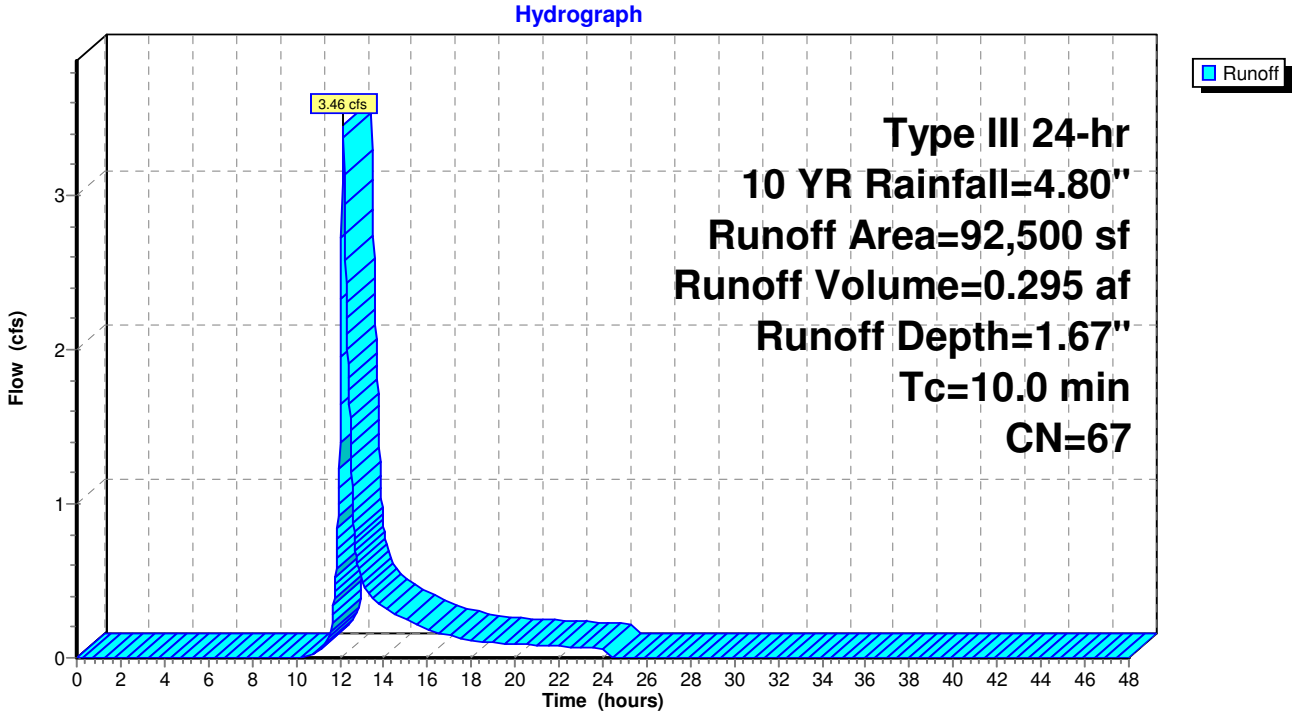
Runoff = 3.46 cfs @ 12.15 hrs, Volume= 0.295 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
4,000	30	Meadow, non-grazed, HSG A
6,000	78	Meadow, non-grazed, HSG D
9,000	30	Woods, Good, HSG A
36,000	70	Woods, Good, HSG C
5,000	39	>75% Grass cover, Good, HSG A
32,500	80	>75% Grass cover, Good, HSG D
92,500	67	Weighted Average
92,500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-9C: Unattenuated Area from "Lot 9" to Wetlands Associated with Cotley River



Summary for Pond 9Pa: Detention Pond - Southwest of Lot 9 Parking

Inflow Area = 1.357 ac,100.00% Impervious, Inflow Depth = 4.19" for 10 YR event
Inflow = 4.00 cfs @ 12.18 hrs, Volume= 0.474 af
Outflow = 2.06 cfs @ 12.57 hrs, Volume= 0.455 af, Atten= 49%, Lag= 23.4 min
Primary = 2.06 cfs @ 12.57 hrs, Volume= 0.455 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 27.33' @ 12.57 hrs Surf.Area= 3,296 sf Storage= 5,211 cf
Flood Elev= 29.00' Surf.Area= 5,450 sf Storage= 12,595 cf

Plug-Flow detention time= 71.3 min calculated for 0.455 af (96% of inflow)
Center-of-Mass det. time= 44.4 min (864.2 - 819.7)

Volume	Invert	Avail.Storage	Storage Description
#1	25.00'	12,595 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

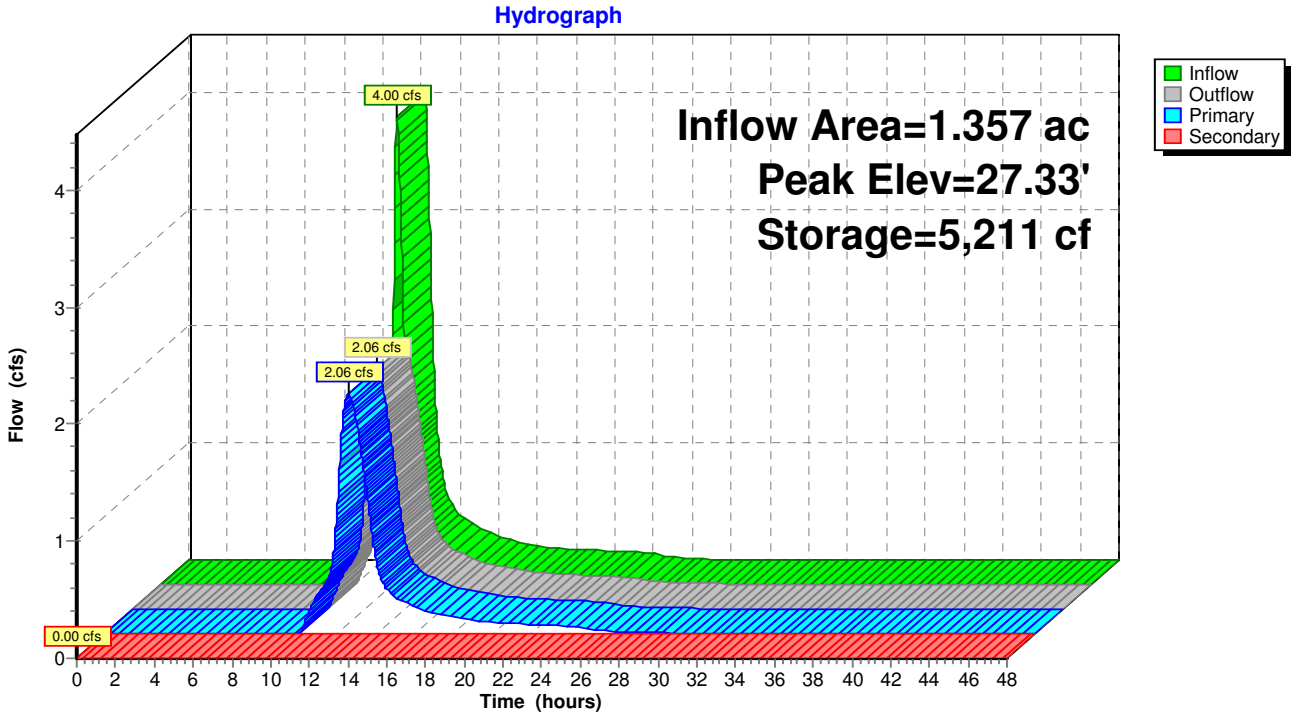
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
25.00	1,420	0	0
26.00	2,080	1,750	1,750
27.00	2,830	2,455	4,205
28.00	4,250	3,540	7,745
29.00	5,450	4,850	12,595

Device	Routing	Invert	Outlet Devices
#1	Primary	25.50'	**8.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 25.50' / 25.00' S= 0.0250 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Secondary	28.50'	**10.0' long x 4.0' 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 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=2.05 cfs @ 12.57 hrs HW=27.33' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.05 cfs @ 5.89 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=25.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9Pa: Detention Pond - Southwest of Lot 9 Parking



Summary for Pond 9Pb: Detention Pond - Southwest of Lot 9 Parking

[79] Warning: Submerged Pond 9Pa Primary device # 1 INLET by 0.41'

Inflow Area =	1.357 ac,100.00% Impervious, Inflow Depth > 4.02" for 10 YR event				
Inflow =	2.06 cfs @	12.57 hrs,	Volume=	0.455 af	
Outflow =	1.75 cfs @	13.06 hrs,	Volume=	0.440 af,	Atten= 15%, Lag= 29.4 min
Primary =	1.75 cfs @	13.06 hrs,	Volume=	0.440 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 25.91' @ 13.06 hrs Surf.Area= 2,010 sf Storage= 3,026 cf
Flood Elev= 27.00' Surf.Area= 2,560 sf Storage= 5,510 cf

Plug-Flow detention time= 58.1 min calculated for 0.440 af (97% of inflow)
Center-of-Mass det. time= 32.5 min (896.6 - 864.2)

Volume	Invert	Avail.Storage	Storage Description
#1	24.00'	5,510 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

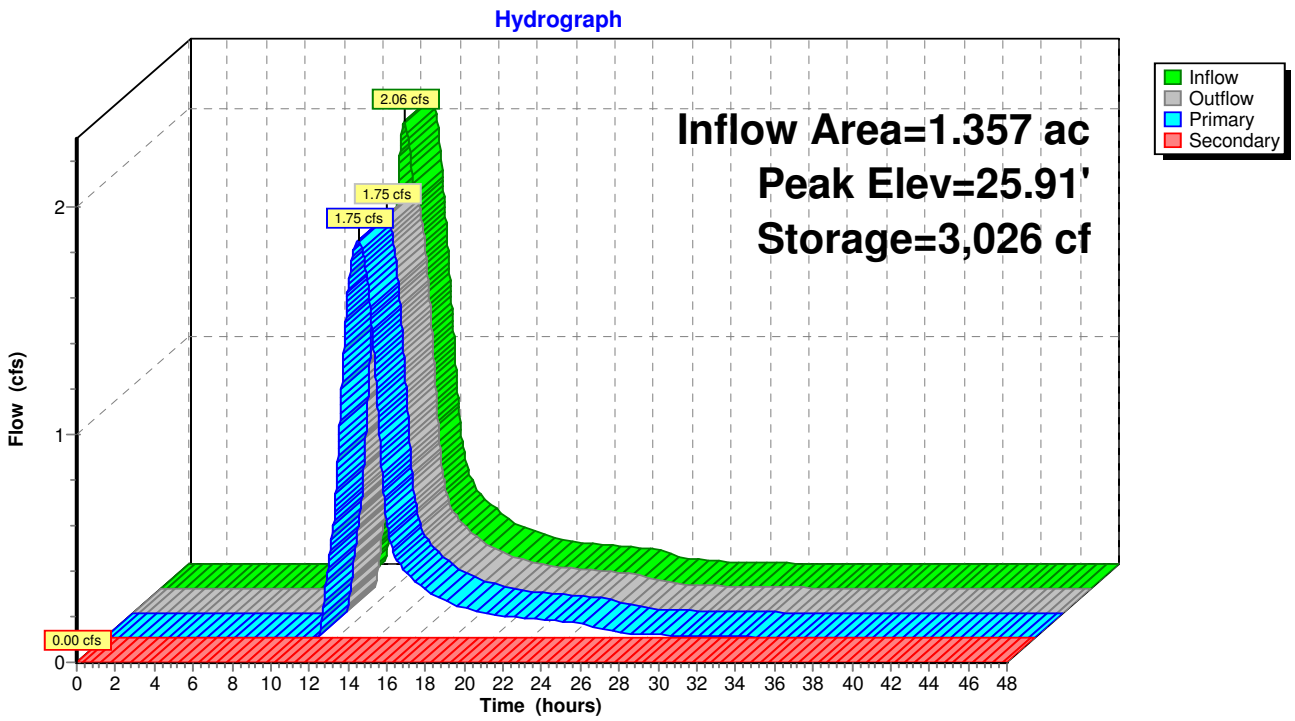
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
24.00	1,160	0	0
25.00	1,600	1,380	1,380
26.00	2,050	1,825	3,205
27.00	2,560	2,305	5,510

Device	Routing	Invert	Outlet Devices
#1	Primary	24.50'	**8.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.50' / 24.00' S= 0.0250 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Secondary	26.50'	**10.0' long x 4.0' 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 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=1.75 cfs @ 13.06 hrs HW=25.91' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.75 cfs @ 5.00 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=24.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9Pb: Detention Pond - Southwest of Lot 9 Parking



Summary for Pond 9Pc: Detention Pond - Southwest of Lot 9 Parking

[79] Warning: Submerged Pond 9Pb Primary device # 1 INLET by 0.33'

Inflow Area = 1.357 ac,100.00% Impervious, Inflow Depth > 3.89" for 10 YR event
Inflow = 1.75 cfs @ 13.06 hrs, Volume= 0.440 af
Outflow = 1.74 cfs @ 13.10 hrs, Volume= 0.422 af, Atten= 0%, Lag= 2.2 min
Primary = 0.72 cfs @ 13.10 hrs, Volume= 0.309 af
Secondary = 1.03 cfs @ 13.10 hrs, Volume= 0.112 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 24.83' @ 13.10 hrs Surf.Area= 2,616 sf Storage= 2,641 cf
Flood Elev= 25.00' Surf.Area= 2,760 sf Storage= 3,103 cf

Plug-Flow detention time= 76.3 min calculated for 0.422 af (96% of inflow)
Center-of-Mass det. time= 43.1 min (939.8 - 896.6)

Volume	Invert	Avail.Storage	Storage Description
#1	23.50'	3,103 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

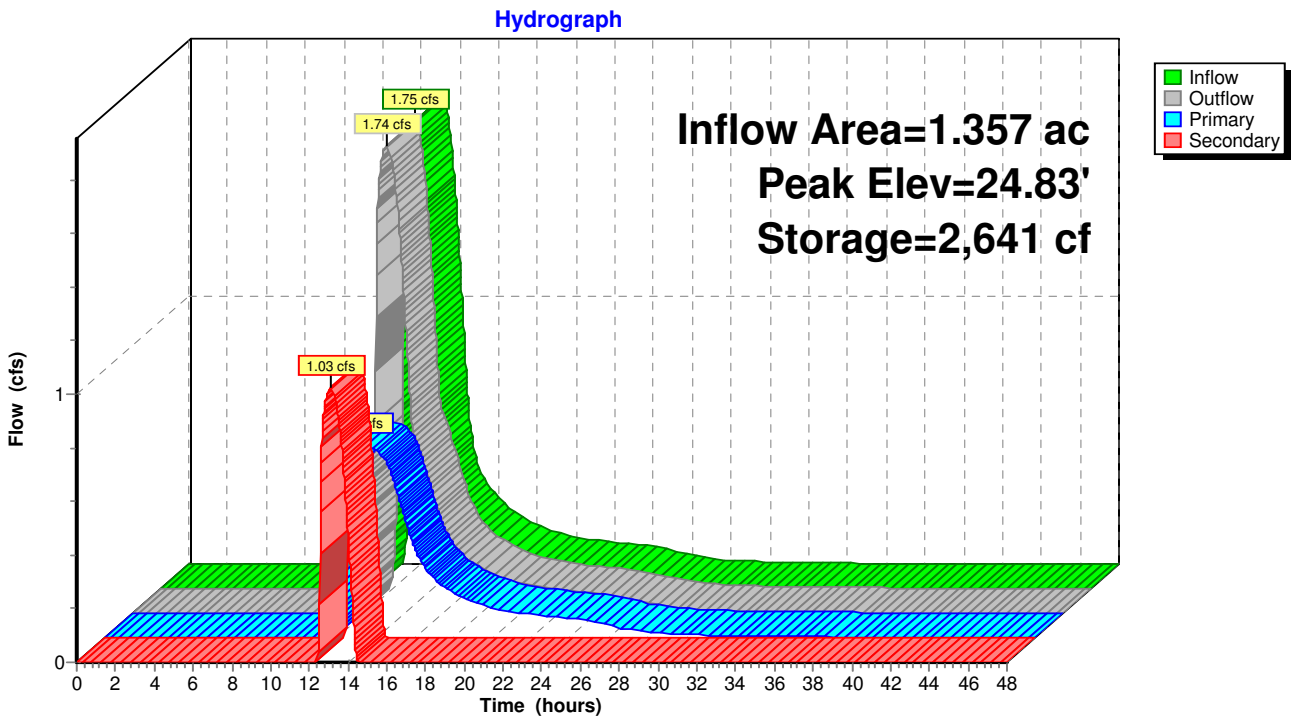
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
23.50	1,130	0	0
24.00	1,920	763	763
25.00	2,760	2,340	3,103

Device	Routing	Invert	Outlet Devices
#1	Primary	24.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	24.75'	**20.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.72 cfs @ 13.10 hrs HW=24.83' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.72 cfs @ 3.66 fps)

Secondary OutFlow Max=1.02 cfs @ 13.10 hrs HW=24.83' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 1.02 cfs @ 0.65 fps)

Pond 9Pc: Detention Pond - Southwest of Lot 9 Parking



Summary for Pond 9Pe: Detention Pond - South of Lot 9 Parking

Inflow Area = 1.357 ac,100.00% Impervious, Inflow Depth = 4.56" for 10 YR event
Inflow = 6.36 cfs @ 12.08 hrs, Volume= 0.516 af
Outflow = 4.00 cfs @ 12.18 hrs, Volume= 0.474 af, Atten= 37%, Lag= 5.8 min
Primary = 4.00 cfs @ 12.18 hrs, Volume= 0.474 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 30.88' @ 12.18 hrs Surf.Area= 3,874 sf Storage= 5,502 cf
Flood Elev= 32.00' Surf.Area= 4,940 sf Storage= 10,445 cf

Plug-Flow detention time= 113.7 min calculated for 0.473 af (92% of inflow)
Center-of-Mass det. time= 71.0 min (819.7 - 748.7)

Volume	Invert	Avail.Storage	Storage Description
#1	29.00'	10,445 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

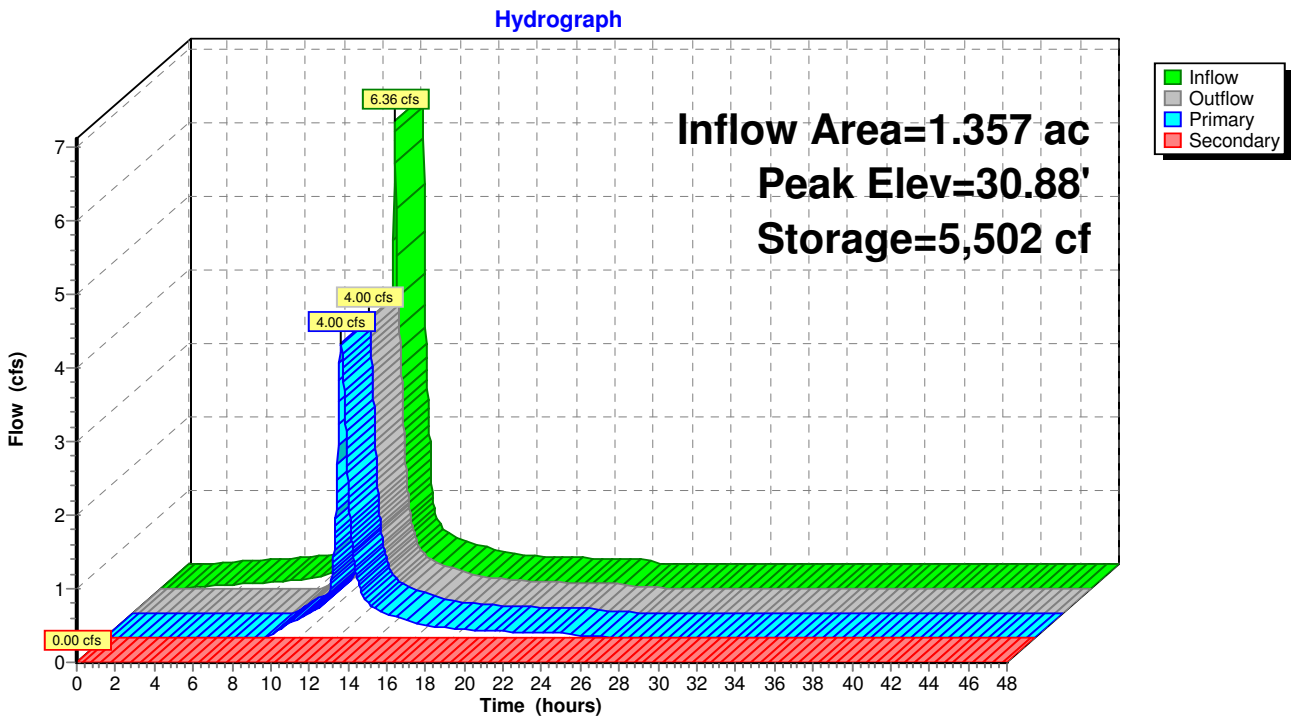
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
29.00	2,210	0	0
30.00	2,860	2,535	2,535
31.00	4,010	3,435	5,970
32.00	4,940	4,475	10,445

Device	Routing	Invert	Outlet Devices
#1	Primary	29.75'	**15.0" Round Culvert** L= 94.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 29.75' / 29.00' S= 0.0080 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Secondary	31.70'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.00 cfs @ 12.18 hrs HW=30.88' (Free Discharge)
└─**1=Culvert** (Barrel Controls 4.00 cfs @ 4.51 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=29.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9Pe: Detention Pond - South of Lot 9 Parking



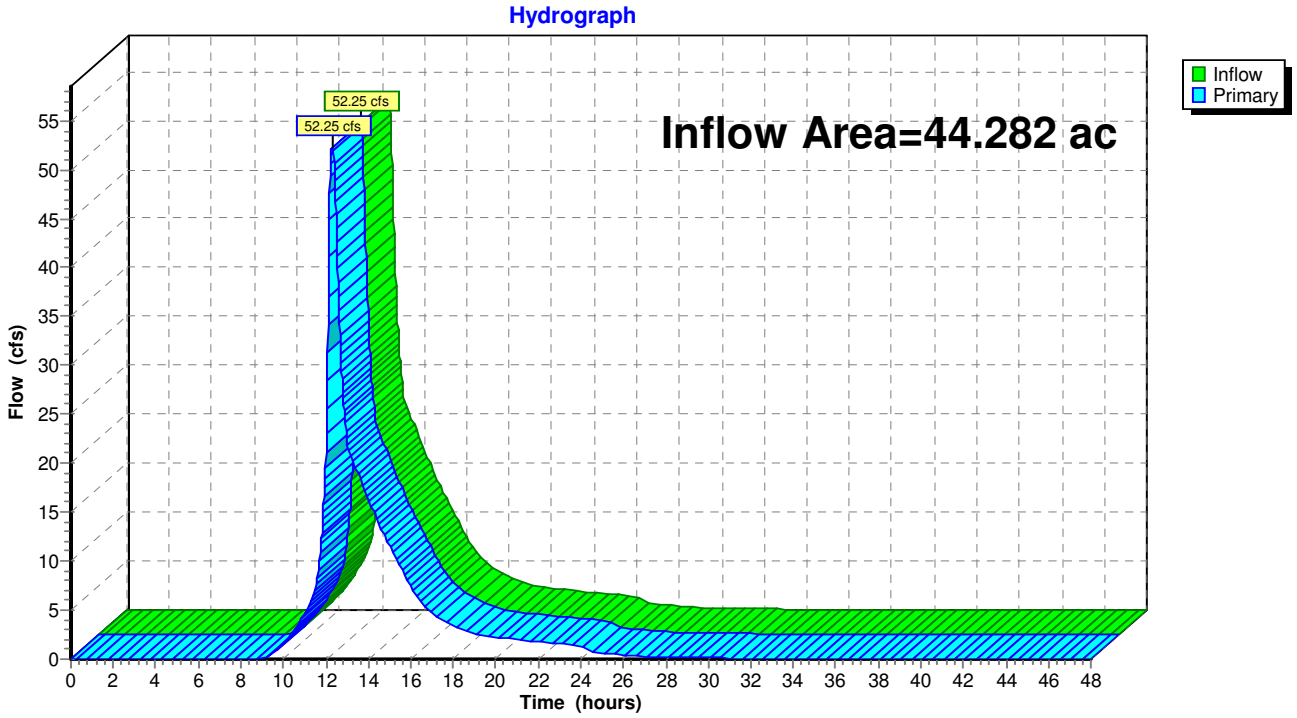
Summary for Pond AP-1: Wetlands South of O'Connell Way

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 44.282 ac, 59.80% Impervious, Inflow Depth > 2.63" for 10 YR event
Inflow = 52.25 cfs @ 12.30 hrs, Volume= 9.700 af
Primary = 52.25 cfs @ 12.30 hrs, Volume= 9.700 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-1: Wetlands South of O'Connell Way



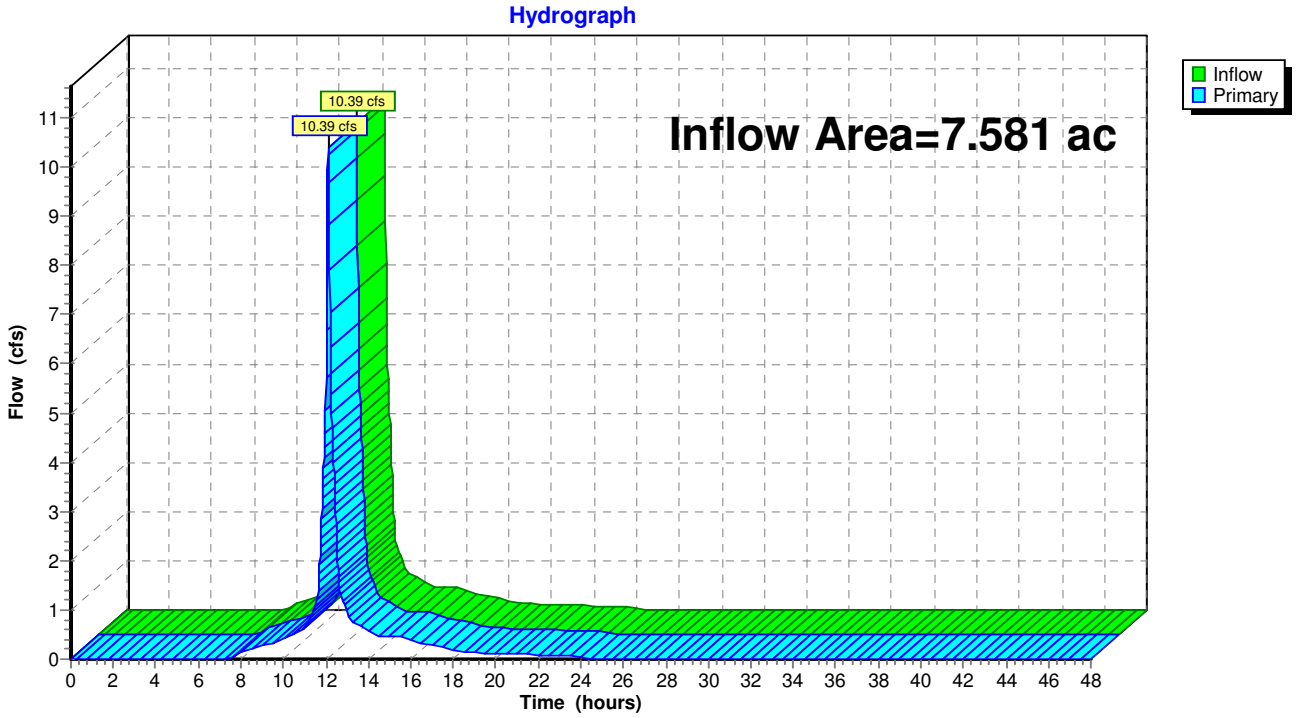
Summary for Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 7.581 ac, 65.23% Impervious, Inflow Depth = 1.22" for 10 YR event
Inflow = 10.39 cfs @ 12.11 hrs, Volume= 0.773 af
Primary = 10.39 cfs @ 12.11 hrs, Volume= 0.773 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11



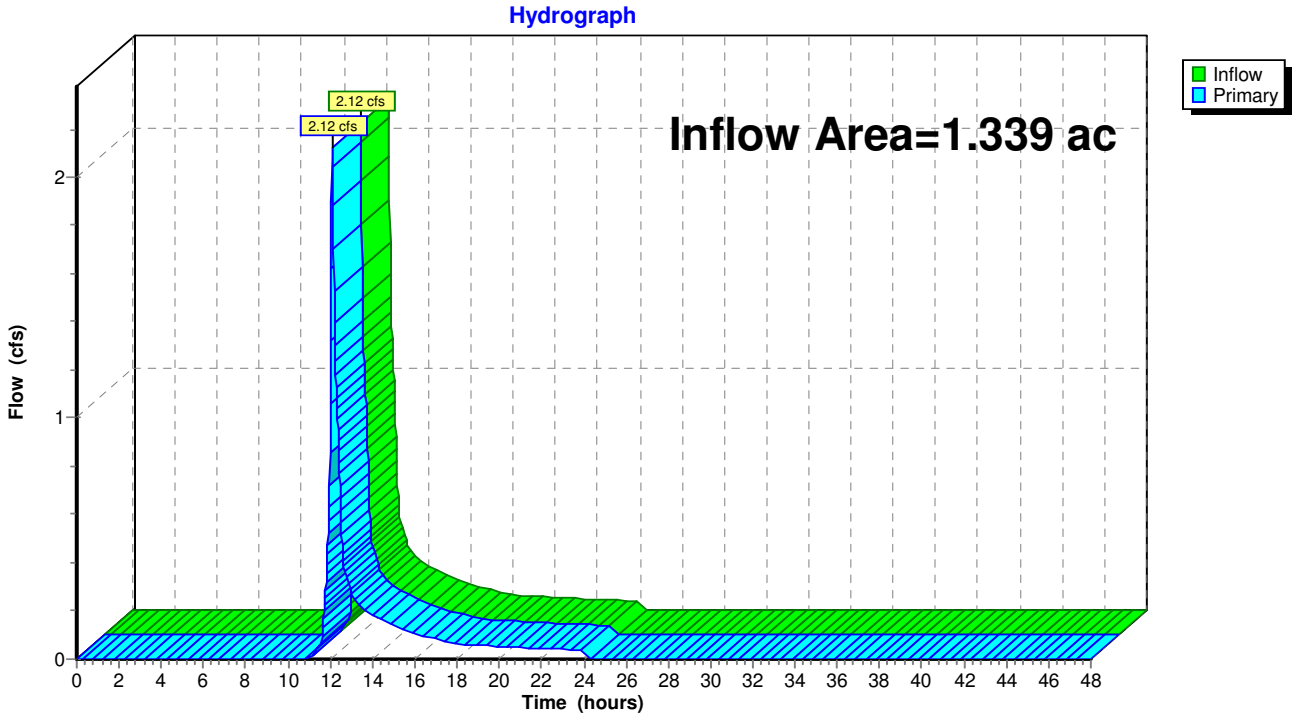
Summary for Pond AP-3: Existing Culvert Crossing at Crossroads

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.339 ac, 0.00% Impervious, Inflow Depth = 1.45" for 10 YR event
Inflow = 2.12 cfs @ 12.10 hrs, Volume= 0.162 af
Primary = 2.12 cfs @ 12.10 hrs, Volume= 0.162 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-3: Existing Culvert Crossing at Crossroads



Summary for Pond POND-1: Maggiore Combined Detention Basin

Inflow Area = 24.144 ac, 82.06% Impervious, Inflow Depth = 3.96" for 10 YR event
Inflow = 100.00 cfs @ 12.09 hrs, Volume= 7.970 af
Outflow = 37.42 cfs @ 12.35 hrs, Volume= 7.419 af, Atten= 63%, Lag= 16.0 min
Primary = 37.42 cfs @ 12.35 hrs, Volume= 7.419 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 33.87' @ 12.35 hrs Surf.Area= 40,976 sf Storage= 137,237 cf

Plug-Flow detention time= 148.0 min calculated for 7.419 af (93% of inflow)
Center-of-Mass det. time= 111.3 min (878.9 - 767.6)

Volume	Invert	Avail.Storage	Storage Description
#1	30.00'	185,603 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

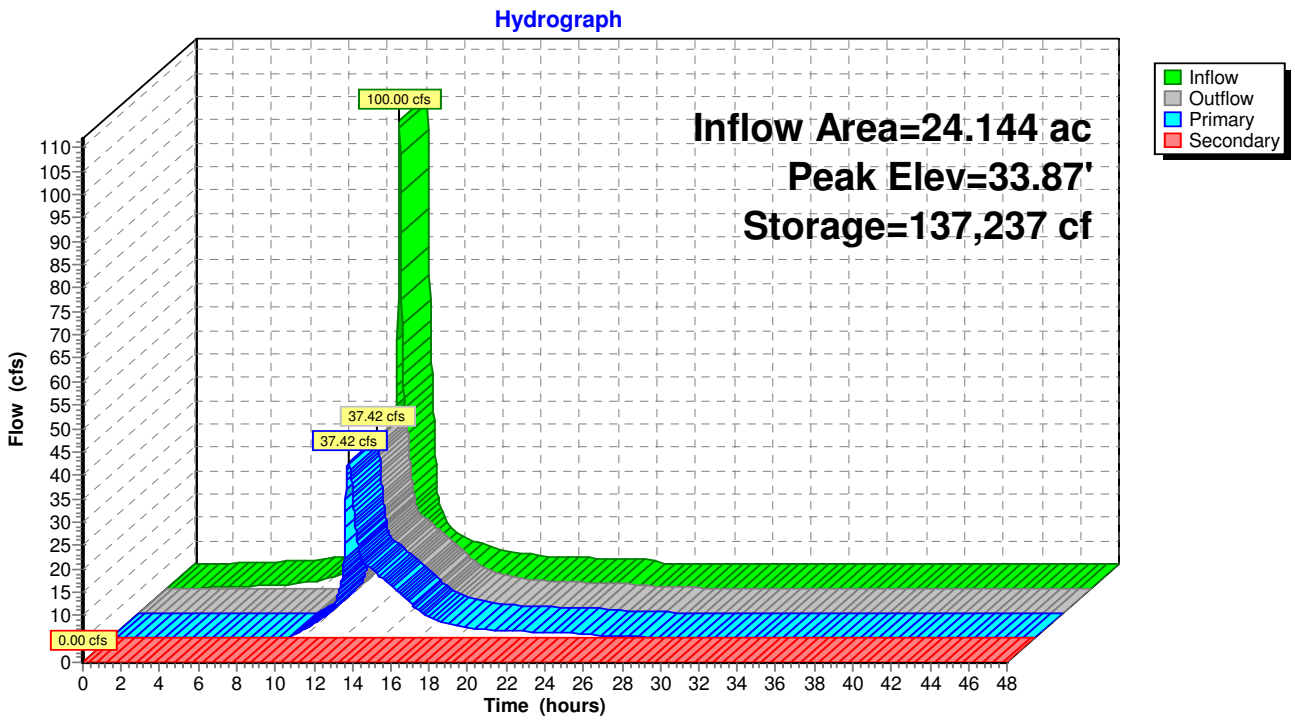
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
30.00	30,160	0	0
31.00	32,879	31,520	31,520
32.00	35,649	34,264	65,784
33.00	38,477	37,063	102,847
34.00	41,364	39,921	142,767
35.00	44,308	42,836	185,603

Device	Routing	Invert	Outlet Devices
#1	Primary	30.00'	**18.0" Round Culvert X 3.00** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 30.00' / 29.25' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	30.75'	**12.0" Vert. Orifice/Grate X 3.00** C= 0.600
#3	Device 1	33.25'	**4.0' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 2.0' Crest Height
#4	Secondary	34.25'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=37.39 cfs @ 12.35 hrs HW=33.87' (Free Discharge)
└─**1=Culvert** (Passes 37.39 cfs of 45.05 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 18.35 cfs @ 7.79 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 19.05 cfs @ 2.66 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=30.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-1: Maggiore Combined Detention Basin



Summary for Pond POND-2: Bioretention Area

Inflow Area =	0.924 ac,	0.00% Impervious,	Inflow Depth =	2.21"	for 10 YR event
Inflow =	2.07 cfs @	12.14 hrs,	Volume=	0.170 af	
Outflow =	0.81 cfs @	12.48 hrs,	Volume=	0.170 af,	Atten= 61%, Lag= 20.2 min
Discarded =	0.13 cfs @	12.48 hrs,	Volume=	0.095 af	
Primary =	0.67 cfs @	12.48 hrs,	Volume=	0.075 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 52.37' @ 12.48 hrs Surf.Area= 5,688 sf Storage= 2,041 cf
Flood Elev= 54.00' Surf.Area= 7,638 sf Storage= 12,871 cf

Plug-Flow detention time= 41.1 min calculated for 0.170 af (100% of inflow)
Center-of-Mass det. time= 41.1 min (884.3 - 843.2)

Volume	Invert	Avail.Storage	Storage Description
#1	52.00'	12,871 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

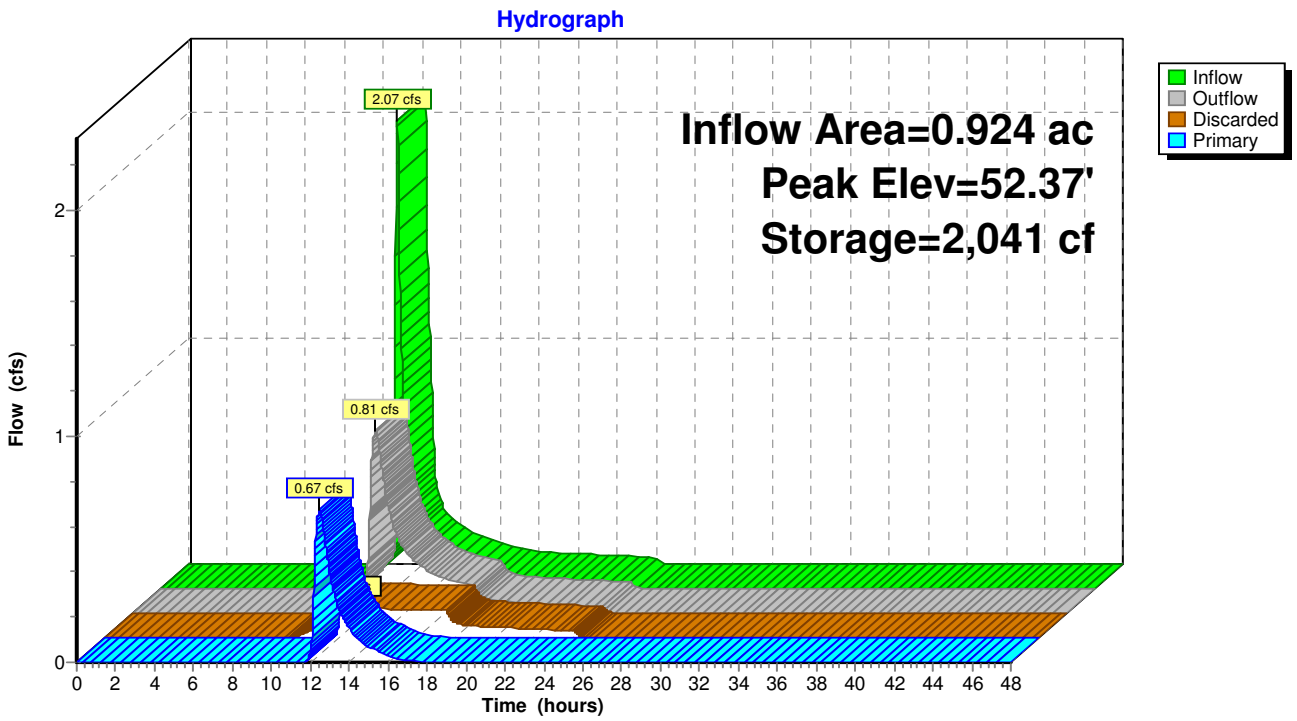
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.00	5,246	0	0
53.00	6,429	5,838	5,838
54.00	7,638	7,034	12,871

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**18.0" Round Headwall** L= 534.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.00' / 49.17' S= 0.0053 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Discarded	52.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.13 cfs @ 12.48 hrs HW=52.37' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.13 cfs)

Primary OutFlow Max=0.67 cfs @ 12.48 hrs HW=52.37' (Free Discharge)
└**1=Headwall** (Barrel Controls 0.67 cfs @ 2.95 fps)

Pond POND-2: Bioretention Area



Summary for Pond POND-3: Bioretention Area

[79] Warning: Submerged Pond POND-2 Primary device # 1 OUTLET by 0.69'

Inflow Area =	4.839 ac,	64.93% Impervious,	Inflow Depth =	3.48"	for 10 YR event
Inflow =	16.97 cfs @	12.08 hrs,	Volume=	1.402 af	
Outflow =	14.17 cfs @	12.14 hrs,	Volume=	1.402 af,	Atten= 17%, Lag= 3.2 min
Discarded =	0.11 cfs @	12.14 hrs,	Volume=	0.189 af	
Primary =	14.07 cfs @	12.14 hrs,	Volume=	1.213 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4
Peak Elev= 49.86' @ 12.14 hrs Surf.Area= 4,525 sf Storage= 5,091 cf
Flood Elev= 51.00' Surf.Area= 5,289 sf Storage= 10,704 cf

Plug-Flow detention time= 39.8 min calculated for 1.402 af (100% of inflow)
Center-of-Mass det. time= 39.7 min (805.2 - 765.5)

Volume	Invert	Avail.Storage	Storage Description
#1	48.50'	10,704 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

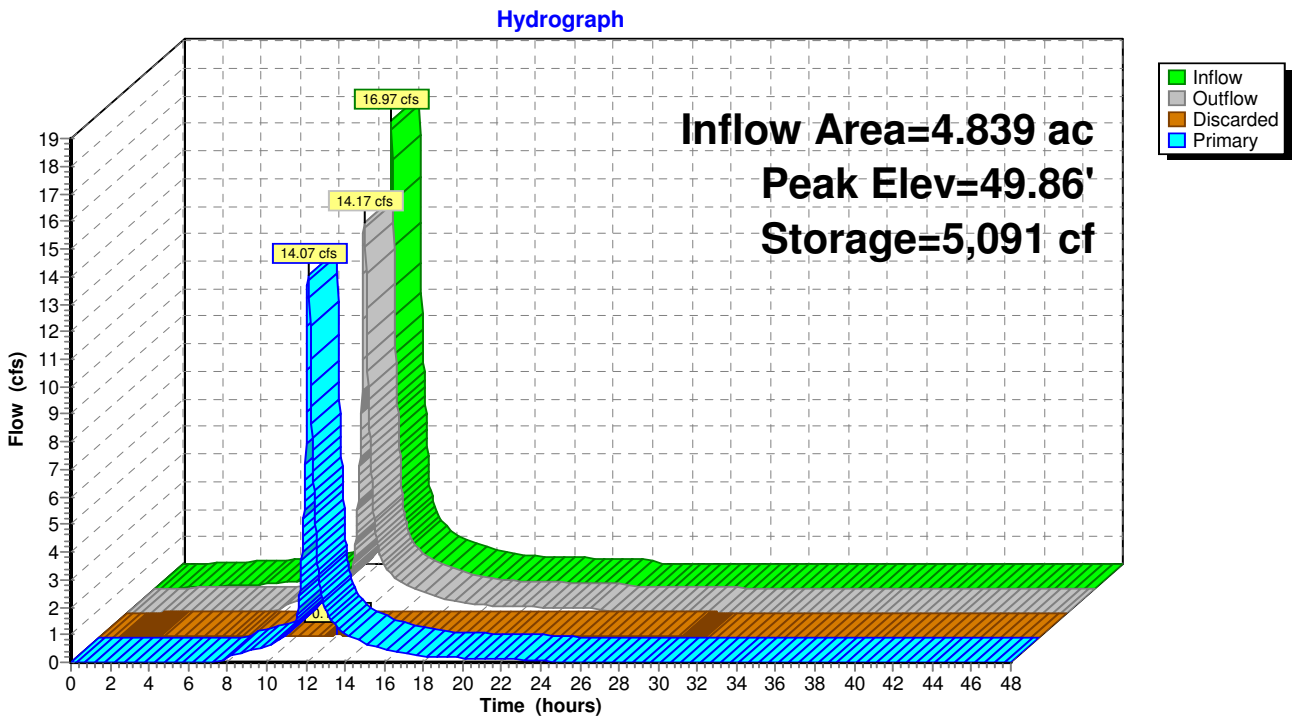
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.50	3,056	0	0
49.00	3,475	1,633	1,633
50.00	4,689	4,082	5,715
51.00	5,289	4,989	10,704

Device	Routing	Invert	Outlet Devices
#1	Primary	45.50'	**18.0" Round Culvert** L= 114.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.50' / 44.36' S= 0.0100 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	49.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	48.50'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.11 cfs @ 12.14 hrs HW=49.86' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=14.06 cfs @ 12.14 hrs HW=49.86' (Free Discharge)
└─**1=Culvert** (Passes 14.06 cfs of 16.17 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 14.06 cfs @ 4.47 fps)

Pond POND-3: Bioretention Area



Summary for Pond POND-4: Bioretention Area

Inflow Area =	4.216 ac, 93.31% Impervious, Inflow Depth = 4.33" for 10 YR event				
Inflow =	19.41 cfs @	12.08 hrs,	Volume=	1.522 af	
Outflow =	18.60 cfs @	12.11 hrs,	Volume=	1.522 af,	Atten= 4%, Lag= 1.5 min
Discarded =	0.10 cfs @	12.11 hrs,	Volume=	0.190 af	
Primary =	9.25 cfs @	12.11 hrs,	Volume=	0.666 af	
Secondary =	9.25 cfs @	12.11 hrs,	Volume=	0.666 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 49.09' @ 12.11 hrs Surf.Area= 4,355 sf Storage= 4,017 cf
Flood Elev= 49.50' Surf.Area= 5,417 sf Storage= 6,033 cf

Plug-Flow detention time= 35.8 min calculated for 1.522 af (100% of inflow)
Center-of-Mass det. time= 35.9 min (799.3 - 763.4)

Volume	Invert	Avail.Storage	Storage Description
#1	48.00'	6,033 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.00	3,163	0	0
49.00	4,130	3,647	3,647
49.50	5,417	2,387	6,033

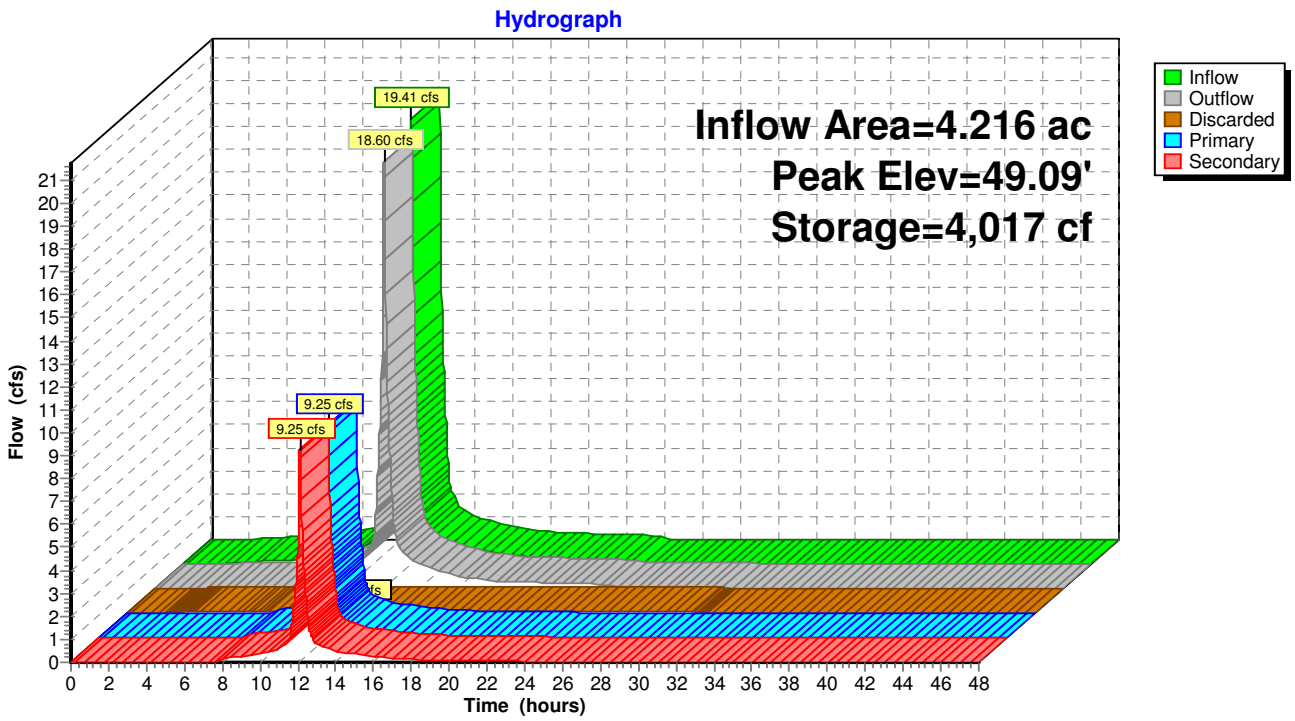
Device	Routing	Invert	Outlet Devices
#1	Primary	45.00'	**18.0" Round Culvert** L= 154.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.00' / 42.96' S= 0.0132 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	45.00'	**18.0" Round Culvert** L= 154.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.00' / 42.96' S= 0.0132 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 1	48.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	48.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	48.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.10 cfs @ 12.11 hrs HW=49.08' (Free Discharge)
└─**5=Exfiltration** (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=9.19 cfs @ 12.11 hrs HW=49.08' (Free Discharge)
└─**1=Culvert** (Passes 9.19 cfs of 15.54 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 9.19 cfs @ 2.50 fps)

Secondary OutFlow Max=9.19 cfs @ 12.11 hrs HW=49.08' (Free Discharge)
└─**2=Culvert** (Passes 9.19 cfs of 15.54 cfs potential flow)
  └─**4=Orifice/Grate** (Weir Controls 9.19 cfs @ 2.50 fps)

Pond POND-4: Bioretention Area



Summary for Pond POND-5: Bioretention Area

Inflow Area = 2.038 ac, 34.67% Impervious, Inflow Depth = 2.90" for 10 YR event
Inflow = 6.91 cfs @ 12.09 hrs, Volume= 0.493 af
Outflow = 0.26 cfs @ 15.67 hrs, Volume= 0.418 af, Atten= 96%, Lag= 215.1 min
Discarded = 0.14 cfs @ 15.67 hrs, Volume= 0.394 af
Primary = 0.12 cfs @ 15.67 hrs, Volume= 0.024 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 43.05' @ 15.67 hrs Surf.Area= 5,959 sf Storage= 14,486 cf

Plug-Flow detention time= 884.2 min calculated for 0.418 af (85% of inflow)
Center-of-Mass det. time= 819.0 min (1,636.9 - 818.0)

Volume	Invert	Avail.Storage	Storage Description
#1	40.00'	27,603 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

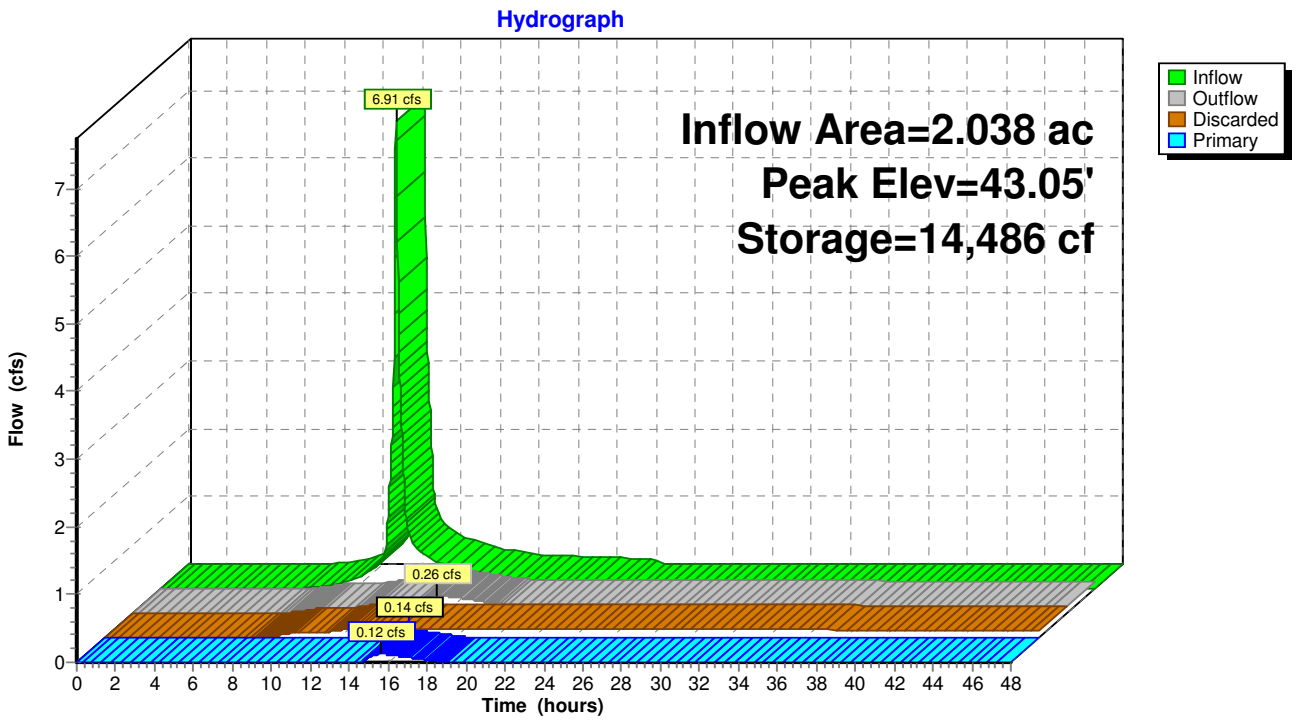
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
40.00	3,535	0	0
45.00	7,506	27,603	27,603

Device	Routing	Invert	Outlet Devices
#1	Device 2	43.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	36.20'	**12.0" Round Culvert** L= 81.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 36.20' / 35.39' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Discarded	40.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.14 cfs @ 15.67 hrs HW=43.05' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.12 cfs @ 15.67 hrs HW=43.05' (Free Discharge)
└─**2=Culvert** (Passes 0.12 cfs of 7.52 cfs potential flow)
└─**1=Orifice/Grate** (Weir Controls 0.12 cfs @ 0.74 fps)

Pond POND-5: Bioretention Area



Summary for Pond POND-6: Bioretention Area

Inflow Area = 0.958 ac, 31.81% Impervious, Inflow Depth = 2.90" for 10 YR event
Inflow = 3.25 cfs @ 12.09 hrs, Volume= 0.231 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= 0.02 hrs
Peak Elev= 40.81' @ 24.36 hrs Surf.Area= 5,049 sf Storage= 10,082 cf

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

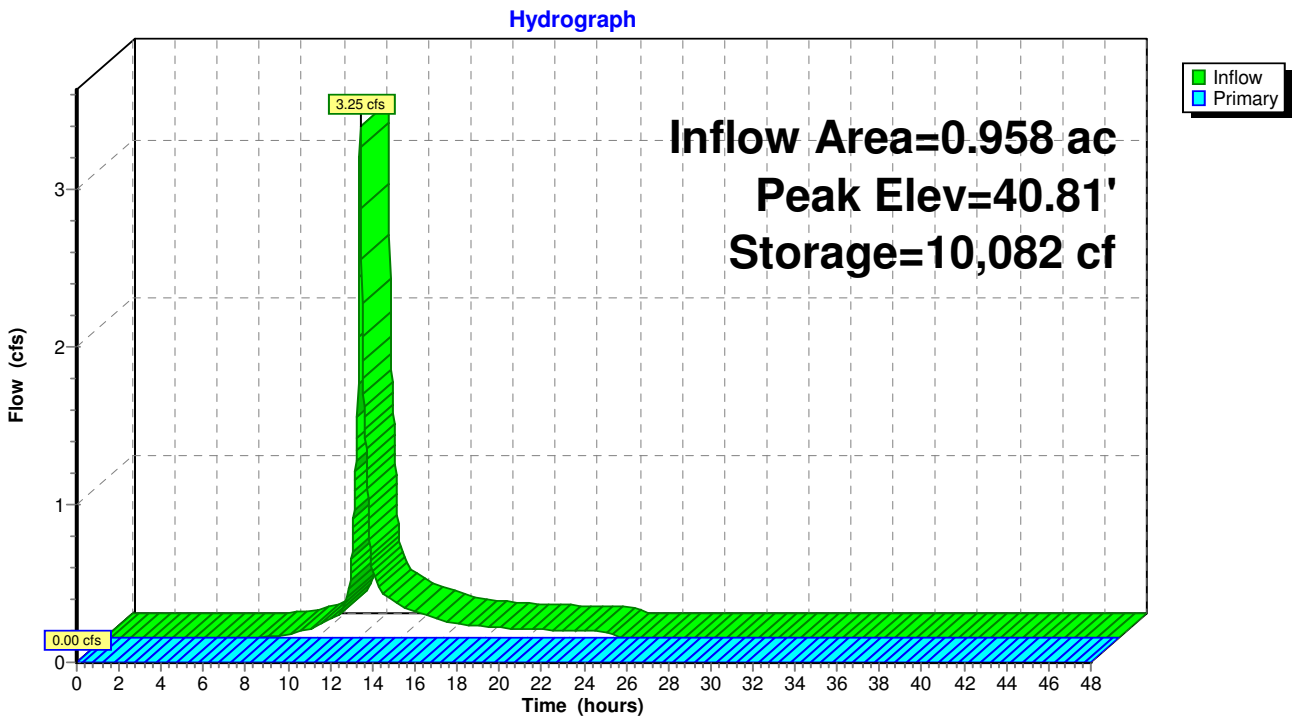
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	41,832 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	2,362	0	0
39.00	3,160	2,761	2,761
40.00	4,061	3,611	6,372
45.00	10,123	35,460	41,832

Device	Routing	Invert	Outlet Devices
#1	Primary	35.20'	**18.0" Round Culvert** L= 78.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 35.20' / 34.42' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Device 1	43.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
└─**1=Culvert** (Passes 0.00 cfs of 9.62 cfs potential flow)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond POND-6: Bioretention Area



Summary for Pond POND-7: O'Connell Way Detention Basin

Inflow Area = 5.536 ac, 69.51% Impervious, Inflow Depth = 4.82" for 10 YR event
Inflow = 25.20 cfs @ 12.15 hrs, Volume= 2.225 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
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 25.19' @ 24.76 hrs Surf.Area= 38,350 sf Storage= 96,917 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	21.50'	173,855 cf	**Custom Stage Data (Prismatic)** Listed below

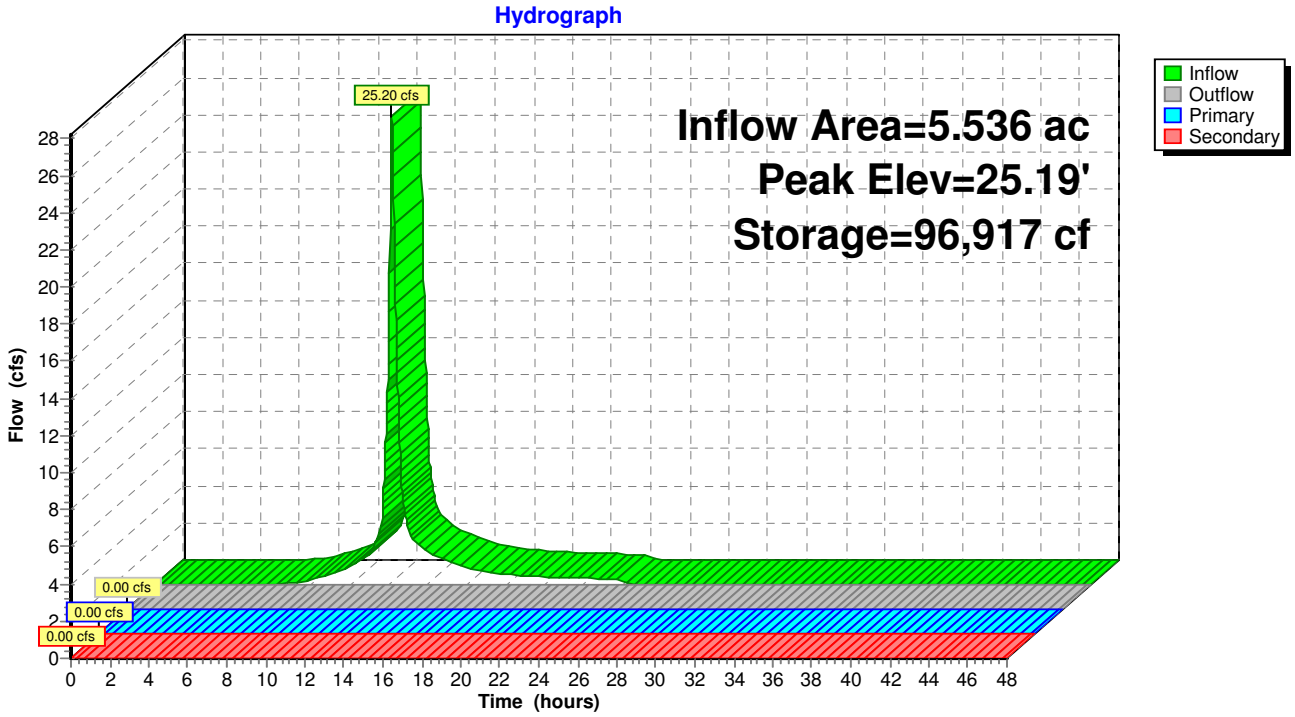
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
21.50	2,384	0	0
22.00	22,143	6,132	6,132
24.00	28,209	50,352	56,484
25.00	37,334	32,772	89,255
26.00	42,638	39,986	129,241
27.00	46,589	44,614	173,855

Device	Routing	Invert	Outlet Devices
#1	Primary	22.15'	**24.0" Round Culvert X 2.00** L= 46.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 22.15' / 22.00' S= 0.0033 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	25.75'	**4.0' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s) 1.0' Crest Height
#3	Secondary	26.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=21.50' (Free Discharge)
└─**1=Culvert** (Controls 0.00 cfs)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=21.50' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-7: O'Connell Way Detention Basin



Summary for Pond POND-9A: Lot 9 Northerly Stormwater Management System

Inflow Area = 1.464 ac,100.00% Impervious, Inflow Depth = 4.56" for 10 YR event
Inflow = 6.86 cfs @ 12.08 hrs, Volume= 0.557 af
Outflow = 2.07 cfs @ 12.39 hrs, Volume= 0.557 af, Atten= 70%, Lag= 18.7 min
Discarded = 0.28 cfs @ 9.52 hrs, Volume= 0.418 af
Primary = 1.80 cfs @ 12.39 hrs, Volume= 0.139 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 1.15' @ 12.39 hrs Surf.Area= 0.270 ac Storage= 0.193 af

Plug-Flow detention time= 141.5 min calculated for 0.557 af (100% of inflow)
Center-of-Mass det. time= 141.5 min (890.2 - 748.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.164 af	**28.33'W x 415.00'L x 2.04'H Field A** 0.551 af Overall - 0.141 af Embedded = 0.410 af x 40.0% Voids
#2A	0.50'	0.141 af	**Cultec C-100** x 440 Inside #1 Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap Row Length Adjustment= +0.50' x 1.86 sf x 8 rows
		0.305 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	0.83'	**6.0" Round Culvert X 7.00** L= 70.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 0.83' / 0.00' S= 0.0119 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.28 cfs @ 9.52 hrs HW=0.02' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=1.80 cfs @ 12.39 hrs HW=1.15' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.80 cfs @ 1.93 fps)

Pond POND-9A: Lot 9 Northerly Stormwater Management System - Chamber Wizard Field A

Chamber Model = Cultec C-100
Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf
Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap
Row Length Adjustment= +0.50' x 1.86 sf x 8 rows

36.0" Wide + 4.0" Spacing = 40.0" C-C Row Spacing

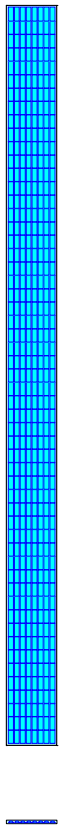
55 Chambers/Row x 7.50' Long +0.50' Row Adjustment = 413.00' Row Length +12.0" End Stone x 2 = 415.00' Base Length
8 Rows x 36.0" Wide + 4.0" Spacing x 7 + 12.0" Side Stone x 2 = 28.33' Base Width
6.0" Base + 12.5" Chamber Height + 6.0" Cover = 2.04' Field Height

440 Chambers x 14.0 cf +0.50' Row Adjustment x 1.86 sf x 8 Rows = 6,150.4 cf Chamber Storage

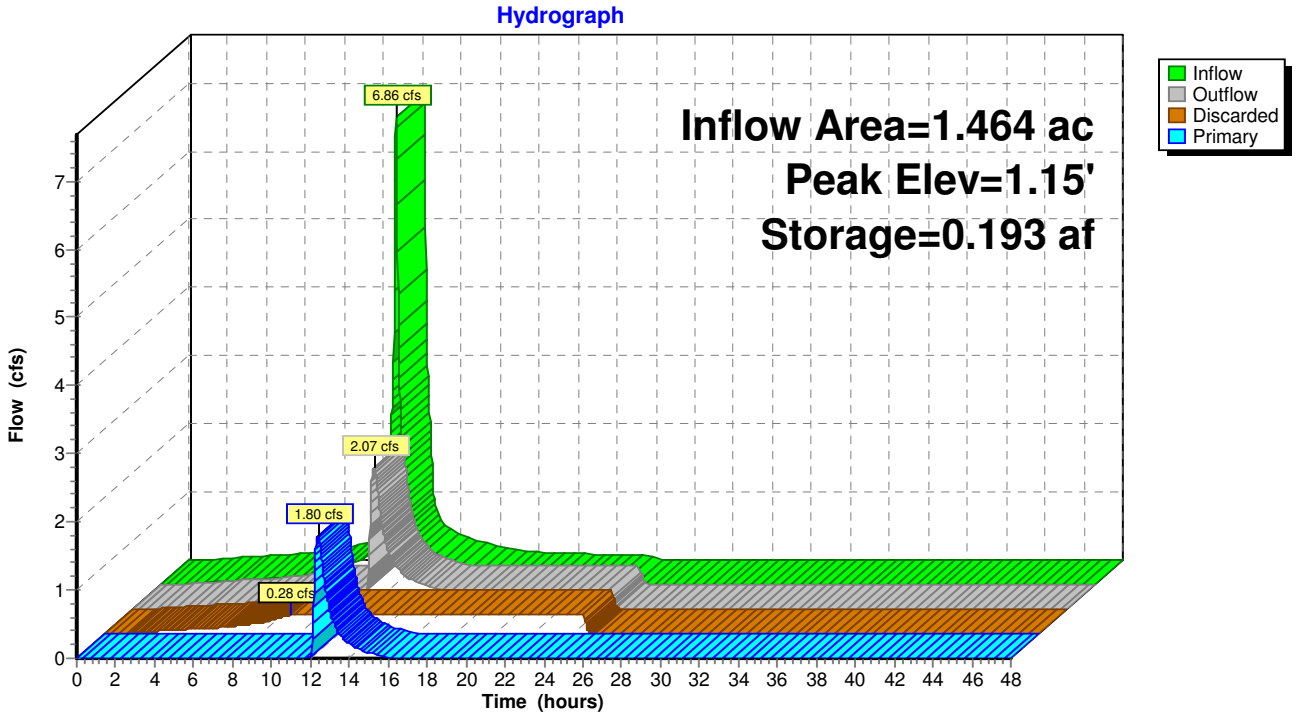
24,006.6 cf Field - 6,150.4 cf Chambers = 17,856.2 cf Stone x 40.0% Voids = 7,142.5 cf Stone Storage

Chamber Storage + Stone Storage = 13,292.9 cf = 0.305 af
Overall Storage Efficiency = 55.4%

440 Chambers
889.1 cy Field
661.3 cy Stone



Pond POND-9A: Lot 9 Northerly Stormwater Management System



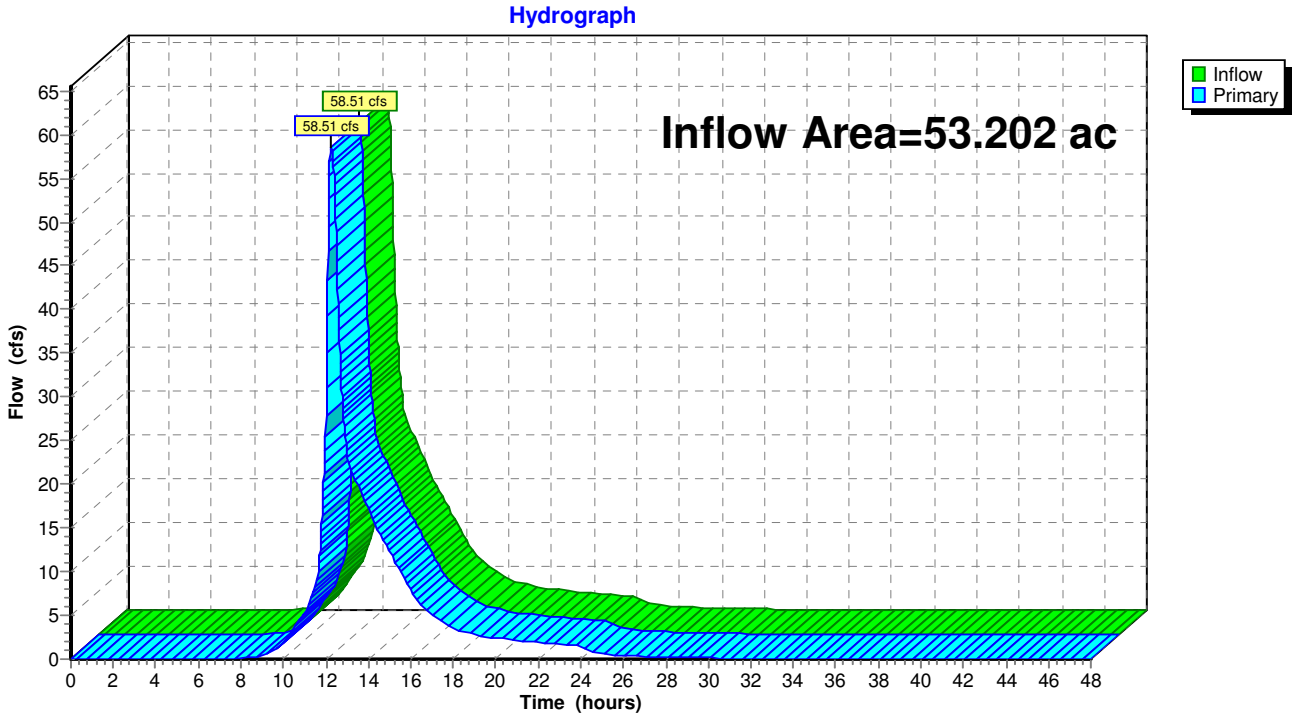
ary for Pond SUM: Summation of Analysis Points to Cotley River Wetlands from Southern portion of develo

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 53.202 ac, 59.07% Impervious, Inflow Depth > 2.40" for 10 YR event
Inflow = 58.51 cfs @ 12.25 hrs, Volume= 10.635 af
Primary = 58.51 cfs @ 12.25 hrs, Volume= 10.635 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond SUM: Summation of Analysis Points to Cotley River Wetlands from Southern portion of development



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment POST 2: Casino and Runoff Area=446,687 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=70.32 cfs 5.777 af

Subcatchment POST 3: Paved Surfaces Runoff Area=394,235 sf 70.88% Impervious Runoff Depth=5.94"
Tc=6.0 min CN=91 Runoff=58.89 cfs 4.479 af

Subcatchment POST-1: Unattenuated Runoff Area=371,335 sf 0.00% Impervious Runoff Depth=3.62"
Tc=10.0 min CN=70 Runoff=31.52 cfs 2.570 af

Subcatchment POST-10: Lot 11 Runoff Area=58,321 sf 0.00% Impervious Runoff Depth=3.00"
Tc=6.0 min CN=64 Runoff=4.64 cfs 0.335 af

Subcatchment POST-11: Portion of Existing Runoff Area=16,084 sf 0.00% Impervious Runoff Depth=4.69"
Tc=6.0 min CN=80 Runoff=2.01 cfs 0.144 af

Subcatchment POST-12: O'Connell Way Runoff Area=241,140 sf 69.51% Impervious Runoff Depth=5.48"
Flow Length=2,195' Tc=13.1 min CN=87 Runoff=27.37 cfs 2.528 af

Subcatchment POST-13: Unattenuated Runoff Area=49,358 sf 0.00% Impervious Runoff Depth=2.12"
Tc=10.0 min CN=55 Runoff=2.28 cfs 0.201 af

Subcatchment POST-4: Grassed Areas Runoff Area=40,262 sf 0.00% Impervious Runoff Depth=4.04"
Tc=10.0 min CN=74 Runoff=3.82 cfs 0.311 af

Subcatchment POST-4A: Grassed Areas Runoff Area=22,803 sf 6.22% Impervious Runoff Depth=4.15"
Tc=6.0 min CN=75 Runoff=2.54 cfs 0.181 af

Subcatchment POST-5: Portion of Runoff Area=110,956 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=17.47 cfs 1.435 af

Subcatchment POST-5A: Portion of Runoff Area=36,782 sf 66.62% Impervious Runoff Depth=5.82"
Tc=6.0 min CN=90 Runoff=5.43 cfs 0.410 af

Subcatchment POST-6: Portion of Runoff Area=183,629 sf 93.31% Impervious Runoff Depth=6.52"
Tc=6.0 min CN=96 Runoff=28.65 cfs 2.292 af

Subcatchment POST-7: Portion of Service Runoff Area=88,786 sf 34.67% Impervious Runoff Depth=4.92"
Tc=6.0 min CN=82 Runoff=11.55 cfs 0.835 af

Subcatchment POST-8: Portion of Service Runoff Area=41,710 sf 31.81% Impervious Runoff Depth=4.92"
Tc=6.0 min CN=82 Runoff=5.42 cfs 0.392 af

Subcatchment POST-9A: Northerly Runoff Area=63,780 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=10.04 cfs 0.825 af

Subcatchment POST-9B: Southerly Runoff Area=59,094 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=9.30 cfs 0.764 af

Subcatchment POST-9C: Unattenuated Runoff Area=92,500 sf 0.00% Impervious Runoff Depth=3.31"
Tc=10.0 min CN=67 Runoff=7.14 cfs 0.585 af

Pond 9Pa: Detention Pond - Southwest of Lot Peak Elev=28.10' Storage=8,160 cf Inflow=5.50 cfs 0.722 af
Primary=2.53 cfs 0.703 af Secondary=0.00 cfs 0.000 af Outflow=2.53 cfs 0.703 af

Pond 9Pb: Detention Pond - Southwest of Lot Peak Elev=26.44' Storage=4,162 cf Inflow=2.53 cfs 0.703 af
Primary=2.13 cfs 0.688 af Secondary=0.00 cfs 0.000 af Outflow=2.13 cfs 0.688 af

Pond 9Pc: Detention Pond - Southwest of Lot Peak Elev=24.85' Storage=2,688 cf Inflow=2.13 cfs 0.688 af
Primary=0.73 cfs 0.428 af Secondary=1.40 cfs 0.243 af Outflow=2.13 cfs 0.670 af

Pond 9Pe: Detention Pond - South of Lot 9 Peak Elev=31.25' Storage=6,995 cf Inflow=9.30 cfs 0.764 af
Primary=5.50 cfs 0.722 af Secondary=0.00 cfs 0.000 af Outflow=5.50 cfs 0.722 af

Pond AP-1: Wetlands South of O'Connell Way Inflow=112.47 cfs 16.916 af
Primary=112.47 cfs 16.916 af

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11 Inflow=15.27 cfs 1.526 af
Primary=15.27 cfs 1.526 af

Pond AP-3: Existing Culvert Crossing at Crossroads Inflow=4.64 cfs 0.335 af
Primary=4.64 cfs 0.335 af

Pond POND-1: Maggiore Combined Peak Elev=34.70' Storage=172,577 cf Inflow=145.83 cfs 12.267 af
Primary=50.75 cfs 11.151 af Secondary=23.77 cfs 0.565 af Outflow=74.52 cfs 11.715 af

Pond POND-2: Bioretention Area Peak Elev=52.61' Storage=3,430 cf Inflow=3.82 cfs 0.311 af
Discarded=0.14 cfs 0.130 af Primary=1.77 cfs 0.182 af Outflow=1.91 cfs 0.311 af

Pond POND-3: Bioretention Area Peak Elev=50.54' Storage=8,359 cf Inflow=26.06 cfs 2.207 af
Discarded=0.12 cfs 0.197 af Primary=17.63 cfs 2.010 af Outflow=17.75 cfs 2.207 af

Pond POND-4: Bioretention Area Peak Elev=49.28' Storage=4,889 cf Inflow=28.65 cfs 2.292 af
Discarded=0.11 cfs 0.199 af Primary=13.33 cfs 1.046 af Secondary=13.33 cfs 1.046 af Outflow=26.78 cfs 2.292 af

Pond POND-5: Bioretention Area Peak Elev=43.50' Storage=17,232 cf Inflow=11.55 cfs 0.835 af
Discarded=0.15 cfs 0.414 af Primary=2.67 cfs 0.335 af Outflow=2.82 cfs 0.749 af

Pond POND-6: Bioretention Area Peak Elev=42.03' Storage=17,087 cf Inflow=5.42 cfs 0.392 af
Outflow=0.00 cfs 0.000 af

Pond POND-7: O'Connell Way Detention Peak Elev=25.91' Storage=125,594 cf Inflow=39.47 cfs 3.574 af
Primary=1.68 cfs 0.836 af Secondary=0.00 cfs 0.000 af Outflow=1.68 cfs 0.836 af

Pond POND-9A: Lot 9 Northerly Stormwater Peak Elev=1.57' Storage=0.254 af Inflow=10.04 cfs 0.825 af
Discarded=0.28 cfs 0.488 af Primary=4.30 cfs 0.337 af Outflow=4.58 cfs 0.825 af

Pond SUM: Summation of Analysis Points to Cotley River Wetlands from Inflow=126.80 cfs 18.776 af
Primary=126.80 cfs 18.776 af

Total Runoff Area = 53.202 ac Runoff Volume = 24.065 af Average Runoff Depth = 5.43"
40.93% Pervious = 21.776 ac 59.07% Impervious = 31.426 ac

Summary for Subcatchment POST 2: Casino and Hotel Roofs

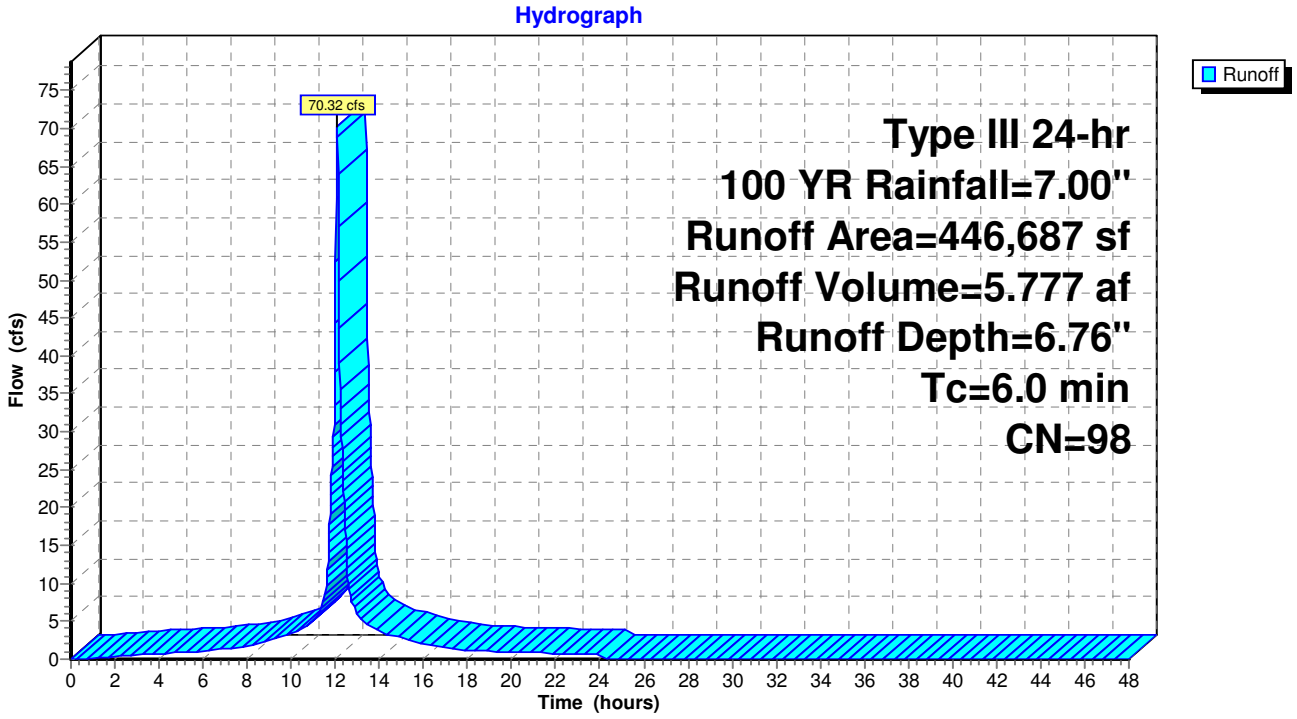
Runoff = 70.32 cfs @ 12.08 hrs, Volume= 5.777 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
446,687	98	Paved parking & roofs
446,687		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST 2: Casino and Hotel Roofs



Summary for Subcatchment POST 3: Paved Surfaces and Associated Landscaped Areas Around Casino

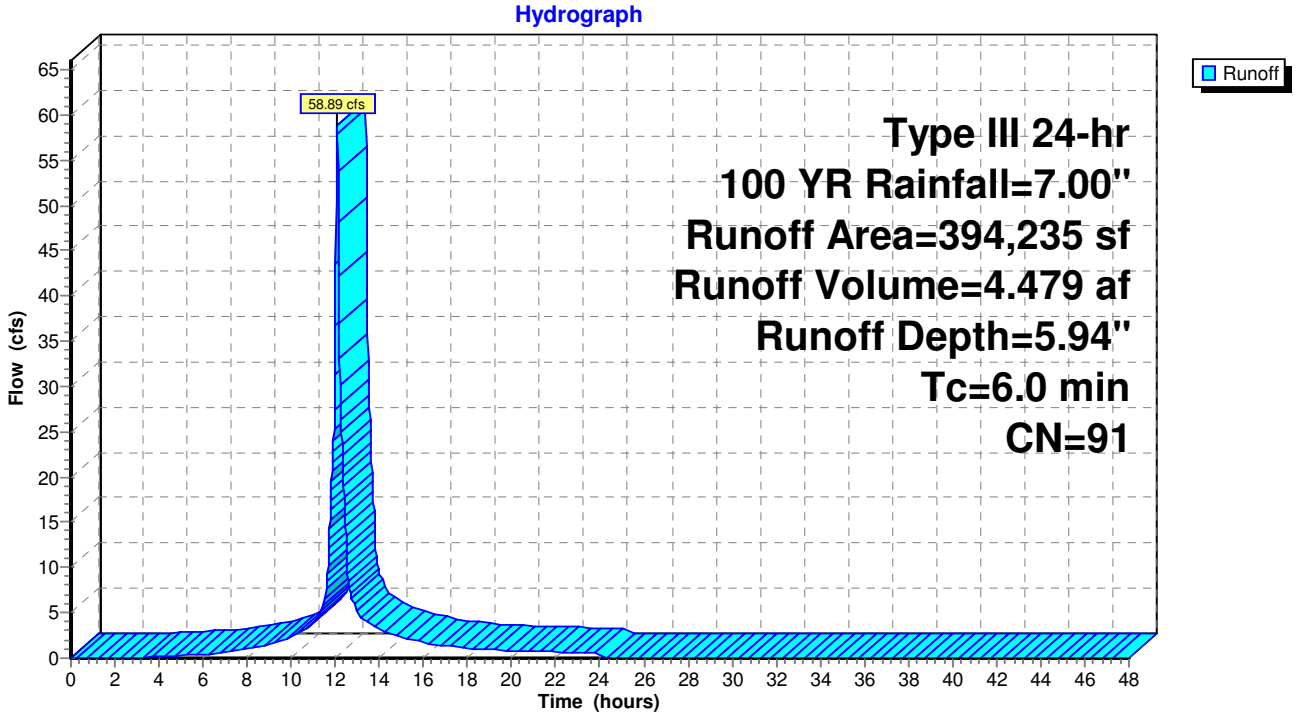
Runoff = 58.89 cfs @ 12.08 hrs, Volume= 4.479 af, Depth= 5.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
249,275	98	Paved parking & roofs
114,800	74	>75% Grass cover, Good, HSG C
30,160	98	Water Surface, HSG C
394,235	91	Weighted Average
114,800		29.12% Pervious Area
279,435		70.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST 3: Paved Surfaces and Associated Landscaped Areas Around Casino



Summary for Subcatchment POST-1: Unattenuated Areas to Wetlands Associated with Cotley River

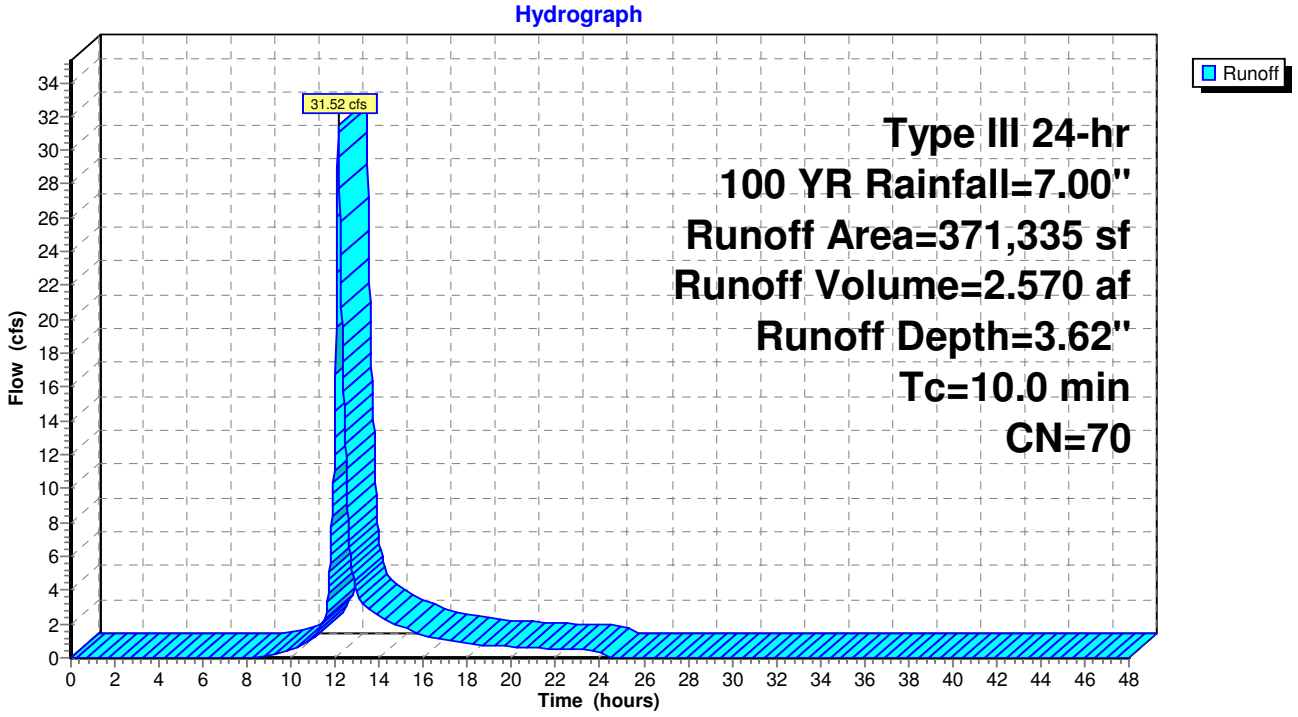
Runoff = 31.52 cfs @ 12.14 hrs, Volume= 2.570 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
11,864	61	>75% Grass cover, Good, HSG B
132,465	74	>75% Grass cover, Good, HSG C
456	80	>75% Grass cover, Good, HSG D
45,589	55	Woods, Good, HSG B
158,052	70	Woods, Good, HSG C
22,909	77	Woods, Good, HSG D
371,335	70	Weighted Average
371,335		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-1: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment POST-10: Lot 11 Unattenuated to Wetland System Through Stream

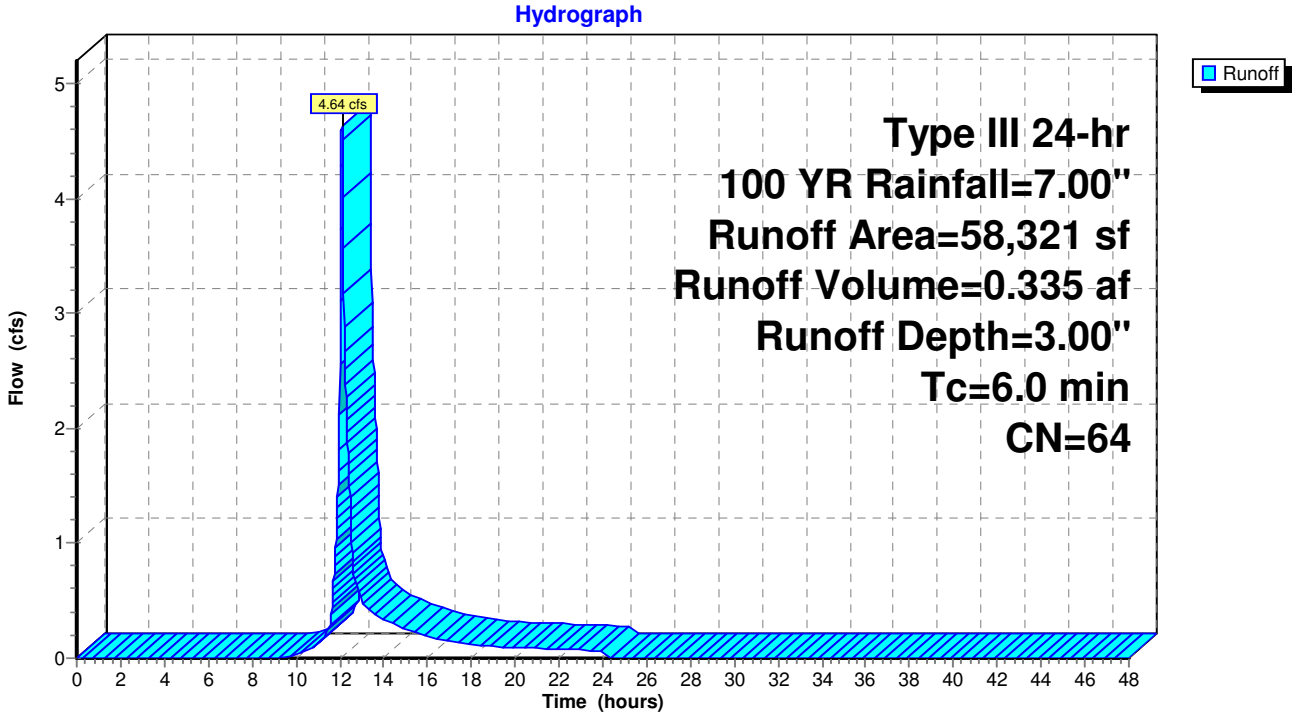
Runoff = 4.64 cfs @ 12.09 hrs, Volume= 0.335 af, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
48,048	61	>75% Grass cover, Good, HSG B
6,493	80	>75% Grass cover, Good, HSG D
1,821	70	Woods, Good, HSG C
1,959	77	Woods, Good, HSG D
58,321	64	Weighted Average
58,321		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-10: Lot 11 Unattenuated to Wetland System Through Stream



Summary for Subcatchment POST-11: Portion of Existing Lot 11 to Existing Stream

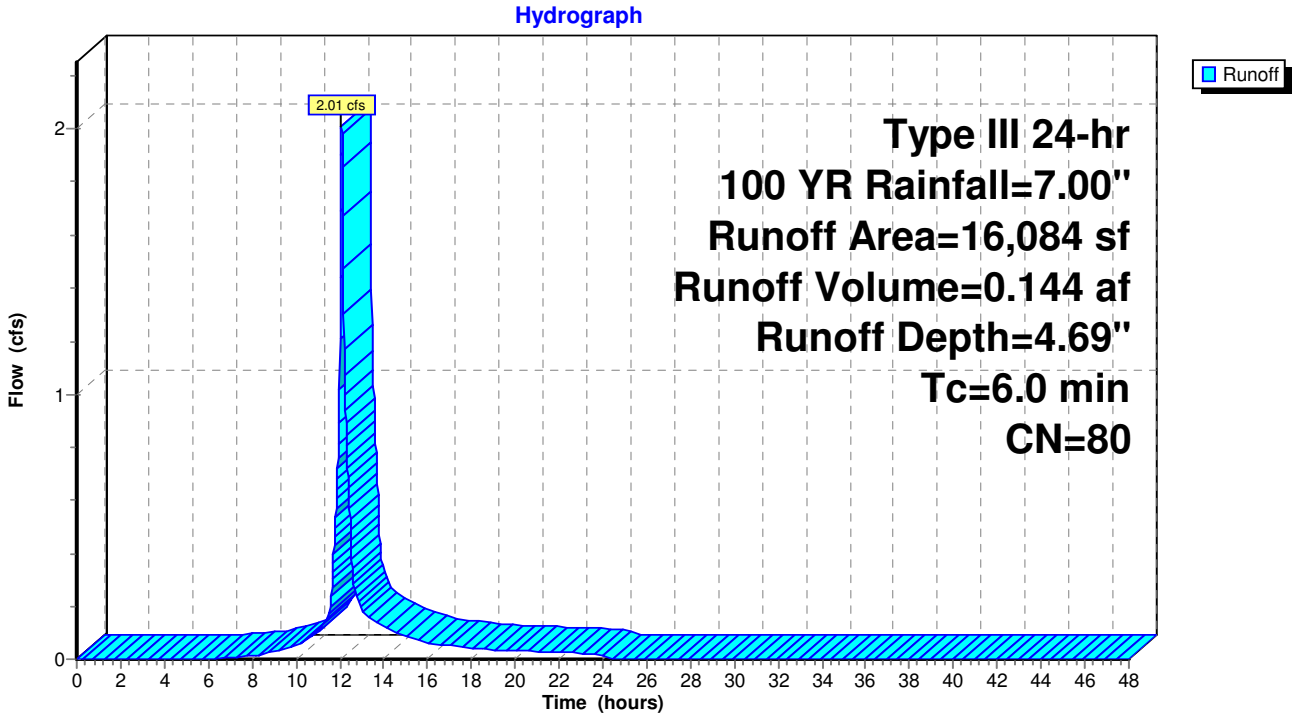
Runoff = 2.01 cfs @ 12.09 hrs, Volume= 0.144 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
16,084	80	>75% Grass cover, Good, HSG D
16,084		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-11: Portion of Existing Lot 11 to Existing Stream



Summary for Subcatchment POST-12: O'Connell Way

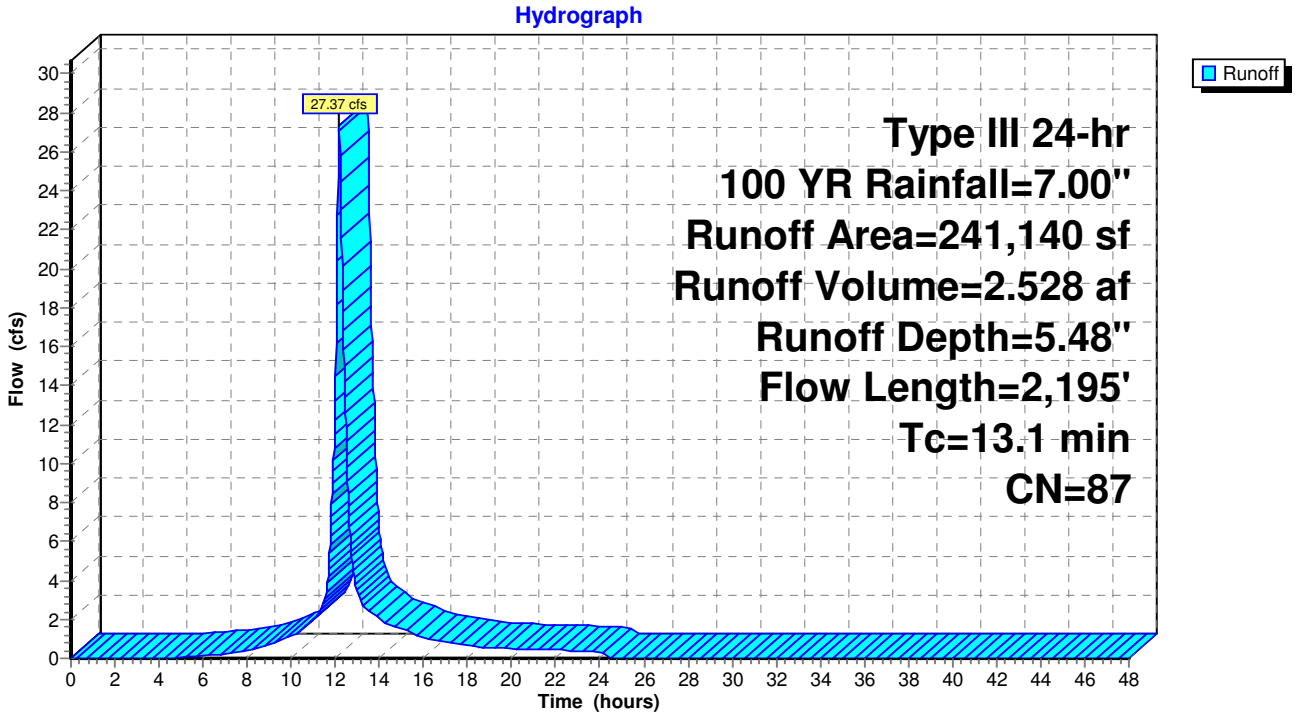
Runoff = 27.37 cfs @ 12.17 hrs, Volume= 2.528 af, Depth= 5.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
145,476	98	Paved parking & roofs
22,143	98	Water Surface
9,233	39	>75% Grass cover, Good, HSG A
43,746	61	>75% Grass cover, Good, HSG B
14,196	74	>75% Grass cover, Good, HSG C
6,346	80	>75% Grass cover, Good, HSG D
241,140	87	Weighted Average
73,521		30.49% Pervious Area
167,619		69.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	65	0.0460	0.16		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.50"
1.3	230	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
4.9	1,900	0.0080	6.44	20.23	**Pipe Channel, C-D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
13.1	2,195	Total			

Subcatchment POST-12: O'Connell Way



Summary for Subcatchment POST-13: Unattenuated Areas to Wetlands Associated with Cotley River

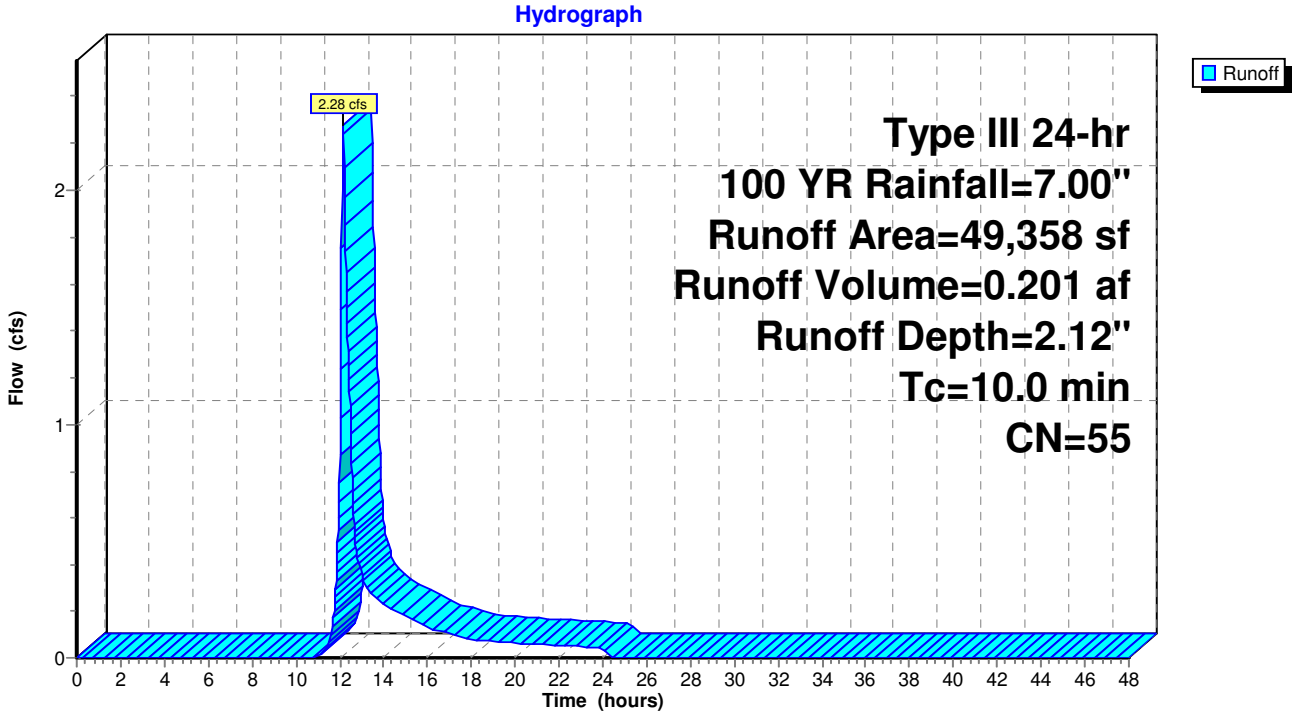
Runoff = 2.28 cfs @ 12.15 hrs, Volume= 0.201 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
15,709	39	>75% Grass cover, Good, HSG A
11,926	61	>75% Grass cover, Good, HSG B
7,879	80	>75% Grass cover, Good, HSG D
6,196	30	Woods, Good, HSG A
432	55	Woods, Good, HSG B
7,216	77	Woods, Good, HSG D
49,358	55	Weighted Average
49,358		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-13: Unattenuated Areas to Wetlands Associated with Cotley River



Summary for Subcatchment POST-4: Grassed Areas Around Parking Garage

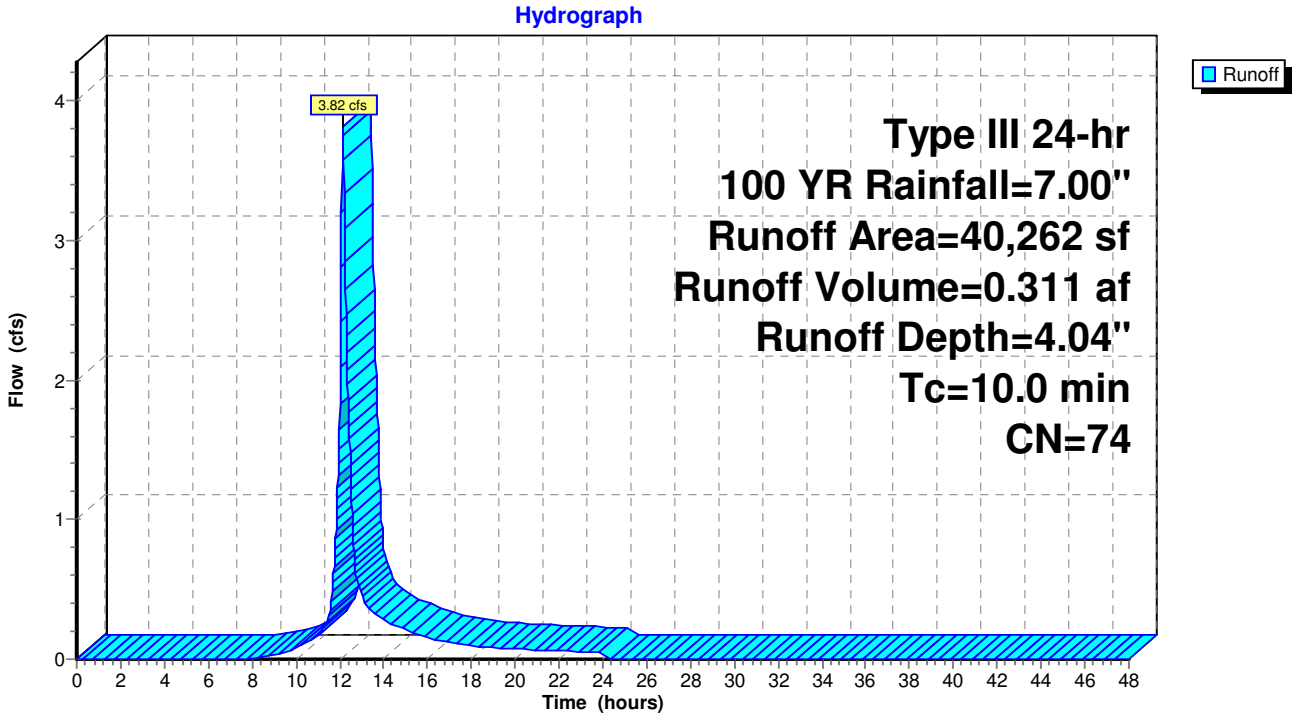
Runoff = 3.82 cfs @ 12.14 hrs, Volume= 0.311 af, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
40,262	74	>75% Grass cover, Good, HSG C
40,262		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-4: Grassed Areas Around Parking Garage



Summary for Subcatchment POST-4A: Grassed Areas Around Garage

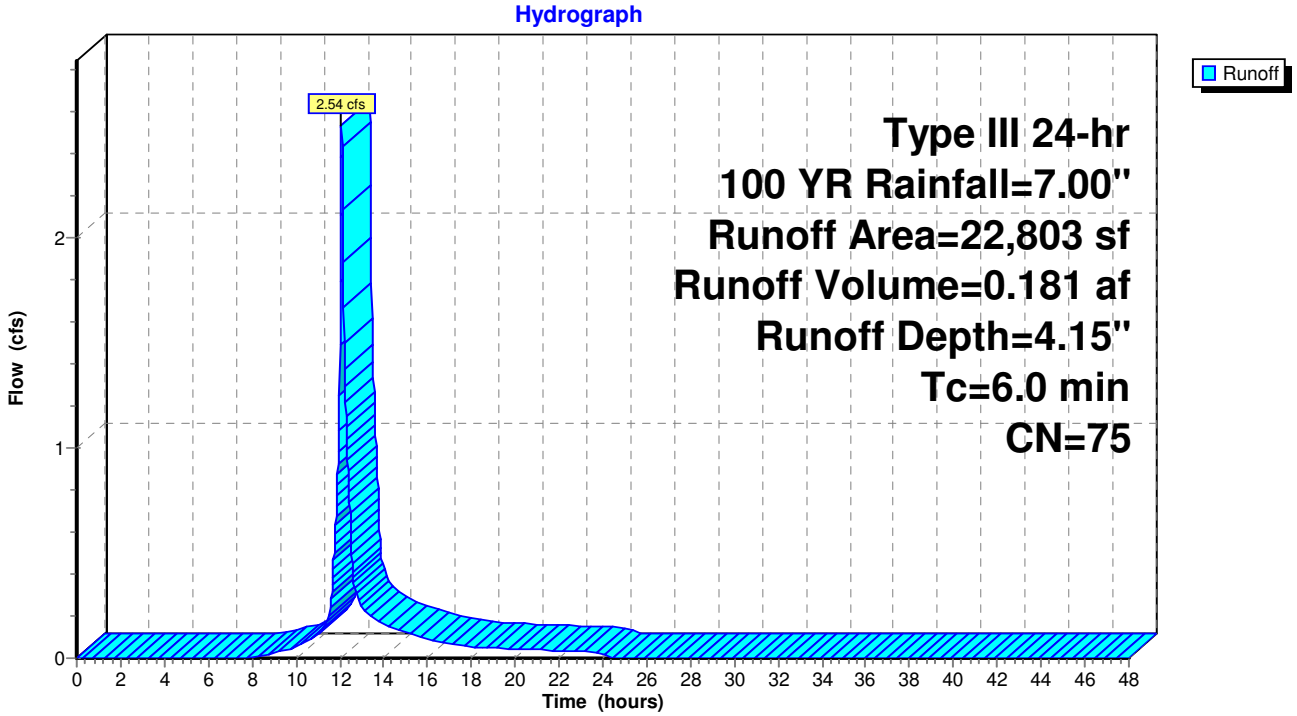
Runoff = 2.54 cfs @ 12.09 hrs, Volume= 0.181 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
21,385	74	>75% Grass cover, Good, HSG C
1,418	98	Unconnected pavement, HSG C
22,803	75	Weighted Average
21,385		93.78% Pervious Area
1,418		6.22% Impervious Area
1,418		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-4A: Grassed Areas Around Garage



Summary for Subcatchment POST-5: Portion of Parking Garage

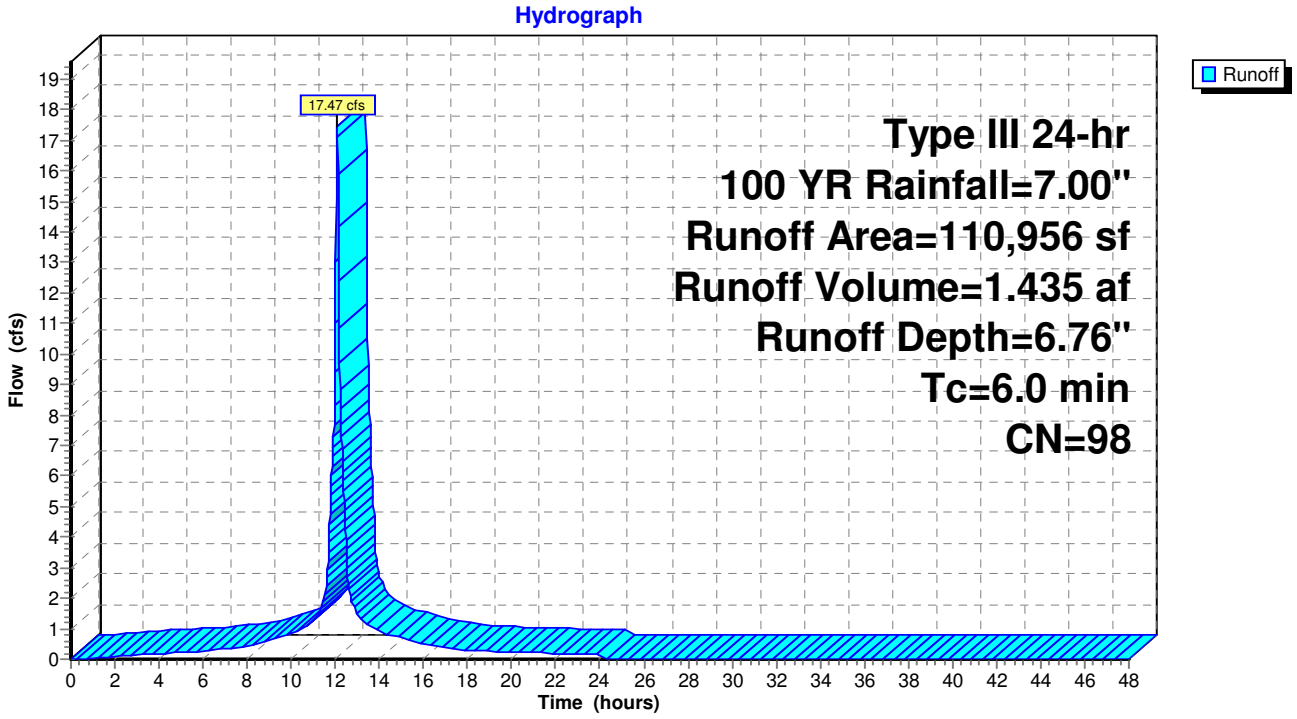
Runoff = 17.47 cfs @ 12.08 hrs, Volume= 1.435 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
110,956	98	Paved parking, HSG C
110,956		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-5: Portion of Parking Garage



Summary for Subcatchment POST-5A: Portion of Grassed Area and Access Drive Adjacent to Garage

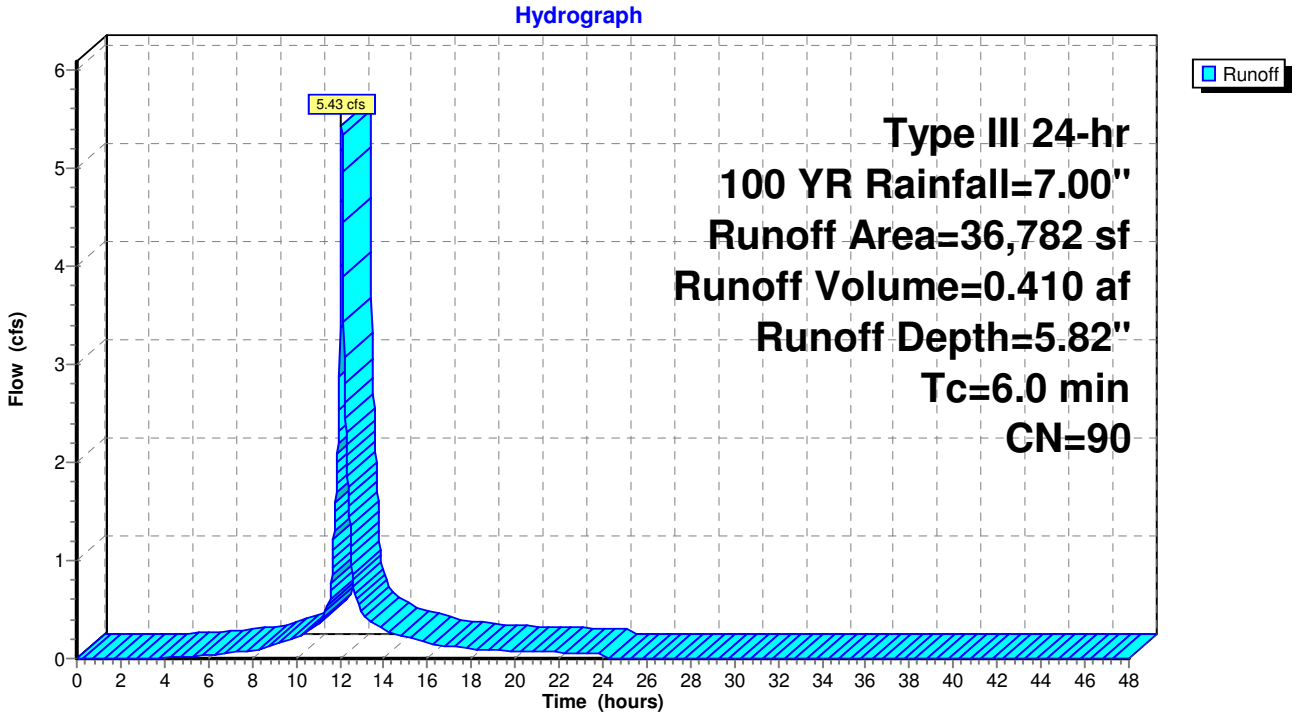
Runoff = 5.43 cfs @ 12.08 hrs, Volume= 0.410 af, Depth= 5.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
24,506	98	Paved parking, HSG C
12,276	74	>75% Grass cover, Good, HSG C
36,782	90	Weighted Average
12,276		33.38% Pervious Area
24,506		66.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-5A: Portion of Grassed Area and Access Drive Adjacent to Garage



Summary for Subcatchment POST-6: Portion of Parking Garage

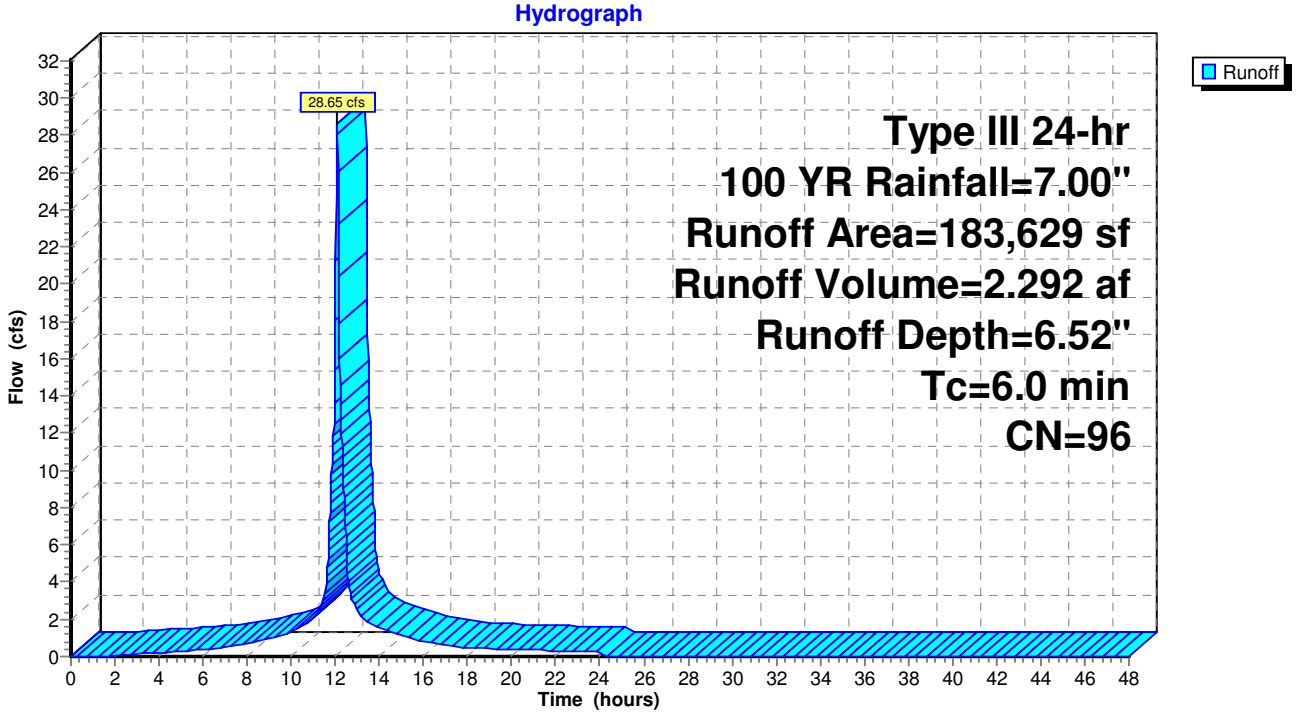
Runoff = 28.65 cfs @ 12.08 hrs, Volume= 2.292 af, Depth= 6.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
171,350	98	Paved parking, HSG C
12,279	74	>75% Grass cover, Good, HSG C
183,629	96	Weighted Average
12,279		6.69% Pervious Area
171,350		93.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-6: Portion of Parking Garage



Summary for Subcatchment POST-7: Portion of Service Road and Central Plant Area

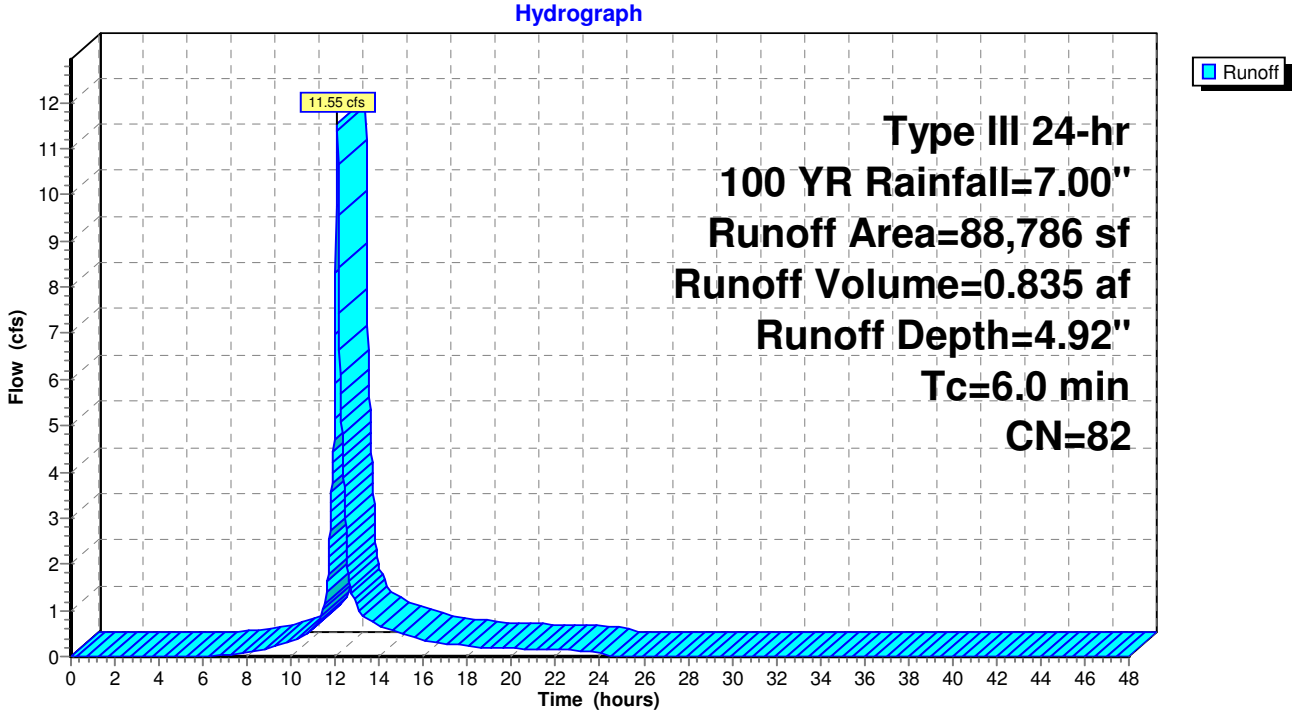
Runoff = 11.55 cfs @ 12.09 hrs, Volume= 0.835 af, Depth= 4.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
58,002	74	>75% Grass cover, Good, HSG C
30,784	98	Paved parking, HSG C
88,786	82	Weighted Average
58,002		65.33% Pervious Area
30,784		34.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-7: Portion of Service Road and Central Plant Area



Summary for Subcatchment POST-8: Portion of Service Road and Basin Area

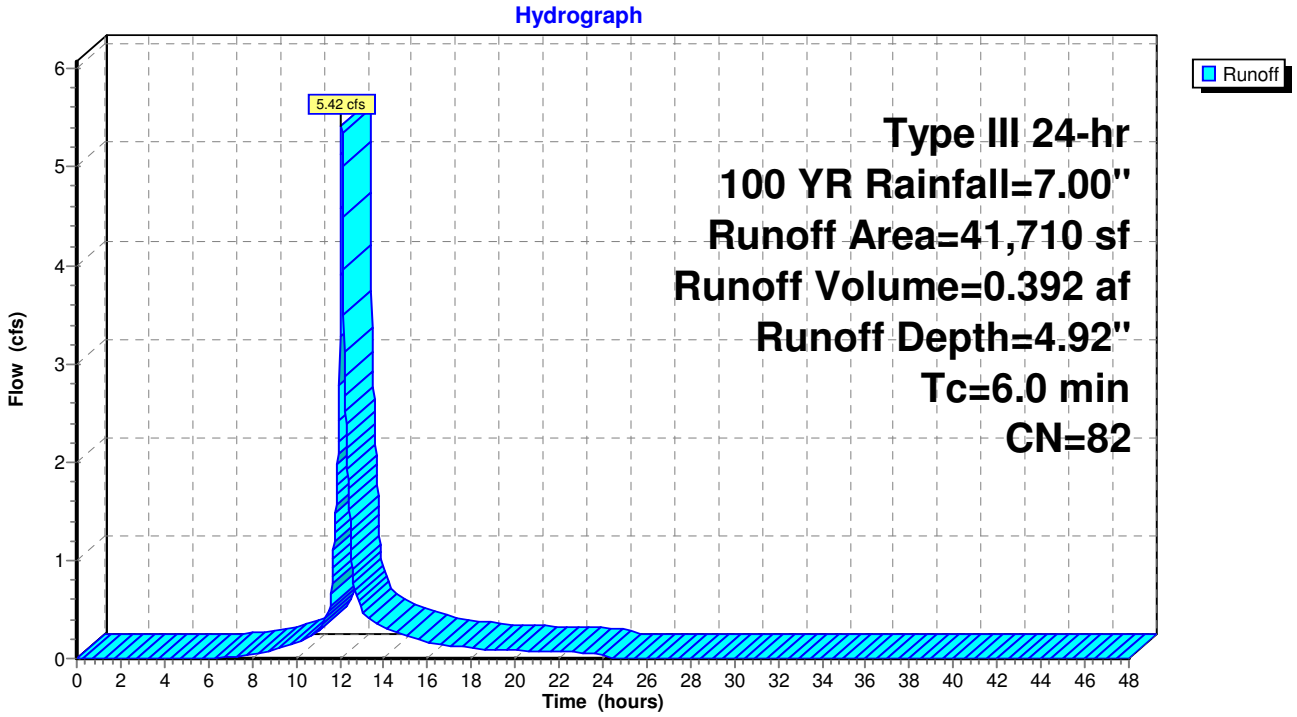
Runoff = 5.42 cfs @ 12.09 hrs, Volume= 0.392 af, Depth= 4.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
13,269	98	Paved parking, HSG C
28,441	74	>75% Grass cover, Good, HSG C
41,710	82	Weighted Average
28,441		68.19% Pervious Area
13,269		31.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-8: Portion of Service Road and Basin Area



Summary for Subcatchment POST-9A: Northerly Portion of Parking on "Lot 9"

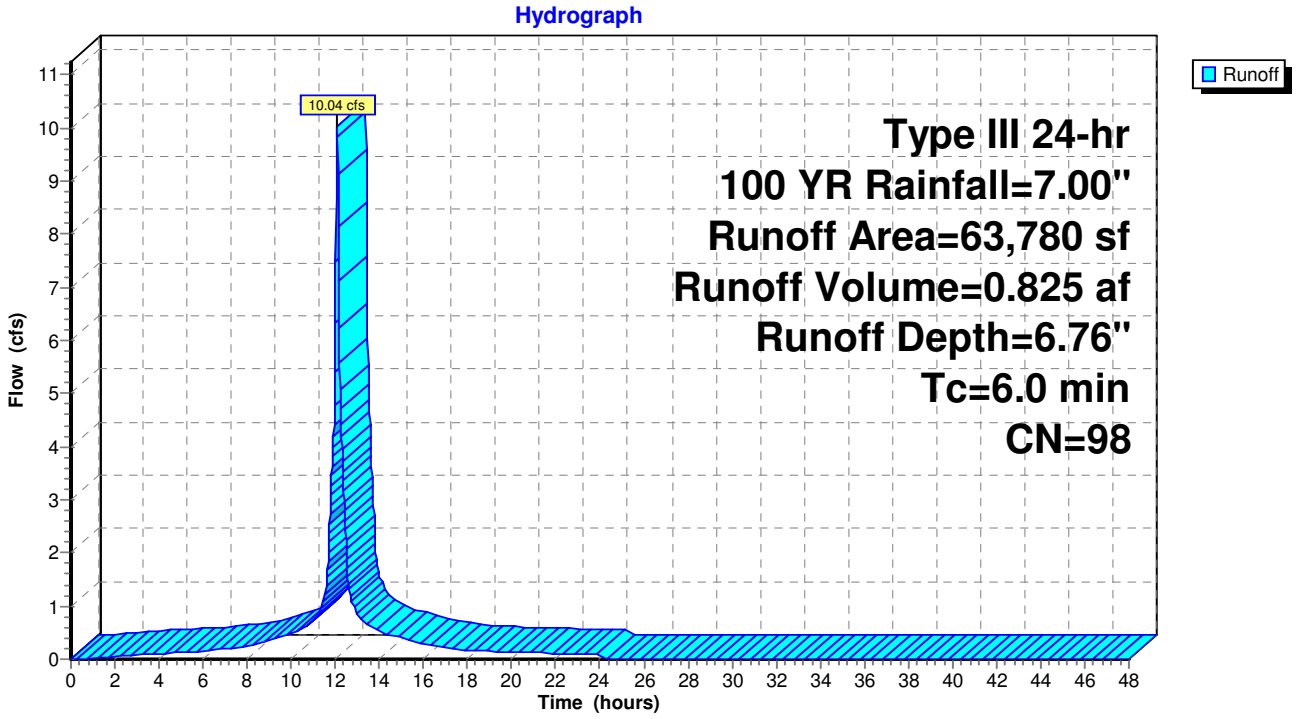
Runoff = 10.04 cfs @ 12.08 hrs, Volume= 0.825 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
63,780	98	Paved parking & roofs
63,780		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-9A: Northerly Portion of Parking on "Lot 9"



Summary for Subcatchment POST-9B: Southerly Portion of Parking on "Lot 9"

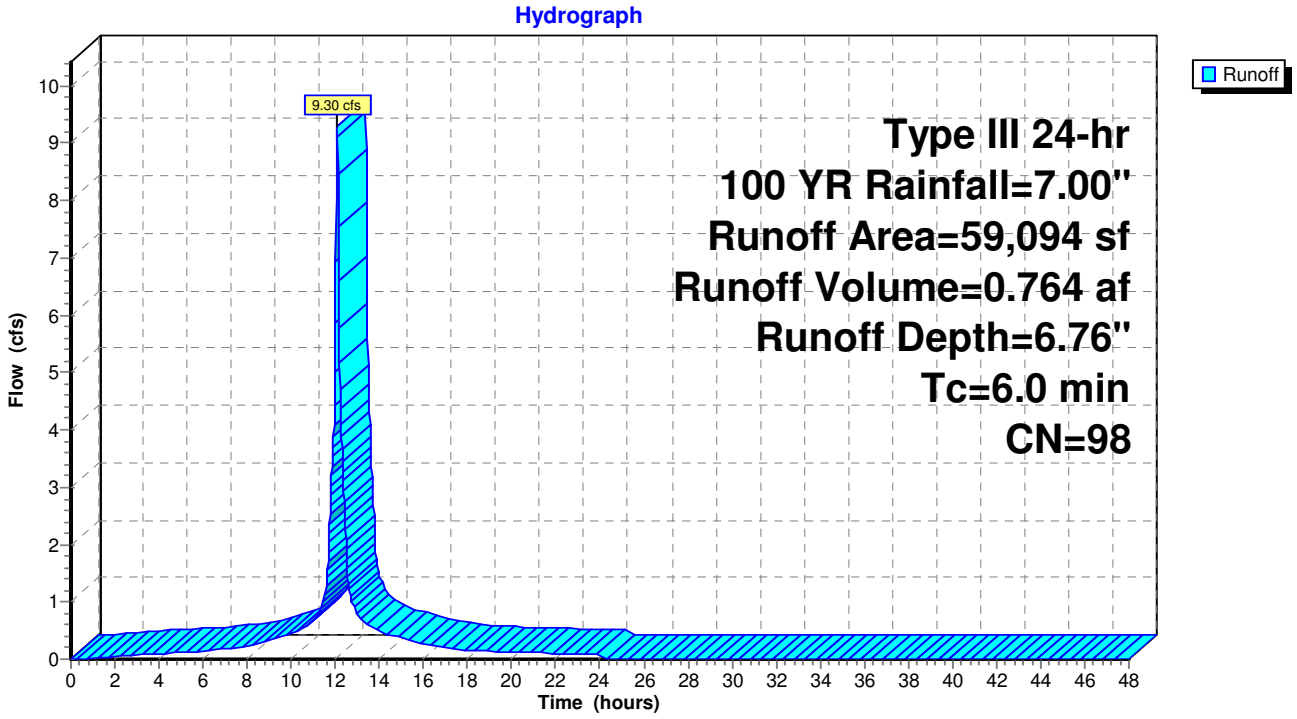
Runoff = 9.30 cfs @ 12.08 hrs, Volume= 0.764 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
59,094	98	Paved parking & roofs
59,094		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-9B: Southerly Portion of Parking on "Lot 9"



mmary for Subcatchment POST-9C: Unattenuated Area from "Lot 9" to Wetlands Associated with Cotley Ri

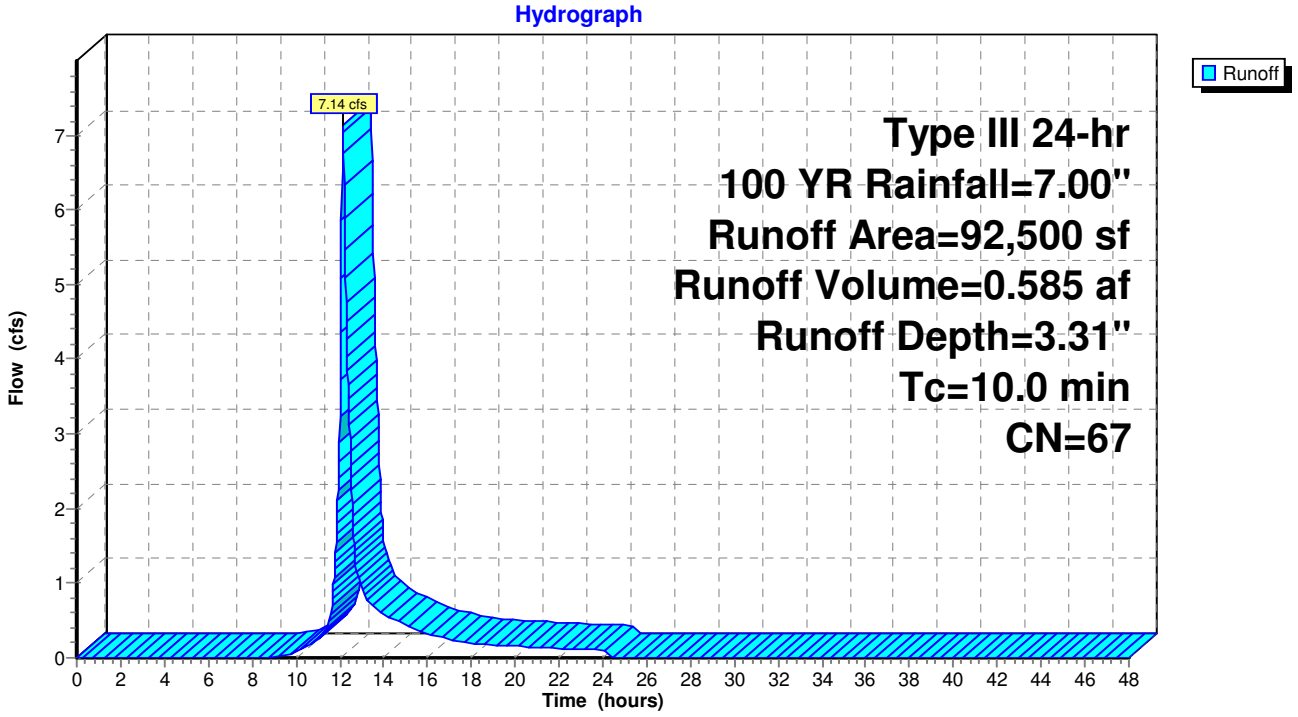
Runoff = 7.14 cfs @ 12.14 hrs, Volume= 0.585 af, Depth= 3.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
4,000	30	Meadow, non-grazed, HSG A
6,000	78	Meadow, non-grazed, HSG D
9,000	30	Woods, Good, HSG A
36,000	70	Woods, Good, HSG C
5,000	39	>75% Grass cover, Good, HSG A
32,500	80	>75% Grass cover, Good, HSG D
92,500	67	Weighted Average
92,500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-9C: Unattenuated Area from "Lot 9" to Wetlands Associated with Cotley River



Summary for Pond 9Pa: Detention Pond - Southwest of Lot 9 Parking

Inflow Area = 1.357 ac,100.00% Impervious, Inflow Depth = 6.39" for 100 YR event
Inflow = 5.50 cfs @ 12.19 hrs, Volume= 0.722 af
Outflow = 2.53 cfs @ 12.65 hrs, Volume= 0.703 af, Atten= 54%, Lag= 27.5 min
Primary = 2.53 cfs @ 12.65 hrs, Volume= 0.703 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 28.10' @ 12.65 hrs Surf.Area= 4,365 sf Storage= 8,160 cf
Flood Elev= 29.00' Surf.Area= 5,450 sf Storage= 12,595 cf

Plug-Flow detention time= 63.6 min calculated for 0.703 af (97% of inflow)
Center-of-Mass det. time= 44.8 min (846.2 - 801.5)

Volume	Invert	Avail.Storage	Storage Description
#1	25.00'	12,595 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

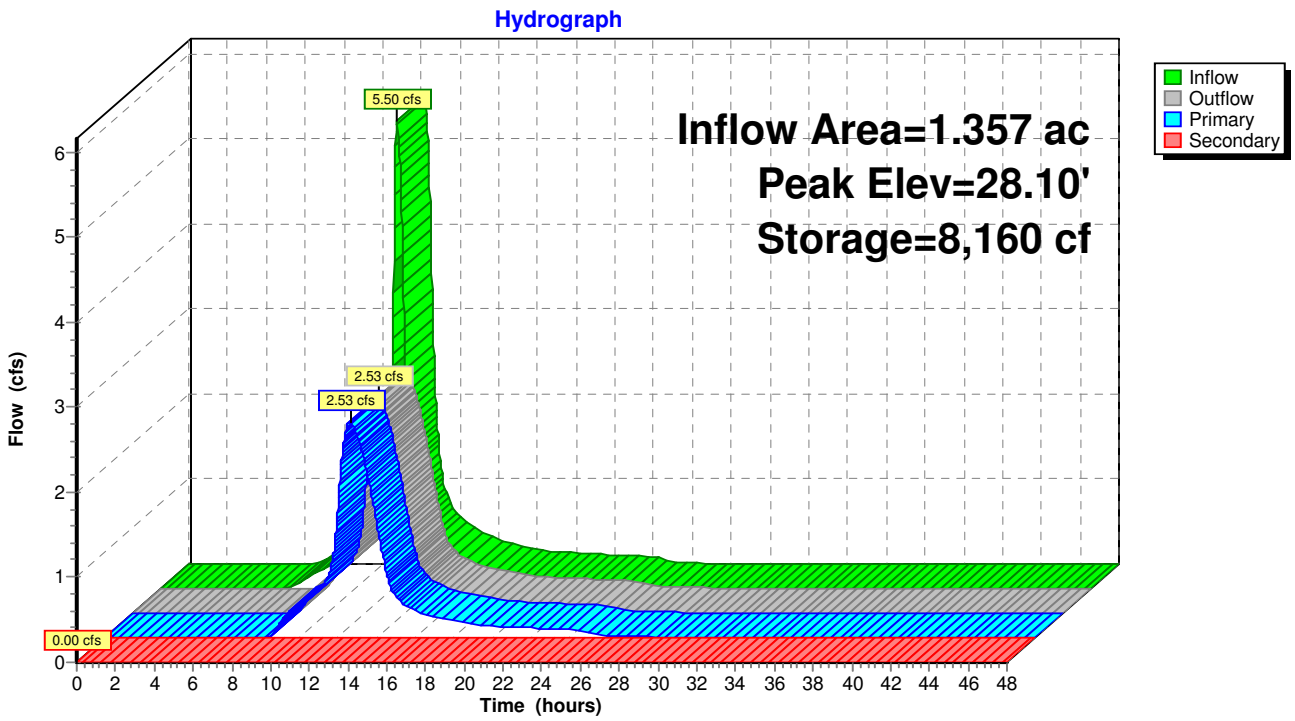
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
25.00	1,420	0	0
26.00	2,080	1,750	1,750
27.00	2,830	2,455	4,205
28.00	4,250	3,540	7,745
29.00	5,450	4,850	12,595

Device	Routing	Invert	Outlet Devices
#1	Primary	25.50'	**8.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 25.50' / 25.00' S= 0.0250 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Secondary	28.50'	**10.0' long x 4.0' 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 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=2.53 cfs @ 12.65 hrs HW=28.10' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.53 cfs @ 7.24 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=25.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9Pa: Detention Pond - Southwest of Lot 9 Parking



Summary for Pond 9Pb: Detention Pond - Southwest of Lot 9 Parking

[79] Warning: Submerged Pond 9Pa Primary device # 1 INLET by 0.94'

Inflow Area =	1.357 ac,100.00% Impervious, Inflow Depth > 6.22" for 100 YR event				
Inflow =	2.53 cfs @	12.65 hrs,	Volume=	0.703 af	
Outflow =	2.13 cfs @	13.34 hrs,	Volume=	0.688 af,	Atten= 16%, Lag= 41.4 min
Primary =	2.13 cfs @	13.34 hrs,	Volume=	0.688 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 26.44' @ 13.34 hrs Surf.Area= 2,276 sf Storage= 4,162 cf
Flood Elev= 27.00' Surf.Area= 2,560 sf Storage= 5,510 cf

Plug-Flow detention time= 48.4 min calculated for 0.688 af (98% of inflow)
Center-of-Mass det. time= 31.4 min (877.7 - 846.2)

Volume	Invert	Avail.Storage	Storage Description
#1	24.00'	5,510 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

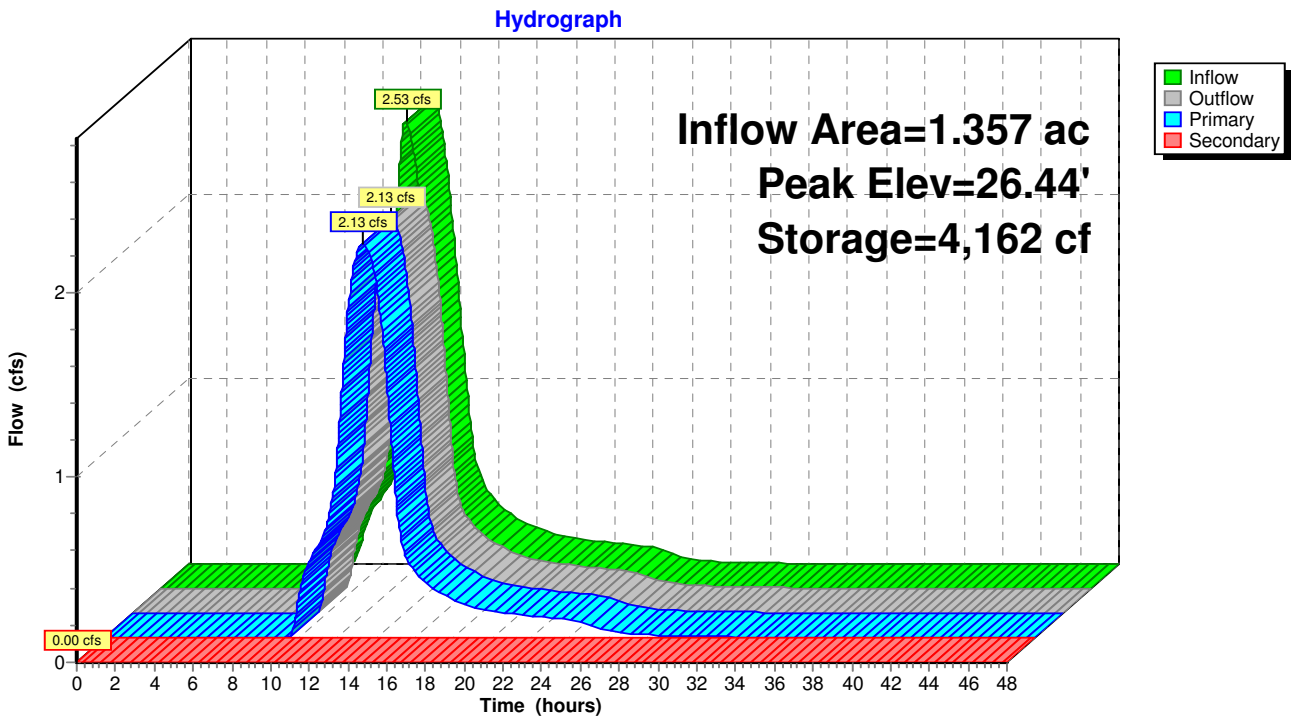
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
24.00	1,160	0	0
25.00	1,600	1,380	1,380
26.00	2,050	1,825	3,205
27.00	2,560	2,305	5,510

Device	Routing	Invert	Outlet Devices
#1	Primary	24.50'	**8.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.50' / 24.00' S= 0.0250 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf
#2	Secondary	26.50'	**10.0' long x 4.0' 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 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=2.13 cfs @ 13.34 hrs HW=26.44' (Free Discharge)
└**1=Culvert** (Inlet Controls 2.13 cfs @ 6.11 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=24.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9Pb: Detention Pond - Southwest of Lot 9 Parking



Summary for Pond 9Pc: Detention Pond - Southwest of Lot 9 Parking

[79] Warning: Submerged Pond 9Pb Primary device # 1 INLET by 0.35'

Inflow Area =	1.357 ac,100.00% Impervious, Inflow Depth > 6.09" for 100 YR event			
Inflow =	2.13 cfs @ 13.34 hrs, Volume=	0.688 af		
Outflow =	2.13 cfs @ 13.37 hrs, Volume=	0.670 af, Atten= 0%, Lag= 2.0 min		
Primary =	0.73 cfs @ 13.37 hrs, Volume=	0.428 af		
Secondary =	1.40 cfs @ 13.37 hrs, Volume=	0.243 af		

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 24.85' @ 13.37 hrs Surf.Area= 2,631 sf Storage= 2,688 cf
Flood Elev= 25.00' Surf.Area= 2,760 sf Storage= 3,103 cf

Plug-Flow detention time= 57.7 min calculated for 0.670 af (97% of inflow)
Center-of-Mass det. time= 35.8 min (913.5 - 877.7)

Volume	Invert	Avail.Storage	Storage Description
#1	23.50'	3,103 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

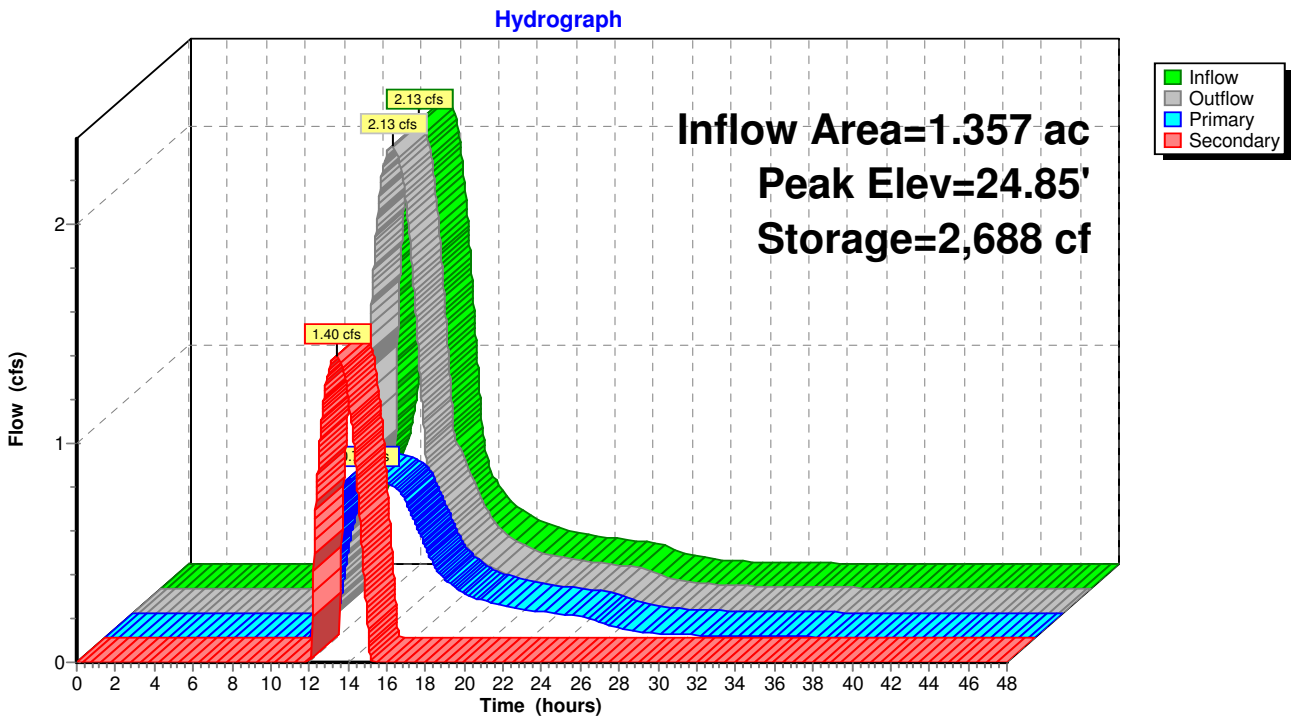
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
23.50	1,130	0	0
24.00	1,920	763	763
25.00	2,760	2,340	3,103

Device	Routing	Invert	Outlet Devices
#1	Primary	24.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	24.75'	**20.0' long x 5.0' 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 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.73 cfs @ 13.37 hrs HW=24.85' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.73 cfs @ 3.72 fps)

Secondary OutFlow Max=1.40 cfs @ 13.37 hrs HW=24.85' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 1.40 cfs @ 0.73 fps)

Pond 9Pc: Detention Pond - Southwest of Lot 9 Parking



Summary for Pond 9Pe: Detention Pond - South of Lot 9 Parking

Inflow Area = 1.357 ac,100.00% Impervious, Inflow Depth = 6.76" for 100 YR event
Inflow = 9.30 cfs @ 12.08 hrs, Volume= 0.764 af
Outflow = 5.50 cfs @ 12.19 hrs, Volume= 0.722 af, Atten= 41%, Lag= 6.4 min
Primary = 5.50 cfs @ 12.19 hrs, Volume= 0.722 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 31.25' @ 12.19 hrs Surf.Area= 4,241 sf Storage= 6,995 cf
Flood Elev= 32.00' Surf.Area= 4,940 sf Storage= 10,445 cf

Plug-Flow detention time= 90.6 min calculated for 0.722 af (94% of inflow)
Center-of-Mass det. time= 58.5 min (801.5 - 743.0)

Volume	Invert	Avail.Storage	Storage Description
#1	29.00'	10,445 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

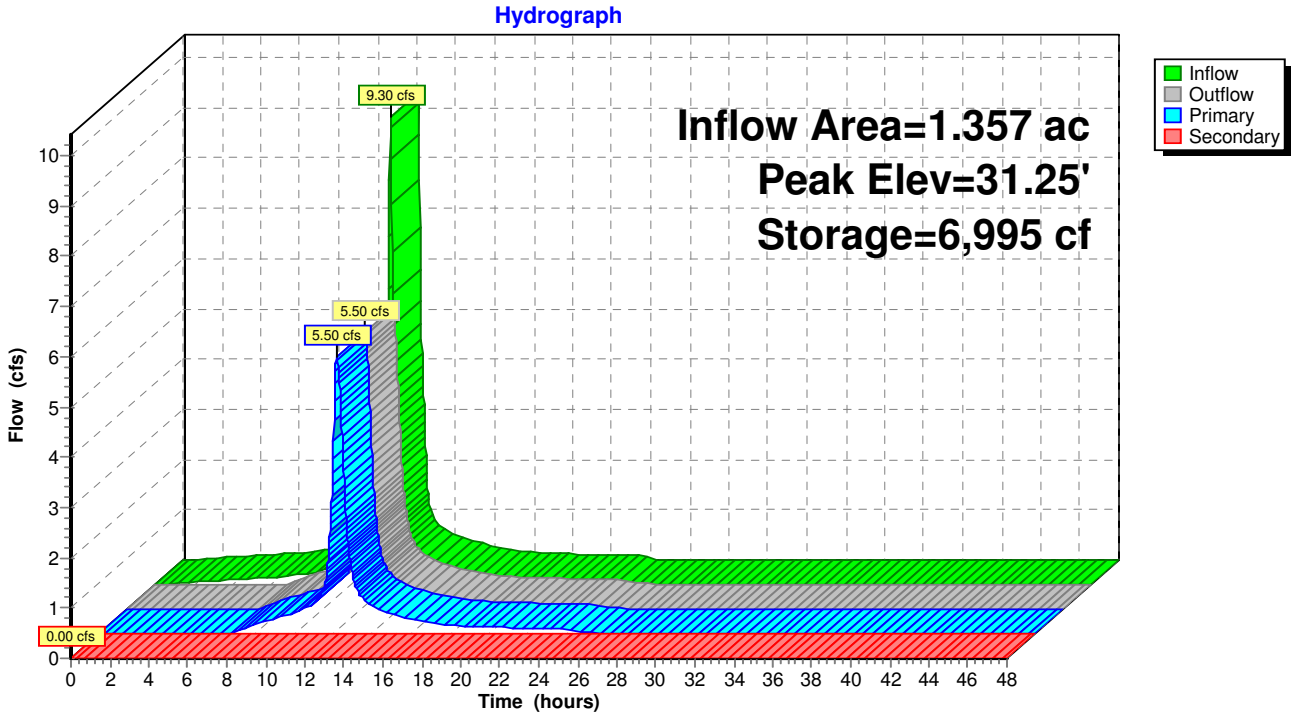
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
29.00	2,210	0	0
30.00	2,860	2,535	2,535
31.00	4,010	3,435	5,970
32.00	4,940	4,475	10,445

Device	Routing	Invert	Outlet Devices
#1	Primary	29.75'	**15.0" Round Culvert** L= 94.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 29.75' / 29.00' S= 0.0080 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Secondary	31.70'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.50 cfs @ 12.19 hrs HW=31.25' (Free Discharge)
└**1=Culvert** (Barrel Controls 5.50 cfs @ 4.73 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=29.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9Pe: Detention Pond - South of Lot 9 Parking



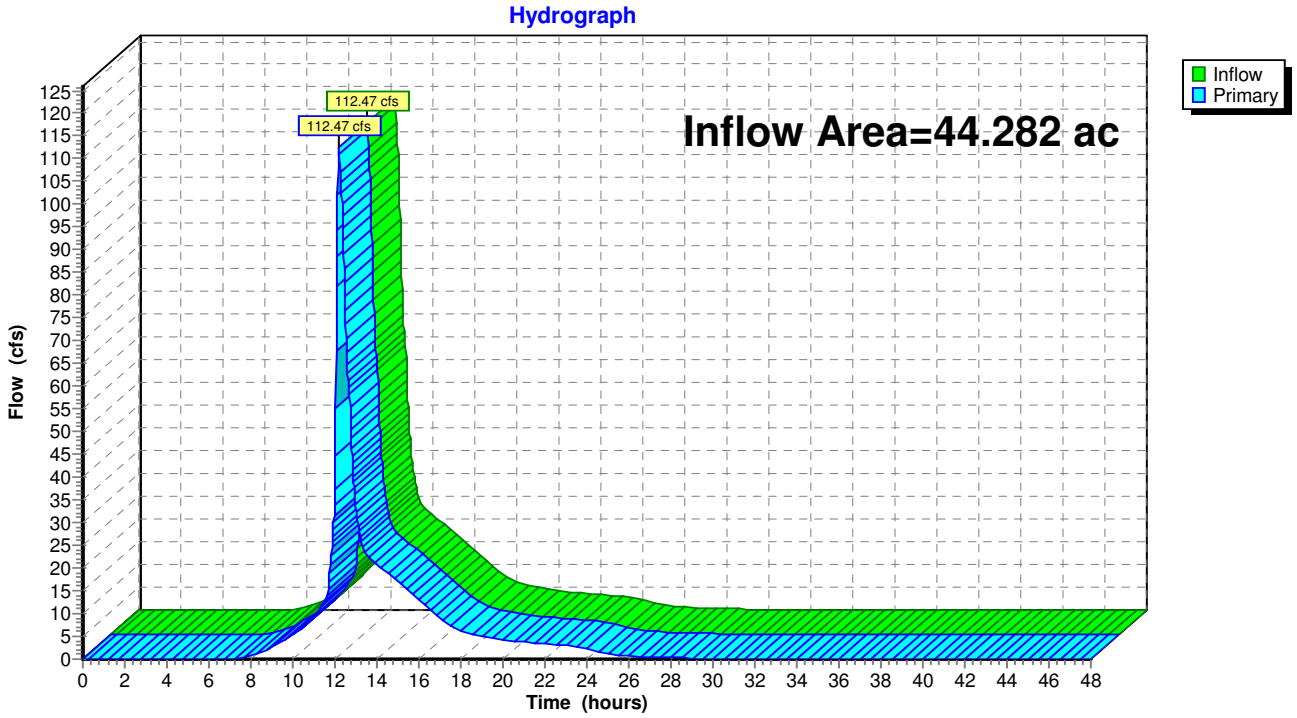
Summary for Pond AP-1: Wetlands South of O'Connell Way

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 44.282 ac, 59.80% Impervious, Inflow Depth > 4.58" for 100 YR event
Inflow = 112.47 cfs @ 12.21 hrs, Volume= 16.916 af
Primary = 112.47 cfs @ 12.21 hrs, Volume= 16.916 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-1: Wetlands South of O'Connell Way



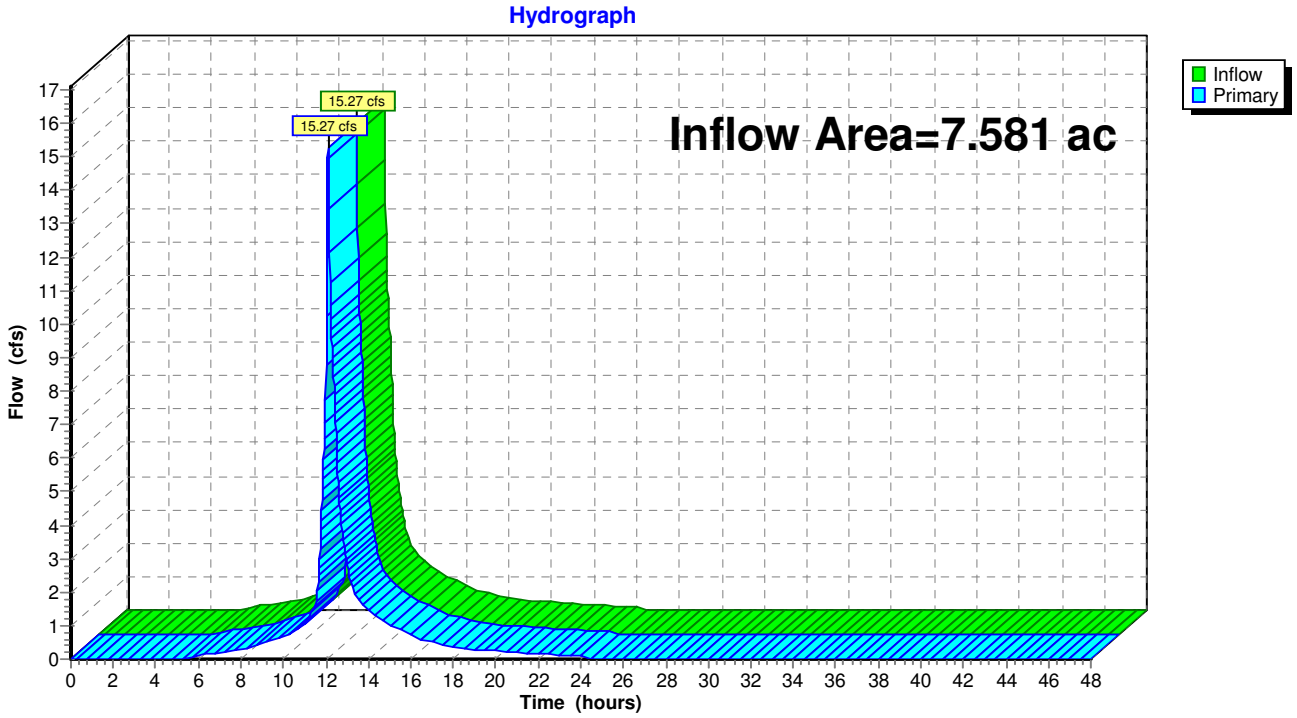
Summary for Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 7.581 ac, 65.23% Impervious, Inflow Depth = 2.42" for 100 YR event
Inflow = 15.27 cfs @ 12.11 hrs, Volume= 1.526 af
Primary = 15.27 cfs @ 12.11 hrs, Volume= 1.526 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-2: Ditch/Stream North of O'Connell Way at Lot 11



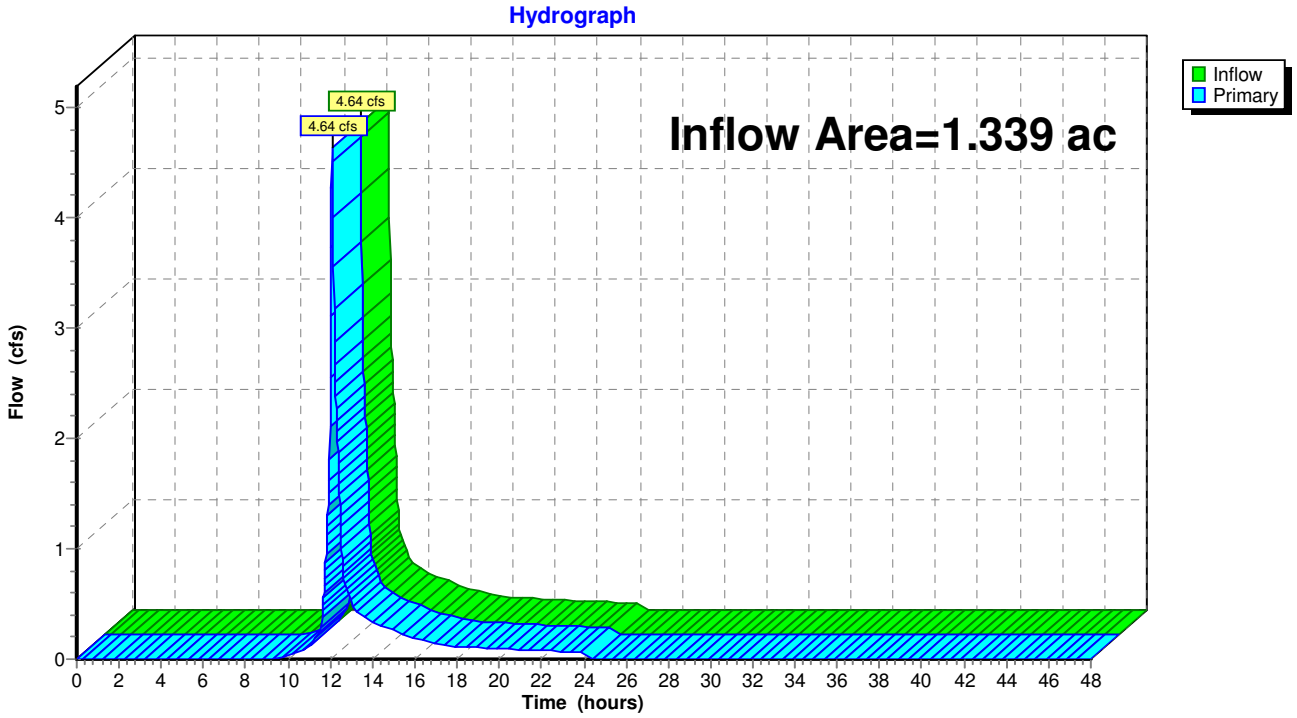
Summary for Pond AP-3: Existing Culvert Crossing at Crossroads

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =	1.339 ac,	0.00% Impervious,	Inflow Depth =	3.00"	for 100 YR event
Inflow =	4.64 cfs @	12.09 hrs,	Volume=	0.335 af	
Primary =	4.64 cfs @	12.09 hrs,	Volume=	0.335 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

Pond AP-3: Existing Culvert Crossing at Crossroads



Summary for Pond POND-1: Maggiore Combined Detention Basin

Inflow Area = 24.144 ac, 82.06% Impervious, Inflow Depth = 6.10" for 100 YR event
Inflow = 145.83 cfs @ 12.09 hrs, Volume= 12.267 af
Outflow = 74.52 cfs @ 12.26 hrs, Volume= 11.715 af, Atten= 49%, Lag= 10.6 min
Primary = 50.75 cfs @ 12.26 hrs, Volume= 11.151 af
Secondary = 23.77 cfs @ 12.26 hrs, Volume= 0.565 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 34.70' @ 12.26 hrs Surf.Area= 43,434 sf Storage= 172,577 cf

Plug-Flow detention time= 118.0 min calculated for 11.710 af (95% of inflow)
Center-of-Mass det. time= 92.5 min (852.9 - 760.4)

Volume	Invert	Avail.Storage	Storage Description
#1	30.00'	185,603 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

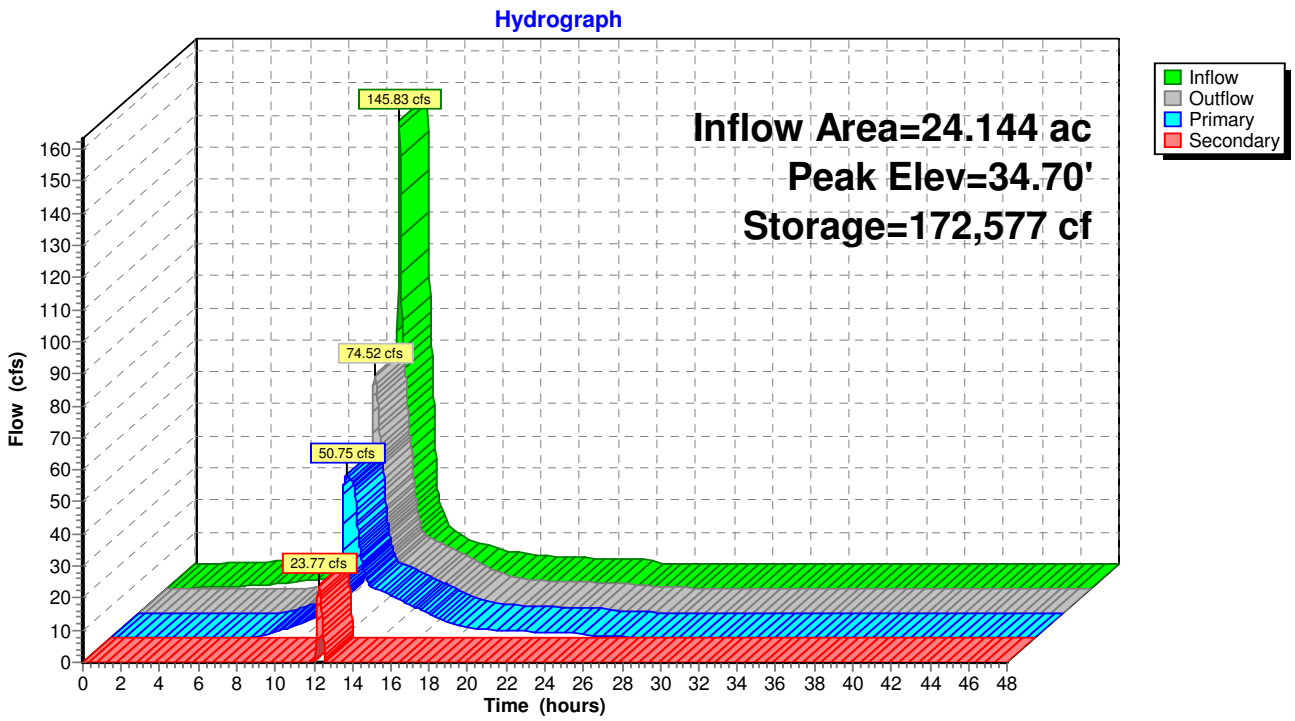
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
30.00	30,160	0	0
31.00	32,879	31,520	31,520
32.00	35,649	34,264	65,784
33.00	38,477	37,063	102,847
34.00	41,364	39,921	142,767
35.00	44,308	42,836	185,603

Device	Routing	Invert	Outlet Devices
#1	Primary	30.00'	**18.0" Round Culvert X 3.00** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 30.00' / 29.25' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	30.75'	**12.0" Vert. Orifice/Grate X 3.00** C= 0.600
#3	Device 1	33.25'	**4.0' long Sharp-Crested Rectangular Weir X 3.00** 2 End Contraction(s) 2.0' Crest Height
#4	Secondary	34.25'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=50.75 cfs @ 12.26 hrs HW=34.70' (Free Discharge)
└─**1=Culvert** (Inlet Controls 50.75 cfs @ 9.57 fps)
  ├─**2=Orifice/Grate** (Passes < 21.08 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Passes < 69.38 cfs potential flow)

Secondary OutFlow Max=23.73 cfs @ 12.26 hrs HW=34.70' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Weir Controls 23.73 cfs @ 1.75 fps)

Pond POND-1: Maggiore Combined Detention Basin



Summary for Pond POND-2: Bioretention Area

Inflow Area =	0.924 ac,	0.00% Impervious,	Inflow Depth =	4.04"	for 100 YR event
Inflow =	3.82 cfs @	12.14 hrs,	Volume=	0.311 af	
Outflow =	1.91 cfs @	12.37 hrs,	Volume=	0.311 af,	Atten= 50%, Lag= 13.8 min
Discarded =	0.14 cfs @	12.37 hrs,	Volume=	0.130 af	
Primary =	1.77 cfs @	12.37 hrs,	Volume=	0.182 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 52.61' @ 12.37 hrs Surf.Area= 5,970 sf Storage= 3,430 cf
Flood Elev= 54.00' Surf.Area= 7,638 sf Storage= 12,871 cf

Plug-Flow detention time= 38.6 min calculated for 0.311 af (100% of inflow)
Center-of-Mass det. time= 38.6 min (864.2 - 825.7)

Volume	Invert	Avail.Storage	Storage Description
#1	52.00'	12,871 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

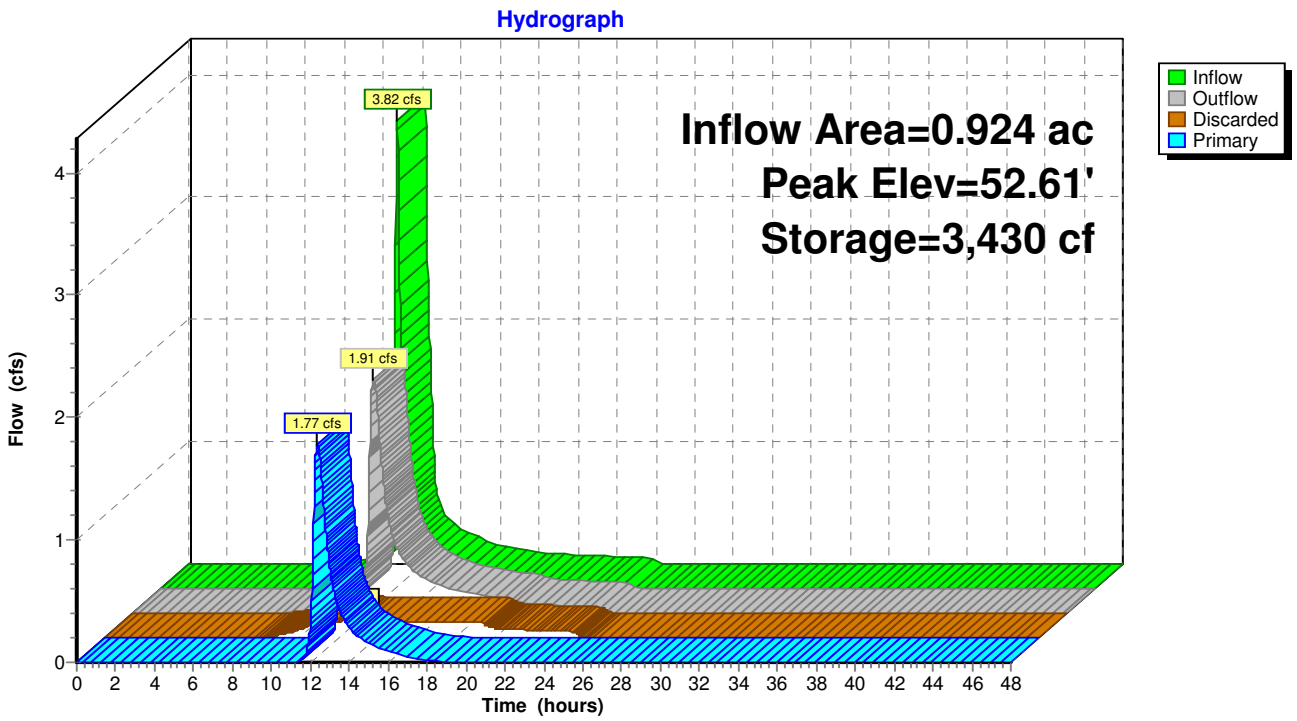
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
52.00	5,246	0	0
53.00	6,429	5,838	5,838
54.00	7,638	7,034	12,871

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**18.0" Round Headwall** L= 534.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.00' / 49.17' S= 0.0053 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Discarded	52.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.14 cfs @ 12.37 hrs HW=52.61' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=1.77 cfs @ 12.37 hrs HW=52.61' (Free Discharge)
└**1=Headwall** (Barrel Controls 1.77 cfs @ 3.86 fps)

Pond POND-2: Bioretention Area



Summary for Pond POND-3: Bioretention Area

[79] Warning: Submerged Pond POND-2 Primary device # 1 OUTLET by 1.37'

Inflow Area =	4.839 ac,	64.93% Impervious,	Inflow Depth =	5.47"	for 100 YR event
Inflow =	26.06 cfs @	12.09 hrs,	Volume=	2.207 af	
Outflow =	17.75 cfs @	12.18 hrs,	Volume=	2.207 af,	Atten= 32%, Lag= 5.4 min
Discarded =	0.12 cfs @	12.18 hrs,	Volume=	0.197 af	
Primary =	17.63 cfs @	12.18 hrs,	Volume=	2.010 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4
Peak Elev= 50.54' @ 12.18 hrs Surf.Area= 5,016 sf Storage= 8,359 cf
Flood Elev= 51.00' Surf.Area= 5,289 sf Storage= 10,704 cf

Plug-Flow detention time= 29.2 min calculated for 2.206 af (100% of inflow)
Center-of-Mass det. time= 29.4 min (789.8 - 760.4)

Volume	Invert	Avail.Storage	Storage Description
#1	48.50'	10,704 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

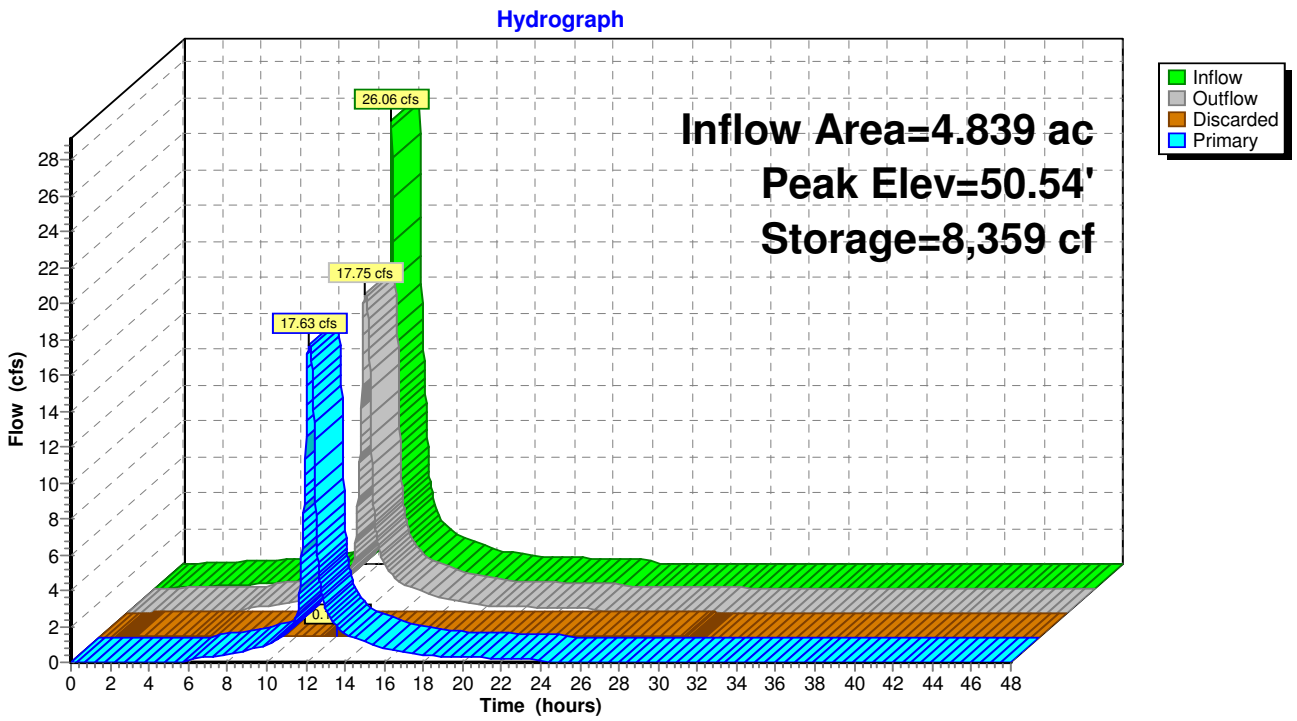
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.50	3,056	0	0
49.00	3,475	1,633	1,633
50.00	4,689	4,082	5,715
51.00	5,289	4,989	10,704

Device	Routing	Invert	Outlet Devices
#1	Primary	45.50'	**18.0" Round Culvert** L= 114.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.50' / 44.36' S= 0.0100 '/' Cc= 0.900 n= 0.011, Flow Area= 1.77 sf
#2	Device 1	49.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	48.50'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.12 cfs @ 12.18 hrs HW=50.54' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=17.63 cfs @ 12.18 hrs HW=50.54' (Free Discharge)
└─**1=Culvert** (Inlet Controls 17.63 cfs @ 9.98 fps)
  └─**2=Orifice/Grate** (Passes 17.63 cfs of 18.79 cfs potential flow)

Pond POND-3: Bioretention Area



Summary for Pond POND-4: Bioretention Area

Inflow Area =	4.216 ac, 93.31% Impervious, Inflow Depth = 6.52" for 100 YR event				
Inflow =	28.65 cfs @	12.08 hrs,	Volume=	2.292 af	
Outflow =	26.78 cfs @	12.11 hrs,	Volume=	2.292 af,	Atten= 7%, Lag= 1.8 min
Discarded =	0.11 cfs @	12.11 hrs,	Volume=	0.199 af	
Primary =	13.33 cfs @	12.11 hrs,	Volume=	1.046 af	
Secondary =	13.33 cfs @	12.11 hrs,	Volume=	1.046 af	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 49.28' @ 12.11 hrs Surf.Area= 4,843 sf Storage= 4,889 cf
Flood Elev= 49.50' Surf.Area= 5,417 sf Storage= 6,033 cf

Plug-Flow detention time= 26.6 min calculated for 2.291 af (100% of inflow)
Center-of-Mass det. time= 26.8 min (781.7 - 755.0)

Volume	Invert	Avail.Storage	Storage Description
#1	48.00'	6,033 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.00	3,163	0	0
49.00	4,130	3,647	3,647
49.50	5,417	2,387	6,033

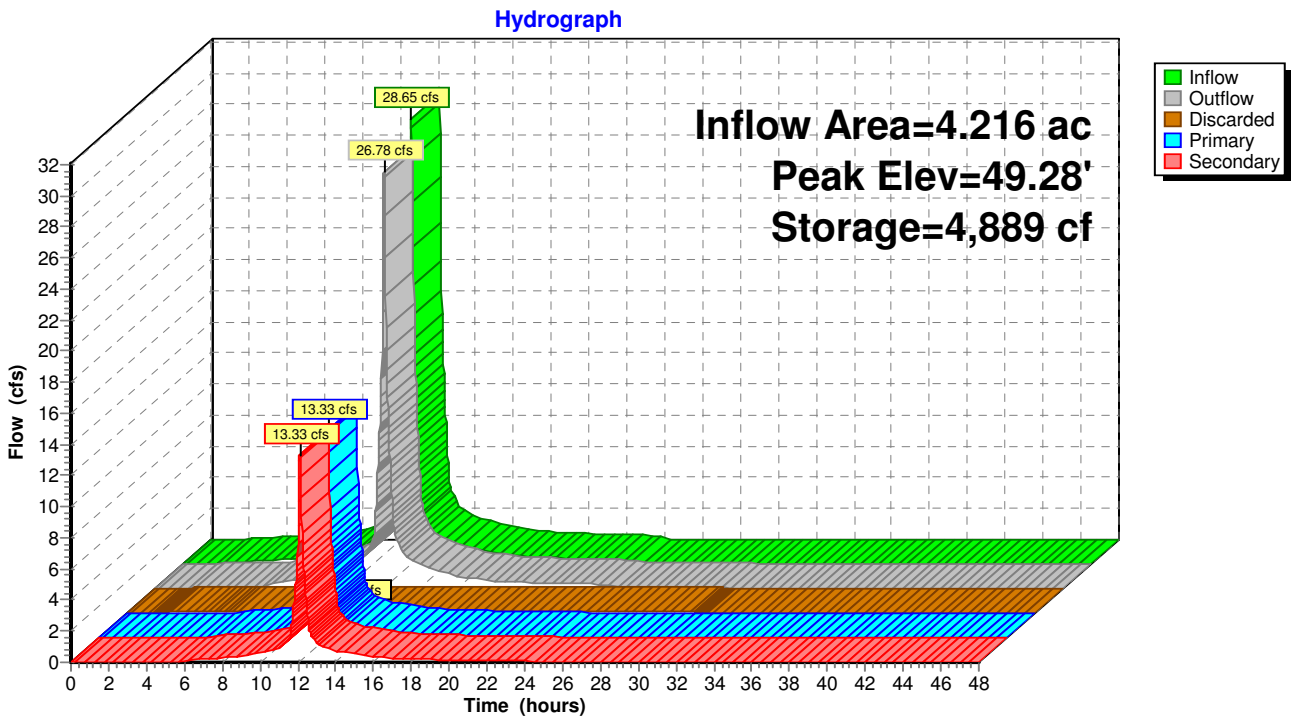
Device	Routing	Invert	Outlet Devices
#1	Primary	45.00'	**18.0" Round Culvert** L= 154.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.00' / 42.96' S= 0.0132 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	45.00'	**18.0" Round Culvert** L= 154.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.00' / 42.96' S= 0.0132 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 1	48.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	48.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	48.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.11 cfs @ 12.11 hrs HW=49.27' (Free Discharge)
└─**5=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=13.30 cfs @ 12.11 hrs HW=49.27' (Free Discharge)
└─**1=Culvert** (Passes 13.30 cfs of 15.97 cfs potential flow)
  └─**3=Orifice/Grate** (Orifice Controls 13.30 cfs @ 4.23 fps)

Secondary OutFlow Max=13.30 cfs @ 12.11 hrs HW=49.27' (Free Discharge)
└─**2=Culvert** (Passes 13.30 cfs of 15.97 cfs potential flow)
  └─**4=Orifice/Grate** (Orifice Controls 13.30 cfs @ 4.23 fps)

Pond POND-4: Bioretention Area



Summary for Pond POND-5: Bioretention Area

Inflow Area = 2.038 ac, 34.67% Impervious, Inflow Depth = 4.92" for 100 YR event
Inflow = 11.55 cfs @ 12.09 hrs, Volume= 0.835 af
Outflow = 2.82 cfs @ 12.48 hrs, Volume= 0.749 af, Atten= 76%, Lag= 23.4 min
Discarded = 0.15 cfs @ 12.48 hrs, Volume= 0.414 af
Primary = 2.67 cfs @ 12.48 hrs, Volume= 0.335 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 43.50' @ 12.48 hrs Surf.Area= 6,314 sf Storage= 17,232 cf

Plug-Flow detention time= 529.0 min calculated for 0.749 af (90% of inflow)
Center-of-Mass det. time= 479.4 min (1,282.4 - 803.0)

Volume	Invert	Avail.Storage	Storage Description
#1	40.00'	27,603 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

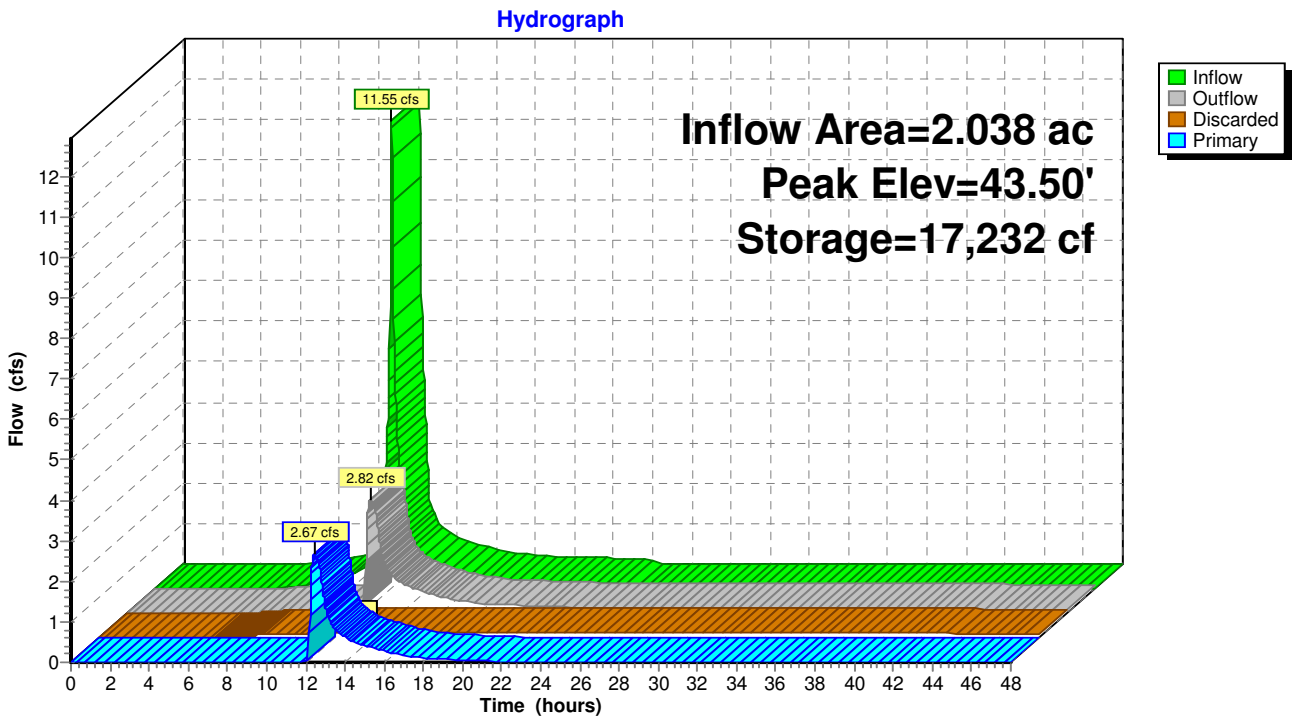
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
40.00	3,535	0	0
45.00	7,506	27,603	27,603

Device	Routing	Invert	Outlet Devices
#1	Device 2	43.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	36.20'	**12.0" Round Culvert** L= 81.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 36.20' / 35.39' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Discarded	40.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.15 cfs @ 12.48 hrs HW=43.50' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=2.67 cfs @ 12.48 hrs HW=43.50' (Free Discharge)
└─**2=Culvert** (Passes 2.67 cfs of 7.78 cfs potential flow)
└─**1=Orifice/Grate** (Orifice Controls 2.67 cfs @ 3.40 fps)

Pond POND-5: Bioretention Area



Summary for Pond POND-6: Bioretention Area

Inflow Area = 0.958 ac, 31.81% Impervious, Inflow Depth = 4.92" for 100 YR event
Inflow = 5.42 cfs @ 12.09 hrs, Volume= 0.392 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= 0.02 hrs
Peak Elev= 42.03' @ 24.36 hrs Surf.Area= 6,517 sf Storage= 17,087 cf

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

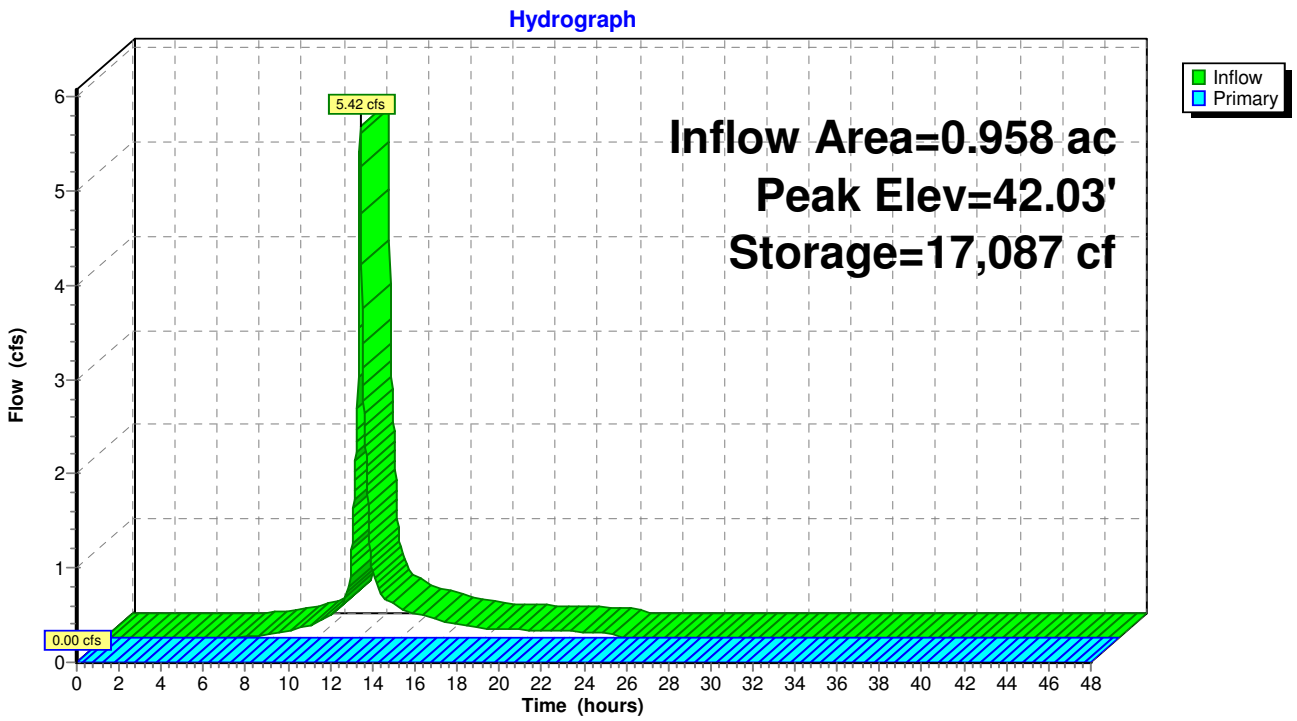
Volume	Invert	Avail.Storage	Storage Description
#1	38.00'	41,832 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
38.00	2,362	0	0
39.00	3,160	2,761	2,761
40.00	4,061	3,611	6,372
45.00	10,123	35,460	41,832

Device	Routing	Invert	Outlet Devices
#1	Primary	35.20'	**18.0" Round Culvert** L= 78.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 35.20' / 34.42' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Device 1	43.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=38.00' (Free Discharge)
└─**1=Culvert** (Passes 0.00 cfs of 9.62 cfs potential flow)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Pond POND-6: Bioretention Area



Summary for Pond POND-7: O'Connell Way Detention Basin

Inflow Area = 5.536 ac, 69.51% Impervious, Inflow Depth = 7.75" for 100 YR event
Inflow = 39.47 cfs @ 12.15 hrs, Volume= 3.574 af
Outflow = 1.68 cfs @ 15.57 hrs, Volume= 0.836 af, Atten= 96%, Lag= 205.6 min
Primary = 1.68 cfs @ 15.57 hrs, Volume= 0.836 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 25.91' @ 15.57 hrs Surf.Area= 42,154 sf Storage= 125,594 cf

Plug-Flow detention time= 506.6 min calculated for 0.836 af (23% of inflow)
Center-of-Mass det. time= 338.3 min (1,125.1 - 786.9)

Volume	Invert	Avail.Storage	Storage Description
#1	21.50'	173,855 cf	**Custom Stage Data (Prismatic)** Listed below

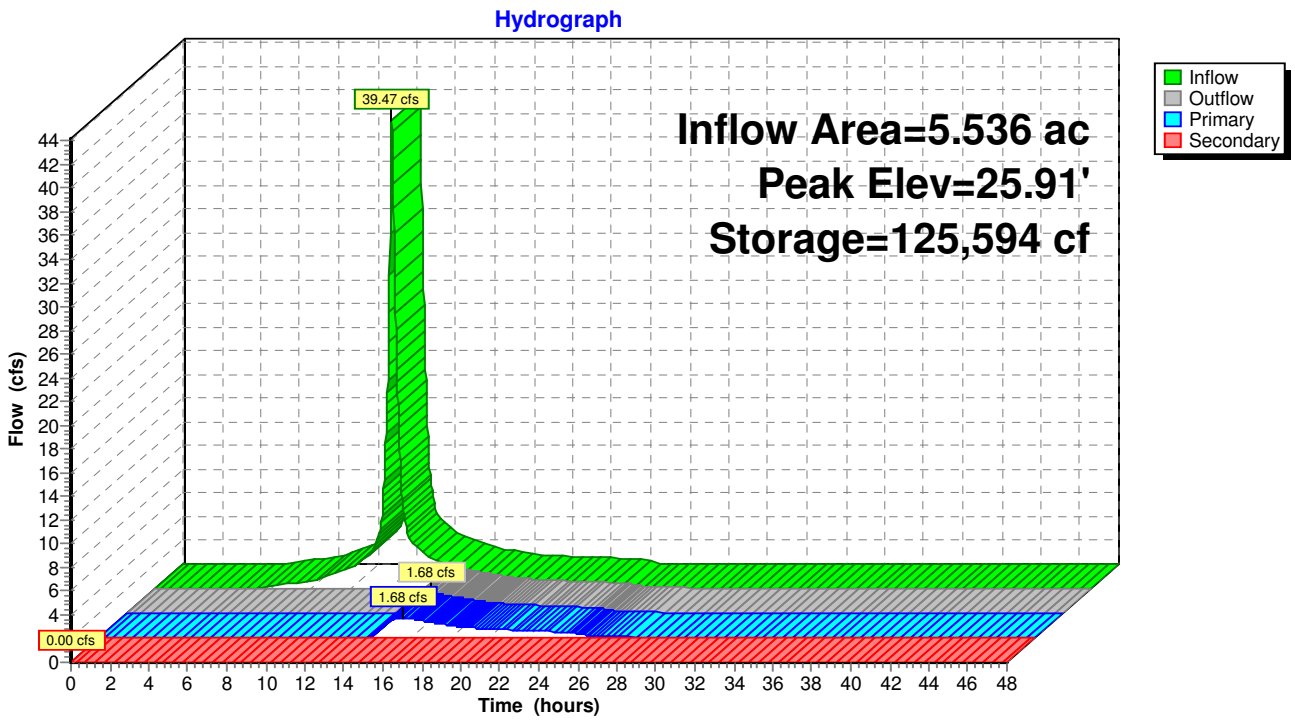
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
21.50	2,384	0	0
22.00	22,143	6,132	6,132
24.00	28,209	50,352	56,484
25.00	37,334	32,772	89,255
26.00	42,638	39,986	129,241
27.00	46,589	44,614	173,855

Device	Routing	Invert	Outlet Devices
#1	Primary	22.15'	**24.0" Round Culvert X 2.00** L= 46.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 22.15' / 22.00' S= 0.0033 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	25.75'	**4.0' long Sharp-Crested Rectangular Weir X 2.00** 2 End Contraction(s) 1.0' Crest Height
#3	Secondary	26.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=1.67 cfs @ 15.57 hrs HW=25.91' (Free Discharge)
└─**1=Culvert** (Passes 1.67 cfs of 48.38 cfs potential flow)
└─**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.67 cfs @ 1.33 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=21.50' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond POND-7: O'Connell Way Detention Basin



Summary for Pond POND-9A: Lot 9 Northerly Stormwater Management System

Inflow Area = 1.464 ac,100.00% Impervious, Inflow Depth = 6.76" for 100 YR event
Inflow = 10.04 cfs @ 12.08 hrs, Volume= 0.825 af
Outflow = 4.58 cfs @ 12.25 hrs, Volume= 0.825 af, Atten= 54%, Lag= 10.0 min
Discarded = 0.28 cfs @ 8.38 hrs, Volume= 0.488 af
Primary = 4.30 cfs @ 12.25 hrs, Volume= 0.337 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 1.57' @ 12.25 hrs Surf.Area= 0.270 ac Storage= 0.254 af

Plug-Flow detention time= 122.9 min calculated for 0.825 af (100% of inflow)
Center-of-Mass det. time= 122.9 min (865.8 - 743.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.164 af	**28.33'W x 415.00'L x 2.04'H Field A** 0.551 af Overall - 0.141 af Embedded = 0.410 af x 40.0% Voids
#2A	0.50'	0.141 af	**Cultec C-100** x 440 Inside #1 Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap Row Length Adjustment= +0.50' x 1.86 sf x 8 rows
		0.305 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	0.83'	**6.0" Round Culvert X 7.00** L= 70.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 0.83' / 0.00' S= 0.0119 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.28 cfs @ 8.38 hrs HW=0.02' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=4.30 cfs @ 12.25 hrs HW=1.57' (Free Discharge)
└─**2=Culvert** (Barrel Controls 4.30 cfs @ 3.13 fps)

Pond POND-9A: Lot 9 Northerly Stormwater Management System - Chamber Wizard Field A

Chamber Model = Cultec C-100
Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf
Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap
Row Length Adjustment= +0.50' x 1.86 sf x 8 rows

36.0" Wide + 4.0" Spacing = 40.0" C-C Row Spacing

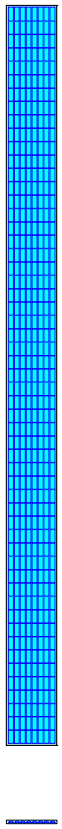
55 Chambers/Row x 7.50' Long +0.50' Row Adjustment = 413.00' Row Length +12.0" End Stone x 2 = 415.00' Base Length
8 Rows x 36.0" Wide + 4.0" Spacing x 7 + 12.0" Side Stone x 2 = 28.33' Base Width
6.0" Base + 12.5" Chamber Height + 6.0" Cover = 2.04' Field Height

440 Chambers x 14.0 cf +0.50' Row Adjustment x 1.86 sf x 8 Rows = 6,150.4 cf Chamber Storage

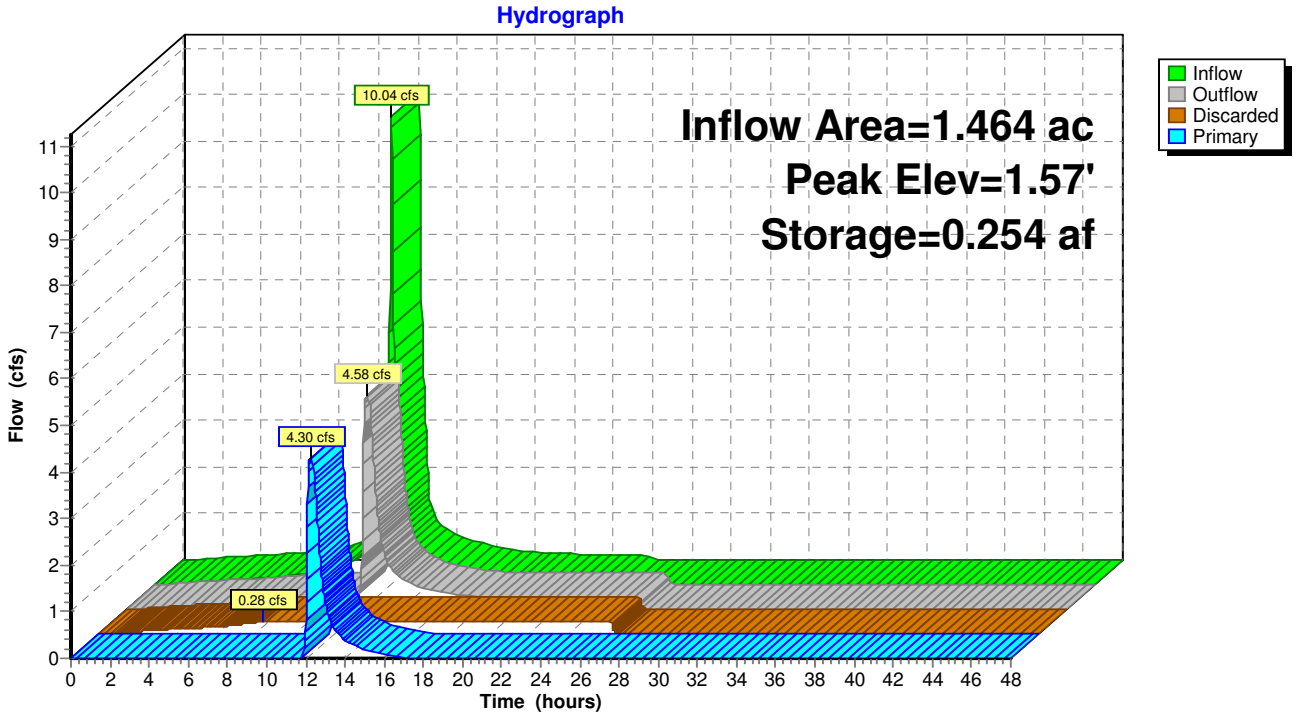
24,006.6 cf Field - 6,150.4 cf Chambers = 17,856.2 cf Stone x 40.0% Voids = 7,142.5 cf Stone Storage

Chamber Storage + Stone Storage = 13,292.9 cf = 0.305 af
Overall Storage Efficiency = 55.4%

440 Chambers
889.1 cy Field
661.3 cy Stone



Pond POND-9A: Lot 9 Northerly Stormwater Management System



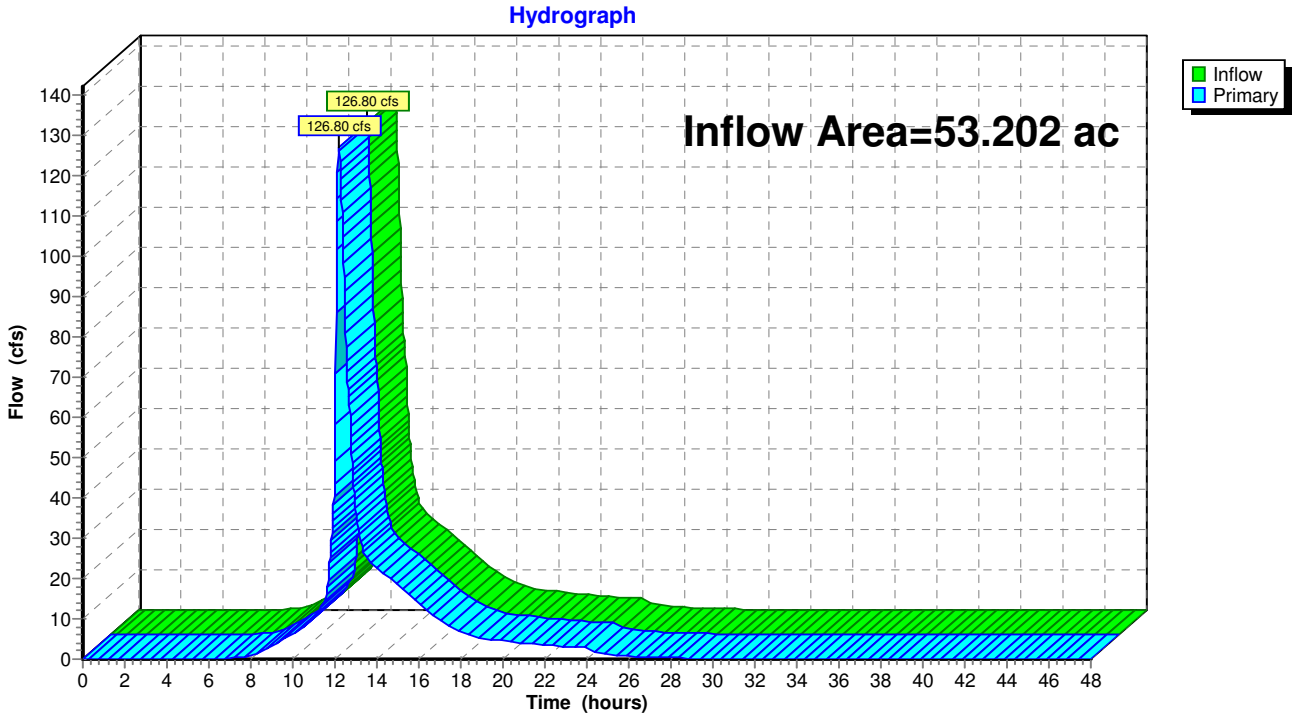
ary for Pond SUM: Summation of Analysis Points to Cotley River Wetlands from Southern portion of develo

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 53.202 ac, 59.07% Impervious, Inflow Depth > 4.24" for 100 YR event
Inflow = 126.80 cfs @ 12.19 hrs, Volume= 18.776 af
Primary = 126.80 cfs @ 12.19 hrs, Volume= 18.776 af, Atten= 0%, Lag= 0.0 min

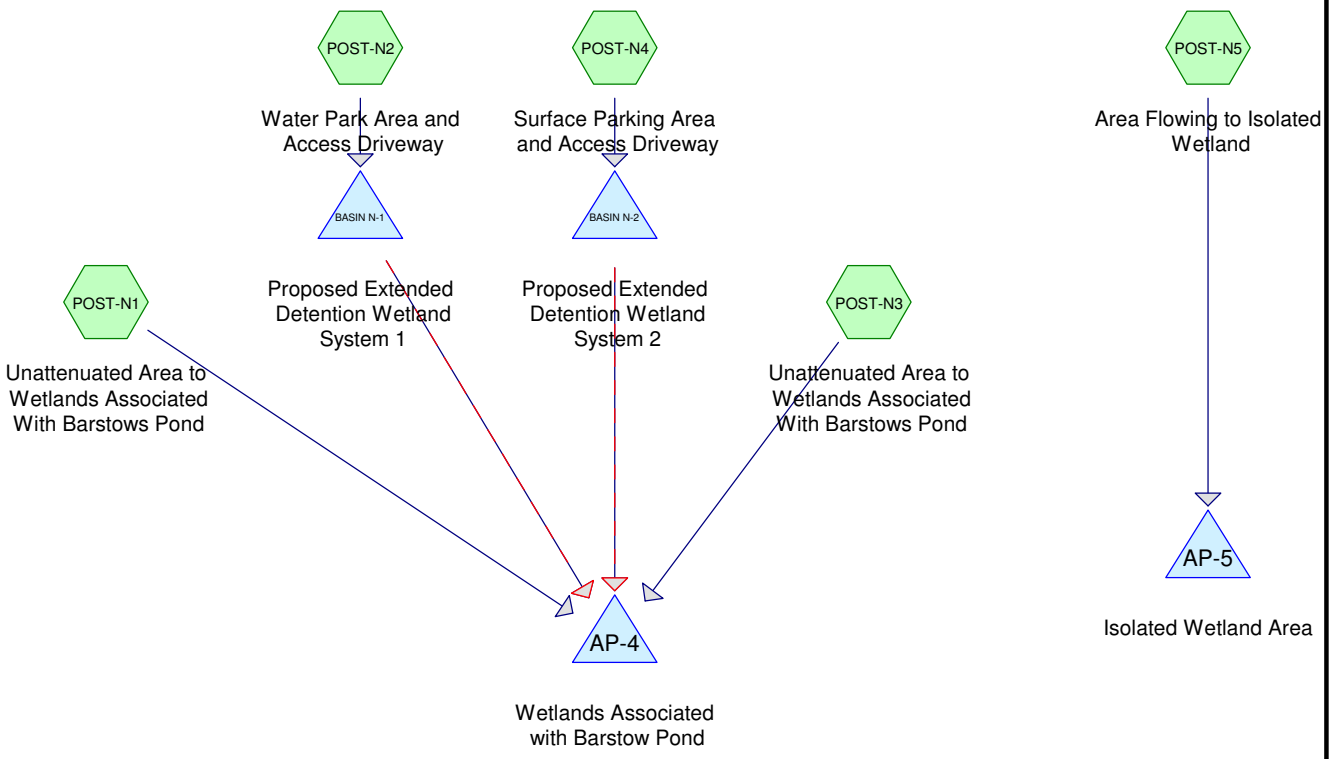
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs

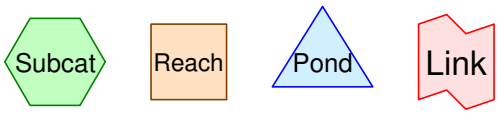
Pond SUM: Summation of Analysis Points to Cotley River Wetlands from Southern portion of development



Section 5

Post Development Hydrologic Analysis
LIT Site-North Parcel





Routing Diagram for 1905-Post-Development-LIT Site-North-FEIS
Prepared by Field Engineering Co. Inc., Printed 4/14/2014
HydroCAD® 10.00 s/n 01897 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
437,672	74	>75% Grass cover, Good, HSG C (POST-N1, POST-N2, POST-N3, POST-N4)
109,905	98	Paved parking, HSG B (POST-N4)
200,390	98	Paved parking, HSG C (POST-N2)
8,370	98	Water Surface (POST-N5)
502,165	70	Woods, Good, HSG C (POST-N1, POST-N2, POST-N3, POST-N5)
1,258,502	**78**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment POST-N1: Unattenuated Runoff Area=187,943 sf 0.00% Impervious Runoff Depth=1.06"
Tc=6.0 min CN=71 Runoff=5.02 cfs 16,660 cf

Subcatchment POST-N2: Water Park Area Runoff Area=617,653 sf 32.44% Impervious Runoff Depth=1.64"
Tc=6.0 min CN=80 Runoff=26.99 cfs 84,225 cf

Subcatchment POST-N3: Unattenuated Runoff Area=78,860 sf 0.00% Impervious Runoff Depth=1.06"
Tc=6.0 min CN=71 Runoff=2.11 cfs 6,991 cf

Subcatchment POST-N4: Surface Parking Runoff Area=311,577 sf 35.27% Impervious Runoff Depth=1.78"
Tc=6.0 min CN=82 Runoff=14.91 cfs 46,285 cf

Subcatchment POST-N5: Area Flowing to Runoff Area=62,469 sf 13.40% Impervious Runoff Depth=1.24"
Tc=10.0 min CN=74 Runoff=1.74 cfs 6,455 cf

Pond AP-4: Wetlands Associated with Barstow Pond Inflow=11.57 cfs 140,155 cf
Primary=11.57 cfs 140,155 cf

Pond AP-5: Isolated Wetland Area Inflow=1.74 cfs 6,455 cf
Primary=1.74 cfs 6,455 cf

Pond BASIN N-1: Proposed Extended Peak Elev=22.03' Storage=43,500 cf Inflow=26.99 cfs 84,225 cf
Primary=2.08 cfs 74,944 cf Secondary=0.00 cfs 0 cf Outflow=2.08 cfs 74,944 cf

Pond BASIN N-2: Proposed Extended Peak Elev=24.62' Storage=17,109 cf Inflow=14.91 cfs 46,285 cf
Primary=4.00 cfs 41,560 cf Secondary=0.00 cfs 0 cf Outflow=4.00 cfs 41,560 cf

Total Runoff Area = 1,258,502 sf Runoff Volume = 160,616 cf Average Runoff Depth = 1.53"
74.68% Pervious = 939,837 sf 25.32% Impervious = 318,665 sf

Summary for Subcatchment POST-N1: Unattenuated Area to Wetlands Associated With Barstows Pond

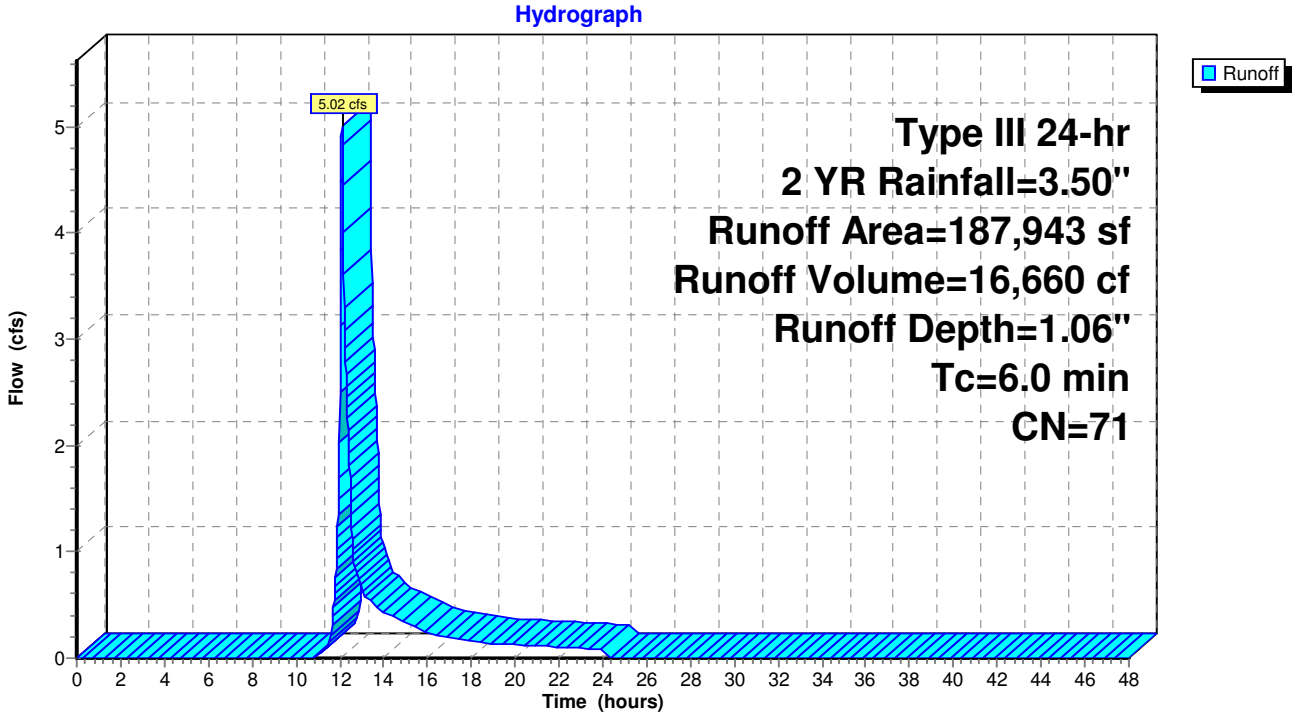
Runoff = 5.02 cfs @ 12.10 hrs, Volume= 16,660 cf, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
147,943	70	Woods, Good, HSG C
40,000	74	>75% Grass cover, Good, HSG C
187,943	71	Weighted Average
187,943		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N1: Unattenuated Area to Wetlands Associated With Barstows Pond



Summary for Subcatchment POST-N2: Water Park Area and Access Driveway

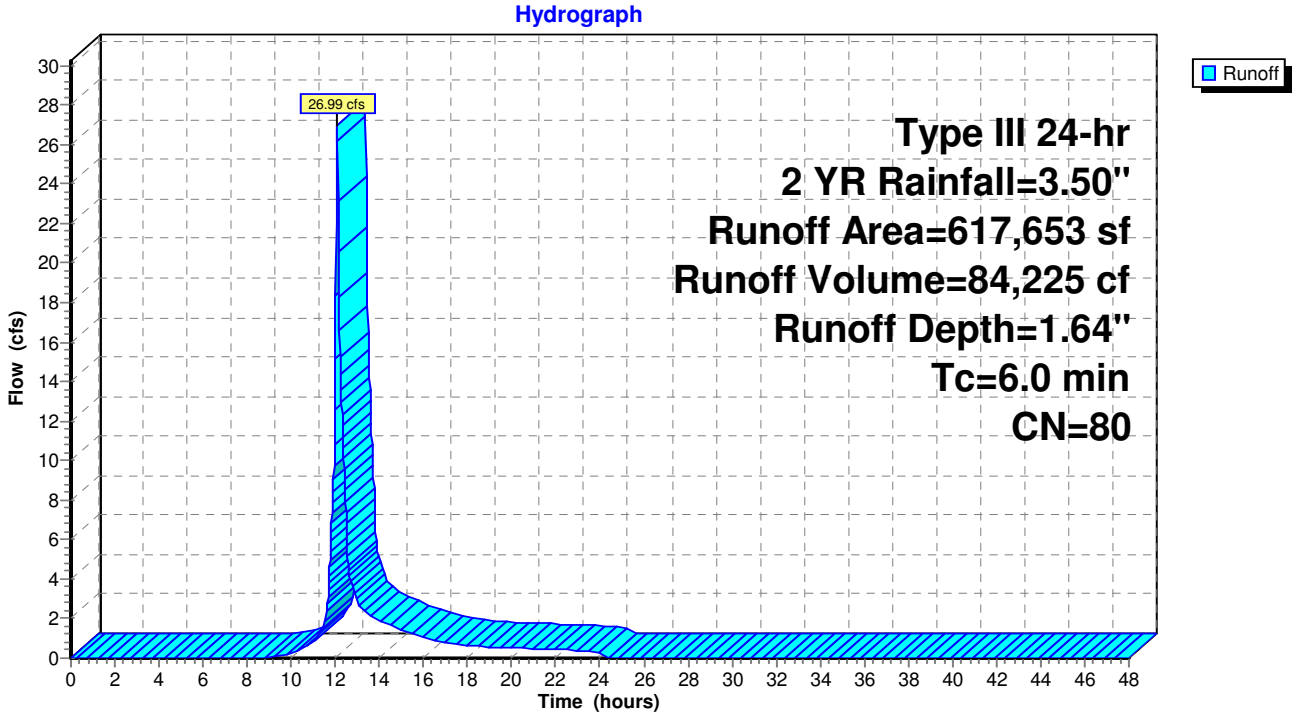
Runoff = 26.99 cfs @ 12.09 hrs, Volume= 84,225 cf, Depth= 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
200,390	98	Paved parking, HSG C
237,263	70	Woods, Good, HSG C
180,000	74	>75% Grass cover, Good, HSG C
617,653	80	Weighted Average
417,263		67.56% Pervious Area
200,390		32.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N2: Water Park Area and Access Driveway



Summary for Subcatchment POST-N3: Unattenuated Area to Wetlands Associated With Barstows Pond

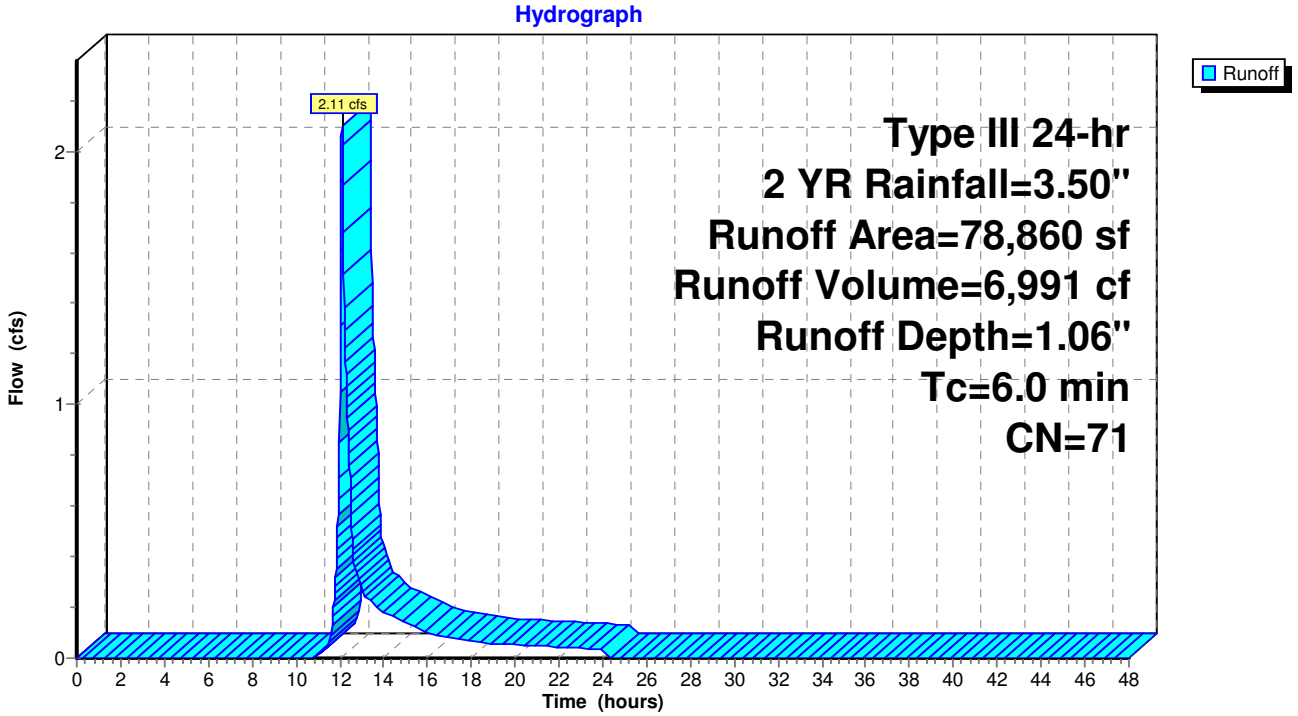
Runoff = 2.11 cfs @ 12.10 hrs, Volume= 6,991 cf, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
62,860	70	Woods, Good, HSG C
16,000	74	>75% Grass cover, Good, HSG C
78,860	71	Weighted Average
78,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N3: Unattenuated Area to Wetlands Associated With Barstows Pond



Summary for Subcatchment POST-N4: Surface Parking Area and Access Driveway

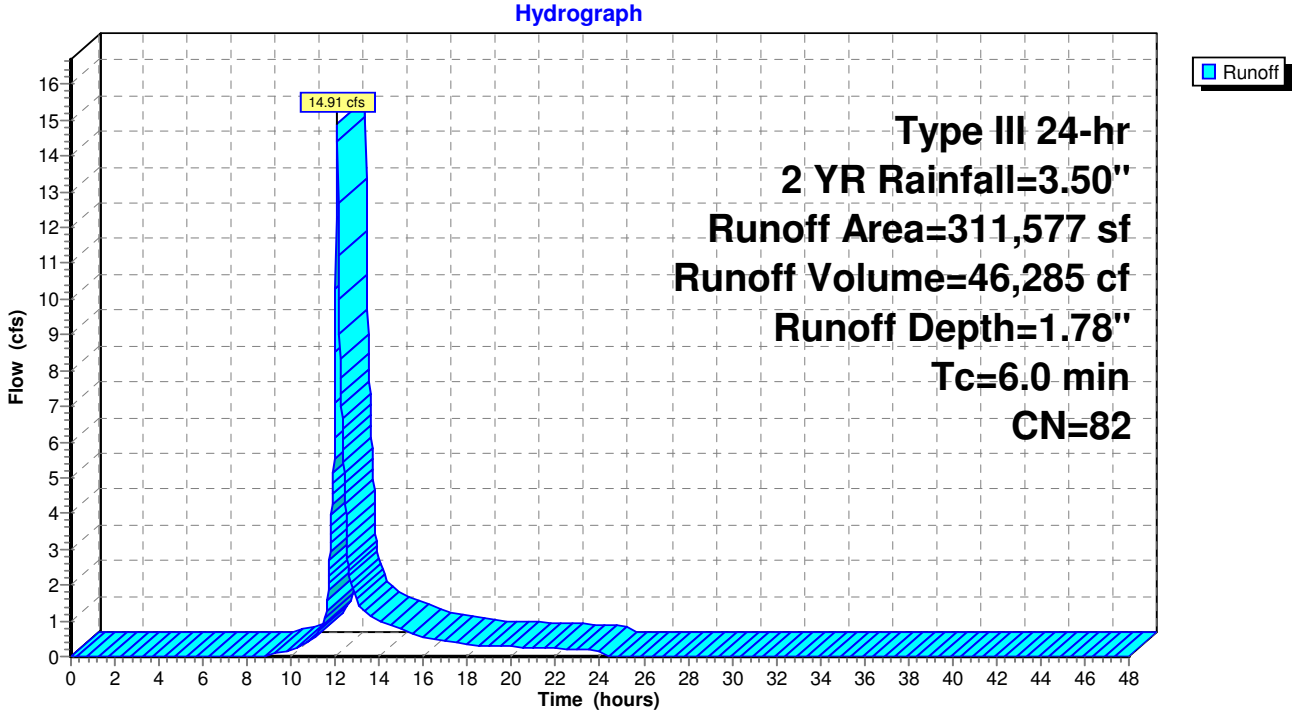
Runoff = 14.91 cfs @ 12.09 hrs, Volume= 46,285 cf, Depth= 1.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
109,905	98	Paved parking, HSG B
201,672	74	>75% Grass cover, Good, HSG C
311,577	82	Weighted Average
201,672		64.73% Pervious Area
109,905		35.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N4: Surface Parking Area and Access Driveway



Summary for Subcatchment POST-N5: Area Flowing to Isolated Wetland

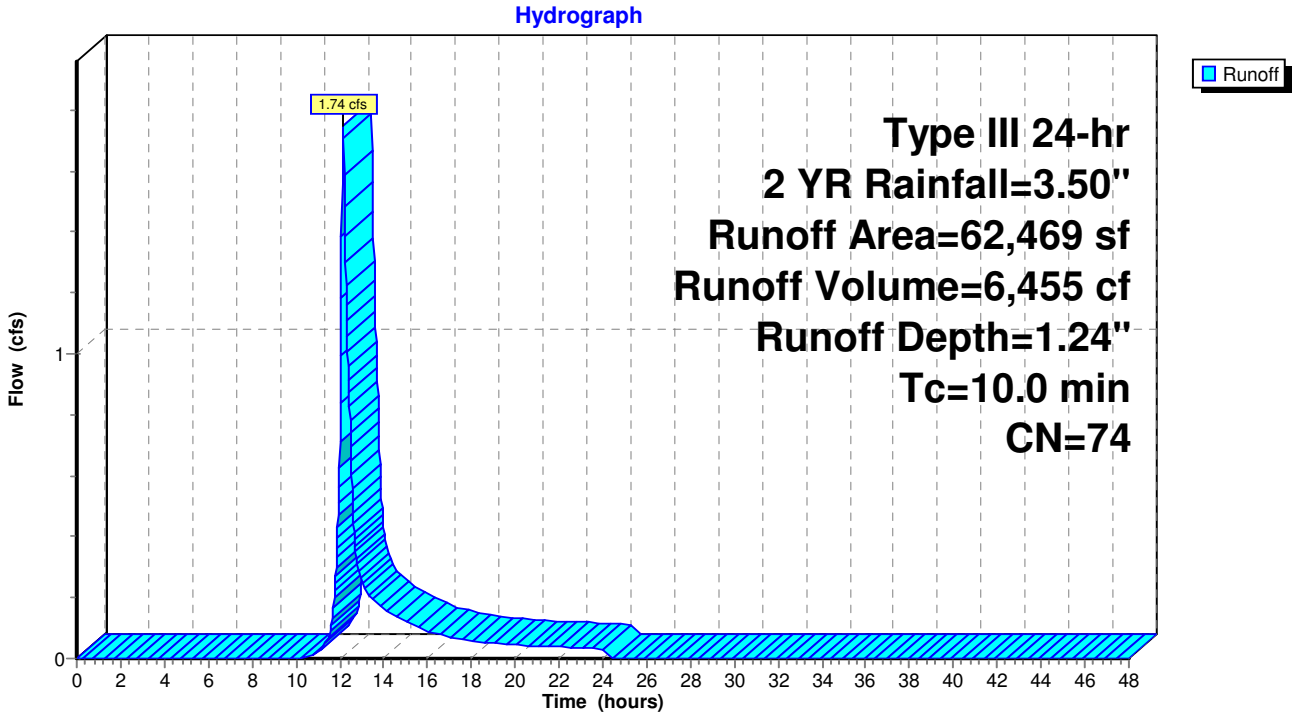
Runoff = 1.74 cfs @ 12.15 hrs, Volume= 6,455 cf, Depth= 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YR Rainfall=3.50"

Area (sf)	CN	Description
8,370	98	Water Surface
54,099	70	Woods, Good, HSG C
62,469	74	Weighted Average
54,099		86.60% Pervious Area
8,370		13.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-N5: Area Flowing to Isolated Wetland



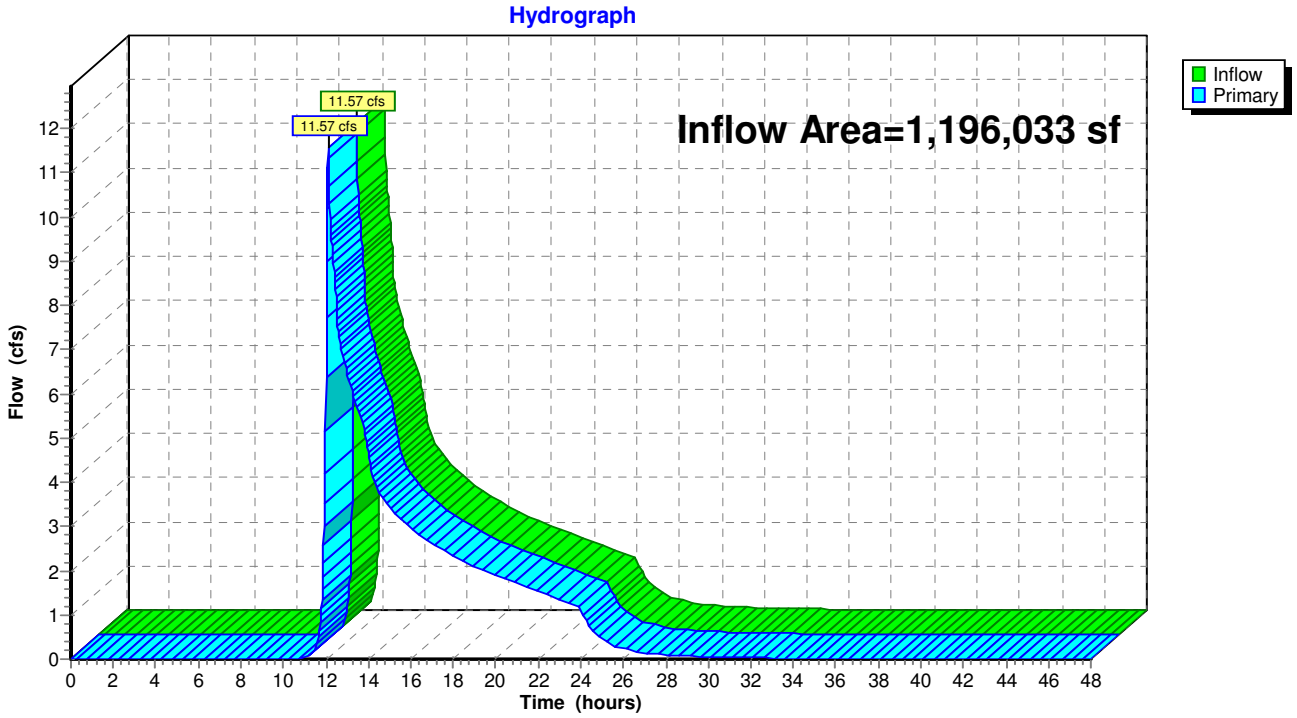
Summary for Pond AP-4: Wetlands Associated with Barstow Pond

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1,196,033 sf, 25.94% Impervious, Inflow Depth = 1.41" for 2 YR event
Inflow = 11.57 cfs @ 12.11 hrs, Volume= 140,155 cf
Primary = 11.57 cfs @ 12.11 hrs, Volume= 140,155 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

Pond AP-4: Wetlands Associated with Barstow Pond



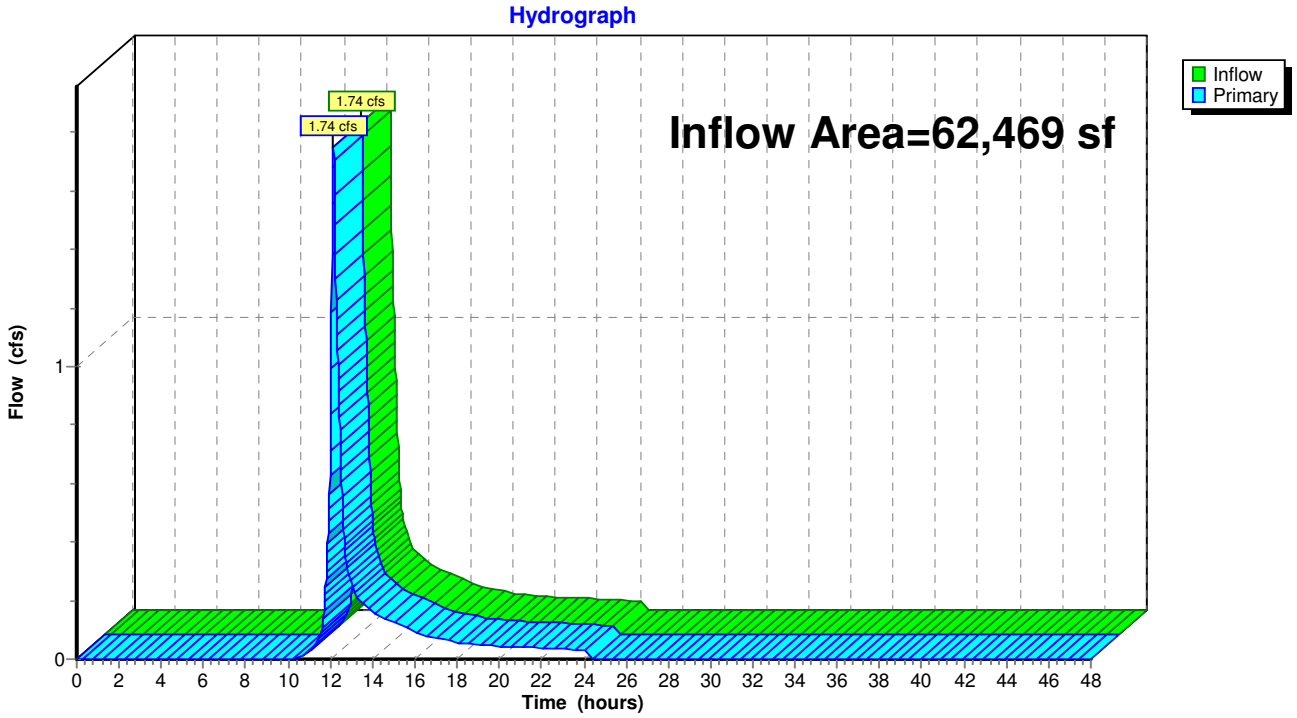
Summary for Pond AP-5: Isolated Wetland Area

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 62,469 sf, 13.40% Impervious, Inflow Depth = 1.24" for 2 YR event
Inflow = 1.74 cfs @ 12.15 hrs, Volume= 6,455 cf
Primary = 1.74 cfs @ 12.15 hrs, Volume= 6,455 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

Pond AP-5: Isolated Wetland Area



Summary for Pond BASIN N-1: Proposed Extended Detention Wetland System 1

Inflow Area = 617,653 sf, 32.44% Impervious, Inflow Depth = 1.64" for 2 YR event
Inflow = 26.99 cfs @ 12.09 hrs, Volume= 84,225 cf
Outflow = 2.08 cfs @ 13.75 hrs, Volume= 74,944 cf, Atten= 92%, Lag= 99.6 min
Primary = 2.08 cfs @ 13.75 hrs, Volume= 74,944 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 22.03' @ 13.75 hrs Surf.Area= 25,288 sf Storage= 43,500 cf
Flood Elev= 25.00' Surf.Area= 37,045 sf Storage= 135,944 cf

Plug-Flow detention time= 285.1 min calculated for 74,913 cf (89% of inflow)
Center-of-Mass det. time= 233.1 min (1,071.3 - 838.2)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	135,944 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

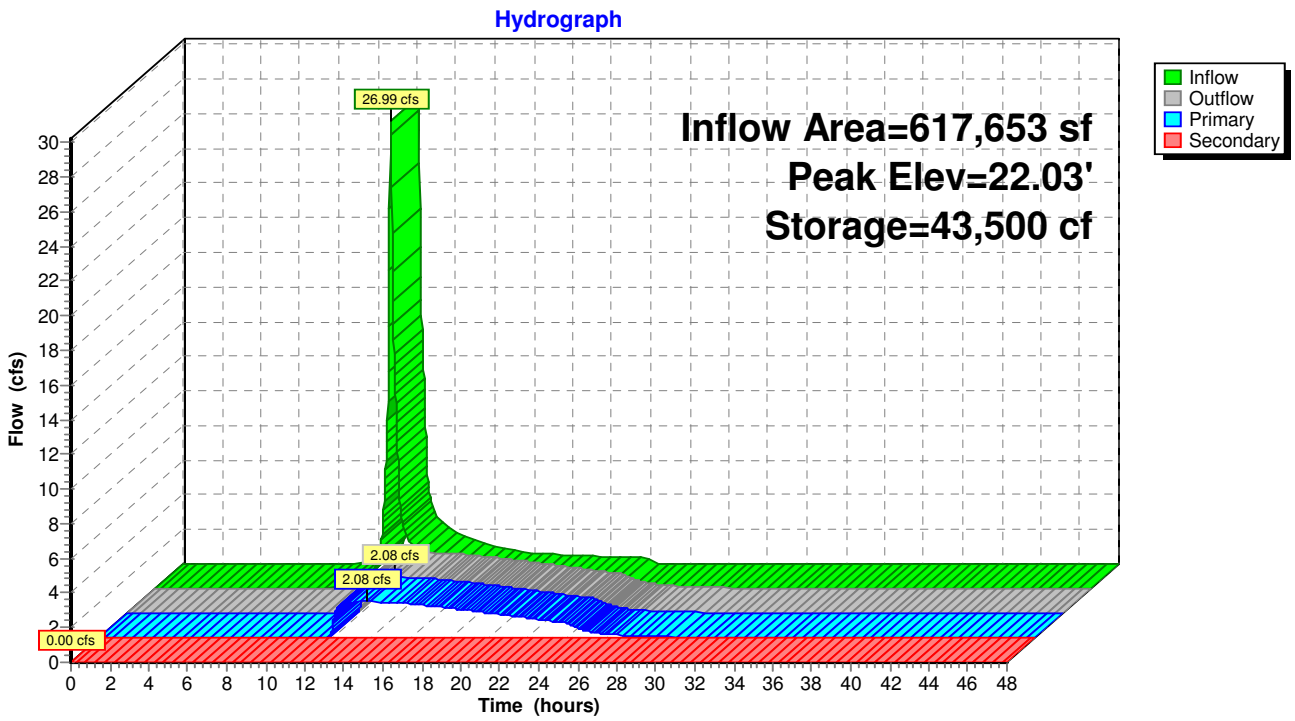
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
20.00	17,621	0	0
21.00	21,362	19,492	19,492
22.00	25,174	23,268	42,760
23.00	29,059	27,117	69,876
24.00	33,016	31,038	100,914
25.00	37,045	35,031	135,944

Device	Routing	Invert	Outlet Devices
#1	Secondary	24.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	16.00'	**18.0" Round Culvert** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 16.00' / 15.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	20.50'	**8.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	22.50'	**4.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=2.08 cfs @ 13.75 hrs HW=22.03' (Free Discharge)
└─**2=Culvert** (Passes 2.08 cfs of 19.55 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 2.08 cfs @ 5.95 fps)
  └─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=20.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond BASIN N-1: Proposed Extended Detention Wetland System 1



Summary for Pond BASIN N-2: Proposed Extended Detention Wetland System 2

Inflow Area = 311,577 sf, 35.27% Impervious, Inflow Depth = 1.78" for 2 YR event
Inflow = 14.91 cfs @ 12.09 hrs, Volume= 46,285 cf
Outflow = 4.00 cfs @ 12.48 hrs, Volume= 41,560 cf, Atten= 73%, Lag= 23.2 min
Primary = 4.00 cfs @ 12.48 hrs, Volume= 41,560 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 24.62' @ 12.48 hrs Surf.Area= 12,176 sf Storage= 17,109 cf
Flood Elev= 27.00' Surf.Area= 17,218 sf Storage= 51,998 cf

Plug-Flow detention time= 112.2 min calculated for 41,560 cf (90% of inflow)
Center-of-Mass det. time= 62.6 min (894.6 - 832.0)

Volume	Invert	Avail.Storage	Storage Description
#1	23.00'	51,998 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

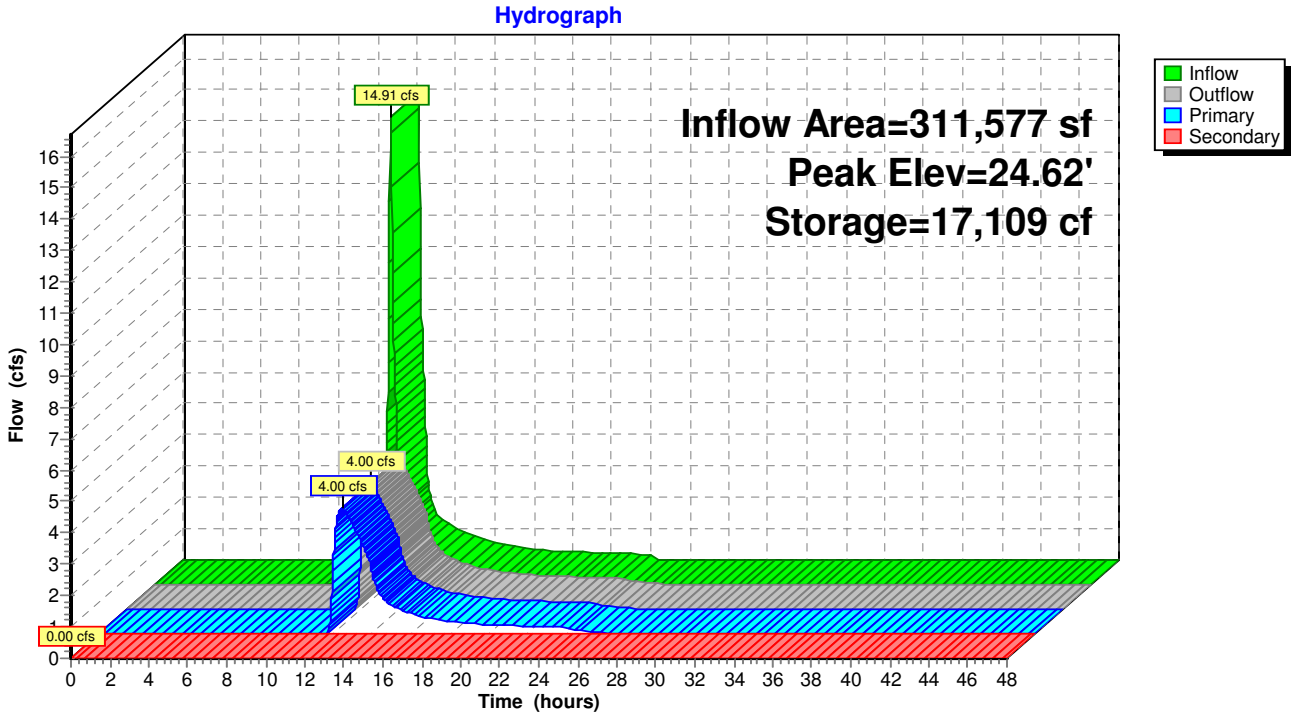
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
23.00	8,961	0	0
24.00	10,917	9,939	9,939
25.00	12,945	11,931	21,870
26.00	15,046	13,996	35,866
27.00	17,218	16,132	51,998

Device	Routing	Invert	Outlet Devices
#1	Device 2	23.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	20.00'	**12.0" Round Culvert** L= 75.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 19.00' S= 0.0133 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Secondary	26.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.00 cfs @ 12.48 hrs HW=24.62' (Free Discharge)
└─**2=Culvert** (Passes 4.00 cfs of 7.59 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 4.00 cfs @ 5.10 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=23.00' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond BASIN N-2: Proposed Extended Detention Wetland System 2



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment POST-N1: Unattenuated Runoff Area=187,943 sf 0.00% Impervious Runoff Depth=1.97"
Tc=6.0 min CN=71 Runoff=9.75 cfs 30,799 cf

Subcatchment POST-N2: Water Park Area Runoff Area=617,653 sf 32.44% Impervious Runoff Depth=2.72"
Tc=6.0 min CN=80 Runoff=45.15 cfs 139,956 cf

Subcatchment POST-N3: Unattenuated Runoff Area=78,860 sf 0.00% Impervious Runoff Depth=1.97"
Tc=6.0 min CN=71 Runoff=4.09 cfs 12,923 cf

Subcatchment POST-N4: Surface Parking Runoff Area=311,577 sf 35.27% Impervious Runoff Depth=2.90"
Tc=6.0 min CN=82 Runoff=24.25 cfs 75,319 cf

Subcatchment POST-N5: Area Flowing to Runoff Area=62,469 sf 13.40% Impervious Runoff Depth=2.21"
Tc=10.0 min CN=74 Runoff=3.21 cfs 11,483 cf

Pond AP-4: Wetlands Associated with Barstow Pond Inflow=20.12 cfs 244,988 cf
Primary=20.12 cfs 244,988 cf

Pond AP-5: Isolated Wetland Area Inflow=3.21 cfs 11,483 cf
Primary=3.21 cfs 11,483 cf

Pond BASIN N-1: Proposed Extended Peak Elev=22.98' Storage=69,240 cf Inflow=45.15 cfs 139,956 cf
Primary=6.26 cfs 130,671 cf Secondary=0.00 cfs 0 cf Outflow=6.26 cfs 130,671 cf

Pond BASIN N-2: Proposed Extended Peak Elev=25.52' Storage=28,934 cf Inflow=24.25 cfs 75,319 cf
Primary=5.38 cfs 70,594 cf Secondary=0.00 cfs 0 cf Outflow=5.38 cfs 70,594 cf

Total Runoff Area = 1,258,502 sf Runoff Volume = 270,481 cf Average Runoff Depth = 2.58"
74.68% Pervious = 939,837 sf 25.32% Impervious = 318,665 sf

Summary for Subcatchment POST-N1: Unattenuated Area to Wetlands Associated With Barstows Pond

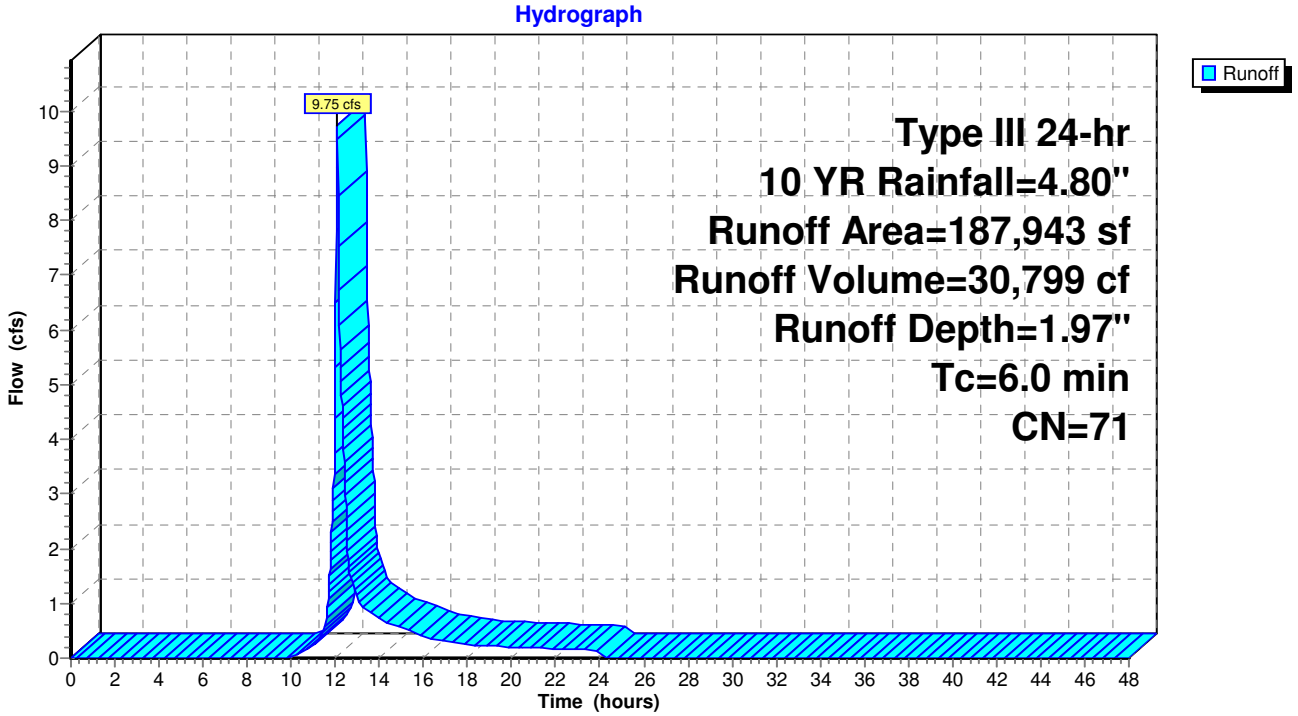
Runoff = 9.75 cfs @ 12.09 hrs, Volume= 30,799 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
147,943	70	Woods, Good, HSG C
40,000	74	>75% Grass cover, Good, HSG C
187,943	71	Weighted Average
187,943		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N1: Unattenuated Area to Wetlands Associated With Barstows Pond



Summary for Subcatchment POST-N2: Water Park Area and Access Driveway

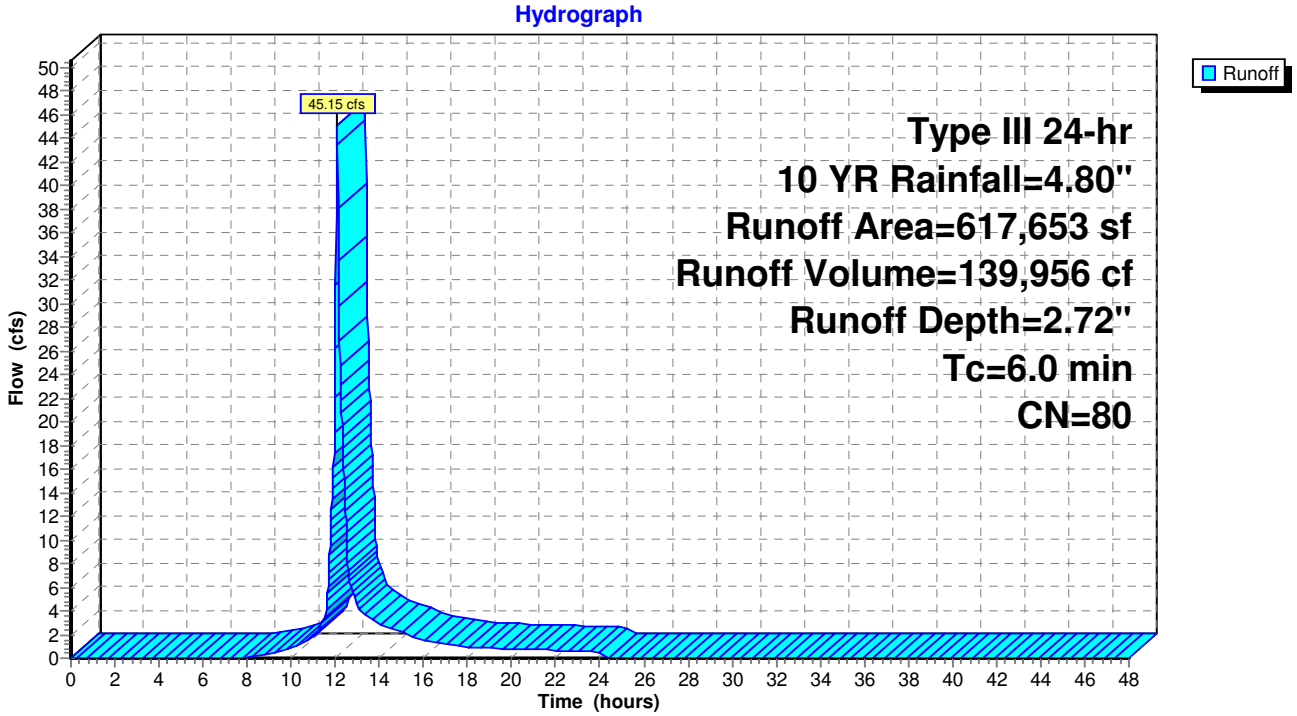
Runoff = 45.15 cfs @ 12.09 hrs, Volume= 139,956 cf, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
200,390	98	Paved parking, HSG C
237,263	70	Woods, Good, HSG C
180,000	74	>75% Grass cover, Good, HSG C
617,653	80	Weighted Average
417,263		67.56% Pervious Area
200,390		32.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N2: Water Park Area and Access Driveway



Summary for Subcatchment POST-N3: Unattenuated Area to Wetlands Associated With Barstows Pond

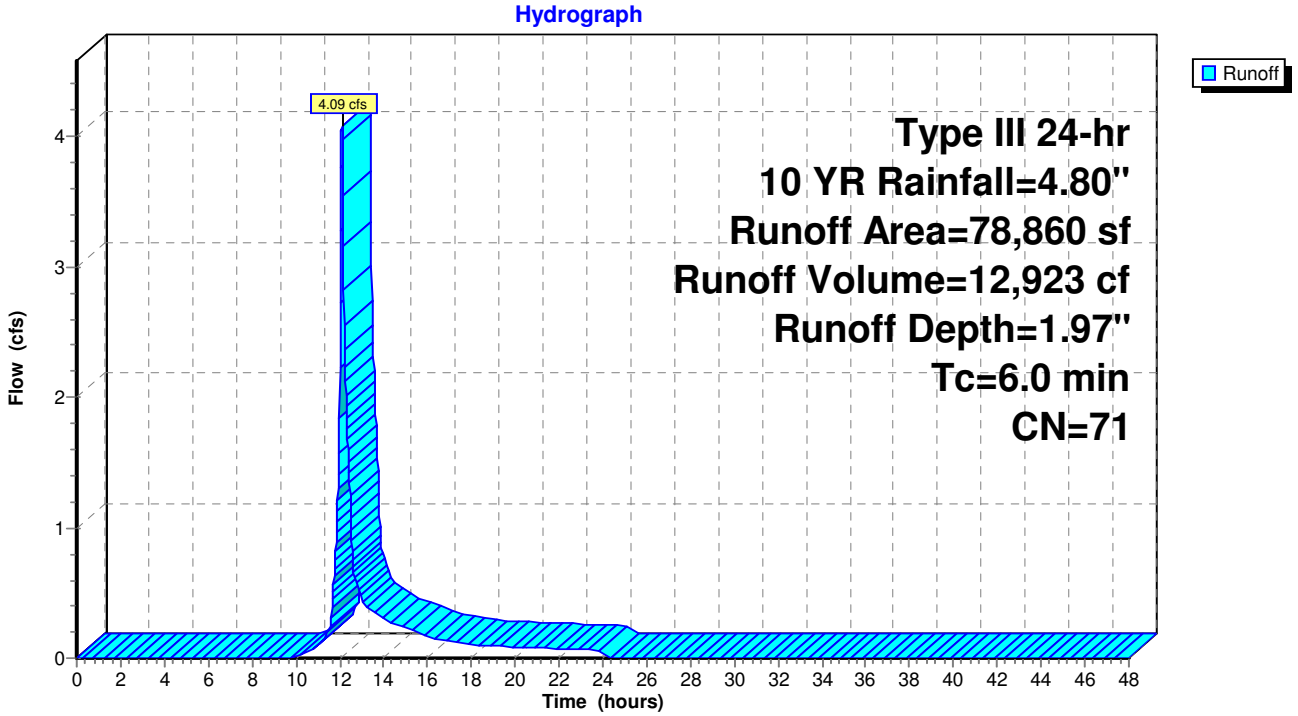
Runoff = 4.09 cfs @ 12.09 hrs, Volume= 12,923 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
62,860	70	Woods, Good, HSG C
16,000	74	>75% Grass cover, Good, HSG C
78,860	71	Weighted Average
78,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N3: Unattenuated Area to Wetlands Associated With Barstows Pond



Summary for Subcatchment POST-N4: Surface Parking Area and Access Driveway

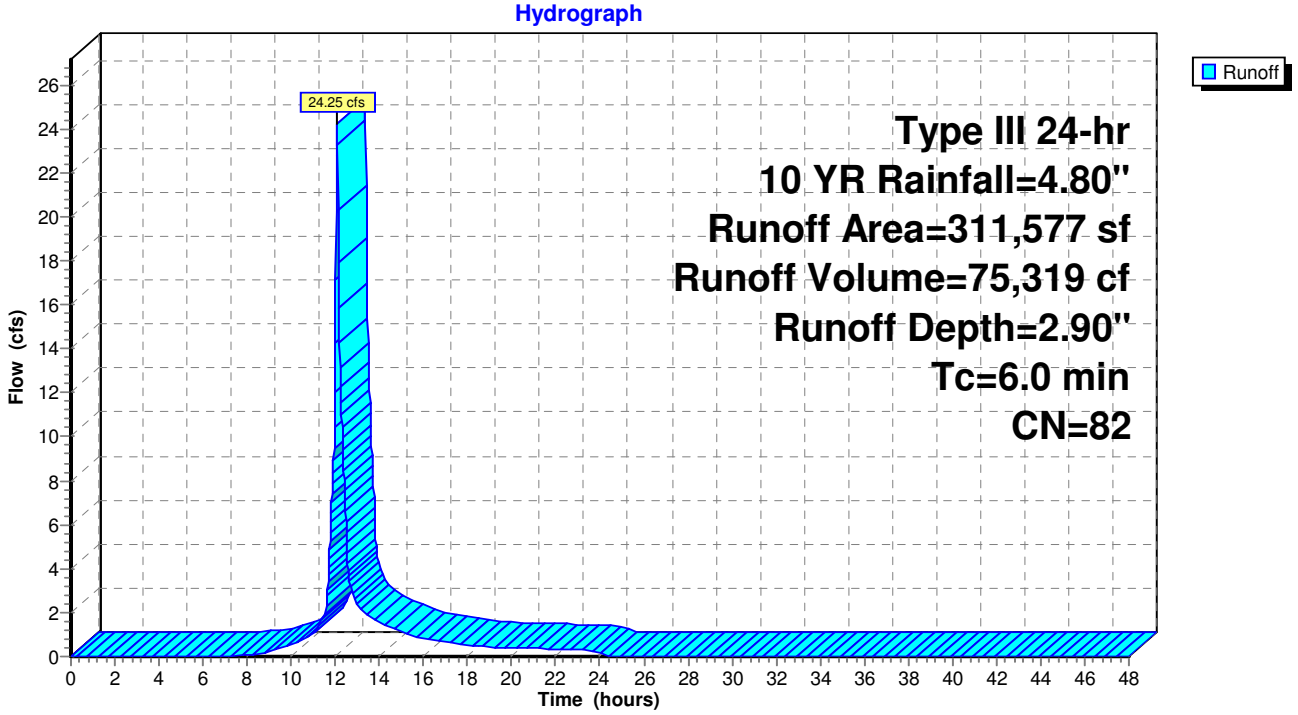
Runoff = 24.25 cfs @ 12.09 hrs, Volume= 75,319 cf, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
109,905	98	Paved parking, HSG B
201,672	74	>75% Grass cover, Good, HSG C
311,577	82	Weighted Average
201,672		64.73% Pervious Area
109,905		35.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N4: Surface Parking Area and Access Driveway



Summary for Subcatchment POST-N5: Area Flowing to Isolated Wetland

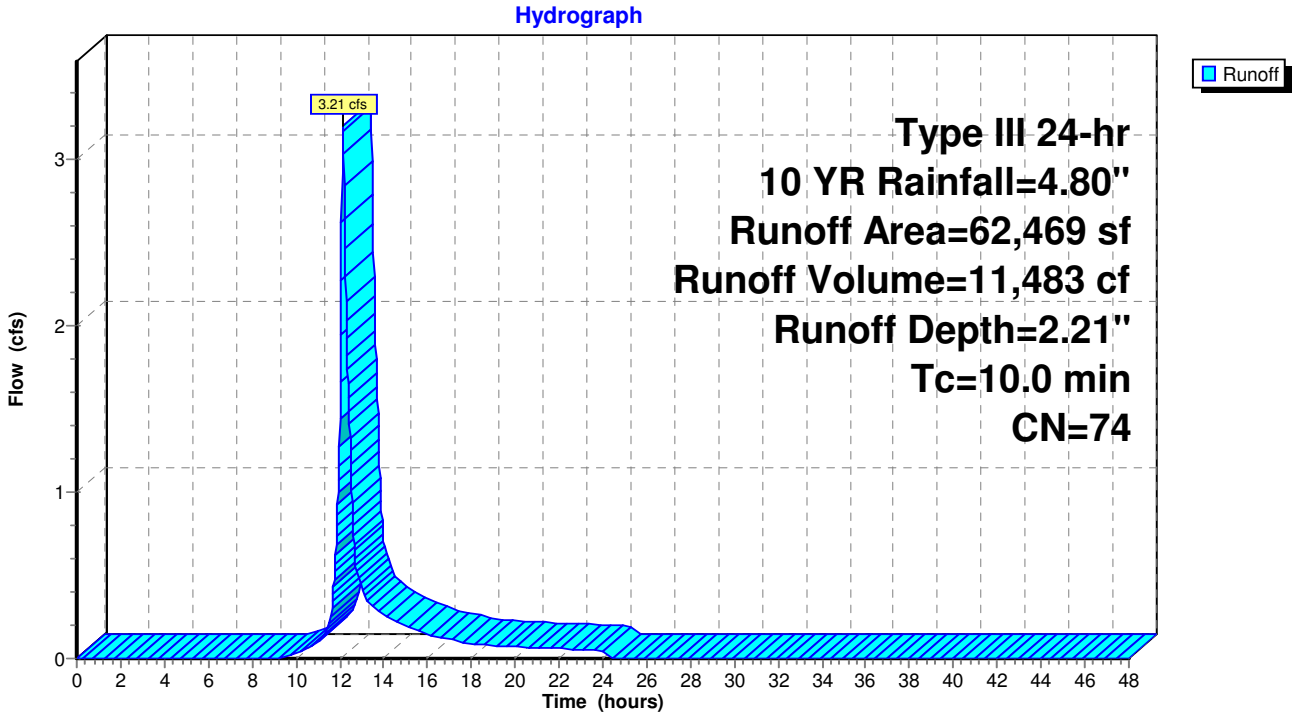
Runoff = 3.21 cfs @ 12.14 hrs, Volume= 11,483 cf, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YR Rainfall=4.80"

Area (sf)	CN	Description
8,370	98	Water Surface
54,099	70	Woods, Good, HSG C
62,469	74	Weighted Average
54,099		86.60% Pervious Area
8,370		13.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-N5: Area Flowing to Isolated Wetland



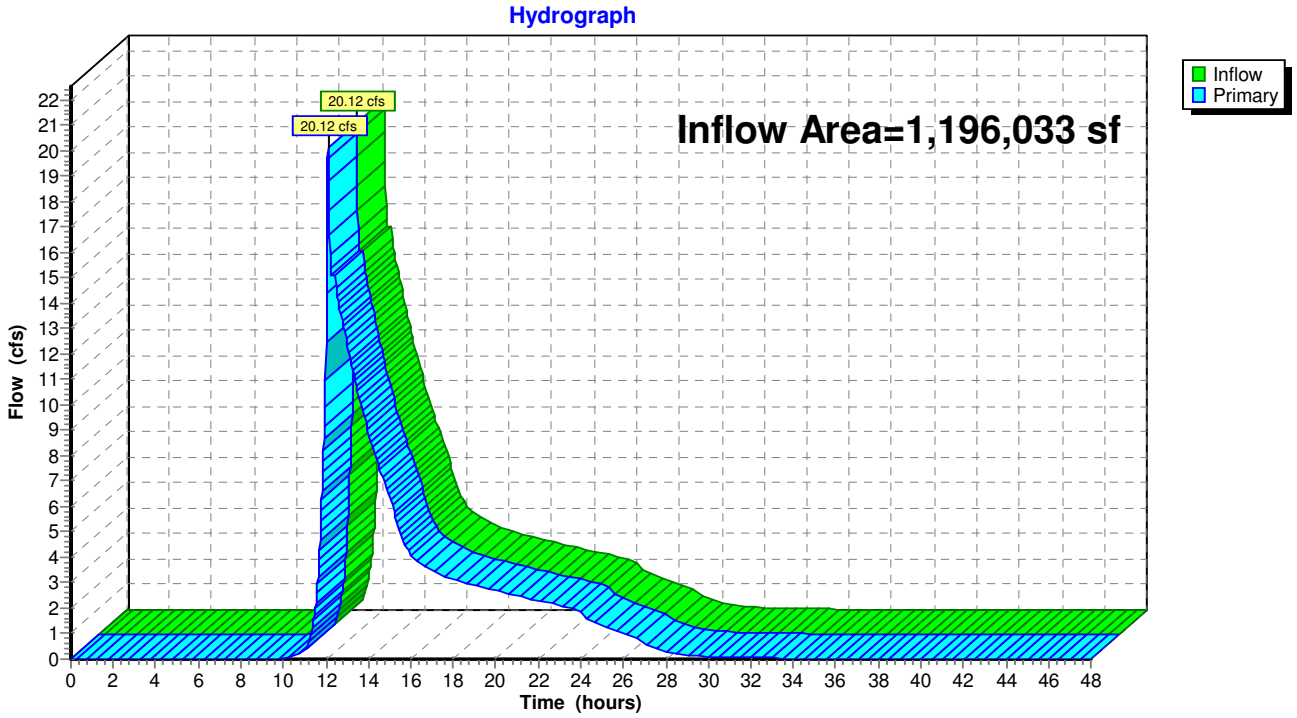
Summary for Pond AP-4: Wetlands Associated with Barstow Pond

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1,196,033 sf, 25.94% Impervious, Inflow Depth = 2.46" for 10 YR event
Inflow = 20.12 cfs @ 12.10 hrs, Volume= 244,988 cf
Primary = 20.12 cfs @ 12.10 hrs, Volume= 244,988 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

Pond AP-4: Wetlands Associated with Barstow Pond



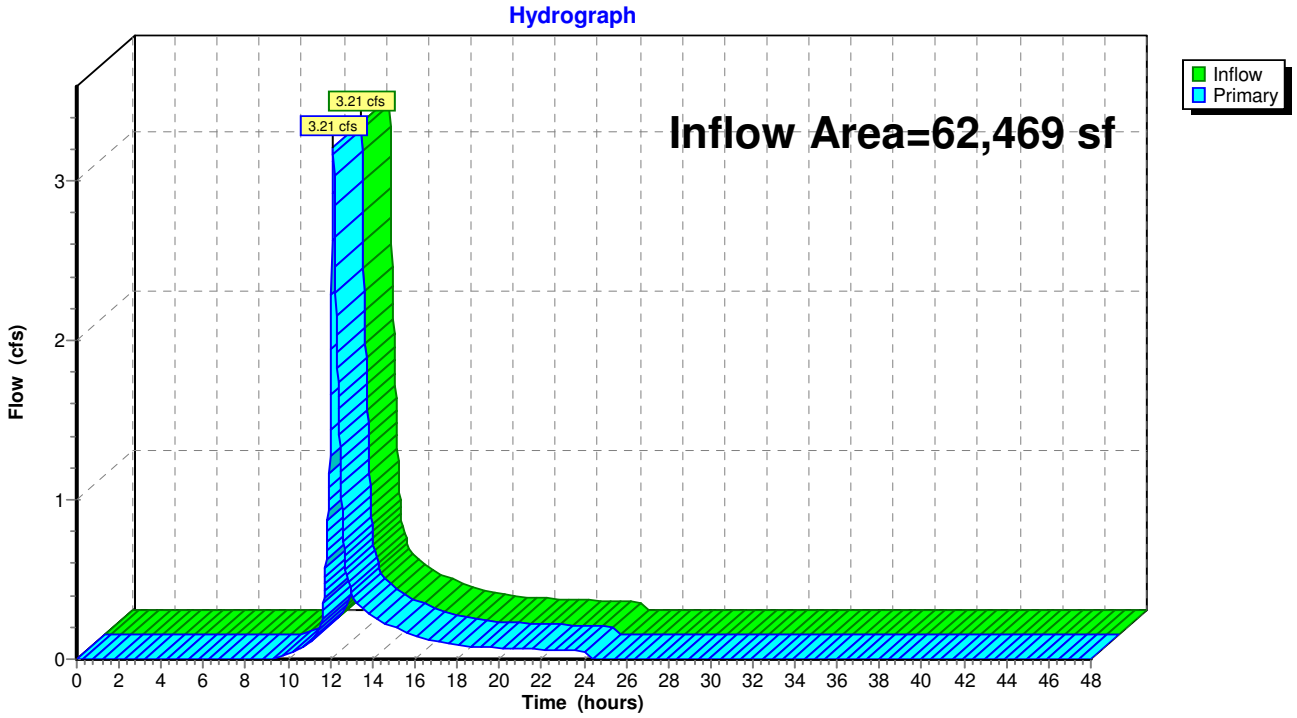
Summary for Pond AP-5: Isolated Wetland Area

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 62,469 sf, 13.40% Impervious, Inflow Depth = 2.21" for 10 YR event
Inflow = 3.21 cfs @ 12.14 hrs, Volume= 11,483 cf
Primary = 3.21 cfs @ 12.14 hrs, Volume= 11,483 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

Pond AP-5: Isolated Wetland Area



Summary for Pond BASIN N-1: Proposed Extended Detention Wetland System 1

Inflow Area = 617,653 sf, 32.44% Impervious, Inflow Depth = 2.72" for 10 YR event
Inflow = 45.15 cfs @ 12.09 hrs, Volume= 139,956 cf
Outflow = 6.26 cfs @ 12.66 hrs, Volume= 130,671 cf, Atten= 86%, Lag= 34.0 min
Primary = 6.26 cfs @ 12.66 hrs, Volume= 130,671 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 22.98' @ 12.66 hrs Surf.Area= 28,974 sf Storage= 69,240 cf
Flood Elev= 25.00' Surf.Area= 37,045 sf Storage= 135,944 cf

Plug-Flow detention time= 278.1 min calculated for 130,616 cf (93% of inflow)
Center-of-Mass det. time= 243.6 min (1,067.2 - 823.6)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	135,944 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

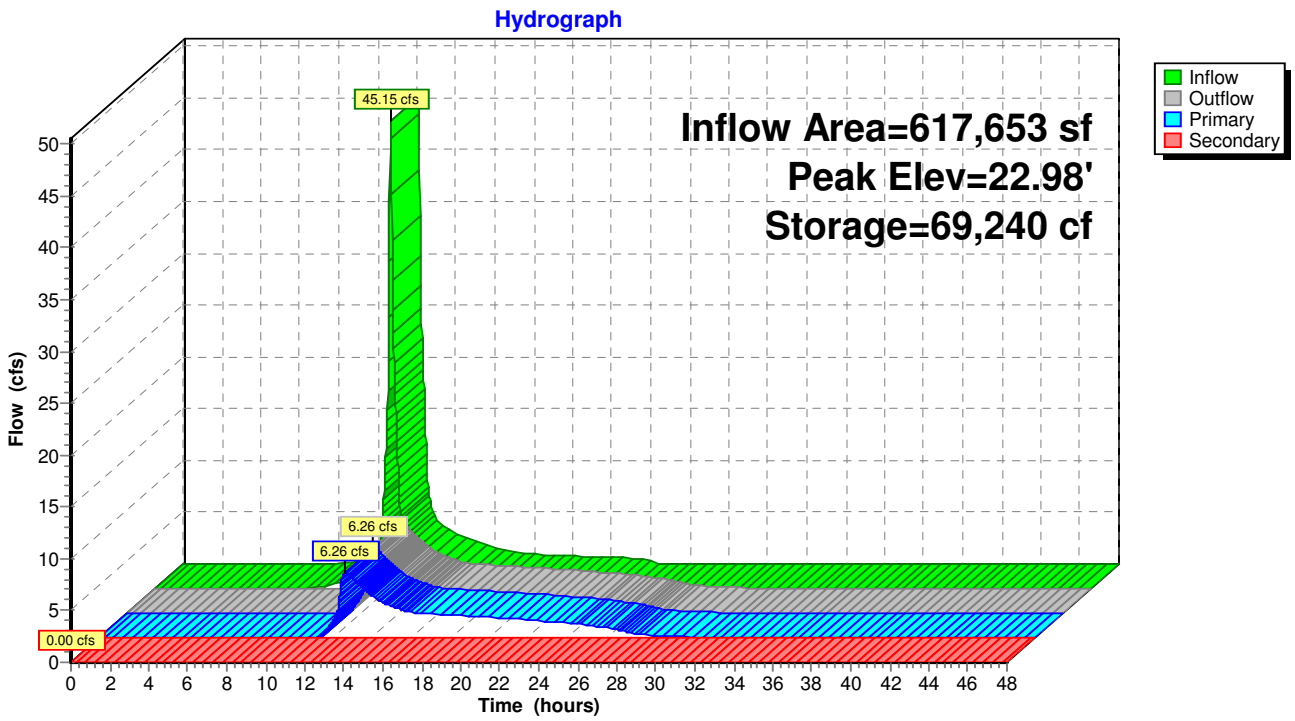
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
20.00	17,621	0	0
21.00	21,362	19,492	19,492
22.00	25,174	23,268	42,760
23.00	29,059	27,117	69,876
24.00	33,016	31,038	100,914
25.00	37,045	35,031	135,944

Device	Routing	Invert	Outlet Devices
#1	Secondary	24.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	16.00'	**18.0" Round Culvert** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 16.00' / 15.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	20.50'	**8.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	22.50'	**4.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=6.26 cfs @ 12.66 hrs HW=22.98' (Free Discharge)
└─**2=Culvert** (Passes 6.26 cfs of 21.23 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 2.65 cfs @ 7.58 fps)
  └─**4=Broad-Crested Rectangular Weir** (Weir Controls 3.61 cfs @ 1.89 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=20.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond BASIN N-1: Proposed Extended Detention Wetland System 1



Summary for Pond BASIN N-2: Proposed Extended Detention Wetland System 2

Inflow Area = 311,577 sf, 35.27% Impervious, Inflow Depth = 2.90" for 10 YR event
Inflow = 24.25 cfs @ 12.09 hrs, Volume= 75,319 cf
Outflow = 5.38 cfs @ 12.51 hrs, Volume= 70,594 cf, Atten= 78%, Lag= 25.4 min
Primary = 5.38 cfs @ 12.51 hrs, Volume= 70,594 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 25.52' @ 12.51 hrs Surf.Area= 14,045 sf Storage= 28,934 cf
Flood Elev= 27.00' Surf.Area= 17,218 sf Storage= 51,998 cf

Plug-Flow detention time= 100.0 min calculated for 70,565 cf (94% of inflow)
Center-of-Mass det. time= 66.9 min (884.9 - 818.0)

Volume	Invert	Avail.Storage	Storage Description
#1	23.00'	51,998 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

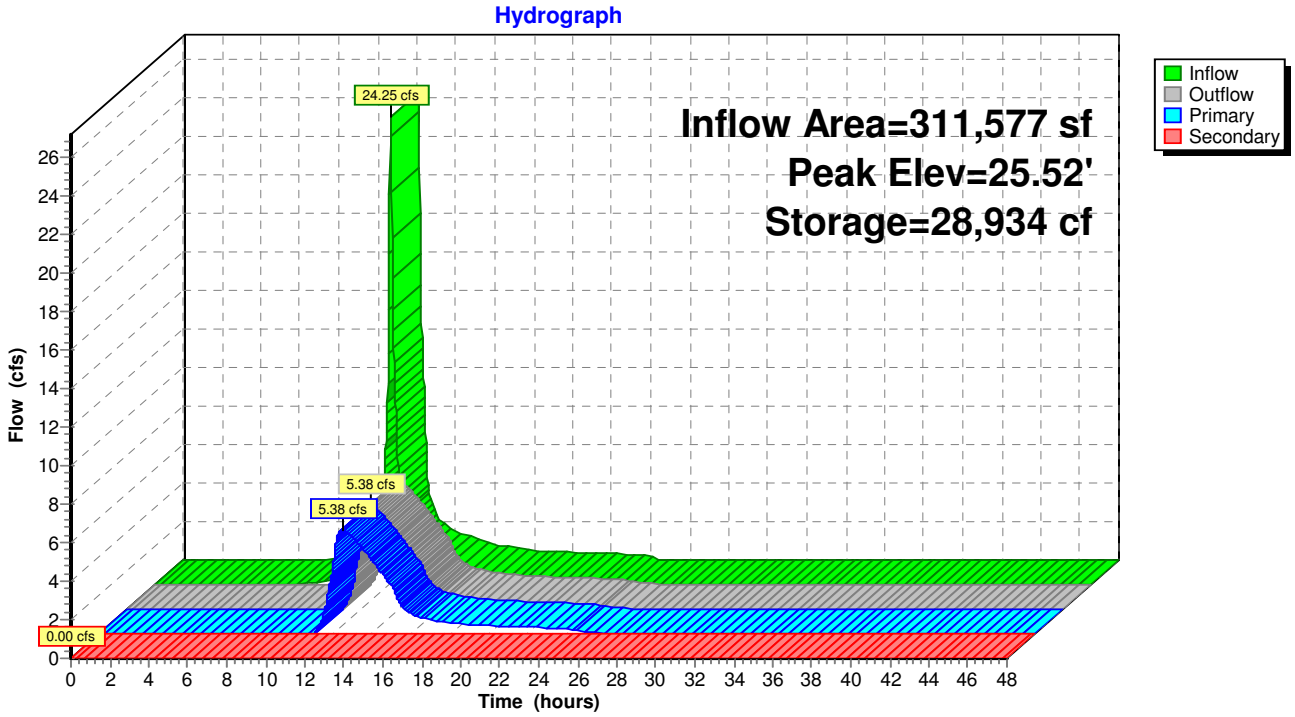
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
23.00	8,961	0	0
24.00	10,917	9,939	9,939
25.00	12,945	11,931	21,870
26.00	15,046	13,996	35,866
27.00	17,218	16,132	51,998

Device	Routing	Invert	Outlet Devices
#1	Device 2	23.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	20.00'	**12.0" Round Culvert** L= 75.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 19.00' S= 0.0133 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Secondary	26.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.38 cfs @ 12.51 hrs HW=25.52' (Free Discharge)
└─**2=Culvert** (Passes 5.38 cfs of 8.30 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 5.38 cfs @ 6.85 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=23.00' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond BASIN N-2: Proposed Extended Detention Wetland System 2



Time span=0.00-48.00 hrs, dt=0.02 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment POST-N1: Unattenuated Runoff Area=187,943 sf 0.00% Impervious Runoff Depth=3.72"
Tc=6.0 min CN=71 Runoff=18.81 cfs 58,316 cf

Subcatchment POST-N2: Water Park Area Runoff Area=617,653 sf 32.44% Impervious Runoff Depth=4.69"
Tc=6.0 min CN=80 Runoff=77.18 cfs 241,628 cf

Subcatchment POST-N3: Unattenuated Runoff Area=78,860 sf 0.00% Impervious Runoff Depth=3.72"
Tc=6.0 min CN=71 Runoff=7.89 cfs 24,469 cf

Subcatchment POST-N4: Surface Parking Runoff Area=311,577 sf 35.27% Impervious Runoff Depth=4.92"
Tc=6.0 min CN=82 Runoff=40.52 cfs 127,647 cf

Subcatchment POST-N5: Area Flowing to Runoff Area=62,469 sf 13.40% Impervious Runoff Depth=4.04"
Tc=10.0 min CN=74 Runoff=5.93 cfs 21,042 cf

Pond AP-4: Wetlands Associated with Barstow Pond Inflow=53.26 cfs 438,046 cf
Primary=53.26 cfs 438,046 cf

Pond AP-5: Isolated Wetland Area Inflow=5.93 cfs 21,042 cf
Primary=5.93 cfs 21,042 cf

Pond BASIN N-1: Proposed Extended Peak Elev=24.00' Storage=100,898 cf Inflow=77.18 cfs 241,628 cf
Primary=22.91 cfs 232,339 cf Secondary=0.00 cfs 0 cf Outflow=22.91 cfs 232,339 cf

Pond BASIN N-2: Proposed Extended Peak Elev=26.36' Storage=41,439 cf Inflow=40.52 cfs 127,647 cf
Primary=6.40 cfs 108,963 cf Secondary=11.05 cfs 13,959 cf Outflow=17.44 cfs 122,922 cf

Total Runoff Area = 1,258,502 sf Runoff Volume = 473,102 cf Average Runoff Depth = 4.51"
74.68% Pervious = 939,837 sf 25.32% Impervious = 318,665 sf

Summary for Subcatchment POST-N1: Unattenuated Area to Wetlands Associated With Barstows Pond

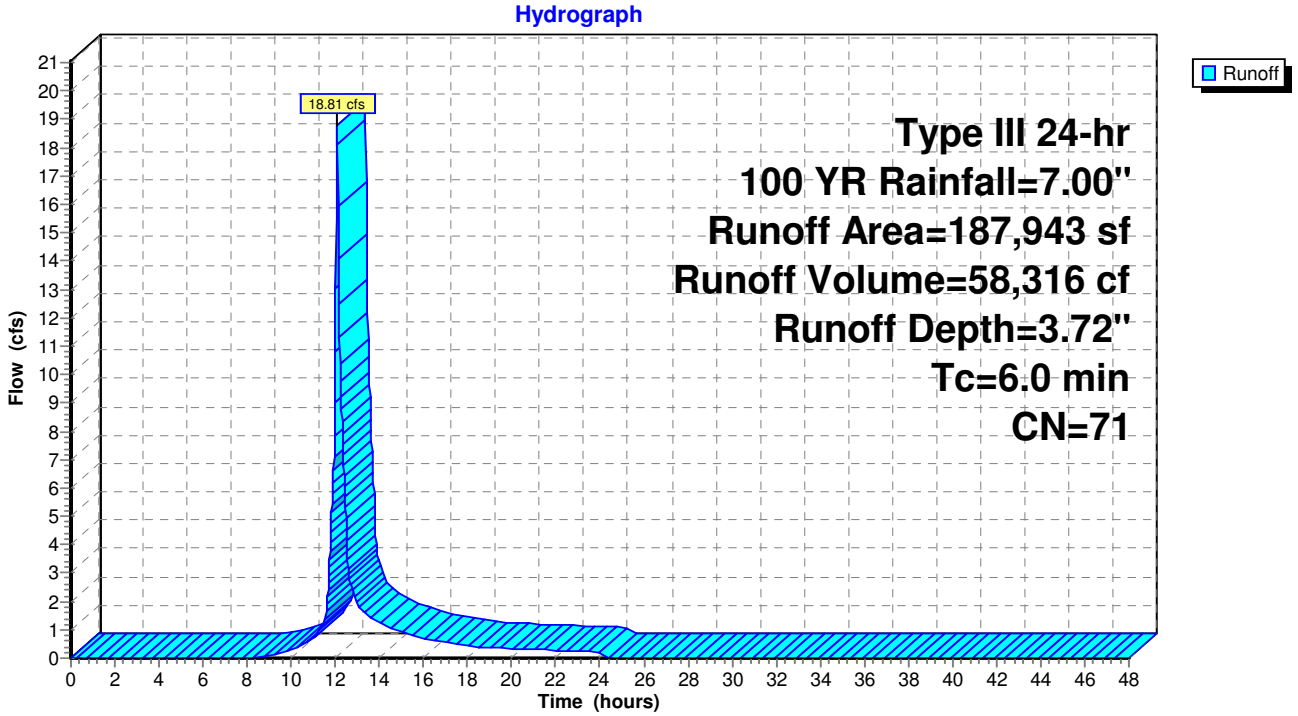
Runoff = 18.81 cfs @ 12.09 hrs, Volume= 58,316 cf, Depth= 3.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
147,943	70	Woods, Good, HSG C
40,000	74	>75% Grass cover, Good, HSG C
187,943	71	Weighted Average
187,943		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N1: Unattenuated Area to Wetlands Associated With Barstows Pond



Summary for Subcatchment POST-N2: Water Park Area and Access Driveway

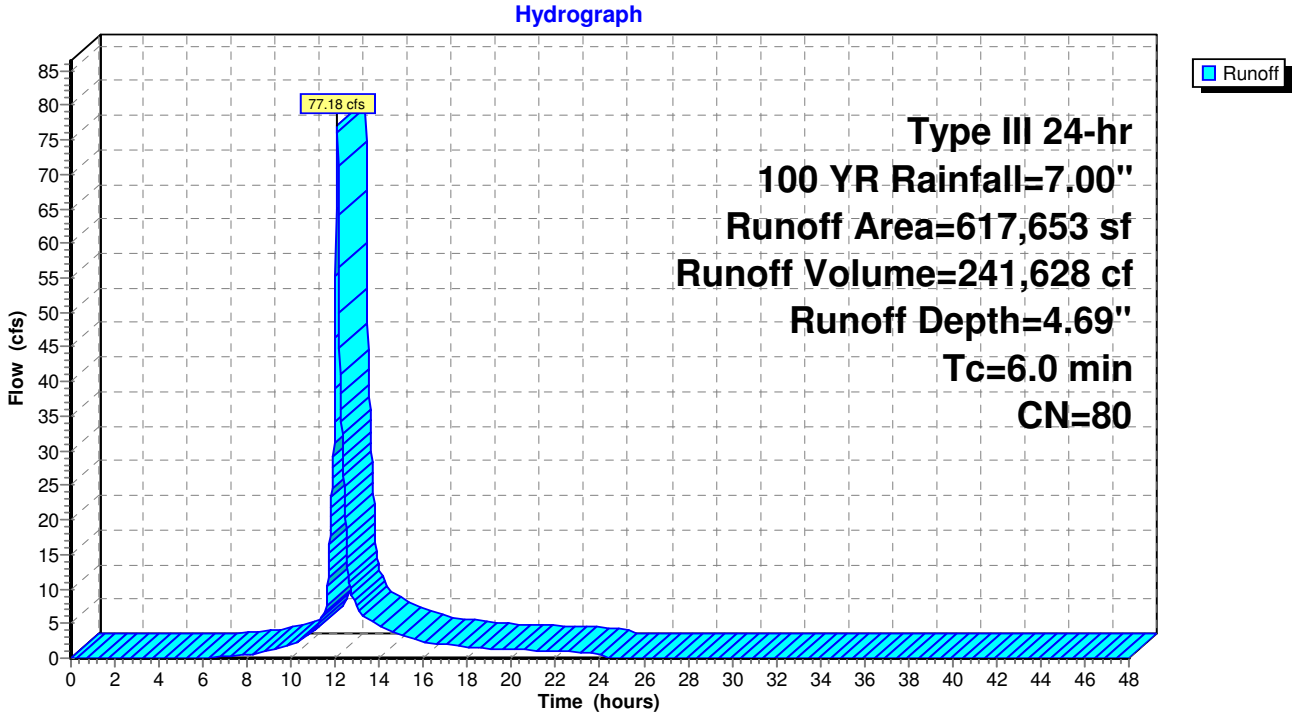
Runoff = 77.18 cfs @ 12.09 hrs, Volume= 241,628 cf, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
200,390	98	Paved parking, HSG C
237,263	70	Woods, Good, HSG C
180,000	74	>75% Grass cover, Good, HSG C
617,653	80	Weighted Average
417,263		67.56% Pervious Area
200,390		32.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N2: Water Park Area and Access Driveway



Summary for Subcatchment POST-N3: Unattenuated Area to Wetlands Associated With Barstows Pond

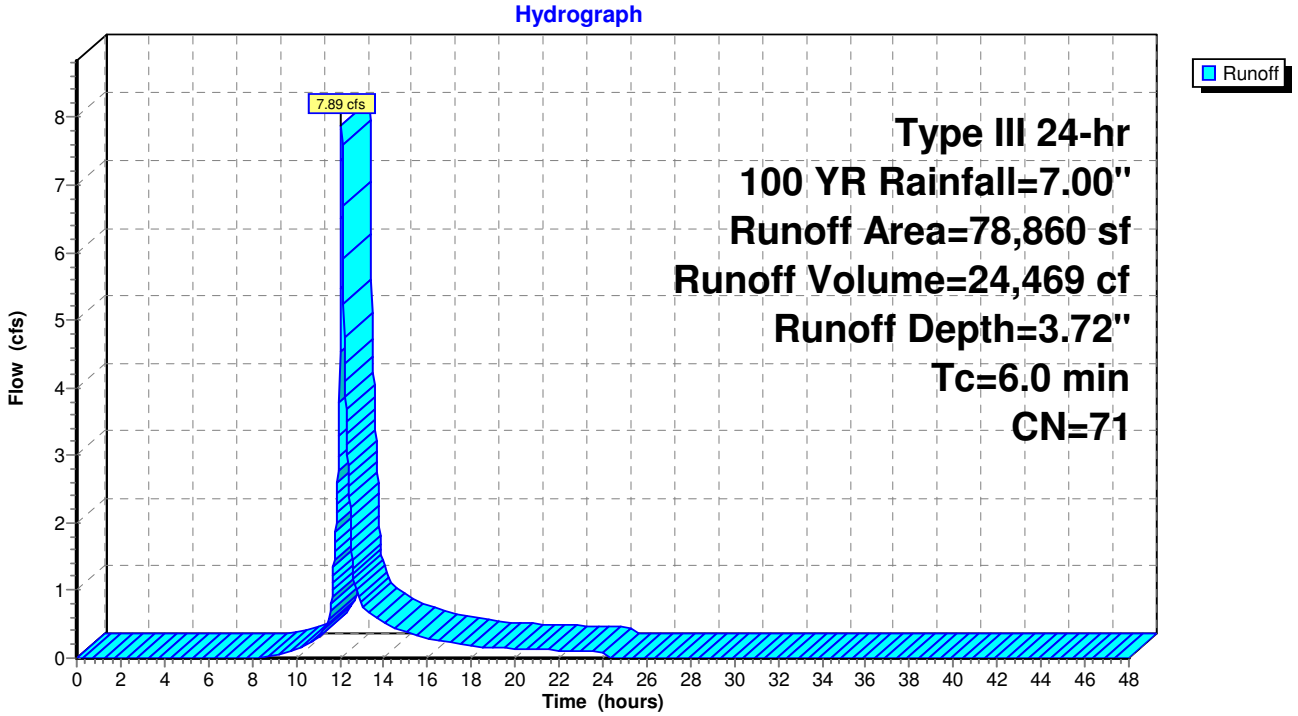
Runoff = 7.89 cfs @ 12.09 hrs, Volume= 24,469 cf, Depth= 3.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
62,860	70	Woods, Good, HSG C
16,000	74	>75% Grass cover, Good, HSG C
78,860	71	Weighted Average
78,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N3: Unattenuated Area to Wetlands Associated With Barstows Pond



Summary for Subcatchment POST-N4: Surface Parking Area and Access Driveway

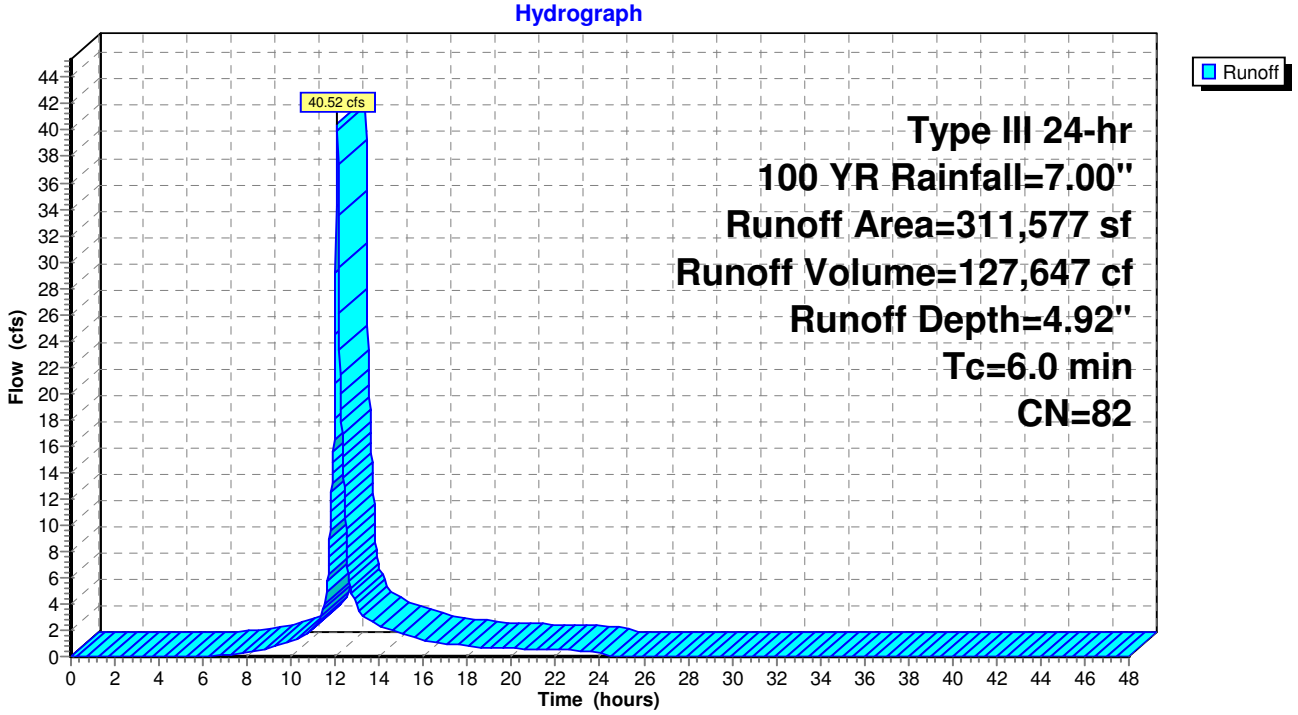
Runoff = 40.52 cfs @ 12.09 hrs, Volume= 127,647 cf, Depth= 4.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
109,905	98	Paved parking, HSG B
201,672	74	>75% Grass cover, Good, HSG C
311,577	82	Weighted Average
201,672		64.73% Pervious Area
109,905		35.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment POST-N4: Surface Parking Area and Access Driveway



Summary for Subcatchment POST-N5: Area Flowing to Isolated Wetland

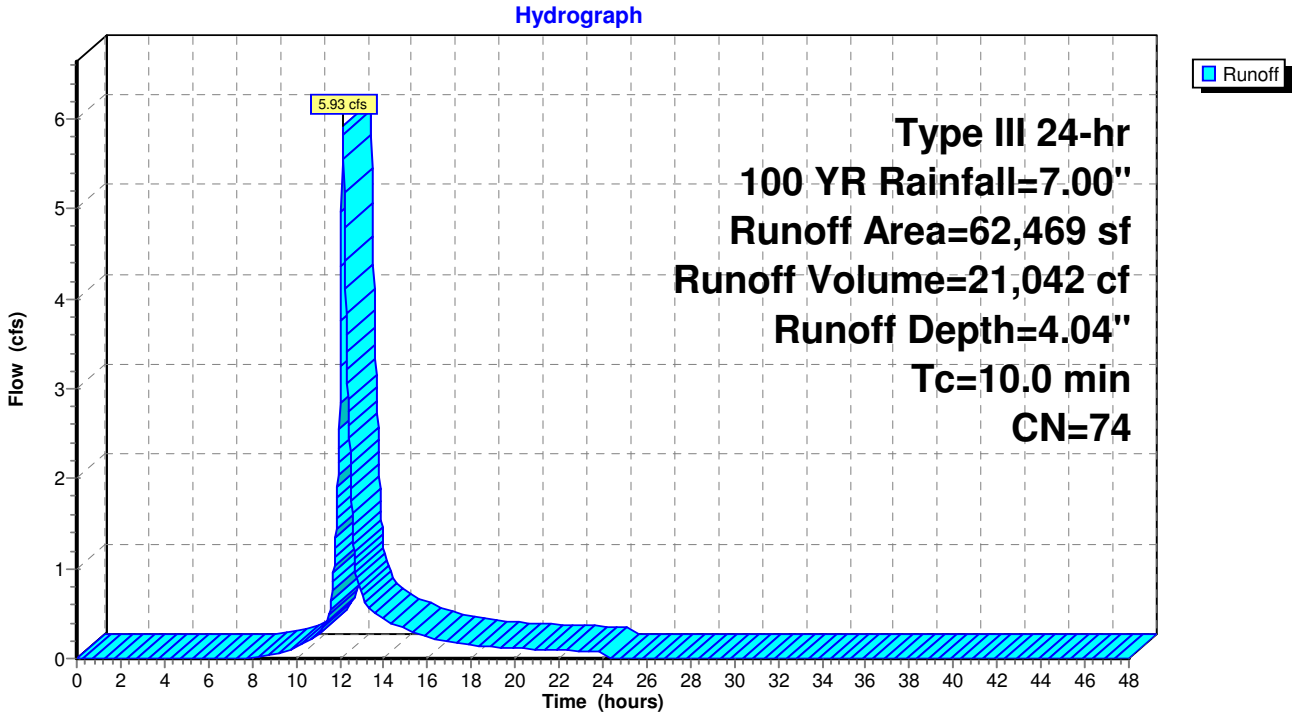
Runoff = 5.93 cfs @ 12.14 hrs, Volume= 21,042 cf, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YR Rainfall=7.00"

Area (sf)	CN	Description
8,370	98	Water Surface
54,099	70	Woods, Good, HSG C
62,469	74	Weighted Average
54,099		86.60% Pervious Area
8,370		13.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment POST-N5: Area Flowing to Isolated Wetland



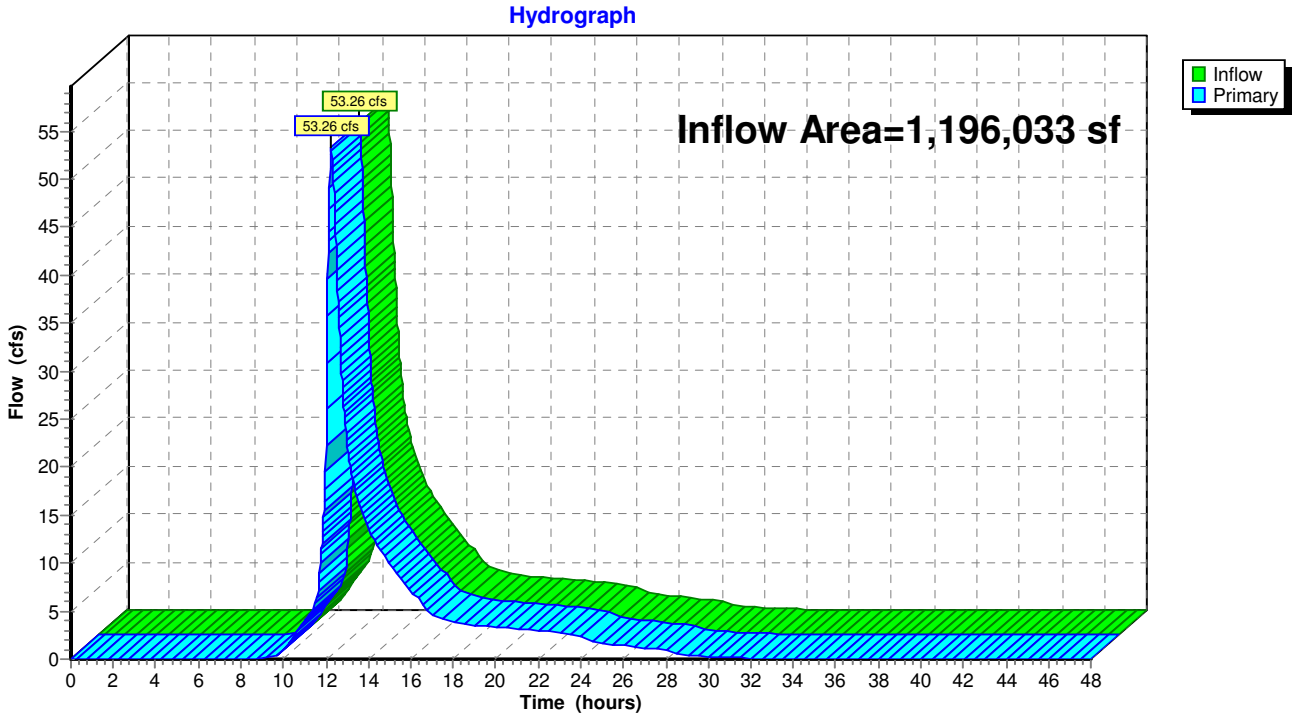
Summary for Pond AP-4: Wetlands Associated with Barstow Pond

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1,196,033 sf, 25.94% Impervious, Inflow Depth = 4.39" for 100 YR event
Inflow = 53.26 cfs @ 12.25 hrs, Volume= 438,046 cf
Primary = 53.26 cfs @ 12.25 hrs, Volume= 438,046 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

Pond AP-4: Wetlands Associated with Barstow Pond



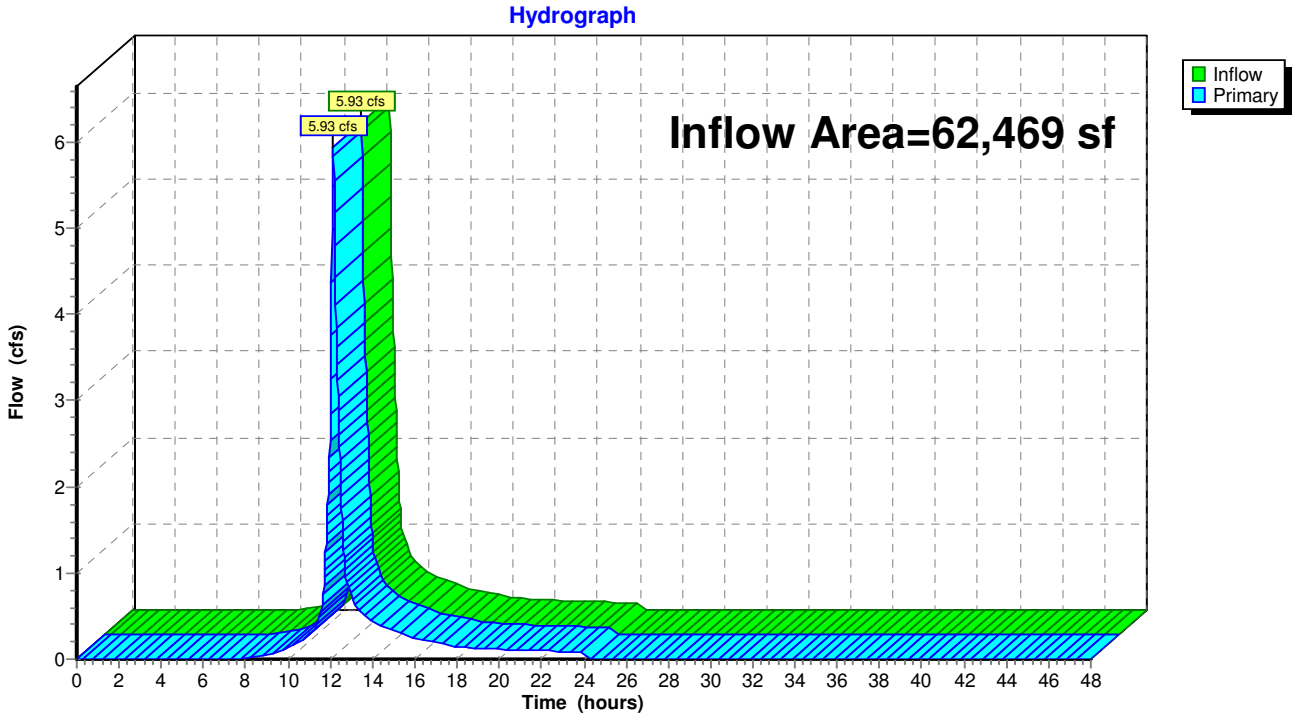
Summary for Pond AP-5: Isolated Wetland Area

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 62,469 sf, 13.40% Impervious, Inflow Depth = 4.04" for 100 YR event
Inflow = 5.93 cfs @ 12.14 hrs, Volume= 21,042 cf
Primary = 5.93 cfs @ 12.14 hrs, Volume= 21,042 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs / 4

Pond AP-5: Isolated Wetland Area



Summary for Pond BASIN N-1: Proposed Extended Detention Wetland System 1

Inflow Area = 617,653 sf, 32.44% Impervious, Inflow Depth = 4.69" for 100 YR event
Inflow = 77.18 cfs @ 12.09 hrs, Volume= 241,628 cf
Outflow = 22.91 cfs @ 12.43 hrs, Volume= 232,339 cf, Atten= 70%, Lag= 20.3 min
Primary = 22.91 cfs @ 12.43 hrs, Volume= 232,339 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 24.00' @ 12.43 hrs Surf.Area= 33,014 sf Storage= 100,898 cf
Flood Elev= 25.00' Surf.Area= 37,045 sf Storage= 135,944 cf

Plug-Flow detention time= 203.7 min calculated for 232,242 cf (96% of inflow)
Center-of-Mass det. time= 182.2 min (990.2 - 808.0)

Volume	Invert	Avail.Storage	Storage Description
#1	20.00'	135,944 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

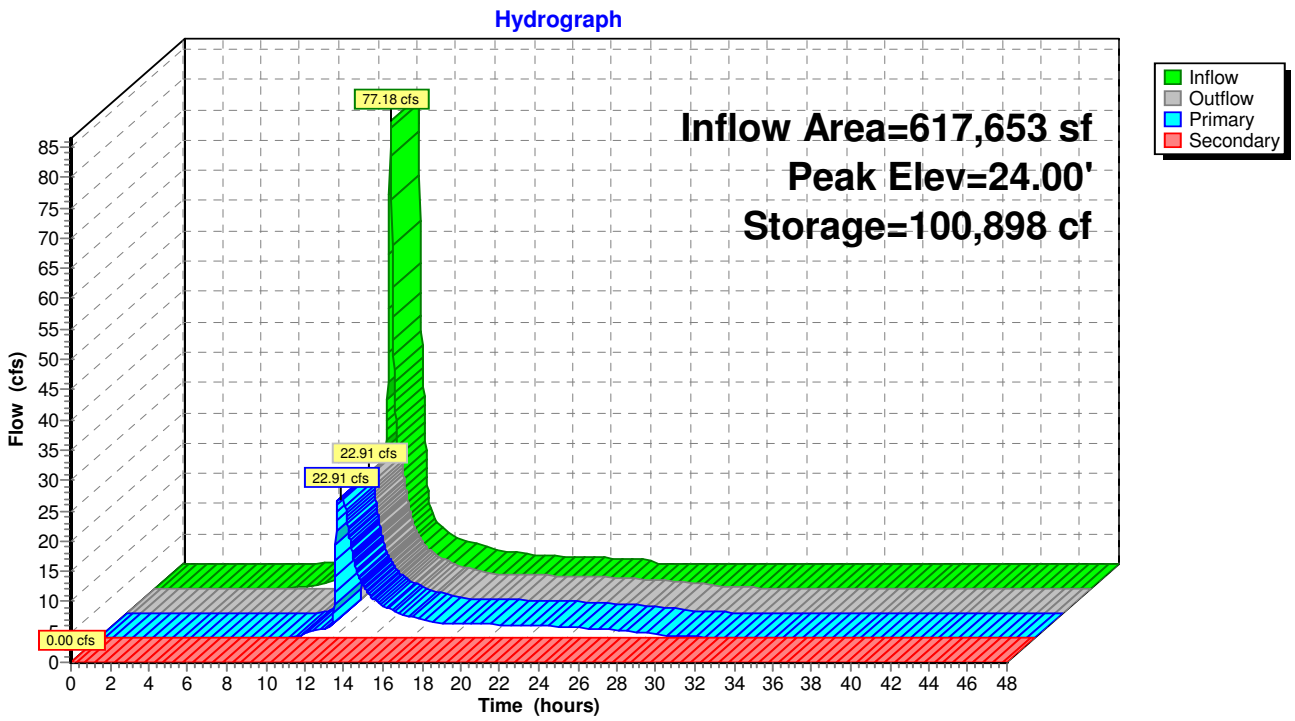
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
20.00	17,621	0	0
21.00	21,362	19,492	19,492
22.00	25,174	23,268	42,760
23.00	29,059	27,117	69,876
24.00	33,016	31,038	100,914
25.00	37,045	35,031	135,944

Device	Routing	Invert	Outlet Devices
#1	Secondary	24.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	16.00'	**18.0" Round Culvert** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 16.00' / 15.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	20.50'	**8.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	22.50'	**4.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=22.91 cfs @ 12.43 hrs HW=24.00' (Free Discharge)
└─**2=Culvert** (Inlet Controls 22.91 cfs @ 12.96 fps)
  ├─**3=Orifice/Grate** (Passes < 3.14 cfs potential flow)
  └─**4=Broad-Crested Rectangular Weir** (Passes < 23.79 cfs potential flow)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=20.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond BASIN N-1: Proposed Extended Detention Wetland System 1



Summary for Pond BASIN N-2: Proposed Extended Detention Wetland System 2

Inflow Area = 311,577 sf, 35.27% Impervious, Inflow Depth = 4.92" for 100 YR event
Inflow = 40.52 cfs @ 12.09 hrs, Volume= 127,647 cf
Outflow = 17.44 cfs @ 12.29 hrs, Volume= 122,922 cf, Atten= 57%, Lag= 12.1 min
Primary = 6.40 cfs @ 12.29 hrs, Volume= 108,963 cf
Secondary = 11.05 cfs @ 12.29 hrs, Volume= 13,959 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 26.36' @ 12.29 hrs Surf.Area= 15,830 sf Storage= 41,439 cf
Flood Elev= 27.00' Surf.Area= 17,218 sf Storage= 51,998 cf

Plug-Flow detention time= 85.4 min calculated for 122,922 cf (96% of inflow)
Center-of-Mass det. time= 63.9 min (866.9 - 803.0)

Volume	Invert	Avail.Storage	Storage Description
#1	23.00'	51,998 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

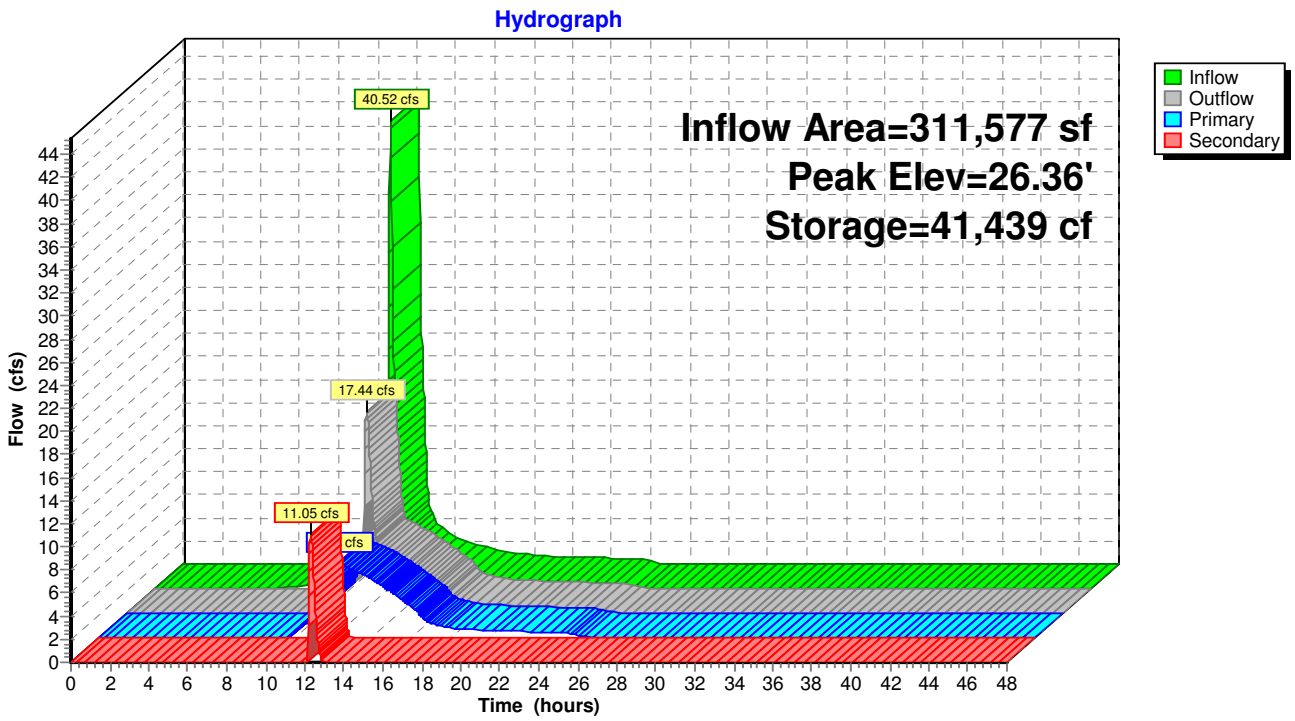
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
23.00	8,961	0	0
24.00	10,917	9,939	9,939
25.00	12,945	11,931	21,870
26.00	15,046	13,996	35,866
27.00	17,218	16,132	51,998

Device	Routing	Invert	Outlet Devices
#1	Device 2	23.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	20.00'	**12.0" Round Culvert** L= 75.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 20.00' / 19.00' S= 0.0133 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Secondary	26.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=6.40 cfs @ 12.29 hrs HW=26.36' (Free Discharge)
└─**2=Culvert** (Passes 6.40 cfs of 8.91 cfs potential flow)
  └─**1=Orifice/Grate** (Orifice Controls 6.40 cfs @ 8.14 fps)

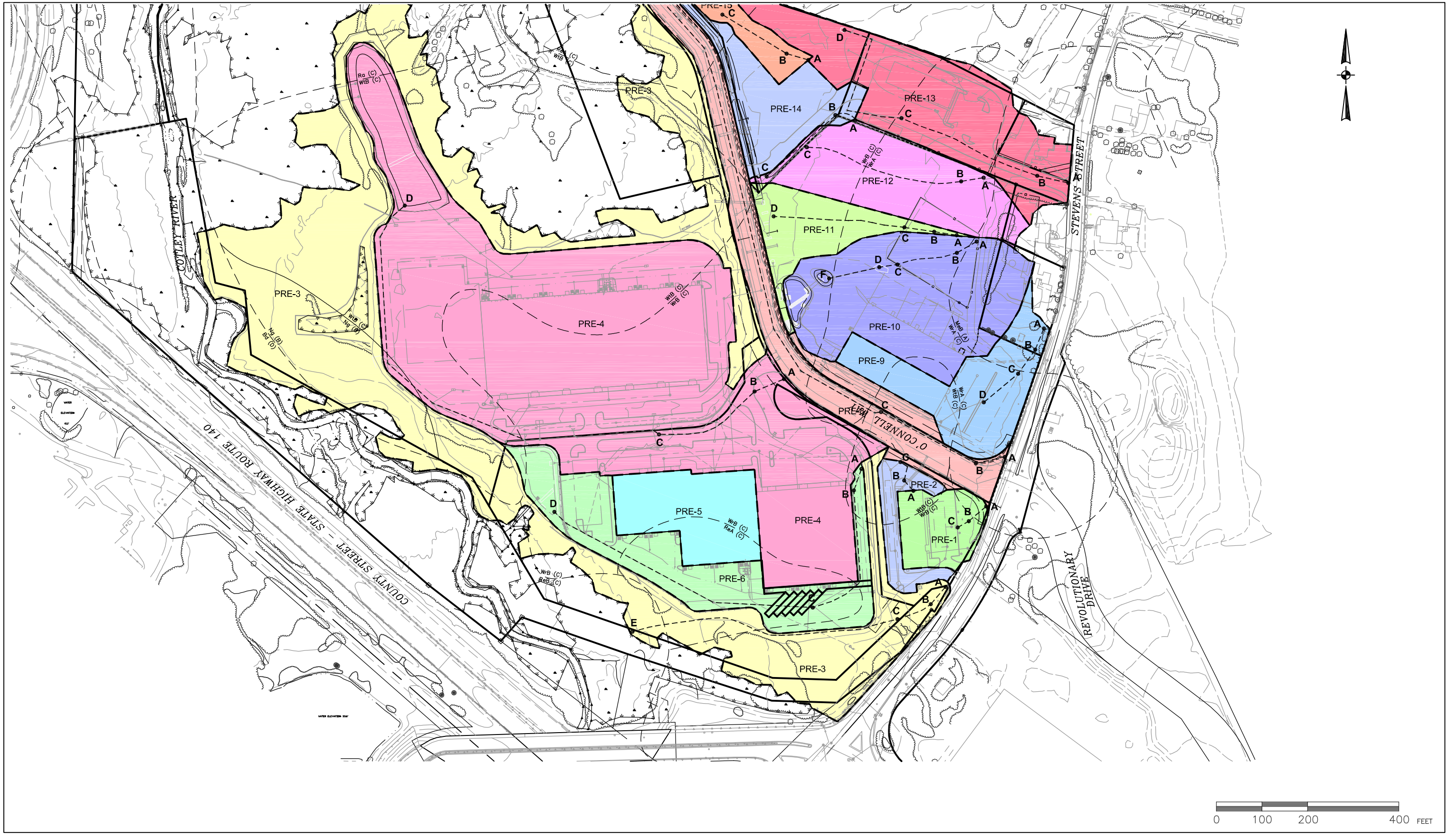
Secondary OutFlow Max=11.02 cfs @ 12.29 hrs HW=26.36' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Weir Controls 11.02 cfs @ 1.53 fps)

Pond BASIN N-2: Proposed Extended Detention Wetland System 2



Appendix A

Pre Development Watershed Plans



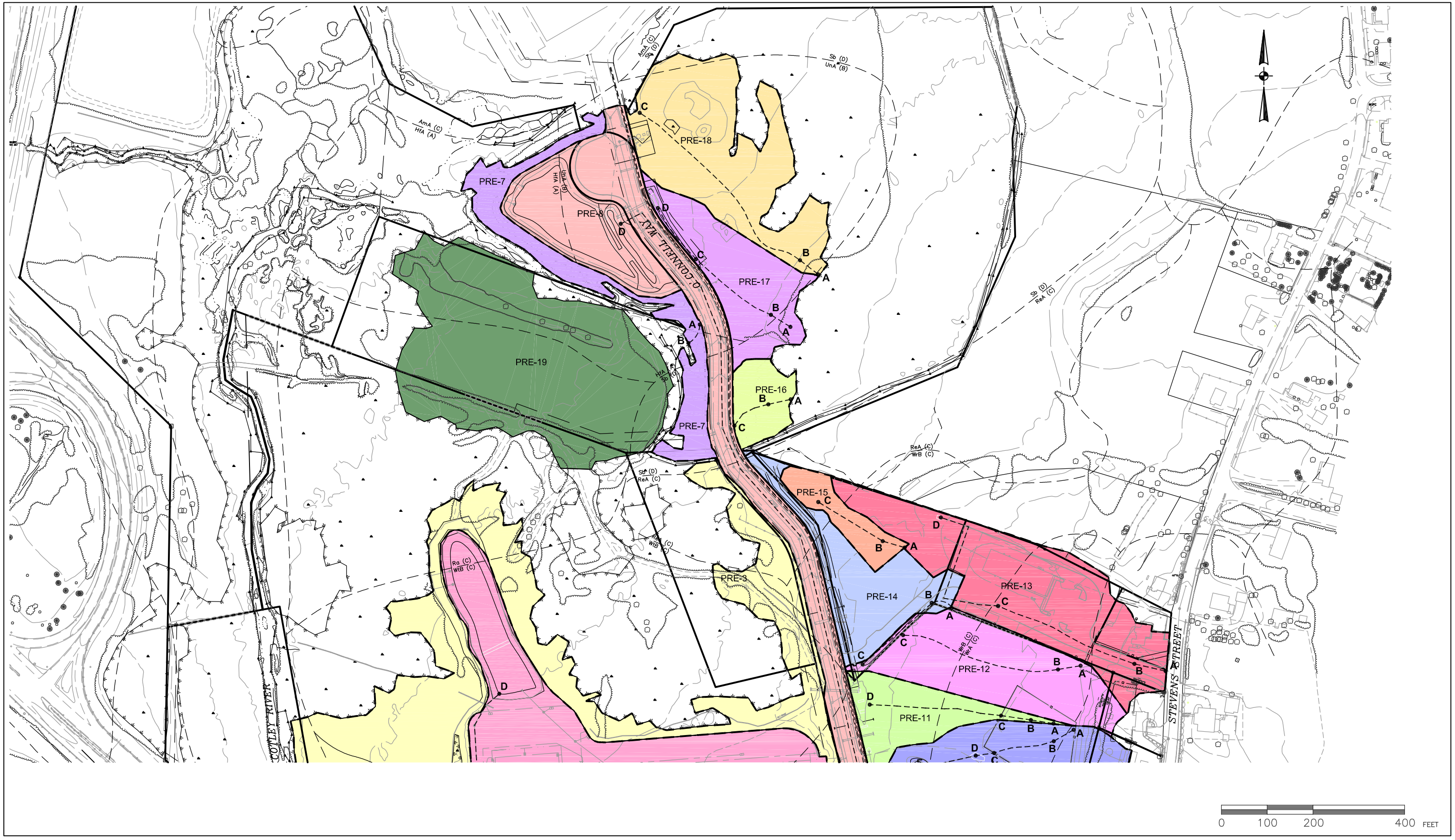
SOURCE: FIELD ENGINEERING CO. INC.

Mashpee Wampanoag Tribe - Fee to Trust Acquisition - Final EIS

Figure PRE-1

PRE-CONSTRUCTION WATERSHED PLAN

ALTERNATIVE A-LIT SITE (SOUTH OF THE RAILROAD TRACKS)



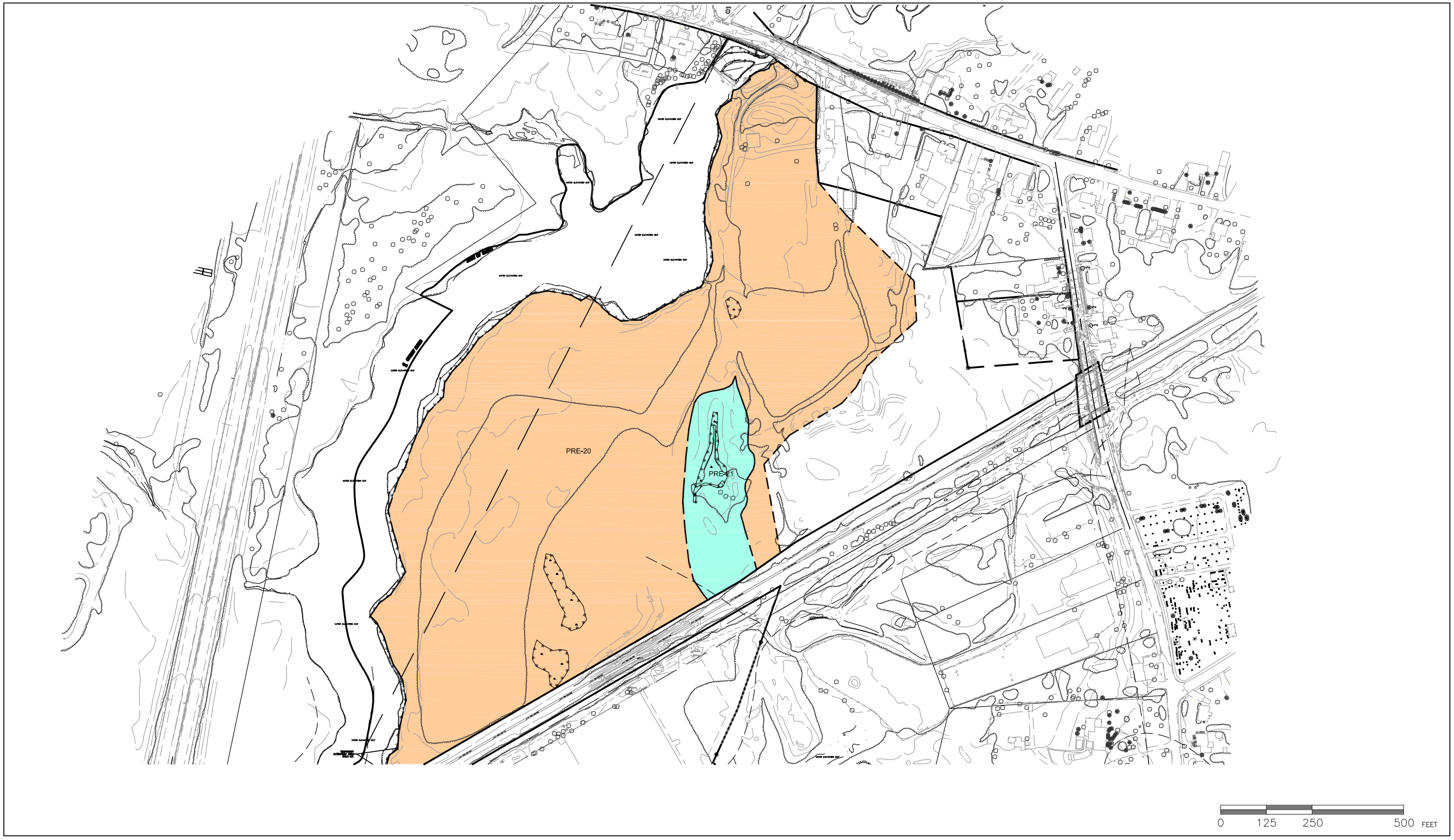
SOURCE: FIELD ENGINEERING CO. INC.

Mashpee Wampanoag Tribe - Fee to Trust Acquisition - Final EIS

Figure PRE-2

PRE-CONSTRUCTION WATERSHED PLAN

ALTERNATIVE A-LIT SITE (SOUTH OF THE RAILROAD TRACKS)



SOURCE: FIELD ENGINEERING CO. INC.

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Figure PRE-3

PRE-CONSTRUCTION WATERSHED PLAN

ALTERNATIVE A-LIT SITE (NORTH OF THE RAILROAD TRACKS)

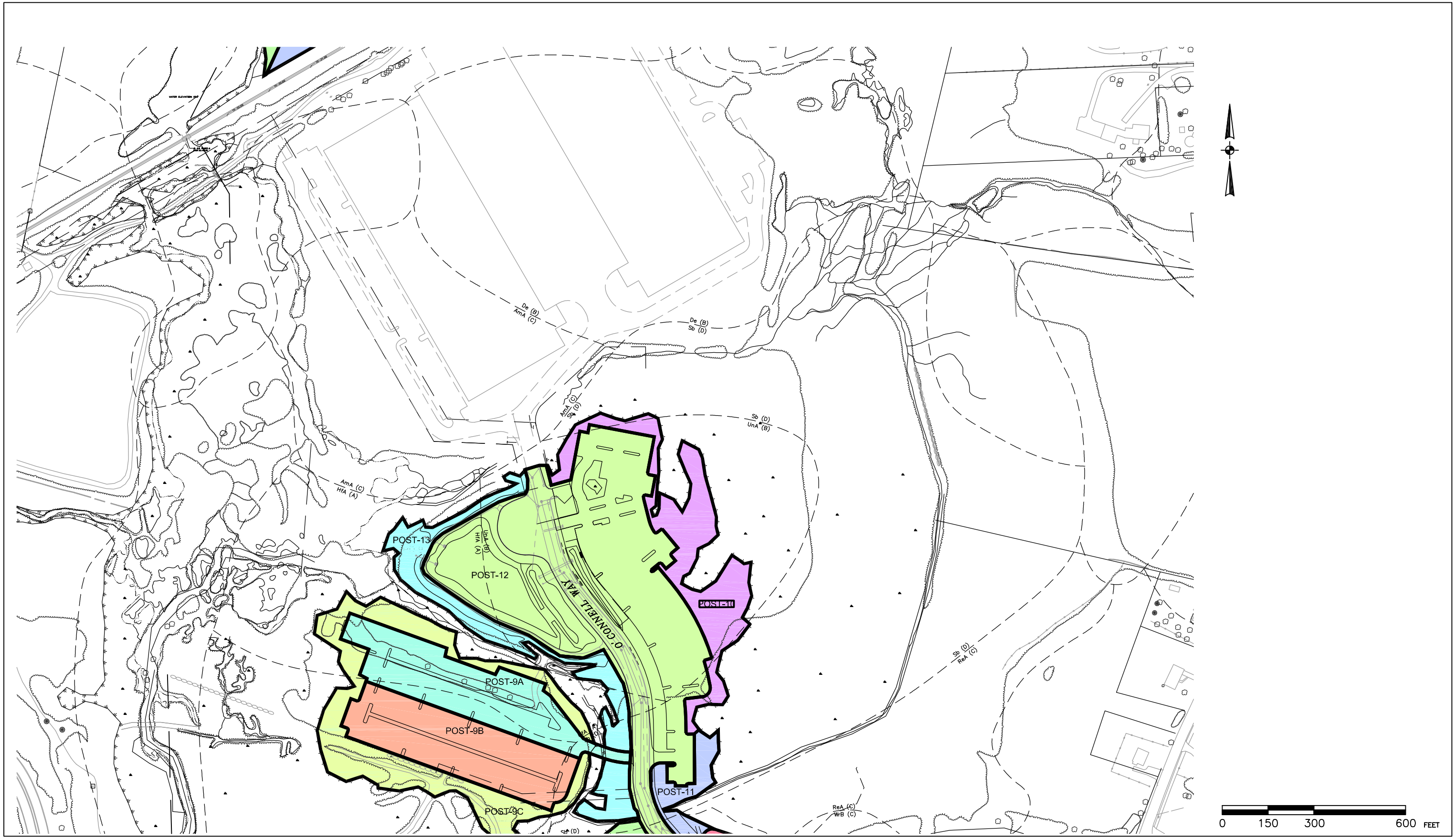
Appendix B

Post Development Watershed Plans

SOURCE: FIELD ENGINEERING CO. INC.

Mashpee Wampanoag Tribe - Fee to Trust Acquisition - Final EIS

Figure POST-1
POST-CONSTRUCTION WATERSHED PLAN
ALTERNATIVE A - LIT SITE (SOUTH OF THE RAILROAD TRACKS)



SOURCE: FIELD ENGINEERING CO. INC.

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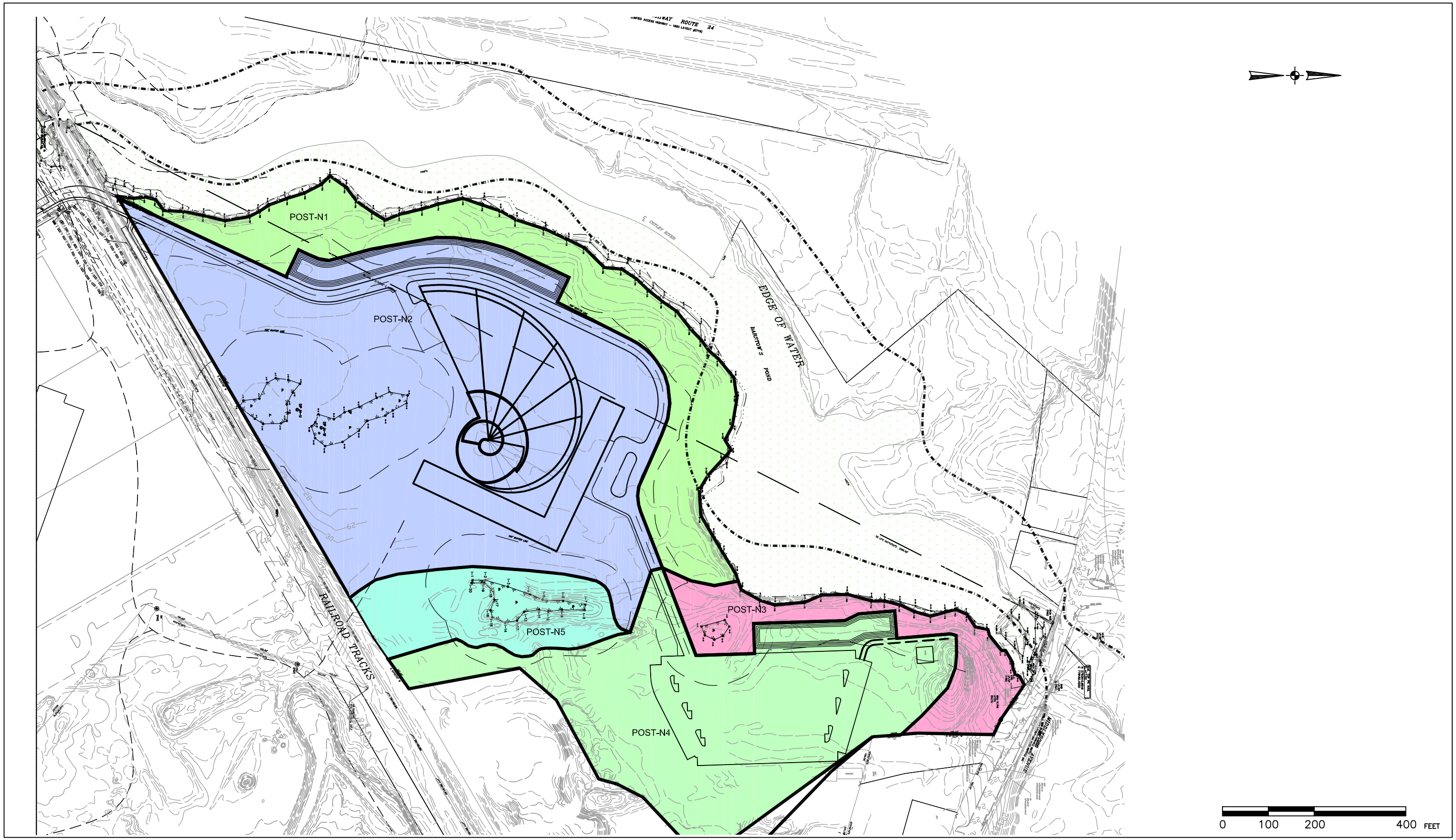
Figure POST-2
POST-CONSTRUCTION WATERSHED PLAN
PROPOSED ACTION-LIT SITE (SOUTH PARCEL)



SOURCE: FIELD ENGINEERING CO., INC.

Mashpee Wampanoag Tribe - Fee to Trust Acquisition - Final EIS

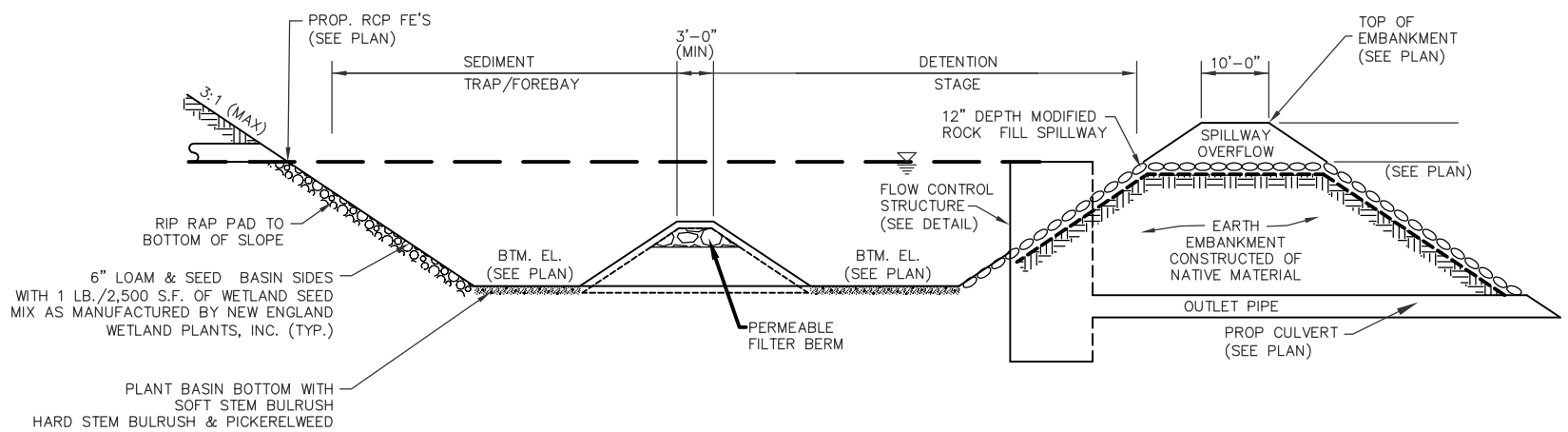
Figure POST-3

POST-CONSTRUCTION WATERSHED PLAN

ALTERNATIVE A - LIT SITE (NORTH OF THE RAILROAD TRACKS)

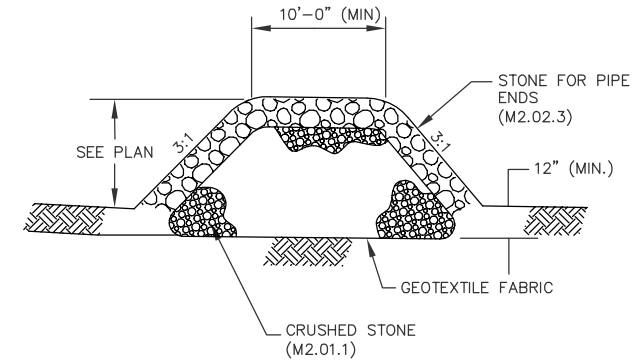
Appendix C

Stormwater BMP's-Typical Details



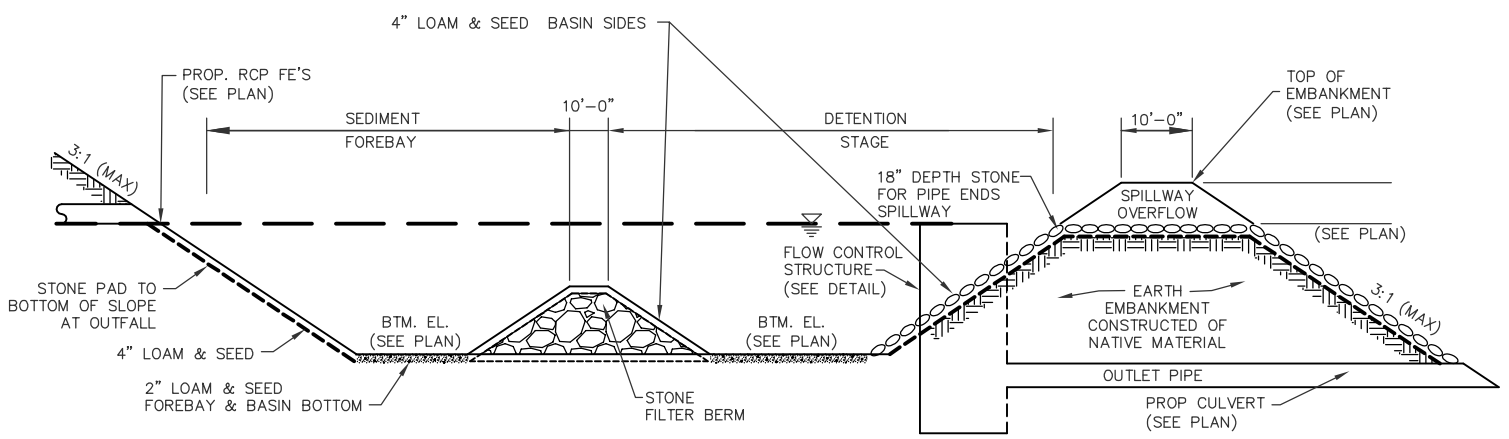
TYPICAL CONSTRUCTED WETLAND/EXTENDED DETENTION WETLAND WITH SEDIMENT FOREBAY

NOT TO SCALE



STONE FILTER BERM

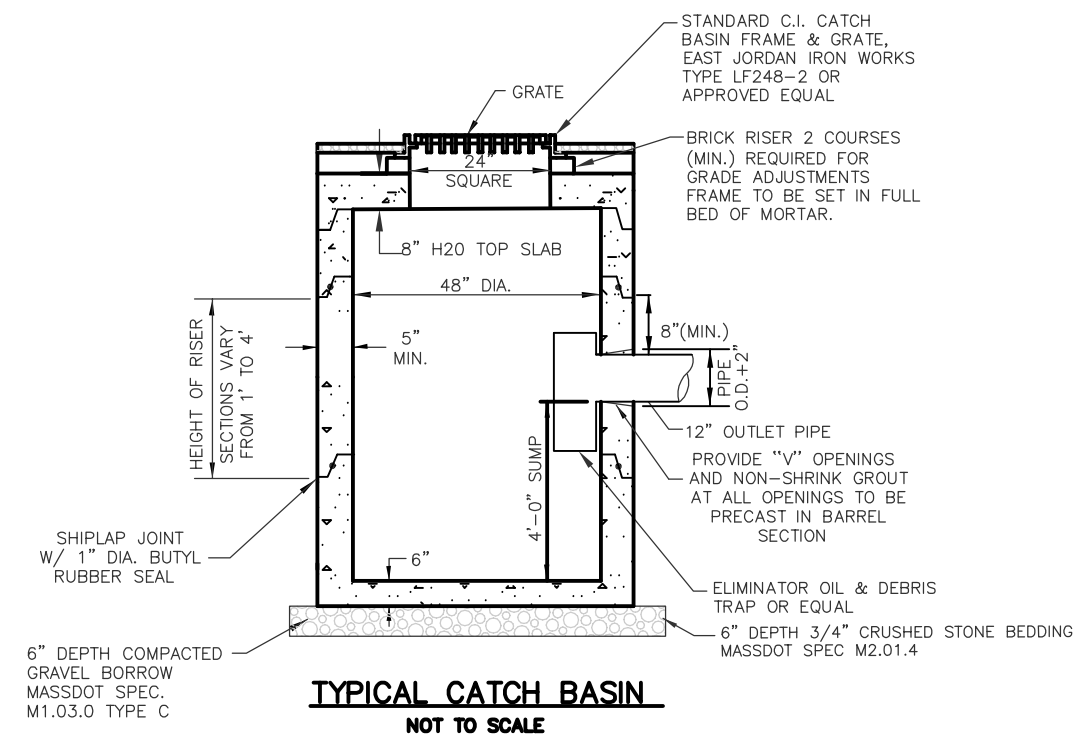
NOT TO SCALE



TYPICAL EXTENDED DETENTION BASIN WITH SEDIMENT FOREBAY

NOT TO SCALE

NOTE: TWO SEDIMENTATION INDICATOR POSTS SHOULD BE INSTALLED WITHIN EACH INFILTRATION/DETENTION BASIN AT EACH END.



TYPICAL CATCH BASIN

NOT TO SCALE

NOTES:

1. CATCH BASIN DESIGN TO CONFORM TO ASTM C478 LATEST REVISION.
2. CONCRETE SHALL BE WET CAST 4000 P.S.I. @ 28 DAYS.
3. FILL OUTSIDE FACE OF ALL MANHOLE JOINTS WITH NON-SHRINK MORTAR.
4. BASE SECTION TO BE MONOLITHIC.

FIELD ENGINEERING CO., INC.
CONSULTING ENGINEERS

11D INDUSTRIAL DRIVE
P.O. BOX 1178
MATTAPOISETT, MA 02739
TEL: (508) 758-2749
FAX: (508) 758-2849

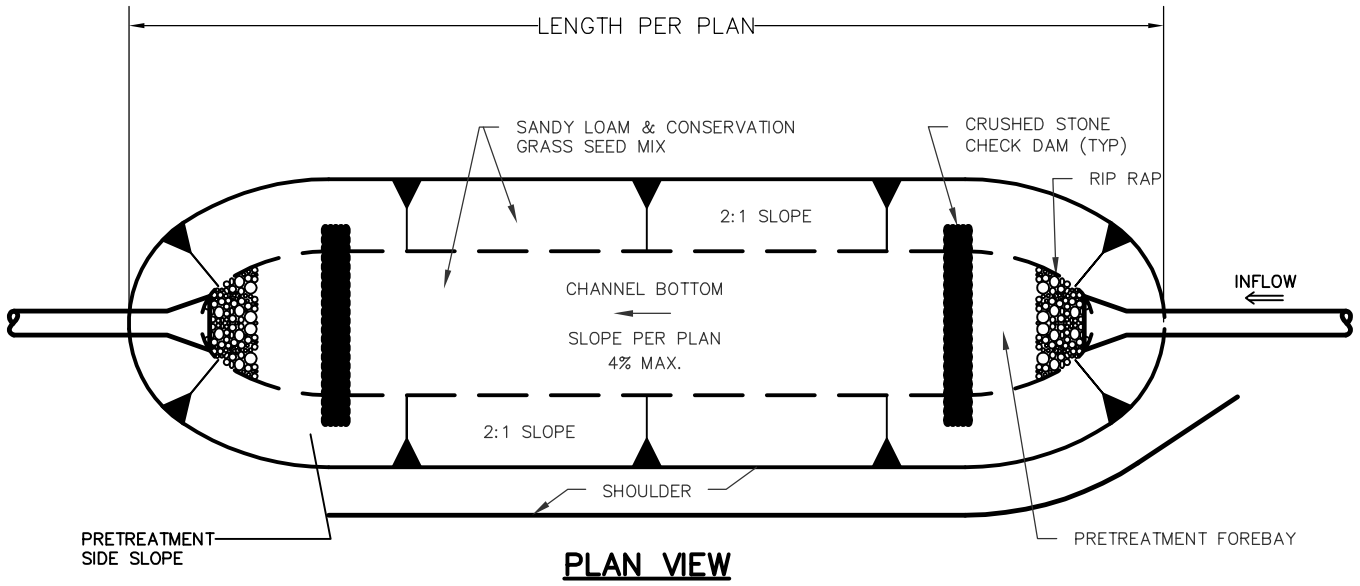
THE CROCKER BUILDING
4 COURT STREET SUITE 104
TAUNTON, MA 02780
TEL: (508) 824-9279
FAX: (508) 824-9276

TYPICAL STORMWATER BMP DETAILS
MASHPEE WAMPANOAG TRIBE -FEE TO TRUST ACQUISITION FINAL EIS

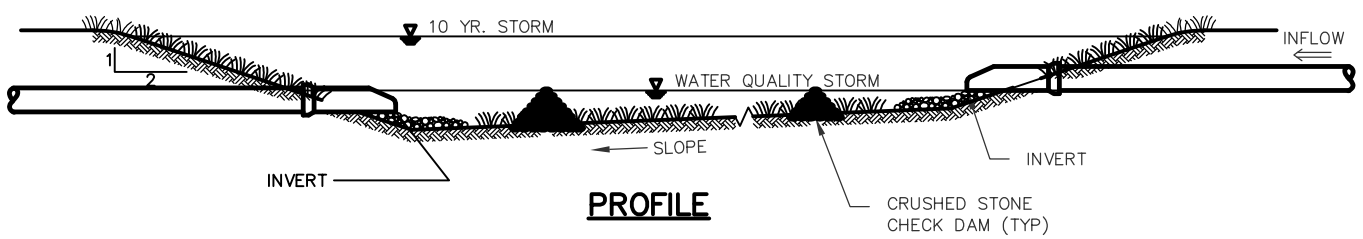
STEVENS ST
TAUNTON, MASSACHUSETTS

Project No.	Date
1905	4/11/14
Scale: N.T.S.	Revised
Issued For: FEIS	Sheet: 1 OF 4

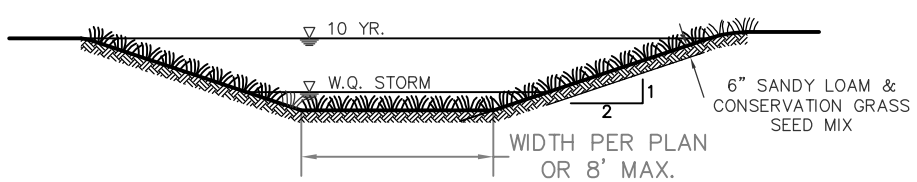
1905-EIS-Details.dwg



PLAN VIEW



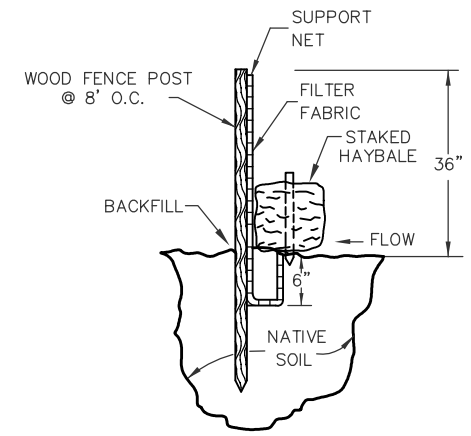
PROFILE



SECTION

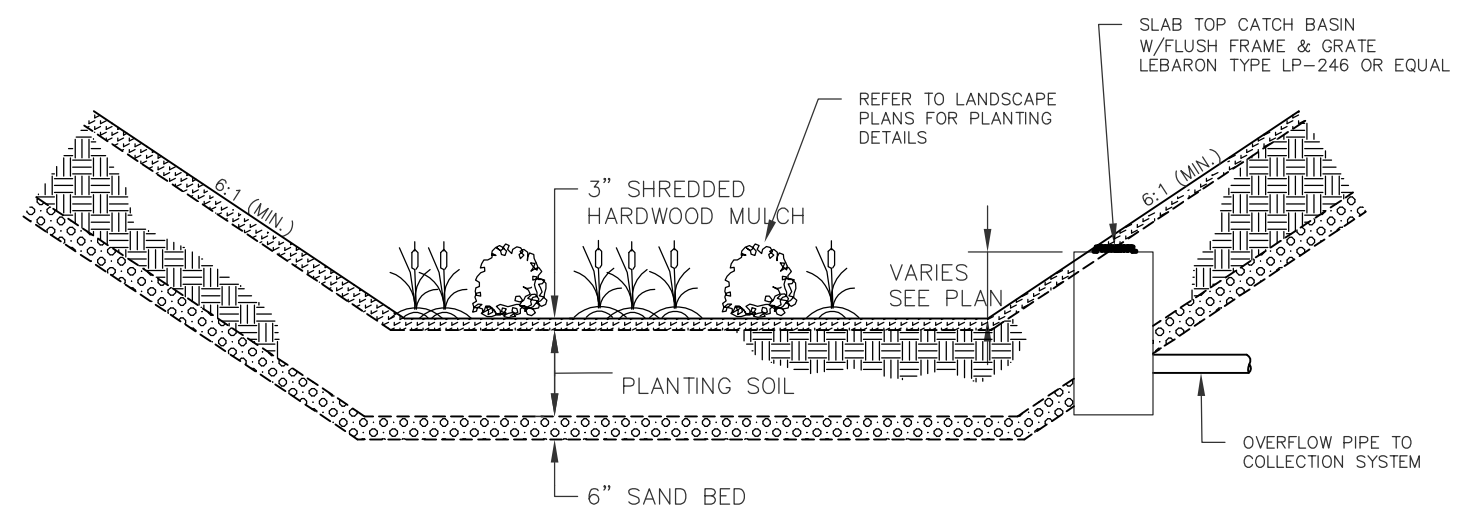
GRASSED "BIOFILTER" WATER QUALITY DITCH/SWALE

NOT TO SCALE



TYPICAL SILT FENCE DETAIL

NOT TO SCALE



BIORETENTION AREA SECTION

NOT TO SCALE

1.) PLANTING SOIL MIX SHALL BE A MIXTURE OF SAND COMPOST AND SOIL COMPRISED OF THE FOLLOWING:

4.0% SAND
20–30% SCREENED TOPSOIL
30–40% COMPOST
CLAY CONTENT <5%
PH 5.5–6.5
SOLUBLE SALT < 500 PPM

2.) SAND BED SHALL CONFORM TO ASTM D422 MAX. STONE SIZE – 3/4 INCH AND NO GREATER THAN 3.0% PASSING NO. 200 SIEVE.

FIELD ENGINEERING CO., INC.
CONSULTING ENGINEERS

11D INDUSTRIAL DRIVE
P.O. BOX 1178
MATTAPOISETT, MA 02739
TEL: (508) 758-2749
FAX: (508) 758-2849

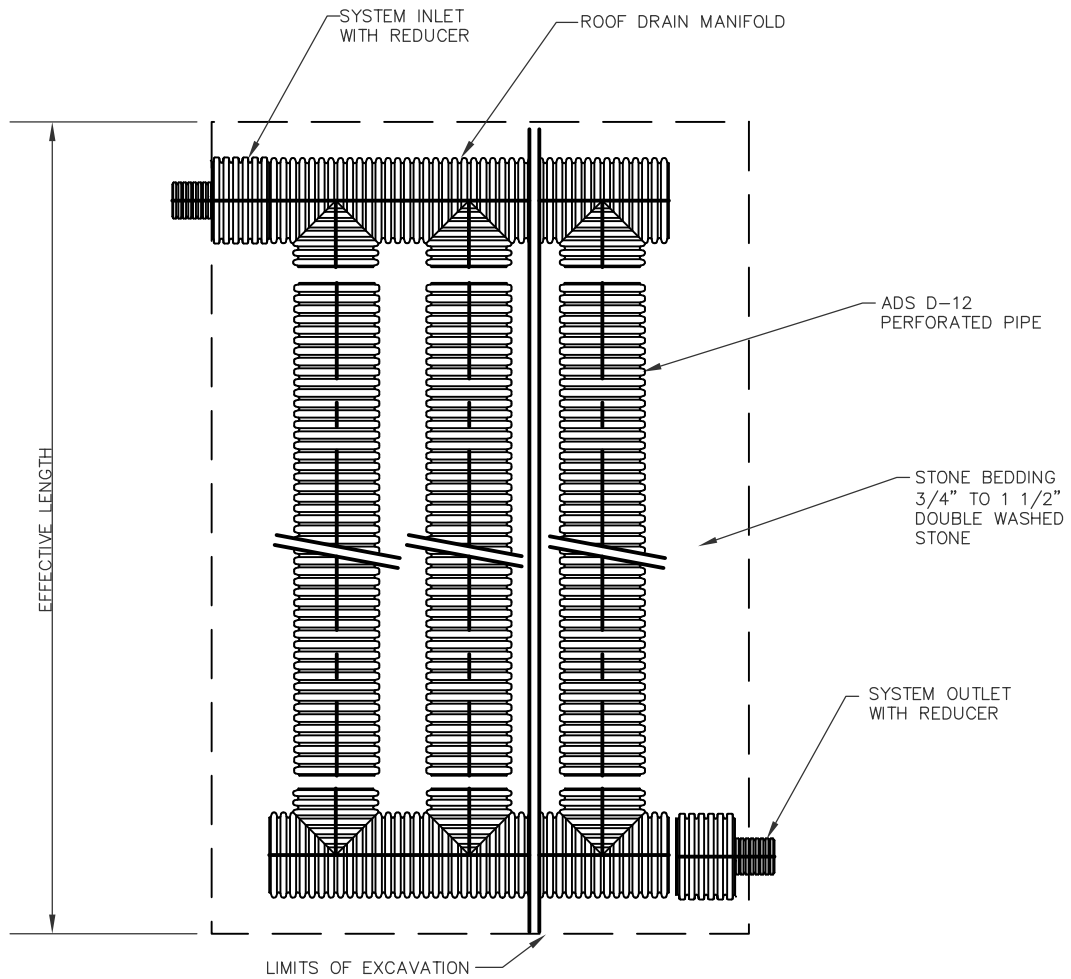
THE CROCKER BUILDING
4 COURT STREET SUITE 104
TAUNTON, MA 02780
TEL: (508) 824-9279
FAX: (508) 824-9276

TYPICAL STORMWATER BMP DETAILS
MASHPEE WAMPANOAG TRIBE -FEE TO TRUST ACQUISITION FINAL EIS

STEVENS ST
TAUNTON, MASSACHUSETTS

Project No.	1905	Date	4/11/14
Scale	N.T.S.	Revised	
Issued For	FEIS	Sheet	2 OF 4

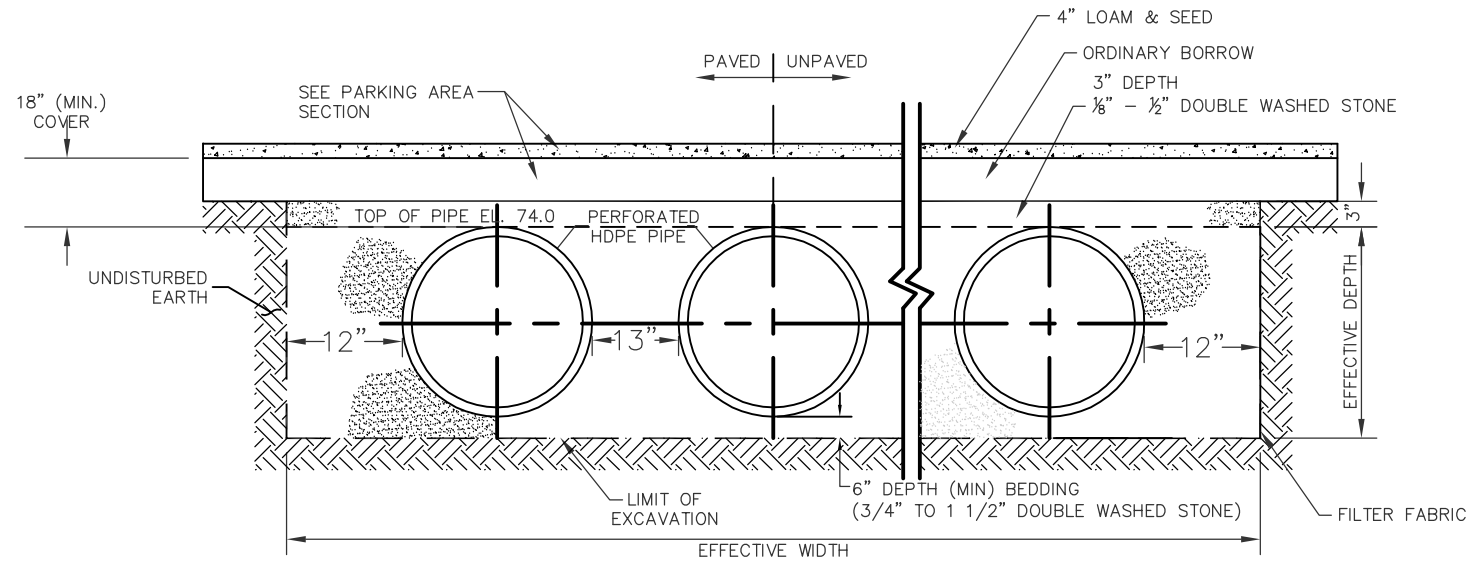
1905-EIS-Details.dwg



TYPICAL SUBSURFACE STORMWATER MANAGEMENT SYSTEM LAYOUT

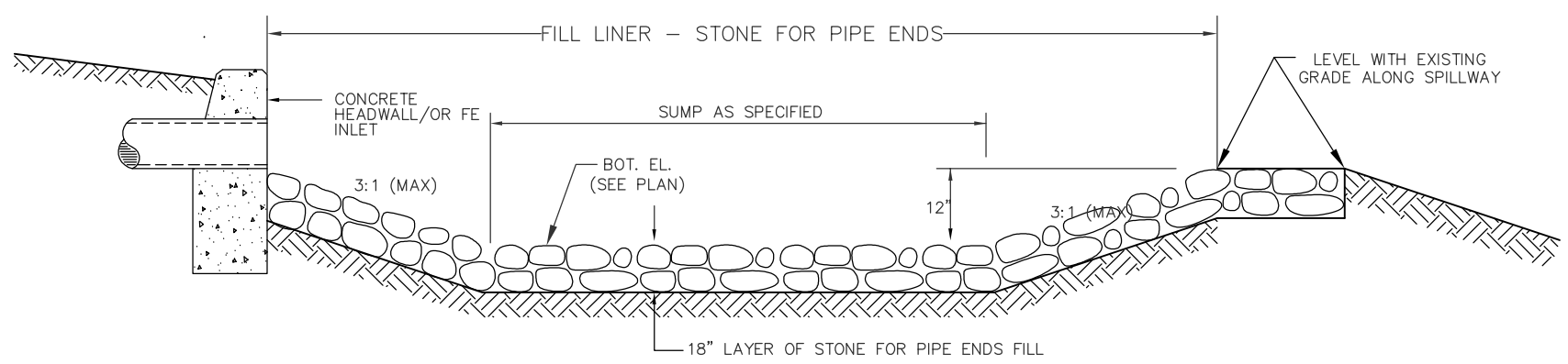
NOT TO SCALE

NOTE: ABOVE CONFIGURATION IS A TYPICAL CONFIGURATION UNDERGROUND DETENTION SYSTEM. REFER TO SITE PLAN FOR ACTUAL ORIENTATION OF INLETS AND OUTLETS FOR EACH SYSTEM.



TYPICAL SUBSURFACE STORMWATER MANAGEMENT SYSTEM CROSS SECTION

NOT TO SCALE



LEVEL SPREADER DETAIL

NOT TO SCALE

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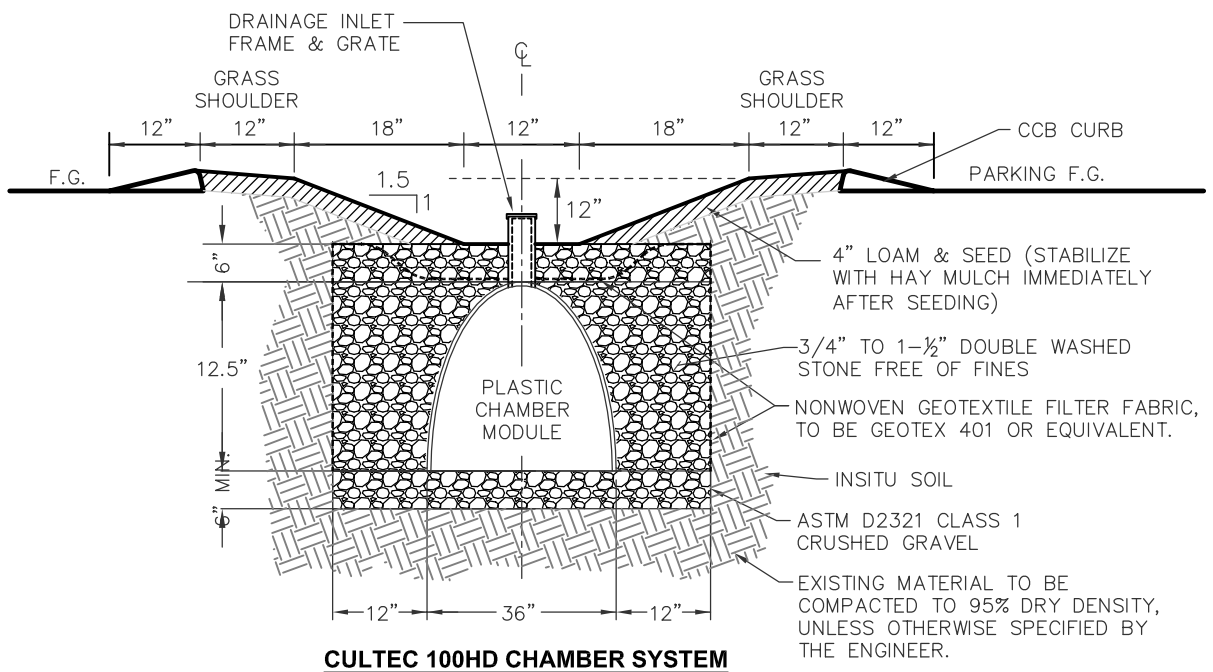
TYPICAL STORMWATER BMP DETAILS
MASHPEE WAMPANOAG TRIBE -FEE TO TRUST ACQUISITION FINAL EIS

STEVENS ST
TAUNTON, MASSACHUSETTS

Project No.	1905	Date	4/11/14
Scale	N.T.S.	Revised	
Issued For	FEIS	Sheet	3 OF 4

1905-EIS-Details.dwg

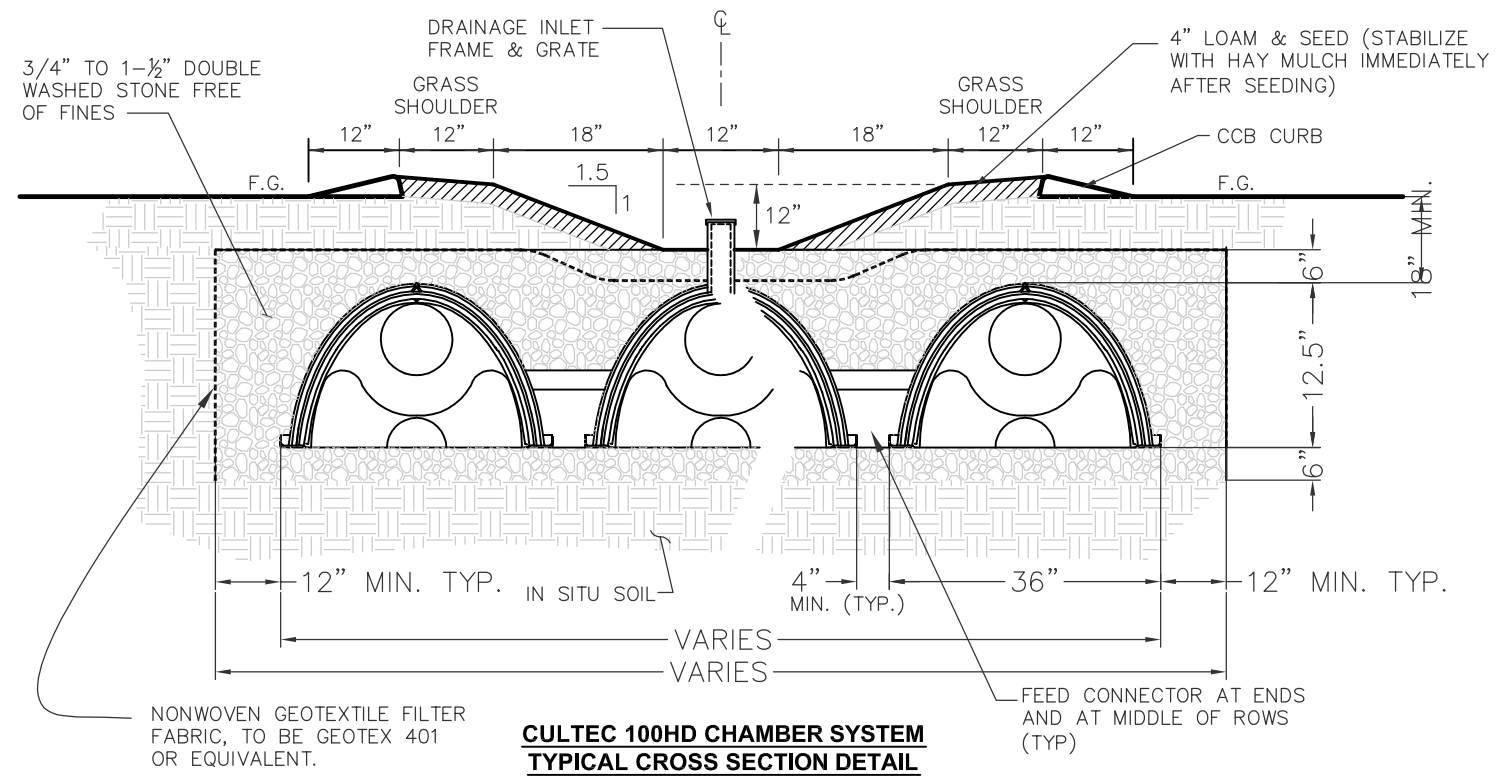


CULTEC 100HD CHAMBER SYSTEM
TYPICAL CROSS SECTION DETAIL

SINGLE ROW SECTION

PARKING LOT ISLAND VEGETATED SWALE & UNDERGROUND CHAMBERS DETAIL

NOT TO SCALE



CULTEC 100HD CHAMBER SYSTEM
TYPICAL CROSS SECTION DETAIL

MULTIPLE ROW SECTION

PARKING LOT ISLAND VEGETATED SWALE & UNDERGROUND CHAMBERS DETAIL

NOT TO SCALE

FIELD ENGINEERING CO., INC.
CONSULTING ENGINEERS

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TYPICAL STORMWATER BMP DETAILS
MASHPEE WAMPANOAG TRIBE -FEE TO TRUST ACQUISITION FINAL EIS

STEVENS ST
TAUNTON, MASSACHUSETTS

Project No. 1905	Date 4/11/14
Scale N.T.S.	Revised
Issued For FEIS	Sheet 4 OF 4

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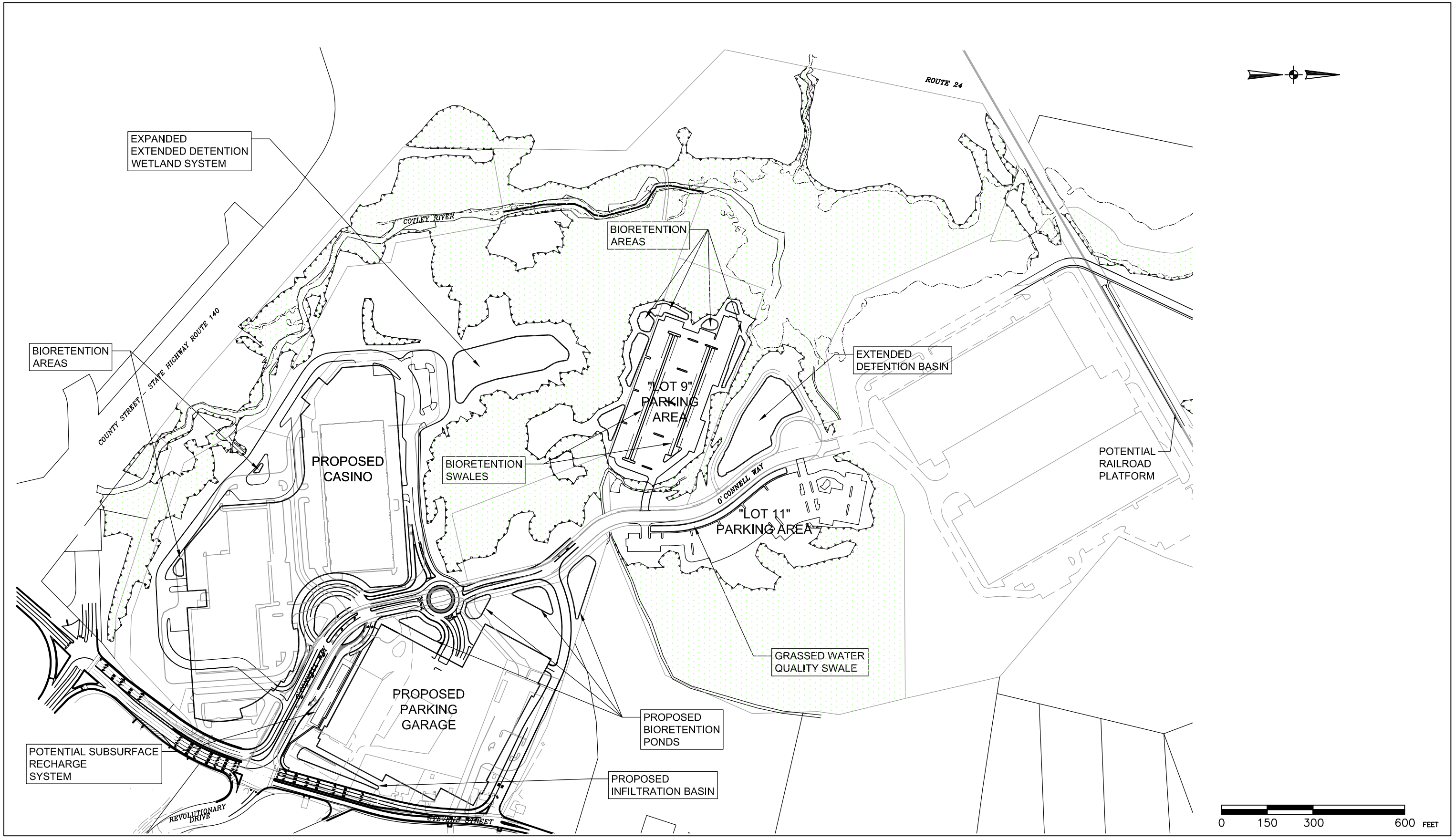
Appendix D

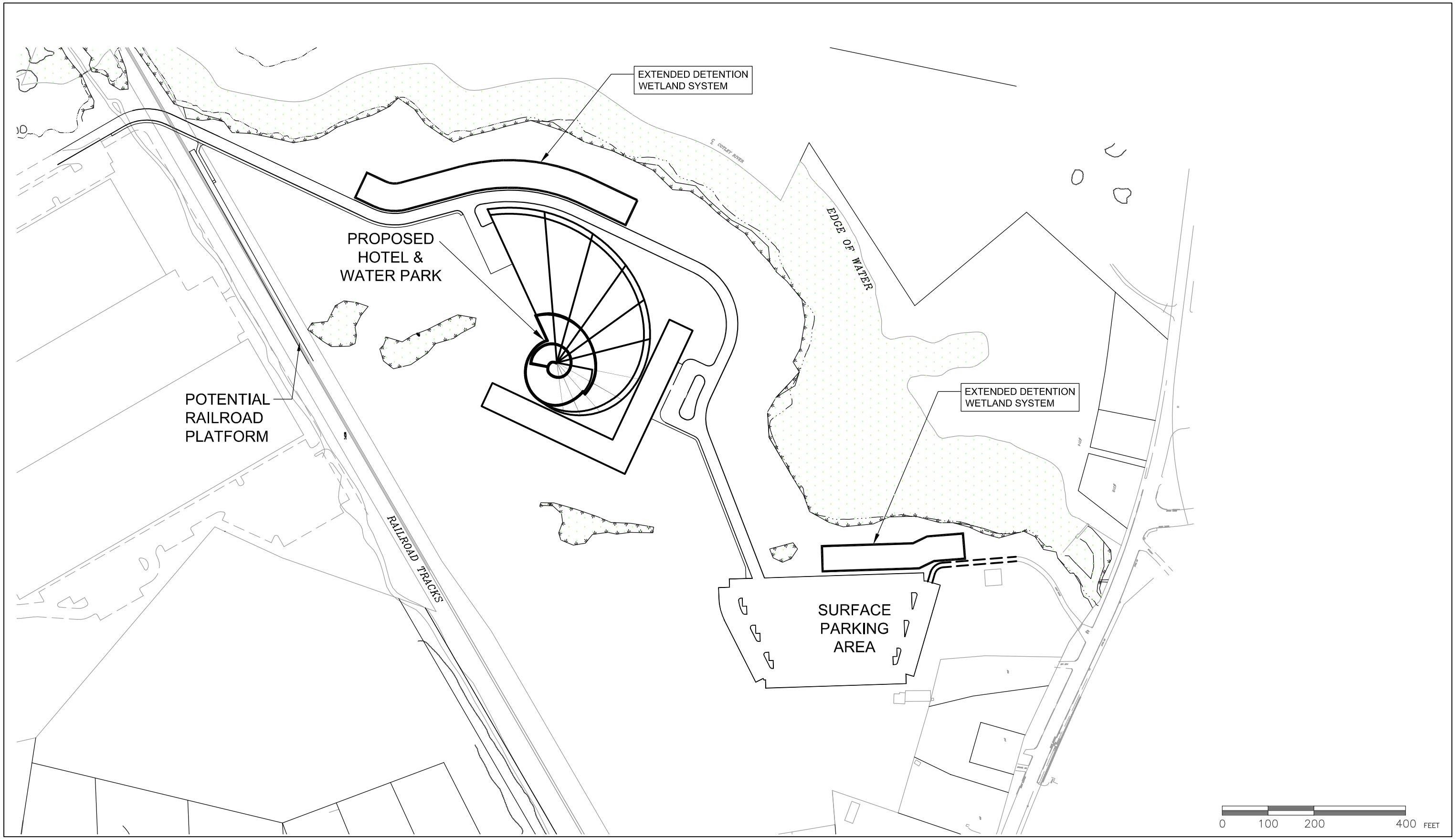
Preliminary Drainage Plans



SOURCE: FIELD ENGINEERING CO. INC.

Figure 8.3-1

ALTERNATIVE A - CONCEPTUAL STORMWATER MANAGEMENT SYSTEM PLAN
LIT SITE (SOUTH OF RAILROAD TRACKS)



SOURCE: FIELD ENGINEERING CO. INC.

Figure 8.3-2

ALTERNATIVE A - CONCEPTUAL STORMWATER MANAGEMENT SYSTEM PLAN
LIT SITE (NORTH OF RAILROAD TRACKS)

Appendix E

Updated Water Quality Volume Calculation Sheets

FIELD ENGINEERING, INC. MATTAPOISETT, MA

WATER QUALITY VOLUME CALCULATIONS

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED WATER QUALITY VOLUME-POST-2, 3, 5, 6 (MAGGIORE BASIN)

UNIT VOLUME (in.) =	1.00
IMPERVIOUS AREA (s.f.) =	531,537
WATER QUALITY VOLUME (cu.ft.) =	44,295

AVAILABLE VOLUME CALCULATION-MAGGIORE BASIN

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
30.00	30,160.0	0.0	0.0	```
31.00	32,879.0	31,519.5	31,519.5	0.724
32.00	35,649.0	34,264.0	65,783.5	1.510
33.50	39,921.0	56,677.5	122,461.0	2.811

WATER QUALITY VOLUME REQUIRED (cu.ft.):	44,295	
WATER QUALITY VOLUME PROVIDED (cu.ft.):	122,461	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

WATER QUALITY VOLUME CALCULATIONS

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED WATER QUALITY VOLUME-POST 7

UNIT VOLUME (in.) =	1.00
IMPERVIOUS AREA (s.f.) =	30,784
WATER QUALITY VOLUME (cu.ft.) =	2,565

AVAILABLE VOLUME CALCULATION-POND 5

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
40.00	3,535.0	0.0	0.0	```
43.00	5,918.0	14,179.5	14,179.5	0.326

WATER QUALITY VOLUME REQUIRED (cu.ft.):	2,565	
WATER QUALITY VOLUME PROVIDED (cu.ft.):	14,180	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

WATER QUALITY VOLUME CALCULATIONS

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED WATER QUALITY VOLUME-POST 8

UNIT VOLUME (in.) =	1.00
IMPERVIOUS AREA (s.f.) =	41,710
WATER QUALITY VOLUME (cu.ft.) =	3,476

AVAILABLE VOLUME CALCULATION-POND 6

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
38.00	2,360.0	0.0	0.0	```
43.00	7,698.0	25,145.0	25,145.0	0.577

WATER QUALITY VOLUME REQUIRED (cu.ft.):	3,476	
WATER QUALITY VOLUME PROVIDED (cu.ft.):	25,145	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

WATER QUALITY VOLUME CALCULATIONS

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	12/17/2012 Rev 4/11/14
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED WATER QUALITY VOLUME-POST 9A

UNIT VOLUME (in.) =	1.00
IMPERVIOUS AREA (s.f.) =	61,470
WATER QUALITY VOLUME (cu.ft.) =	5,123

13,285 CF OF STORAGE PROVIDED WITHIN THE SUBSURFACE RECHARGE SYSTEM (BASED ON HYDROCAD CALCULATIONS-SEE ATTACHED SHEET)

WATER QUALITY VOLUME REQUIRED (cu.ft.):	5,123	
WATER QUALITY VOLUME PROVIDED (cu.ft.):	13,285	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

WATER QUALITY VOLUME CALCULATIONS

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	12/17/2012 Rev 4/11/14
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED WATER QUALITY VOLUME-POST 9A

UNIT VOLUME (in.) =	1.00
IMPERVIOUS AREA (s.f.) =	59,100
WATER QUALITY VOLUME (cu.ft.) =	4,925

25,758 CF OF STORAGE PROVIDED WITHIN THE BIORETENTION PONDS
(BASED ON HYDROCAD CALCULATIONS-SEE ATTACHED SHEET)

WATER QUALITY VOLUME REQUIRED (cu.ft.):	4,925	
WATER QUALITY VOLUME PROVIDED (cu.ft.):	25,758	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

WATER QUALITY VOLUME CALCULATIONS

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED WATER QUALITY VOLUME-POND-N1

UNIT VOLUME (in.) =	1.00
IMPERVIOUS AREA (s.f.) =	165,712
WATER QUALITY VOLUME (cu.ft.) =	13,809

AVAILABLE VOLUME CALCULATION-POND N1

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
20.00	17,621.0	0.0	0.0	```
22.50	27,117.0	55,922.5	55,922.5	1.284

WATER QUALITY VOLUME REQUIRED (cu.ft.):	13,809	
WATER QUALITY VOLUME PROVIDED (cu.ft.):	55,923	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

WATER QUALITY VOLUME CALCULATIONS

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED WATER QUALITY VOLUME-POND-N2

UNIT VOLUME (in.) =	1.00
IMPERVIOUS AREA (s.f.) =	109,905
WATER QUALITY VOLUME (cu.ft.) =	9,159

AVAILABLE VOLUME CALCULATION-POND N2

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
23.00	8,961.0	0.0	0.0	```
26.00	15,046.0	36,010.5	36,010.5	0.827

WATER QUALITY VOLUME REQUIRED (cu.ft.):	9,159	
WATER QUALITY VOLUME PROVIDED (cu.ft.):	36,011	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

WATER QUALITY VOLUME CALCULATIONS

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED WATER QUALITY VOLUME-POST-12 (OCONNELL BASIN)

UNIT VOLUME (in.) =	1.00
IMPERVIOUS AREA (s.f.) =	145,476
WATER QUALITY VOLUME (cu.ft.) =	12,123

AVAILABLE VOLUME CALCULATION-OCONNELL BASIN

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
21.50	2,384.0	0.0	0.0	```
22.00	22,143.0	6,131.8	6,131.8	0.141
24.00	28,209.0	50,352.0	56,483.8	1.297
24.70	34,596.0	21,981.8	78,465.5	1.801

WATER QUALITY VOLUME REQUIRED (cu.ft.):	12,123	
WATER QUALITY VOLUME PROVIDED (cu.ft.):	78,466	OK

Appendix F

Updated Recharge Volume Calculation Sheets

FIELD ENGINEERING, INC. MATTAPOISETT, MA

RECHARGE VOLUME CALCULATION

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED RECHARGE VOLUME-MAGGIORE BASIN (POST 2,3,5,6)

HYDROLOGIC SOIL GROUP	A
UNIT VOLUME (in.) =	0.60
IMPERVIOUS AREA (s.f.) =	27,739
RECHARGE VOLUME (cu.ft.) =	1,387
HYDROLOGIC SOIL GROUP	B
UNIT VOLUME (in.) =	0.35
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0
HYDROLOGIC SOIL GROUP	C
UNIT VOLUME (in.) =	0.25
IMPERVIOUS AREA (s.f.) =	950,529
RECHARGE VOLUME (cu.ft.) =	19,803
HYDROLOGIC SOIL GROUP	D
UNIT VOLUME (in.) =	0.10
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0

AVAILABLE VOLUME CALCULATION-EXTENDED DETENTION/INFILTRATION SYSTEM
(STORAGE VOLUME BENEATH LOWEST ORIFICE
IN EXTENDED DETENTION/INFILTRATION SYSTEM)

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
30.00	30,160.0	0.0	0.0	```
30.75	34,957.0	24,418.9	24,418.9	0.561

RECHARGE VOLUME REQUIRED (cu.ft.):	21,190	
RECHARGE VOLUME PROVIDED (cu.ft.):	24,419	OK
RECHARGE VOLUME PROVIDED (ac.ft.):	0.561	

DRAWDOWN TIME CALCULATION

DRAWDOWN TIME=(REQ.RECH. VOL.)/(DES. INFILTRATION RATE "K"*BOTTOM AREA)

RECHARGE VOLUME PROVIDED (CF)=	24,418.9	
DESIGN INFILTRATION RATE (IN/HR)=	1.0	
BOTTOM AREA(SF)=	30,160.0	
DRAWDOWN TIME (HRS)=	9.7	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

RECHARGE VOLUME CALCULATION

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED RECHARGE VOLUME-BIORETENTION AREA (POST 7)

HYDROLOGIC SOIL GROUP	A
UNIT VOLUME (in.) =	0.60
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0
HYDROLOGIC SOIL GROUP	B
UNIT VOLUME (in.) =	0.35
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0
HYDROLOGIC SOIL GROUP	C
UNIT VOLUME (in.) =	0.25
IMPERVIOUS AREA (s.f.) =	30,784
RECHARGE VOLUME (cu.ft.) =	641
HYDROLOGIC SOIL GROUP	D
UNIT VOLUME (in.) =	0.10
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0

AVAILABLE VOLUME CALCULATION-BIORETENTION AREA
(STORAGE VOLUME BENEATH LOWEST ORIFICE
IN EXTENDED DETENTION/INFILTRATION SYSTEM)

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
40.00	3,535.0	0.0	0.0	```
42.00	5,123.0	8,658.0	8,658.0	0.199

RECHARGE VOLUME REQUIRED (cu.ft.):	641	
RECHARGE VOLUME PROVIDED (cu.ft.):	8,658	OK
RECHARGE VOLUME PROVIDED (ac.ft.):	0.199	

DRAWDOWN TIME CALCULATION

DRAWDOWN TIME=(REQ.RECH. VOL.)/(DES. INFILTRATION RATE "K"*BOTTOM AREA)

RECHARGE VOLUME PROVIDED (CF)=	8,658.0	
DESIGN INFILTRATION RATE (IN/HR)=	1.0	
BOTTOM AREA(SF)=	3,535.0	
DRAWDOWN TIME (HRS)=	29.4	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

RECHARGE VOLUME CALCULATION

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED RECHARGE VOLUME-BIORETENTION AREA (POST 8)

HYDROLOGIC SOIL GROUP	A
UNIT VOLUME (in.) =	0.60
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0
HYDROLOGIC SOIL GROUP	B
UNIT VOLUME (in.) =	0.35
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0
HYDROLOGIC SOIL GROUP	C
UNIT VOLUME (in.) =	0.25
IMPERVIOUS AREA (s.f.) =	13,269
RECHARGE VOLUME (cu.ft.) =	276
HYDROLOGIC SOIL GROUP	D
UNIT VOLUME (in.) =	0.10
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0

AVAILABLE VOLUME CALCULATION-BIORETENTION AREA
(STORAGE VOLUME BENEATH LOWEST ORIFICE
IN EXTENDED DETENTION/INFILTRATION SYSTEM)

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
38.00	2,362.0	0.0	0.0	```
40.00	7,698.0	10,060.0	10,060.0	0.231

RECHARGE VOLUME REQUIRED (cu.ft.):	276	
RECHARGE VOLUME PROVIDED (cu.ft.):	10,060	OK
RECHARGE VOLUME PROVIDED (ac.ft.):	0.231	

DRAWDOWN TIME CALCULATION

DRAWDOWN TIME=(REQ.RECH. VOL.)/(DES. INFILTRATION RATE "K"*BOTTOM AREA)

RECHARGE VOLUME PROVIDED (CF)=	10,060.0	
DESIGN INFILTRATION RATE (IN/HR)=	1.0	
BOTTOM AREA(SF)=	2,362.0	
DRAWDOWN TIME (HRS)=	51.1	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

RECHARGE VOLUME CALCULATION

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED RECHARGE VOLUME-OCONNELL DRIVE BASIN (POST 12)

HYDROLOGIC SOIL GROUP	A
UNIT VOLUME (in.) =	0.60
IMPERVIOUS AREA (s.f.) =	1,454
RECHARGE VOLUME (cu.ft.) =	73
HYDROLOGIC SOIL GROUP	B
UNIT VOLUME (in.) =	0.35
IMPERVIOUS AREA (s.f.) =	101,833
RECHARGE VOLUME (cu.ft.) =	2,970
HYDROLOGIC SOIL GROUP	C
UNIT VOLUME (in.) =	0.25
IMPERVIOUS AREA (s.f.) =	23,276
RECHARGE VOLUME (cu.ft.) =	485
HYDROLOGIC SOIL GROUP	D
UNIT VOLUME (in.) =	0.10
IMPERVIOUS AREA (s.f.) =	18,912
RECHARGE VOLUME (cu.ft.) =	158

AVAILABLE VOLUME CALCULATION-EXTENDED DETENTION/INFILTRATION SYSTEM
(STORAGE VOLUME BENEATH LOWEST ORIFICE
IN EXTENDED DETENTION/INFILTRATION SYSTEM)

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
21.50	2,384.0	0.0	0.0	```
22.15	22,600.0	8,119.8	8,119.8	0.186

RECHARGE VOLUME REQUIRED (cu.ft.):	3,685	
RECHARGE VOLUME PROVIDED (cu.ft.):	8,120	OK
RECHARGE VOLUME PROVIDED (ac.ft.):	0.186	

DRAWDOWN TIME CALCULATION

DRAWDOWN TIME=(REQ.RECH. VOL.)/(DES. INFILTRATION RATE "K"*BOTTOM AREA)

RECHARGE VOLUME PROVIDED (CF)=	8,119.8	
DESIGN INFILTRATION RATE (IN/HR)=	1.0	
BOTTOM AREA(SF)=	2,384.0	
DRAWDOWN TIME (HRS)=	40.9	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

RECHARGE VOLUME CALCULATION

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	12/17/2012 Rev 4/11/14
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED RECHARGE VOLUME POST DEVELOPMENT AREA 9A

HYDROLOGIC SOIL GROUP	A
UNIT VOLUME (in.) =	0.60
IMPERVIOUS AREA (s.f.) =	46,103
RECHARGE VOLUME (cu.ft.) =	2,305
HYDROLOGIC SOIL GROUP	B
UNIT VOLUME (in.) =	0.35
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0
HYDROLOGIC SOIL GROUP	C
UNIT VOLUME (in.) =	0.25
IMPERVIOUS AREA (s.f.) =	15,368
RECHARGE VOLUME (cu.ft.) =	320
HYDROLOGIC SOIL GROUP	D
UNIT VOLUME (in.) =	0.10
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0

5700 CF OF STORAGE PROVIDED WITHIN THE SUBSURFACE RECHARGE SYSTEM BELOW THE ORIFICE ELEVATION (BASED ON HYDROCAD CALCULATIONS-SEE ATTACHED SHEET)

RECHARGE VOLUME REQUIRED (cu.ft.):	2,625	
RECHARGE VOLUME PROVIDED (cu.ft.):	5,700	OK
RECHARGE VOLUME PROVIDED (ac.ft.):	0.131	

DRAWDOWN TIME CALCULATION

DRAWDOWN TIME=(REQ.RECH. VOL.)/(DES. INFILTRATION RATE "K"*BOTTOM AREA)

RECHARGE VOLUME PROVIDED (CF)=	5,700.0	
DESIGN INFILTRATION RATE (IN/HR)=	1.0	
BOTTOM AREA(SF)=	11,757.0	
DRAWDOWN TIME (HRS)=	5.8	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

RECHARGE VOLUME CALCULATION

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	12/17/2012 Rev 4/11/14
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED RECHARGE VOLUME POST DEVELOPMENT AREA 9B

HYDROLOGIC SOIL GROUP	C
UNIT VOLUME (in.) =	0.25
IMPERVIOUS AREA (s.f.) =	56,000
RECHARGE VOLUME (cu.ft.) =	1,167

4,032 CF OF STORAGE PROVIDED WITHIN THE PONDS BELOW THE ORIFICE ELEVATION (BASED ON HYDROCAD CALCULATIONS-SEE ATTACHED SHEET)

RECHARGE VOLUME REQUIRED (cu.ft.):	1,167	
RECHARGE VOLUME PROVIDED (cu.ft.):	4,032	OK
RECHARGE VOLUME PROVIDED (ac.ft.):	0.093	

DRAWDOWN TIME CALCULATION

DRAWDOWN TIME=(REQ.RECH. VOL.)/(DES. INFILTRATION RATE "K"*BOTTOM AREA)

RECHARGE VOLUME PROVIDED (CF)=	4,032.0	
DESIGN INFILTRATION RATE (IN/HR)=	1.0	
BOTTOM AREA(SF)=	5,920.0	
DRAWDOWN TIME (HRS)=	8.2	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

RECHARGE VOLUME CALCULATION

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED RECHARGE VOLUME-NORTH BASIN 1

HYDROLOGIC SOIL GROUP	A
UNIT VOLUME (in.) =	0.60
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0
HYDROLOGIC SOIL GROUP	B
UNIT VOLUME (in.) =	0.35
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0
HYDROLOGIC SOIL GROUP	C
UNIT VOLUME (in.) =	0.25
IMPERVIOUS AREA (s.f.) =	200,390
RECHARGE VOLUME (cu.ft.) =	4,175
HYDROLOGIC SOIL GROUP	D
UNIT VOLUME (in.) =	0.10
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0

AVAILABLE VOLUME CALCULATION-EXTENDED DETENTION/INFILTRATION SYSTEM
(STORAGE VOLUME BENEATH LOWEST ORIFICE
IN EXTENDED DETENTION/INFILTRATION SYSTEM)

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
20.00	17,621.0	0.0	0.0	```
20.50	19,492.0	9,278.3	9,278.3	0.213

RECHARGE VOLUME REQUIRED (cu.ft.):	4,175	
RECHARGE VOLUME PROVIDED (cu.ft.):	9,278	OK
RECHARGE VOLUME PROVIDED (ac.ft.):	0.213	

DRAWDOWN TIME CALCULATION

DRAWDOWN TIME=(REQ.RECH. VOL.)/(DES. INFILTRATION RATE "K"*BOTTOM AREA)

RECHARGE VOLUME PROVIDED (CF)=	9,278.3	
DESIGN INFILTRATION RATE (IN/HR)=	1.0	
BOTTOM AREA(SF)=	17,621.0	
DRAWDOWN TIME (HRS)=	6.3	OK

FIELD ENGINEERING, INC. MATTAPOISETT, MA

RECHARGE VOLUME CALCULATION

Client:	MASHPEE	Job No.	1905
Project:	LAND INTO TRUST CASINO SITE	Date:	4/11/2014
Location:	STEVENS STREET, TAUNTON, MA	Design by:	R. RICCIO

REQUIRED RECHARGE VOLUME-NORTH BASIN 2

HYDROLOGIC SOIL GROUP	A
UNIT VOLUME (in.) =	0.60
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0
HYDROLOGIC SOIL GROUP	B
UNIT VOLUME (in.) =	0.35
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0
HYDROLOGIC SOIL GROUP	C
UNIT VOLUME (in.) =	0.25
IMPERVIOUS AREA (s.f.) =	109,905
RECHARGE VOLUME (cu.ft.) =	2,290
HYDROLOGIC SOIL GROUP	D
UNIT VOLUME (in.) =	0.10
IMPERVIOUS AREA (s.f.) =	0
RECHARGE VOLUME (cu.ft.) =	0

AVAILABLE VOLUME CALCULATION-EXTENDED DETENTION/INFILTRATION SYSTEM
(STORAGE VOLUME BENEATH LOWEST ORIFICE
IN EXTENDED DETENTION/INFILTRATION SYSTEM)

ELEV (ft.)	AREA (s.f.)	VOL (cu.ft.)	CUM. VOL (cu.ft.)	CUM. VOL (ac.ft.)
**	**			
23.00	8,961.0	0.0	0.0	```
23.50	9,939.0	4,725.0	4,725.0	0.108

RECHARGE VOLUME REQUIRED (cu.ft.):	2,290	
RECHARGE VOLUME PROVIDED (cu.ft.):	4,725	OK
RECHARGE VOLUME PROVIDED (ac.ft.):	0.108	

DRAWDOWN TIME CALCULATION

DRAWDOWN TIME=(REQ.RECH. VOL.)/(DES. INFILTRATION RATE "K"*BOTTOM AREA)

RECHARGE VOLUME PROVIDED (CF)=	4,725.0	
DESIGN INFILTRATION RATE (IN/HR)=	1.0	
BOTTOM AREA(SF)=	17,621.0	
DRAWDOWN TIME (HRS)=	3.2	OK

Appendix G

Preliminary TSS Removal Calculation Sheets

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Maggiore Combined Basin (LIT Site-South Parcel)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 10%	**0.10**	**1.00**	**0.10**	**0.90**
Deep Sump and Hooded Catch Basin	**0.25**	**0.90**	**0.23**	**0.68**
Constructed Stormwater Wetland	**0.80**	**0.68**	**0.54**	**0.14**
	0.00	**0.14**	**0.00**	**0.14**
	0.00	**0.14**	**0.00**	**0.14**

Total TSS Removal = **87%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Land Into Trust Casino Site**
Prepared By: **RRR**
Date: **12/11/2012**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: O'Connell Way Basin (LIT Site South Parcel)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 10%	**0.10**	**1.00**	**0.10**	**0.90**
Deep Sump and Hooded Catch Basin	**0.25**	**0.90**	**0.23**	**0.68**
Sediment Forebay	**0.25**	**0.68**	**0.17**	**0.51**
Wet Basin	**0.80**	**0.51**	**0.41**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**

Total TSS Removal = **90%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Land Into Trust Casino Site**
Prepared By: **RRR**
Date: **12/11/2012**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Remote Parking Areas (Lots 9 and 13)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 10%	**0.10**	**1.00**	**0.10**	**0.90**
Bioretention Area	**0.90**	**0.90**	**0.81**	**0.09**
	0.00	**0.09**	**0.00**	**0.09**
	0.00	**0.09**	**0.00**	**0.09**
	0.00	**0.09**	**0.00**	**0.09**

Total TSS Removal = **91%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Land Into Trust Casino Site**
Prepared By: **RRR**
Date: **12/11/2012**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: LIT Site-North Parcel

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 10%	**0.10**	**1.00**	**0.10**	**0.90**
Deep Sump and Hooded Catch Basin	**0.25**	**0.90**	**0.23**	**0.68**
Constructed Stormwater Wetland	**0.80**	**0.68**	**0.54**	**0.14**
	0.00	**0.14**	**0.00**	**0.14**
	0.00	**0.14**	**0.00**	**0.14**

Total TSS Removal = **87%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **Land Into Trust Casino Site**
Prepared By: **RRR**
Date: **12/11/2012**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

Appendix H

Soil Evaluation Logs

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-1 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-8	A	Loamy Sand	10 YR 3/3		Friable
8-22	B	Loamy Sand	10 YR 5/6		Friable
22-48	C_1	Fine-Medium Sand	2.5 Y 6/4	@ 44"	Loose, Caving
48-84	C_2	Fine Loamy Sand	2.5 Y 6/2		Friable to Firm, Damp, Little to No Gravel

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 54" Weeping from Pit Face: 66"

Estimated Seasonal High Ground Water: Mottles at 44"

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-2 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-6	A	Loamy Sand	10 YR 3/3		Friable
6-30	B	Loamy Sand	10 YR 5/6		Friable
30-42	C_1	Fine-Medium Sand	2.5 Y 6/4	@33"	Loose, Caving
42-72	C_2	Fine Loamy Sand	2.5 Y 6/2		Friable to Firm, Damp, Little to No Gravel
72-84	C_3	Fine Sandy Loam	2.5 Y 6/2		Firm in Place

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: 56"

Estimated Seasonal High Ground Water: Mottles at 33"

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-3 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*					
Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-8	A	Loamy Sand	10 YR 3/3		Friable
8-26	B	Loamy Sand	10 YR 5/6		Friable
26-52	C_1	Loamy Sand	2.5 Y 5/3	@36"	Loose-Friable, Damp
72-84	C_2	Fine Sandy Loam	2.5 Y 6/2		Firm in Place

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: N/E

Estimated Seasonal High Ground Water: Mottles at 36"

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-4 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*					
Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-12	A	Loamy Sand	10 YR 3/3		Friable
12-30	B	Loamy Sand	10 YR 5/6		Friable
30-72	C_1	Fine Sandy Loam	2.5 Y 6/2	@26"	Friable to Firm, Damp Mottles with Roots

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: N/E

Estimated Seasonal High Ground Water: Mottles at 26"

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-5 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-10	A	Loamy Sand	10 YR 3/3		Friable
10-24	B	Loamy Sand	10 YR 5/6		Friable
24-60	C_1	Fine Sandy Loam	2.5 Y 6/2	@24"	Friable to Firm, Damp Mottles with Roots

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: N/E

Estimated Seasonal High Ground Water: Mottles at 24"

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-6 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-12	A	Loamy Sand	10 YR 3/3		Friable
12-24	B	Loamy Sand	10 YR 5/6		Friable
24-44	C_1	Loamy Sand	2.5 Y 5/3	@44"	Loose-Friable, Damp
44-72	C_2	Fine Sandy Loam	2.5 Y 6/2		Saturated, No Gravel. Heavy Weeping at 48"

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: 48"

Estimated Seasonal High Ground Water: Mottles at 44"

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-7 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-16	A	Loamy Sand	10 YR 3/3		Friable
16-28	B	Loamy Sand	10 YR 5/6		Friable
28-52	C_1	Loamy Sand	2.5 Y 5/3	@36"	Loose-Friable, Damp
52-72	C_2	Fine Sandy Loam	2.5 Y 6/2		Saturated, No Gravel

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: 46"

Estimated Seasonal High Ground Water: Mottles at 36"

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-8 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: In Woods Road

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-4	O/A	Loamy Sand	10 YR 3/3		Friable
4-24	B	Loamy Sand	10 YR 5/6		Friable
24-36	C_1	Loamy Sand	2.5 Y 5/3	@24"	Loose-Friable, Saturated.. Heavy Weeping
36-60	C_2	Sandy Loam	2.5 Y 5/2		Saturated, No Gravel

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: 24"

Estimated Seasonal High Ground Water: Mottles at 24"

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-9 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan (Near 404)

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Woods.

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-12	O/A	Loamy Sand	10 YR 3/3		Friable
12-24	B	Loamy Sand	10 YR 5/6		Friable
24-48	C_1	Loamy Sand	2.5 Y 6/3	@32"	Saturated, Friable
48-60	C_2	Sandy Loam	2.5 Y 6/3		Saturated, Friable
60-72	C_3	Medium Sand	2.5 Y 6/3		Loose, Caving, Saturated

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: 36"

Estimated Seasonal High Ground Water: Mottles at 32"

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-10 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-12	A	Loamy Sand	10 YR 3/3		Friable
12-20	B	Loamy Sand	10 YR 5/6		Friable
20-42	C_1	Fine-Medium Sand	2.5 Y 6/4	@ 44"	Loose, Caving
42-72	C_2	Fine Loamy Sand	2.5 Y 6/2		Friable to Firm, Damp, Little to No Gravel

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: 44"

Estimated Seasonal High Ground Water: Mottles at 44"

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-11 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-12	A	Loamy Sand	10 YR 3/3		Friable
12-28	B	Loamy Sand	10 YR 5/6		Friable
28-72	C_1	Medium Sand	2.5 Y 6/4	@ 48"	Loose, Caving
72+	C_2	Fine Loamy Sand	2.5 Y 6/2		Friable to Firm, Damp, Little to No Gravel

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: 60"

Estimated Seasonal High Ground Water: Mottles at 48"

Location Address or Lot No. Lot 9 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-9-12 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*					
Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-12	A	Loamy Sand	10 YR 3/3		Friable
12-24	B	Loamy Sand	10 YR 5/6		Friable
24-38	C_1	Coarse Loamy Sand	2.5 Y 6/4	@ 24"	Loose, Caving
38+	C_2	Medium Sand	2.5 Y 6/2		Damp, Little to No Gravel

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: 24"

Estimated Seasonal High Ground Water: Mottles at 24"

Location Address or Lot No. Lot 11 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-11-1 Date: 11/5/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-4	A	Loamy Sand	10 YR 3/3		Friable
4-24	B	Loamy Sand	10 YR 5/6		Friable
24-72	C_1	Coarse Loamy Sand	2.5 Y 6/4	@ 32"	Friable
72-84	C_2	Sandy Loam	2.5 Y 6/2		Friable to Firm, Damp, Little to No Gravel

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: N/E

Estimated Seasonal High Ground Water: Mottles at 32"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-1 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-10	A	Sandy Loam	10 YR 4/4		Friable
10-20	B	Loamy Sand	10 YR 5/6		Firm to Friable
20-74	C_1	Sandy Loam	2.5 Y 6/4	@36"	Very Firm, Gleyed (5 Y 6/2)

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 63" Weeping from Pit Face: 63"

Estimated Seasonal High Ground Water: Mottles at 36"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-2 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-10	A	Sandy Loam	10 YR 4/4		Friable
10-22	B	Loamy Sand	10 YR 6/8		Firm to Friable
22-76	C_1	Sandy Loam	2.5 Y 6/4	@32"	Very Firm, Gleyed (5 Y 6/2)

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 70" Weeping from Pit Face: 70"

Estimated Seasonal High Ground Water: Mottles at 32"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-3 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-14	A	Sandy Loam	10 YR 4/4		Friable
14-23	B	Loamy Sand	10 YR 6/8		Loose
23-79	C_1	Loamy Sand	2.5 Y 6/4	@36"	Firm with loose lenses of Coarse Sand Heavy Rust Band @ 50"

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 77" Weeping from Pit Face: 73"

Estimated Seasonal High Ground Water: Mottles at 36"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-4 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-12	A	Sandy Loam	10 YR 4/4		Friable
12-20	B	Loamy Sand	10 YR 6/8		Loose
20-86	C_1	Med-Coarse Sand	2.5 Y 6/4	@40"	Damp Throughout, Rust Bands at 40" & 60"

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 80" Weeping from Pit Face: 72"

Estimated Seasonal High Ground Water: Mottles at 40"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-5 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*					
Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-14	A	Sandy Loam	10 YR 4/4		Friable
14-22	B	Loamy Sand	10 YR 6/8		Loose to Firm
22-98	C_1	Loamy Sand	2.5 Y 6/4	@32"	Firm

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 96" Weeping from Pit Face: 90"

Estimated Seasonal High Ground Water: Mottles at 32"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-6 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*					
Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-15	A	Sandy Loam	10 YR 4/4		Friable
15-24	B	Loamy Sand	10 YR 5/6		Loose to Firm
24-96	C_1	Fine Sandy Loam	2.5 Y 6/4	@30"	Very Firm in Place

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: N/E

Estimated Seasonal High Ground Water: Mottles at 30"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-7 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-14	A	Sandy Loam	10 YR 4/4		Friable
14-23	B	Loamy Sand	10 YR 5/6		Loose to Firm
23-101	C_1	Fine Sandy Loam	2.5 Y 6/4	@26"	Very Firm in Place

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: 58"

Estimated Seasonal High Ground Water: Mottles at 26"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-8 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-12	A	Sandy Loam	10 YR 4/4		Friable
12-22	B	Loamy Sand	10 YR 5/6		Loose to Firm
22-98	C_1	Fine Sandy Loam	2.5 Y 6/4	@30"	Very Firm in Place

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 95" Weeping from Pit Face: 60"

Estimated Seasonal High Ground Water: Mottles at 30"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-9 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-12	A	Sandy Loam	10 YR 4/4		Friable
12-24	B	Loamy Sand	10 YR 5/6		Loose to Firm
24-90	C_1	Loamy Sand	2.5 Y 6/4	@32"	Firm, Lenses of Fine Sand (loose)

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 86" Weeping from Pit Face: 80"

Estimated Seasonal High Ground Water: Mottles at 32"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-10 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-15	A	Sandy Loam	10 YR 4/4		Friable
15-24	B	Loamy Sand	10 YR 5/6		Loose to Firm
24-88	C_1	Loamy Sand	2.5 Y 6/4	@36"	Firm, Lenses of Fine Sand (loose)

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 88" Weeping from Pit Face: 83"

Estimated Seasonal High Ground Water: Mottles at 36"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-11 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-13	A	Sandy Loam	10 YR 4/4		Friable
13-25	B	Loamy Sand	10 YR 5/6		Friable
25-80	C_1	Coarse Sand	2.5 Y 5/3	@26"	Loose, with lenses of firm fine sandy loam.

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 72" Weeping from Pit Face: 60"

Estimated Seasonal High Ground Water: Mottles at 26"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-12 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-16	A	Sandy Loam	10 YR 4/4		Friable
16-30	B	Loamy Sand	10 YR 5/6		Friable
30-74	C_1	Coarse Sand	2.5 Y 5/3	@34"	Loose, With Areas of Firm Coarse Sand

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 60" Weeping from Pit Face: 46"

Estimated Seasonal High Ground Water: Mottles at 34"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-13 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*					
Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-15	A	Sandy Loam	10 YR 4/4		Friable
15-25	B	Loamy Sand	10 YR 5/6	@24"	Friable
25-55	C_1	Fine Sandy Loam	2.5 Y 6/4		Firm
55=72	C_2	Coarse Sand	2.5 Y 6/4		Loose

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 58" Weeping from Pit Face: 46"

Estimated Seasonal High Ground Water: Mottles at 24"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-14 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-17	A	Sandy Loam	10 YR 4/4		Friable
17-32	B	Loamy Sand	10 YR 5/8	@28"	Loose
32-54	C_1	Fine Sand	10 YR 5/6		Friable
54-86	C_2	Fine Sandy Loam	2.5 Y 6/4		Some Stones/Boulders-Large Stones at Bottom

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole N/E Weeping from Pit Face: N/E

Estimated Seasonal High Ground Water: Mottles @ 28"

Location Address or Lot No. Lot 13 Parking Area-O'Connell Way

On-site Review

Deep Hole Number: TP-13-15 Date: 11/6/12 Time: am Weather: Sunny

Location (Identify on site plan): See site location plan

Land Use: Agricultural Slope (%): 0-5% Surface Stones: None

Vegetation: Field Area

Landform:

Position on Landscape (sketch on the back): See site location plan

Distances from:

Open Water Body: >100 feet Drainage way: 0 feet

Possible Wet Area: >50 feet Property Line: >10 feet

Drinking Water Well: >100 feet Other:

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-16	A	Sandy Loam	10 YR 4/4		Friable
16-30	B	Loamy Sand	10 YR 5/8		Friable
30-48	C_1	Fine-Medium Sand	10 YR 5/6	@30"	Friable
48-60	C_2	Fine Sandy Loam	2.5 Y 6/4		Firm
60-90	C_3	Coarse Sand	2.5 Y 6/4		Loose, Caving

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash Depth to Bedrock: N/E

Depth to Groundwater: Standing Water in the Hole 78" Weeping from Pit Face: 60"

Estimated Seasonal High Ground Water: Mottles @ 30"

DRAFT
CONCEPTUAL STORMWATER MANAGEMENT REPORT

First Light Casino Off-Site Mitigation
Routes 140/24 Improvements Project
Phase 1 & Alternative 1D
Taunton, Massachusetts

July 2014

Prepared for:

Prepared by:

Fay, Spofford & Thorndike, LLC
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FIRST LIGHT CASINO OFF-SITE MITIGATION
ROUTES 140/24 IMPROVEMENTS - PHASE 1 & ALT 1D
TAUNTON, MASSACHUSETTS

CONCEPTUAL STORMWATER MANAGEMENT REPORT

PROJECT DESCRIPTION:

On behalf of the *Project First Light-Destination Resort Casino*, Fay, Spofford & Thorndike, LLC, (FST) has prepared a Conceptual Stormwater Management Report for off-site mitigation on Route 140 at the interchange with Route 24 in the City of Taunton, Massachusetts. These improvements have been identified as *Phase 1* and *Alt 1D* as depicted on Figure Nos. 1 and 3 entitled "Proposed Improvements-Routes 24 NB and SB Ramps/County Street (Route 140) Phase 1 and Alt 1D", respectfully.

Limits of the *Phase 1* Project Improvements extend on County Street (Route 140) from a point approximately 800 feet west of the of the Route 24 SB ramps to a point approximately 600 feet east of the Route 24 NB Ramps.

The *Alt 1D* project proposed by MassDOT consists of long term improvements for the interchange of County Street (Route 140) and Route 24. The interchange design will be developed assuming a third lane travel will be added to the outside on Route 24 Southbound (SB) and Northbound (NB) within the project limits. The design of the interchange will be coordinated with the *Phase 1* Project to be in place when the First Light Casino opens.

With respect to stormwater management, this Conceptual Stormwater Management Report presents FST's evaluation of potential project impacts on the existing surface and closed drainage systems and identifies specific Best Management Practices (BMP's) for improving stormwater treatment and control stormwater discharges for each project. The location and selection of stormwater BMPs are designed to improve existing conditions such as water quality, promote groundwater recharge and minimize impacts of stormwater runoff to the greatest extent practicable.

FST's goal is to design the stormwater management system, including specific BMP's to meet the DEP Stormwater Standards to the maximum extent practicable and comply with the MassDOT Impaired Water Bodies Program and EPA's NPDES MS4 general permit. The project is located within the Taunton River Watershed and discharges stormwater to an MS4 system that eventually discharges via way of Cotley River to the Taunton River, which is listed on the MA 303d list (Category 5) with an Draft TMDL of bacteria/pathogens.

The existing stormwater management facilities located within each project limits are comprised of an open and closed drainage system consisting of overland flow, drainage swales, cross-culverts, catch basins, manholes, piping, and outfalls which ultimately

discharge to the Cotley River. The selected stormwater best management practices (BMPs) will control runoff, provided groundwater recharge and retain contaminants. It is assumed existing cross culverts within the project limits will be retained and where necessary extended.

Proposed BMPs include where applicable, retrofitting of the existing closed drainage system by relocating or providing new pretreatment BMP's such as deep sump/hooded catch basins, piping, drainage manholes, flared end sections w/stone apron and sediment forebays. Anticipated stormwater treatment and infiltration BMPs include grass channels, extended dry detention basins and infiltration basins/trenches. Segments of the proposed stormwater improvements for each project are identified on Figure Nos. 1 and 2 entitled "Phase 1 and Alt 1D Conceptual Drainage Design".

COMPLIANCE WITH DEP STORMWATER MANAGEMENT STANDARDS:

To protect the wetlands and waters of the Commonwealth from the adverse impacts of stormwater runoff, the DEP issued a *Stormwater Management Policy* that established stormwater management standards in November 1996. In 1997, DEP published the *Massachusetts Stormwater Handbook* as guidance on the *Stormwater Policy*. DEP revised the 1997 *Handbook* and associated stormwater management standards, which became effective on January 2, 2008. As such, the proposed projects must comply with these revised standards.

The proposed *Phase 1* and *Alt 1D* project consist of a combination of both redevelopment and new development areas. Stormwater runoff associated with the new development area will meet all of the stormwater standards. Stormwater runoff from areas of the project that qualify as redevelopment will meet the stormwater standards to the maximum extent practicable, while improving upon existing conditions. The Stormwater Handbook states that redevelopment projects are defined to include "maintenance and improvement of existing roadways, including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems, and repaving." As such segments of the proposed *Phase 1* and *Alt 1D* projects are in accord with this definition.

Under the criteria outlined in the handbook "a redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice (BMP) requirements of Standards 4, 5, and 6." In contrast, the project must meet Standards 1, 8, 9 and 10 in full. In general, conformance with the stormwater standards will be achieved in accordance with the Massachusetts Stormwater Handbook (Jan 2008), utilizing methodologies outlined in the MassDOT Stormwater Handbook for Highways and Bridges (May 2004), which has been endorsed by DEP. As such, selected Best Management Practices (BMPs) have been incorporated into each proposed project to improve existing conditions associated with stormwater runoff. For reference see attached Stormwater Report Checklist (*Appendix C*).

The following summarizes the extent to which each proposed project complies with the new Stormwater Management Standards.

Standard No. 1 – No New Untreated Discharges: No new outfalls that discharge directly into the Cotley River will be created as part of each project. Stormwater improvements will include the construction of new deep sump/hooded catch basins, piping, manholes, flared end sections w/stone apron, sediment forebays, grass channels, water quality swales, extended dry detention basins and infiltration basins/trenches. The existing storm drainage culverts located within each project limits will be retained/utilized and extended as part of the stormwater management system.

Standard No. 2 – Peak Rate Attenuation: Proposed project improvements will result in an overall impervious surface area increase of approximately 1.75 acres and 7.05 acres within the *Phase 1* and *Alt 1D* project limits. Existing drainage patterns will be maintained as part of the proposed stormwater management system. See attached hydrologic analysis *(Appendix E)* for calculations and other documentation regarding peak discharge rates for the *Phase 1* project. A summary of the hydrologic calculations for the 2, 10, 25, 50 and 100-yr storm events for pre and post development conditions, within the *Phase 1* project limits are presented below.

PHASE 1

SUBCATCHMENT NAME		POINT OF INTEREST	PRE-DEVELOPMENT STORM EVENT (VOLUME – ac-ft)					POST-DEVELOPMENT STORM EVENT (VOLUME – ac-ft)				
EXISTING CONDITION	PROPOSED CONDITION		2-yr	10-yr	25-yr	50-yr	100-yr	2-yr	10-yr	25-yr	50-yr	100-yr
1S	10L	POI 1	3.73 (0.29)	5.48 (0.43)	6.59 (0.53)	7.33 (0.59)	8.19 (0.66)	3.06 (0.30)	4.13 (0.45)	5.48 (0.54)	6.93 (0.61)	7.81 (0.68)
2S	20L	POI 2	12.61 (1.29)	18.63 (1.93)	22.49 (2.35)	25.07 (2.63)	28.07 (2.96)	8.61 (1.26)	12.46 (1.90)	14.99 (2.33)	16.94 (2.61)	19.22 (2.94)
3S	30L	POI 3	0.39 (0.04)	0.86 (0.07)	1.20 (0.10)	1.43 (0.12)	1.71 (0.14)	0.00 (0.00)	0.00 (0.00)	0.09 (0.03)	0.17 (0.06)	0.35 (0.09)

ALT 1D

Given site constraints such as land area, topography, wetlands, soil texture, groundwater and right-of-way, FST is currently evaluating selected stormwater BMP's which will provide peak flow attenuation for runoff associated with the *ALT 1D* project. Several options being considered include increasing the volume and footprint of BMP Nos. 1, 2, 3, 4 and 5 associated with the *Phase 1* project and providing an additional BMP identified as No. 6, within the new Route 24 SB Ramp Median (See Figure 2). At this time, hydrologic calculations have not been developed; however based on our initial review of the options noted above, we are confident that the peak rate attenuation standard will be met.

Standard No. 3 – Recharge: The intent of Standard 3 is to ensure that the infiltration volume of precipitation into the ground under post-development conditions is at least as much as the infiltration volume under pre-development conditions. The project improvements will result in an increase impervious surface area of approximately 1.74 acres

associated with *Phase 1* and approximately 7.05 acres associated with Alt 1D thereby, resulting in a decrease in the volume of rainfall recharging to the groundwater.

A review of the NRCS Soil Survey map classified soils within the project areas as Udorthents/Urban Land (No Hydrologic Group), Ninigret/Fine Sandy Loam (Hydrologic Group B), Woodbridge/Fine Sandy Loam (Hydrologic Group C) and Scarboro Mucky Loamy Fine Sand (Hydrologic Group D. As part of the drainage analysis, FST utilized the Hydrologic Soil Groups as identified on the Soil Survey Map within each project limit with the goal to coordinate with the project proponent to perform a field investigation at selected locations to further determine soil conditions within each project area. A copy of the NRCS Soil Map is provided within *Appendix A.*The standard states that the amount of groundwater recharge shall be based upon existing soil condition recharge rates as follows:

Hydrologic Group	Volume to Recharge x (Impervious Area)
A	0.60 inches of runoff
B	0.35 inches of runoff
C	0.25 inches of runoff
D	0.10 inches of runoff

Based on the above referenced soil conditions (i.e. Hydrologic Soil Groups B, C and D) times the increase in impervious area results in a required recharge volume of approximately 1242.0 cubic feet for the *Phase 1* project and an estimated required recharge volume of approximately 6398.0 cubic feet for the *Alt 1D* project. As such, the proposed stormwater treatment and infiltration BMP's will be design to provide the required recharge runoff volume.

Standard No. 4 – Water Quality: The proposed project meets the definition of redevelopment, thereby requiring the 80% TSS removal standard to be met only to the maximum extent practicable. Proposed BMP devices selected throughout each project area include the following:

BMP's:

Deep Sump/Hooded Catch Basins	25% TSS Removal Rate
Sediment Forebays	25% TSS Removal Rate
Grass Channel	50% TSS Removal Rate
Water Quality Swale	70% TSS Removal Rate
Extended Dry Detention Basin	50% TSS Removal Rate
Infiltration Basin/Trench	80% TSS Removal Rate

The proposed BMP's meet the 80% TSS removal pretreatment requirement, as a redevelopment project, the BMP's will provide an improvement to existing conditions. TSS removal calculation worksheets for proposed treatment methods at each point of interest (POI 1, 2, 3,) located within the *Phase 1* and *Alt 1D* project area limits are provided within *Appendix D.*

The Massachusetts Stormwater Handbook requires the computation of the water quality treatment volume for stormwater runoff. The required water quality treatment volume is based upon 0.5 inches (1.0-inch if within a Critical Areas, i.e. Zone II) times the new impervious area of the post development project site. As previously noted, each roadway improvement project consists of a combination redevelopment and new development areas. Stormwater runoff associated with the new development area will meet all of the stormwater standards. Stormwater runoff from areas of the project that qualify as redevelopment will meet the stormwater standards to the maximum extent practicable.

For the *Phase 1* and *Alt 1D* projects the required water quality volume is based on 0.5 inches of runoff times the new impervious area of the post development project site. The *Phase 1* project improvements will result in an overall increase in pavement and impervious surface area by approximately 1.74 acres. Approximately 1.10 acres of impervious area is considered new development with the remaining 0.64 acres identified as redevelopment. Based on a new contributing impervious area of 1.10 acres, the required water quality volume is 1997.0 cubic feet. The proposed stormwater treatment and infiltration BMPs will be ultimately sized to treat stormwater flows from the new impervious area and provide a minimum water quality volume of 1977.0 cubic feet.

The *Alt 1D* project improvements will result in an overall increase in pavement and impervious surface area by approximately 7.05 acres. Approximately 5.55 acres of impervious area is considered new development with the remaining 1.50 acres identified as redevelopment. Based on a new contributing impervious area of 5.55 acres, the required water quality volume is 9983.0 cubic feet. The proposed stormwater treatment and infiltration BMPs will be ultimately sized to treat stormwater flows from the new impervious area and provide a minimum water quality volume of 9983.0 cubic feet.

As previously noted, the project is located within the Taunton River Watershed and discharges stormwater to an MS4 system that eventually discharges via way of Cotley River to the Taunton River, which is listed on the MA 303d list (Category 5) with an Draft TMDL of bacteria/pathogens. Based on the BMP Summary Matrix as developed by the MassDOT Impaired Water Bodies Program estimated removal rates for bacteria/pathogens associated with Infiltration BMP's such as basins, trenches and subsurface structures is approximately 90 percent.

In summary the location and selection of stormwater BMP's are intended to improve existing conditions, assist in sediment removal, pollutant attenuation, groundwater recharge, reduce run-off temperatures prior to discharge and minimize impacts of runoff to the Taunton River to the greatest extent practicable.

Standard No. 5 – Land Uses With Higher Potential Pollutant Loads (LUHPPLs):
This standard is not applicable due to the fact that the proposed use is not associated with higher potential pollutant loads.

Standard No. 6 - Critical Areas: This standard is not applicable. The stormwater discharges are not located within/or near a critical area.

Standard No. 7 – Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable: The proposed projects consist of a combination of redevelopment and new development areas. Stormwater runoff from areas of each project that qualify as redevelopment will meet the stormwater standards to the maximum extent practicable, while improving upon existing conditions. Runoff associated with the new development area will meet all of the stormwater standards

Standard No. 8 – Construction Period Pollution Prevention and Erosion and Sedimentation Control: A Construction Period Pollution Prevention/Soil Erosion and Sediment Control Plan will be developed to address activities associated with proposed roadway construction in a manner that minimizes erosion, sediment, debris, and other pollutants from contaminating the resource areas and receiving waters. The installation of soil erosion and sediment controls will comply with the *Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas* (Massachusetts Executive Office of Environmental Affairs et. al.; 2003), and all aspects of Standard No. 8.

As the proposed project will involve more than one (1) acre of earth disturbance, a National Pollutant Discharge Elimination System (NPDES) Stormwater General Permit for construction will be required. In conjunction with this permit, a project specific Stormwater Pollution Prevention Plan (SWPPP) will be generated for construction-related activities. The SWPPP, to be prepared by the contractor prior to construction, will incorporate the soil erosion and sediment controls indicated on the project plans provided under separate cover, and any other structural and non-structural controls that will or may be used, as appropriate, to control erosion/sedimentation within the construction zone.

These measures are anticipated to consist of straw/hay bales/compost filter sock, silt fencing, check dams, catch basin/storm drain inlet protection, and seeding/mulching, although not all of these BMPs necessarily will be implemented. The SWPPP also will document procedures associated with the inspection of erosion/sedimentation controls to ensure that all such controls are functioning properly.

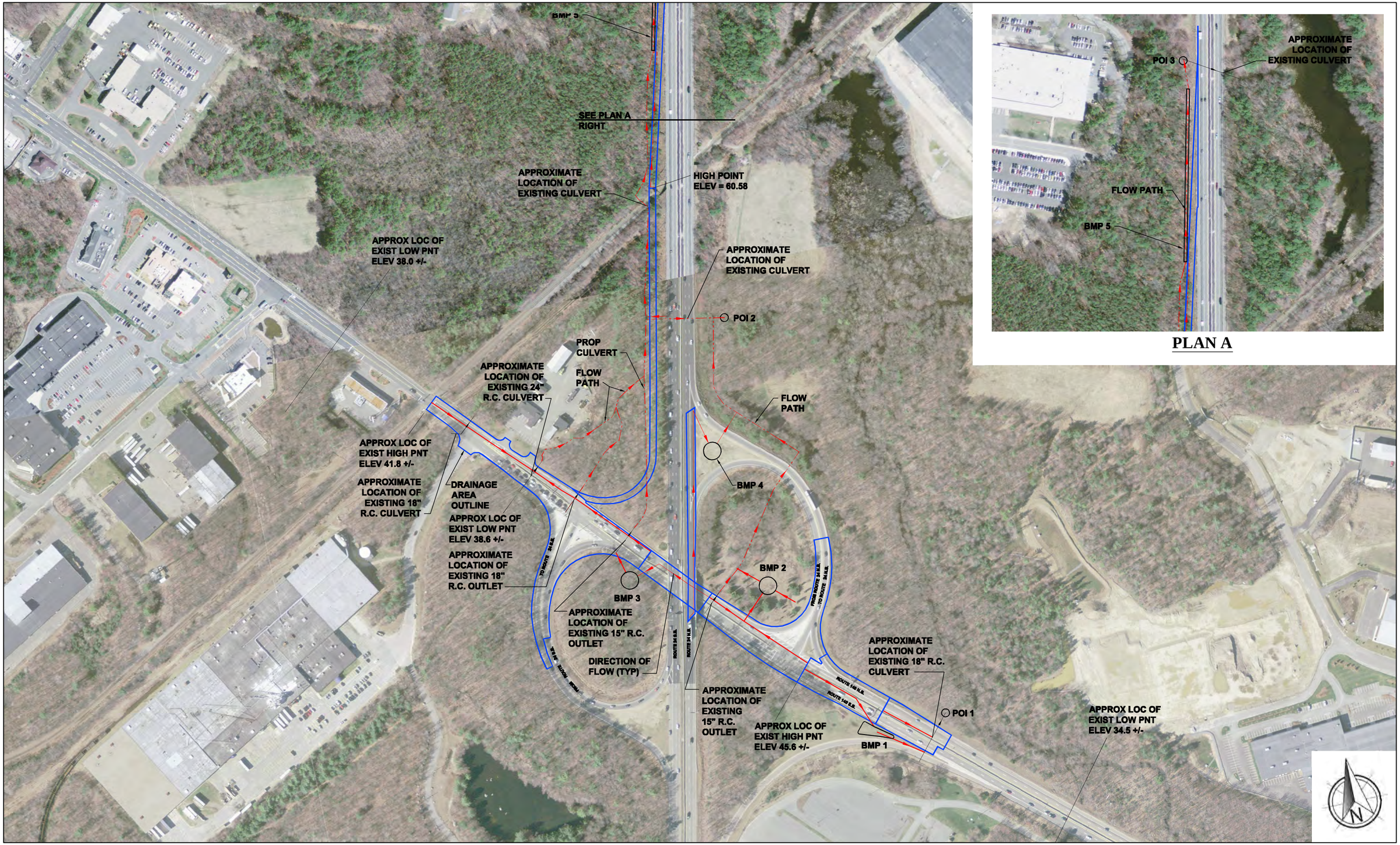
To apply for coverage under the EPA General Permit, a 'Notice of Intent for Stormwater Discharges Associated with Construction Activity under an NPDES General Permit' will be filed with the U.S. Environmental Protection Agency (EPA) prior to the commencement of construction. As required, the SWPPP also will be kept at the construction site for review by regulatory agency staff.

Standard No. 9 - Operation and Maintenance Plan: MassDOT is responsible for the operation and maintenance associated with the Phase 1 and Alt 1D projects. The schedule for inspection and maintenance will be according to MassDOT's annual maintenance program.

<u>Standard No. 10 – Prohibition of Illicit Discharges</u>: A 'No Illicit Discharge Compliance Statement' will be submitted prior to the discharge of any stormwater to post-construction BMP's.

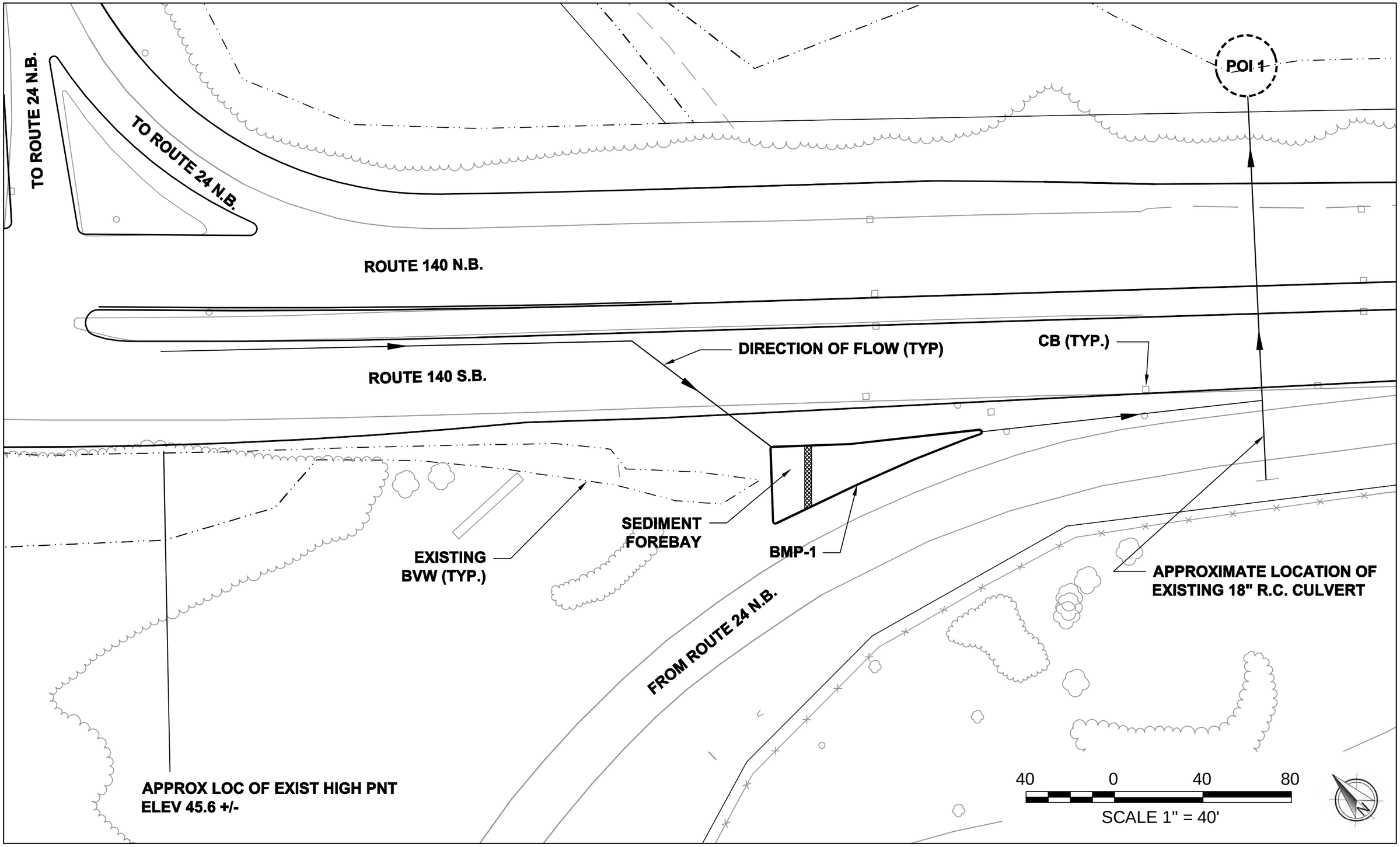
FIGURES

ROUTES 140/24 IMPROVEMENTS



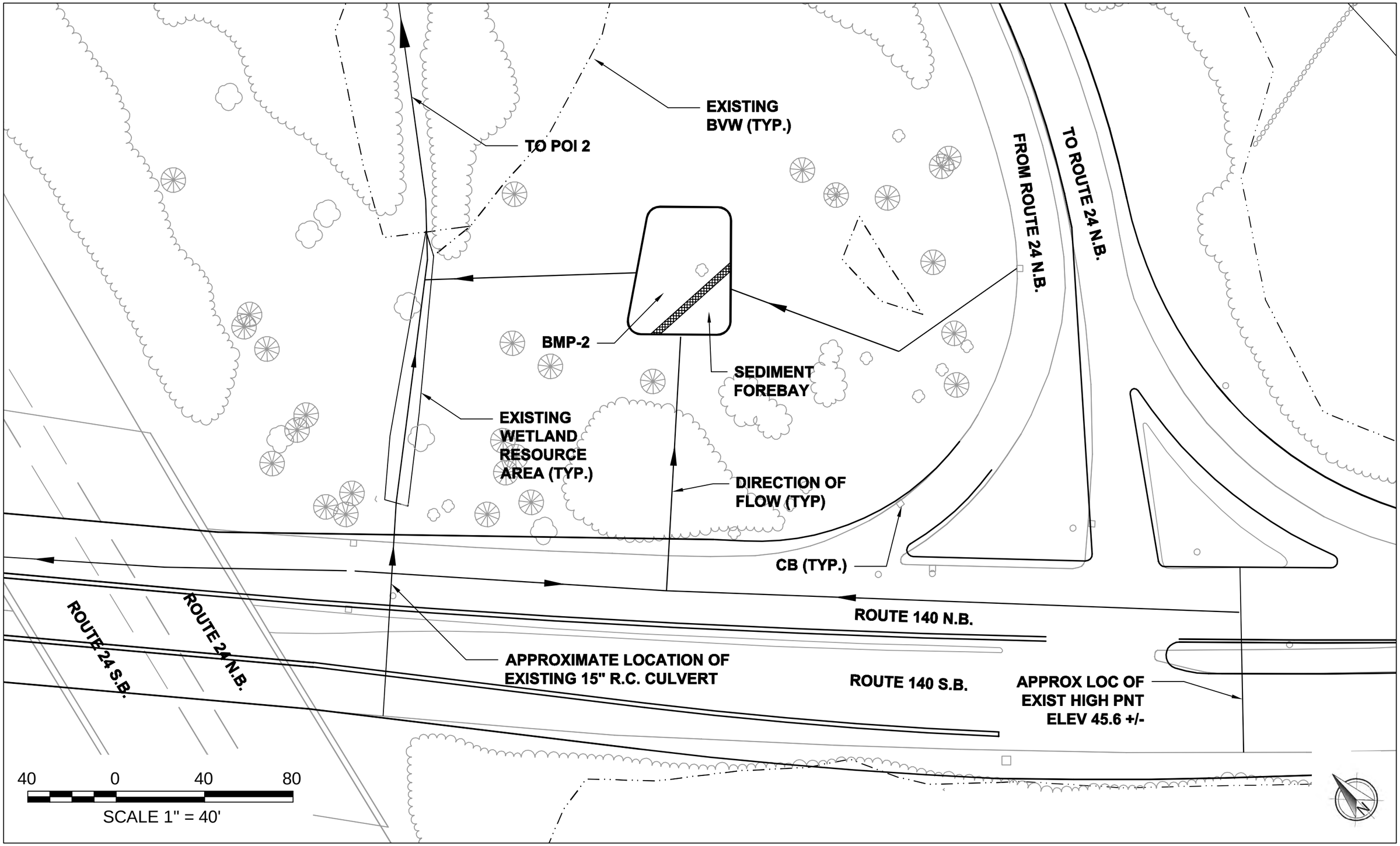
SOURCE: Fay, Spofford & Thorndike

Final EIR - Phase 1
Figure 1.0
Conceptual Drainage Design



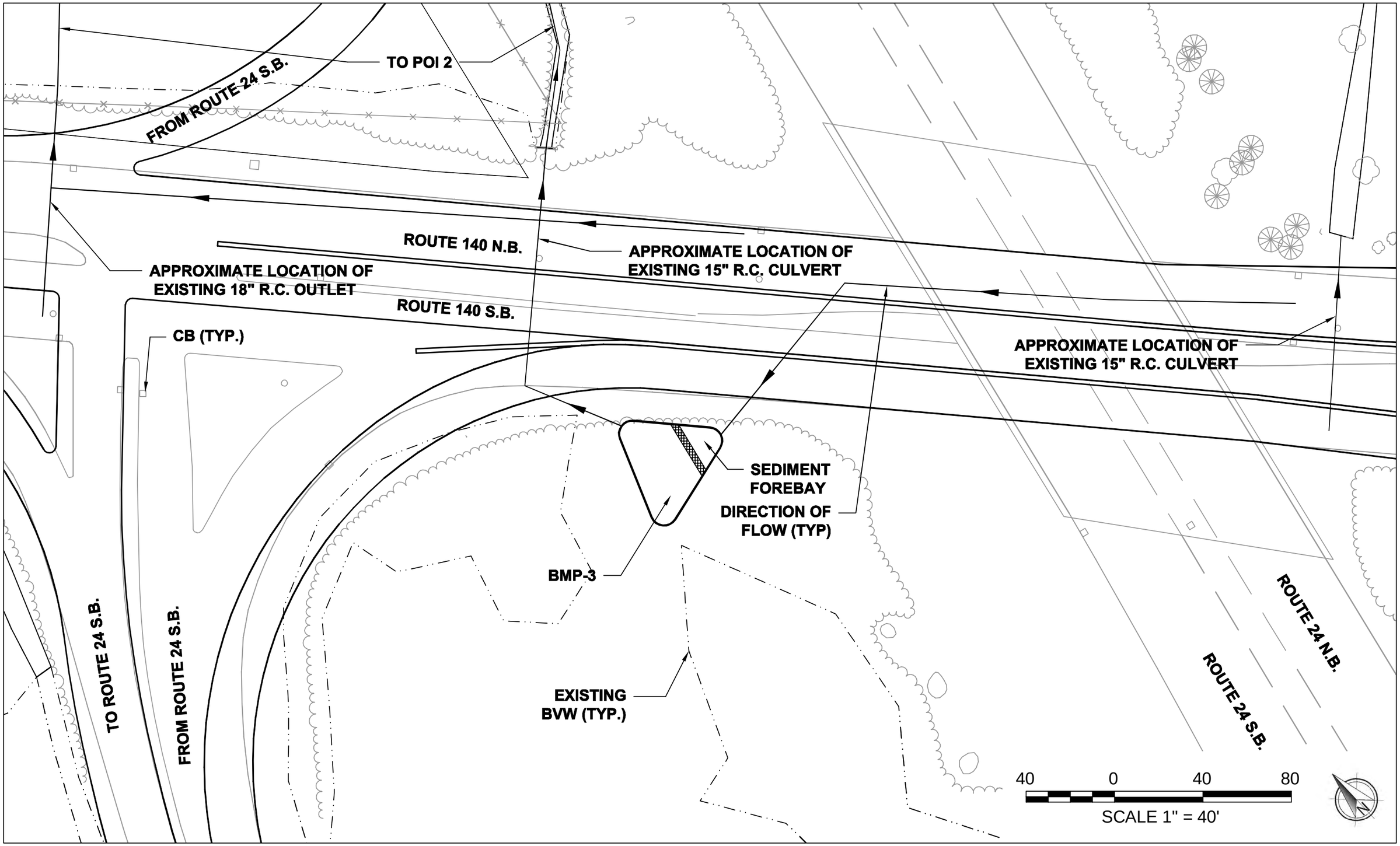
SOURCE: Fay, Spofford & Thorndike

Final EIR - Phase 1
Figure 1.1
Conceptual Drainage Design - BMP-1



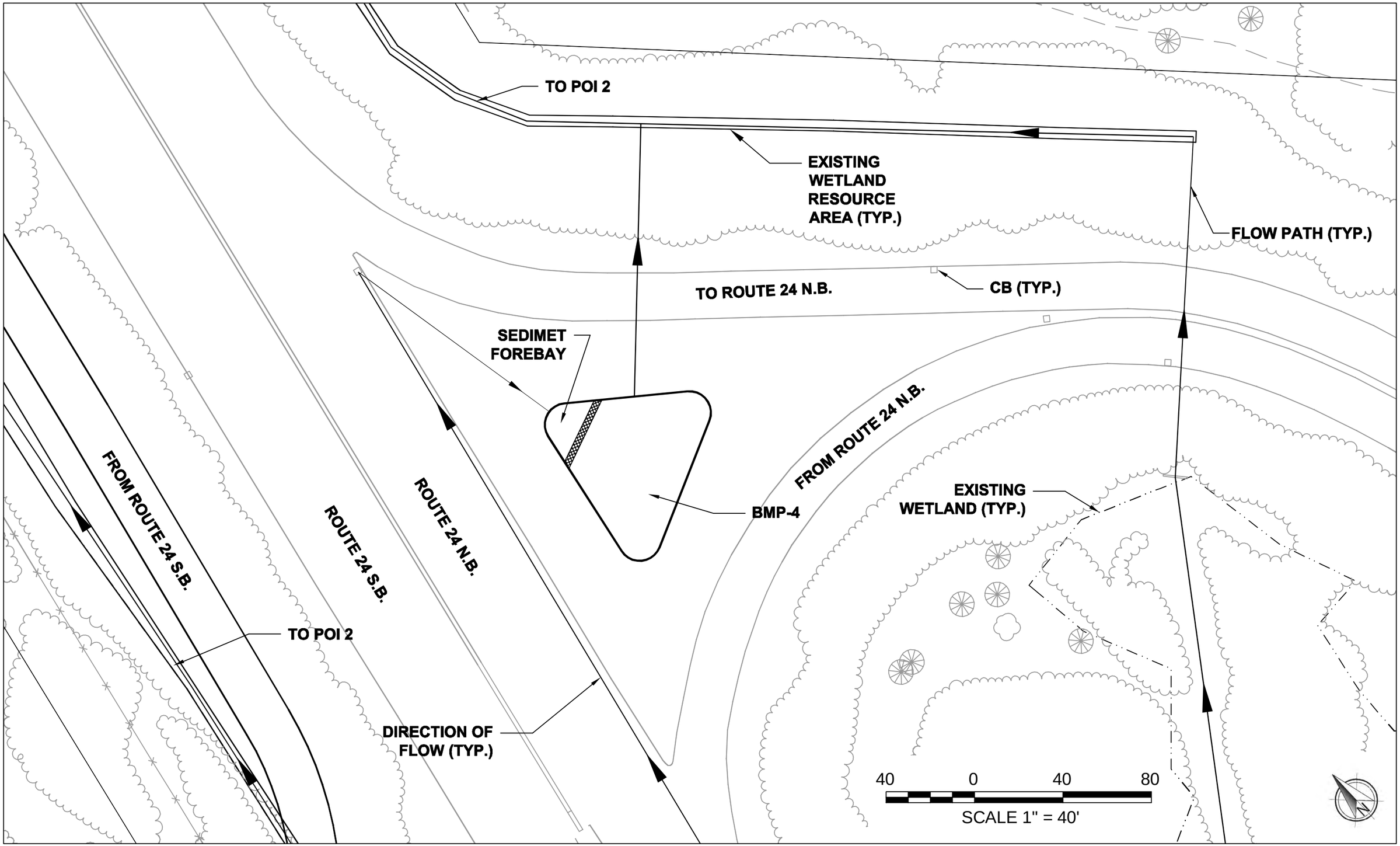
SOURCE: Fay, Spofford & Thorndike

Final EIR - Phase 1
Figure 1.2
Conceptual Drainage Design - BMP-2



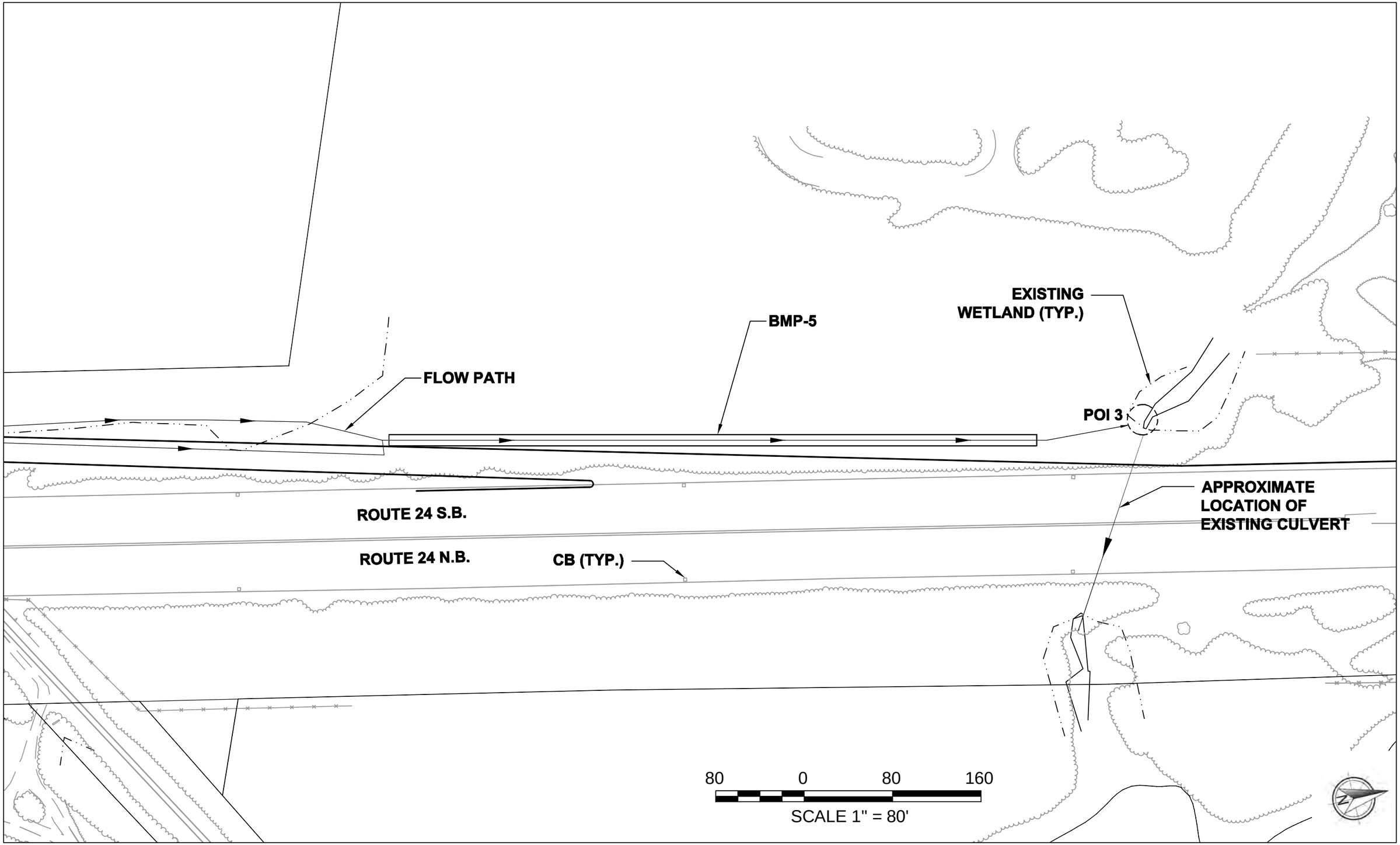
SOURCE: Fay, Spofford & Thorndike

Final EIR - Phase 1
Figure 1.3
Conceptual Drainage Design - BMP-3



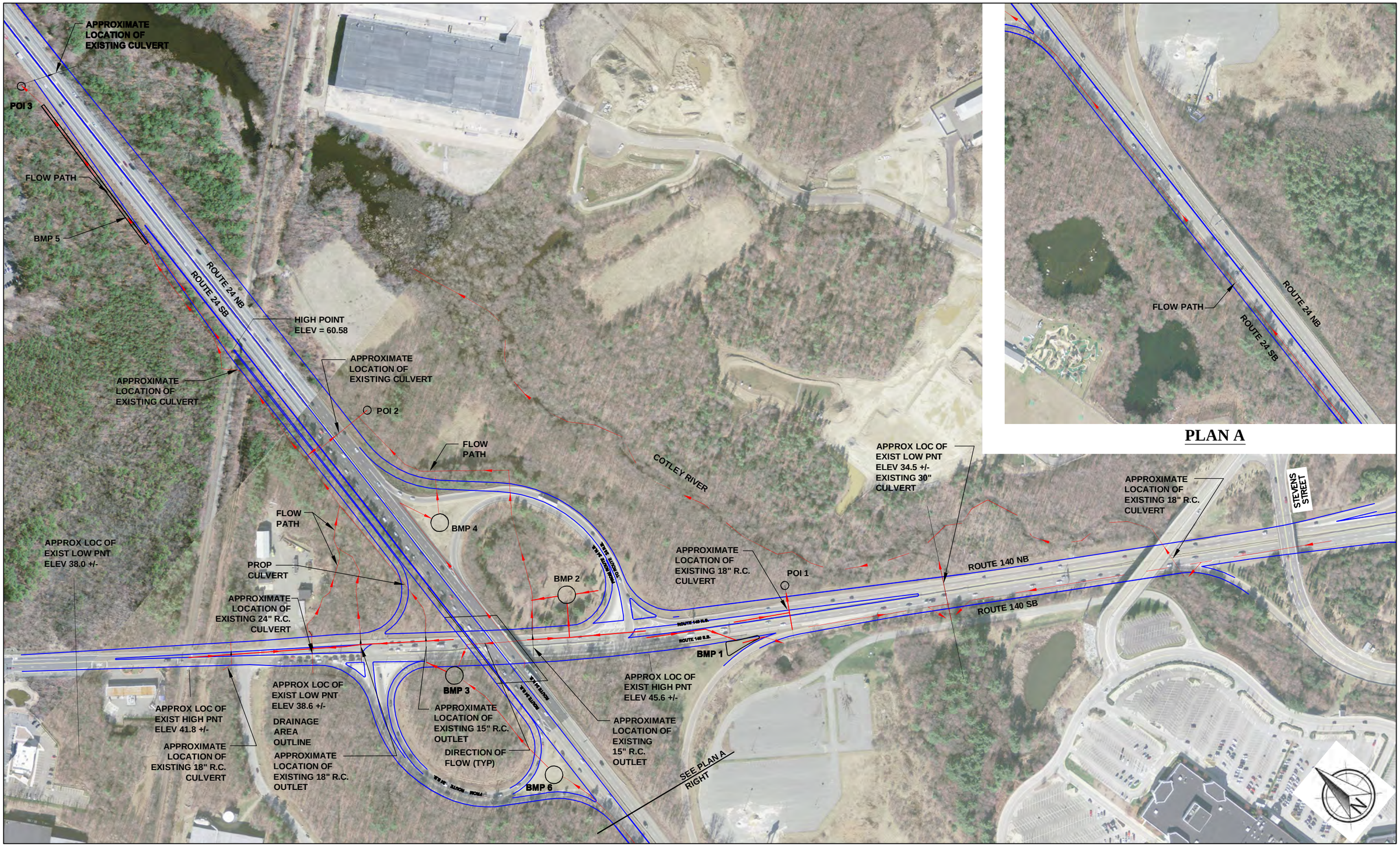
SOURCE: Fay, Spofford & Thorndike

Final EIR - Phase 1
Figure 1.4
Conceptual Drainage Design - BMP-4



SOURCE: Fay, Spofford & Thorndike

Final EIR - Phase 1
Figure 1.5
Conceptual Drainage Design - BMP-5



PLAN A

SOURCE: Fay, Spofford & Thorndike

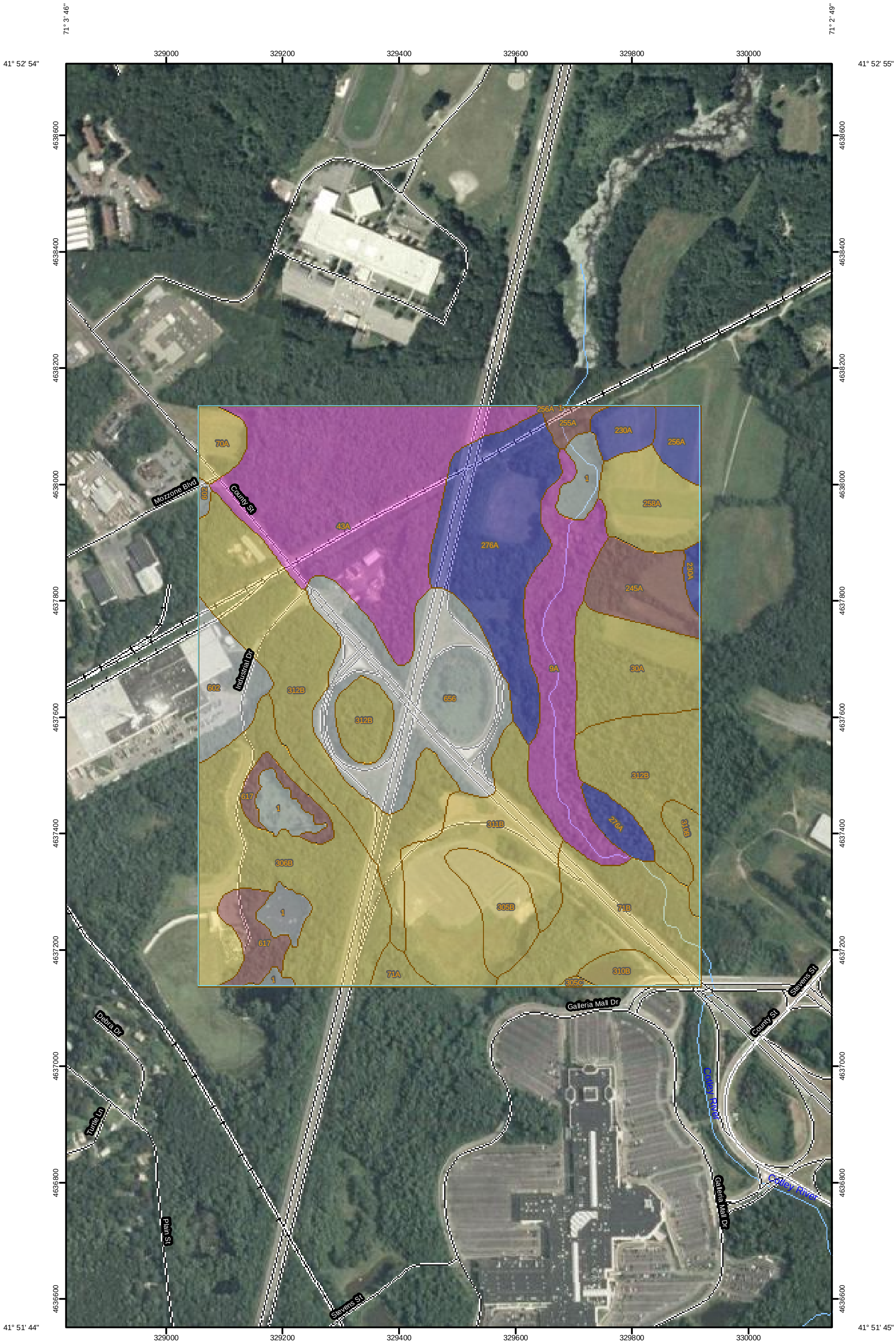
Final EIR - Alt 1D
Figure 2.0
Conceptual Drainage Design

APPENDIX A

ROUTES 140/24 IMPROVEMENTS
PHASE 1

NRCS SOIL SURVEY MAP

Hydrologic Soil Group—Bristol County, Massachusetts, Northern Part
(Taunton RTE 140)



Map Scale: 1:6,000 if printed on B size (11" x 17") sheet.

N

Meters
0 40 80 160 240

Feet
0 150 300 600 900

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:6,000 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 19N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bristol County, Massachusetts, Northern Part
Survey Area Data: Version 5, Jul 27, 2010

Date(s) aerial images were photographed: 8/15/2003; 8/14/2003; 7/31/2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bristol County, Massachusetts, Northern Part (MA602)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1	Water		5.6	2.6%
9A	Birdsall silt loam, 0 to 3 percent slopes	D	13.0	6.1%
30A	Raynham silt loam, 0 to 3 percent slopes	C	8.7	4.1%
43A	Scarboro mucky loamy fine sand, 0 to 3 percent slopes	D	29.5	13.9%
70A	Ridgebury fine sandy loam, 0 to 3 percent slopes	C	2.1	1.0%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	C	1.1	0.5%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	C	12.0	5.6%
230A	Unadilla very fine sandy loam, 0 to 3 percent slopes	B	2.7	1.3%
245A	Hinckley sandy loam, 0 to 3 percent slopes	A	5.5	2.6%
255A	Windsor loamy sand, 0 to 3 percent slopes	A	1.1	0.5%
256A	Deerfield loamy sand, 0 to 3 percent slopes	B	2.3	1.1%
258A	Amostown fine sandy loam, 0 to 5 percent slopes	C	6.0	2.8%
276A	Ninigret fine sandy loam, 0 to 3 percent slopes	B	18.2	8.6%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	4.6	2.2%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	C	0.2	0.1%
306B	Paxton fine sandy loam, 0 to 8 percent slopes, very stony	C	20.6	9.7%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C	3.5	1.6%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	C	14.9	7.0%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	C	31.3	14.8%
602	Urban land		5.4	2.5%
617	Pits - Udorthents complex, gravelly	A	4.5	2.1%
656	Udorthents - Urban land complex		19.4	9.1%
Totals for Area of Interest			**212.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

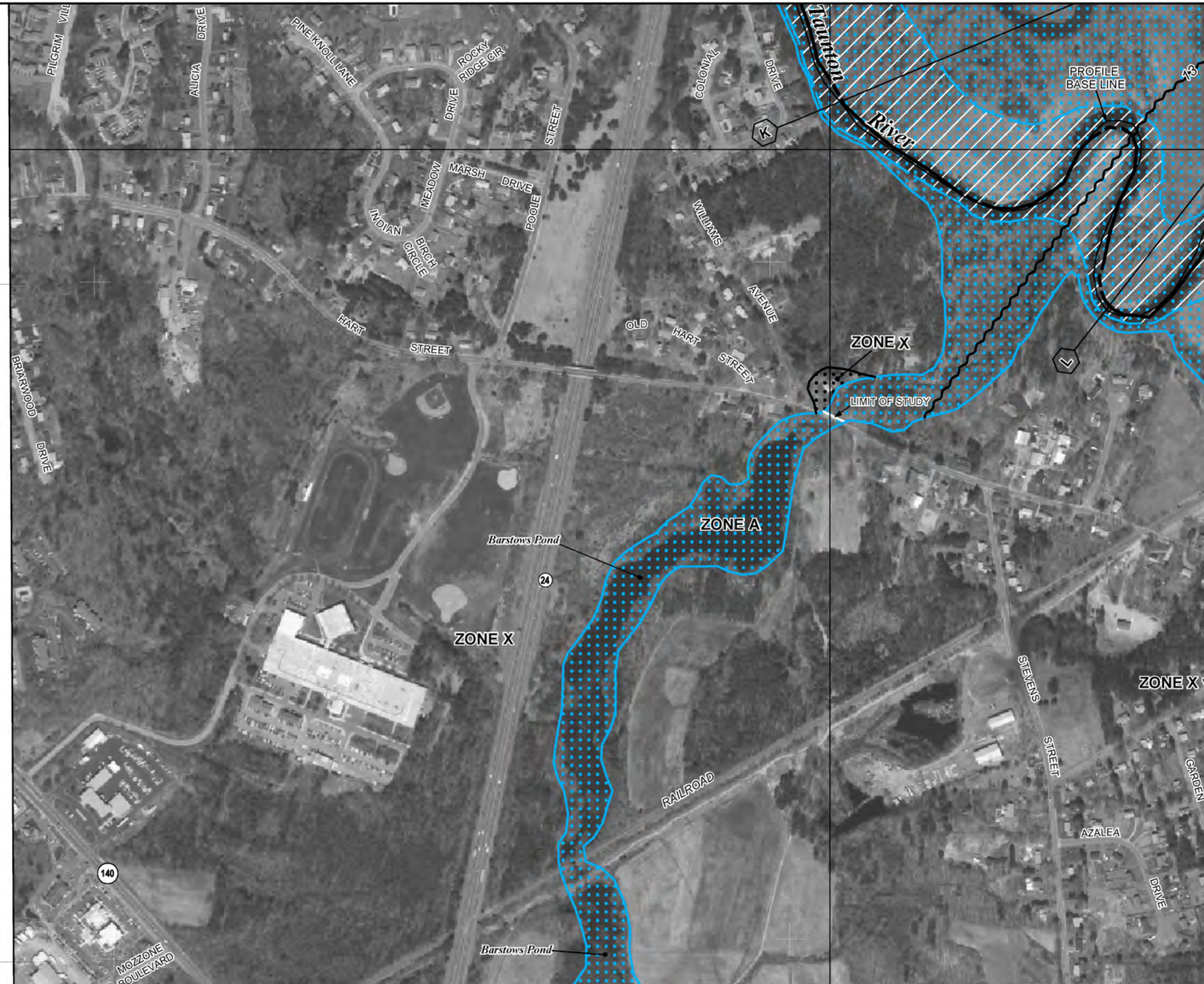
Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

APPENDIX B

ROUTES 140/24 IMPROVEMENTS
PHASE 1

FEMA FIRM PANEL



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0168F

FIRM

FLOOD INSURANCE RATE MAP

BRISTOL COUNTY, MASSACHUSETTS

(ALL JURISDICTIONS)

PANEL 168 OF 550

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
RAYNHAM, TOWN OF	250061	0168	F
TAUNTON, CITY OF	250066	0168	F

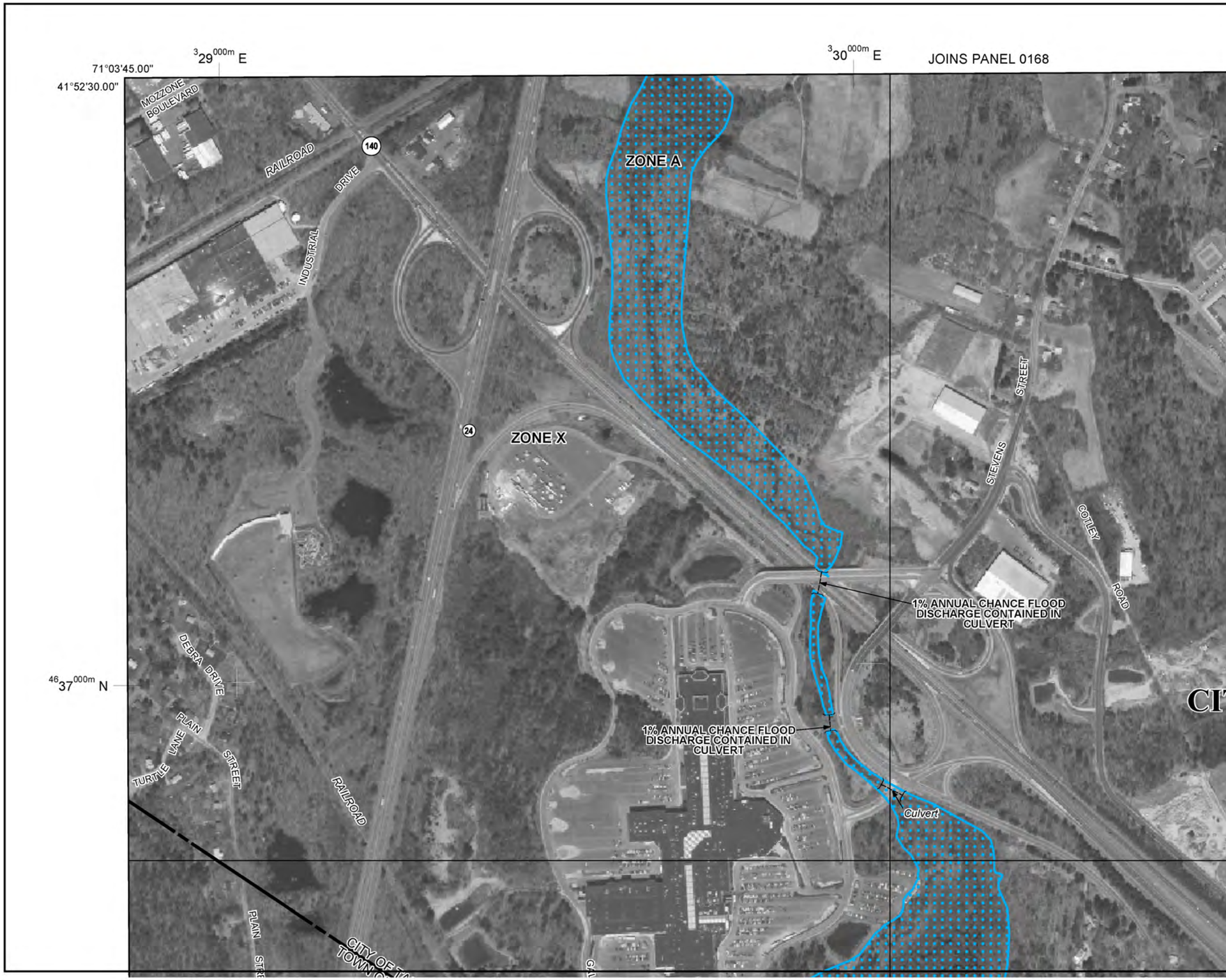
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25005C0168F

EFFECTIVE DATE
JULY 7, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0256F

FIRM

FLOOD INSURANCE RATE MAP

BRISTOL COUNTY, MASSACHUSETTS

(ALL JURISDICTIONS)

PANEL 256 OF 550

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BERKLEY, TOWN OF	250050	0256	F
TAUNTON, CITY OF	250066	0256	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25005C0256F

EFFECTIVE DATE
JULY 7, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0256F

FIRM

FLOOD INSURANCE RATE MAP

BRISTOL COUNTY, MASSACHUSETTS

(ALL JURISDICTIONS)

PANEL 256 OF 550

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BERKLEY, TOWN OF	250050	0256	F
TAUNTON, CITY OF	250066	0256	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25005C0256F

EFFECTIVE DATE
JULY 7, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A — Cross section line

23 - - - - - - - 23 — Transect line

97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

$^{42}75^{000m}$N — 1000-meter Universal Transverse Mercator grid ticks, zone 19

6000000 M — 5000-foot grid values: Massachusetts State Plane coordinate system, mainland zone (FIPSZONE 2001), Lambert Conformal Conic

DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 — River Mile

MAP REPOSITORIES

Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
July 7, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0256F

FIRM

FLOOD INSURANCE RATE MAP

BRISTOL COUNTY, MASSACHUSETTS

(ALL JURISDICTIONS)

PANEL 256 OF 550

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BERKLEY, TOWN OF	250050	0256	F
TAUNTON, CITY OF	250066	0256	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25005C0256F

EFFECTIVE DATE
JULY 7, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

APPENDIX C

ROUTES 140/24 IMPROVEMENTS
PHASE 1

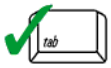
STORMWATER REPORT CHECKLIST

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

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



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☒ Water Quality Swale
- ☒ Grass Channel
- ☐ Green Roof
- ☒ Other (describe): Stormwater Treatment and Infiltration BMPs

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☒ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☐ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☐ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☒ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☐ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☐ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

APPENDIX D

ROUTES 140/24 IMPROVEMENTS
PHASE 1

TSS REMOVAL WORKSHEETS

TSS Removal Calculator

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: POI 1 (RT 140 CULVERT)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Extended Dry Detention Basin	**0.50**	**0.75**	**0.38**	**0.38**
Grass Channel	**0.50**	**0.38**	**0.19**	**0.19**
	0.00	**0.19**	**0.00**	**0.19**
	0.00	**0.19**	**0.00**	**0.19**

Total TSS Removal = 81%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **QM-172 First Light Casino Rt 140/24 Improvements**

Prepared By: **Fay, Spofford & Thorndike**

Date: **4/7/2014**

*Equals remaining load from previous BMP (E) which enters the BMP

TSS Removal Calculator

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: POI 2 (RT 24 CULVERT)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Infiltration Basin	**0.80**	**0.75**	**0.60**	**0.15**
Grass Channel	**0.50**	**0.15**	**0.08**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**

Total TSS Removal = **93%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **QM-172 First Light Casino Rt 140/24 Improvements**

Prepared By: **Fay, Spofford & Thorndike**

Date: **4/4/2014**

*Equals remaining load from previous BMP (E) which enters the BMP

TSS Removal Calculator

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: POI 3 (ROUTE 24 CULVERT)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Water Quality Swale - Dry	**0.70**	**0.75**	**0.53**	**0.23**
	0.00	**0.23**	**0.00**	**0.23**
	0.00	**0.23**	**0.00**	**0.23**
	0.00	**0.23**	**0.00**	**0.23**

Total TSS Removal = **78%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **QM-172 First Light Casino Rt 140/24 Improvements**

Prepared By: **Fay, Spofford & Thorndike**

Date: **4/7/2014**

*Equals remaining load from previous BMP (E) which enters the BMP

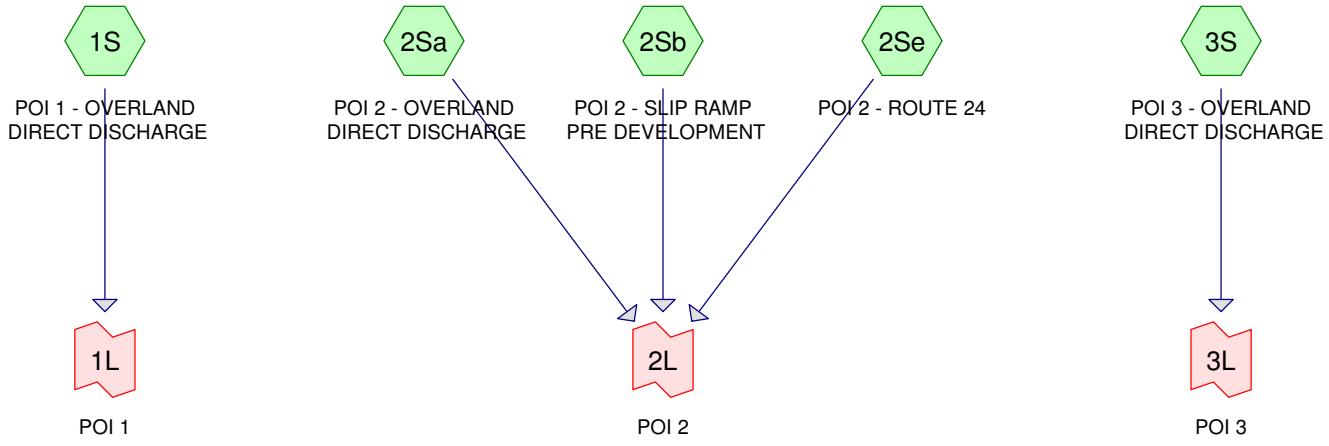
APPENDIX E

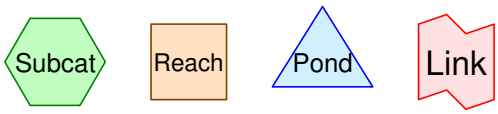
ROUTES 140/24 IMPROVEMENTS
PHASE 1

HYDROCADD ANALYSIS

EXISTING CONDITIONS

ROUTES 140/24 IMPROVEMENTS





Routing Diagram for TAUNTON RTE 140 PRE DEVELOPMENT
Prepared by Hewlett-Packard Company, Printed 4/11/2014
HydroCAD® 10.00 s/n 00758 © 2013 HydroCAD Software Solutions LLC

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: POI 1 - OVERLAND Runoff Area=54,833 sf 82.65% Impervious Runoff Depth>2.74"
Tc=6.0 min CN=95 Runoff=3.73 cfs 12,525 cf

Subcatchment 2Sa: POI 2 - OVERLAND Runoff Area=203,310 sf 89.93% Impervious Runoff Depth>2.84"
Flow Length=957' Slope=0.0094 '/' Tc=14.9 min CN=96 Runoff=11.01 cfs 48,151 cf

Subcatchment 2Sb: POI 2 - SLIP RAMP PRE Runoff Area=27,151 sf 0.00% Impervious Runoff Depth>1.41"
Tc=10.0 min CN=79 Runoff=0.88 cfs 3,189 cf

Subcatchment 2Se: POI 2 - ROUTE 24 Runoff Area=18,275 sf 100.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=98 Runoff=1.31 cfs 4,668 cf

Subcatchment 3S: POI 3 - OVERLAND Runoff Area=20,867 sf 0.00% Impervious Runoff Depth>0.88"
Tc=10.0 min CN=70 Runoff=0.39 cfs 1,538 cf

Link 1L: POI 1 Inflow=3.73 cfs 12,525 cf
Primary=3.73 cfs 12,525 cf

Link 2L: POI 2 Inflow=12.61 cfs 56,008 cf
Primary=12.61 cfs 56,008 cf

Link 3L: POI 3 Inflow=0.39 cfs 1,538 cf
Primary=0.39 cfs 1,538 cf

Total Runoff Area = 324,436 sf Runoff Volume = 70,071 cf Average Runoff Depth = 2.59"
24.04% Pervious = 78,004 sf 75.96% Impervious = 246,432 sf

Summary for Subcatchment 1S: POI 1 - OVERLAND DIRECT DISCHARGE

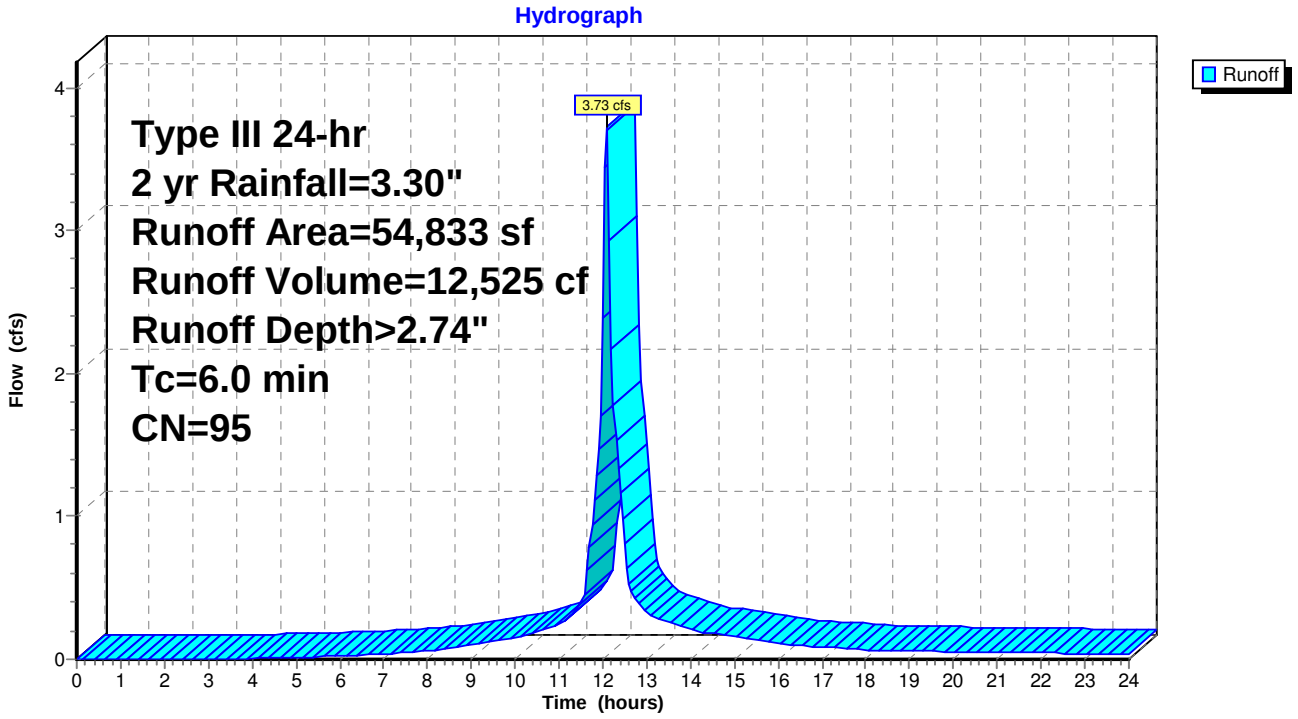
Runoff = 3.73 cfs @ 12.09 hrs, Volume= 12,525 cf, Depth> 2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
45,321	98	Paved roads w/curbs & sewers, HSG C
9,512	79	50-75% Grass cover, Fair, HSG C
54,833	95	Weighted Average
9,512		17.35% Pervious Area
45,321		82.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: POI 1 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 2Sa: POI 2 - OVERLAND DIRECT DISCHARGE

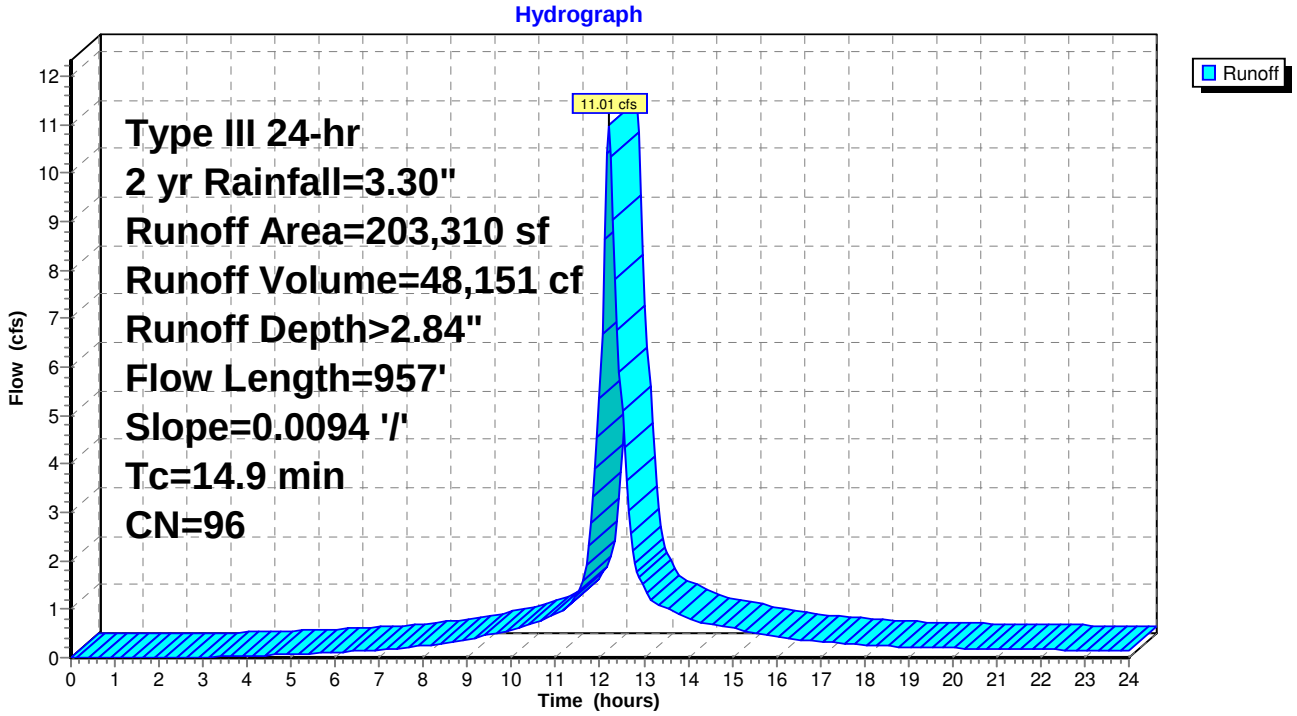
Runoff = 11.01 cfs @ 12.20 hrs, Volume= 48,151 cf, Depth> 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
176,004	98	Paved roads w/curbs & sewers, HSG C
19,306	79	50-75% Grass cover, Fair, HSG C
6,832	98	Paved roads w/curbs & sewers, HSG D
1,168	84	50-75% Grass cover, Fair, HSG D
203,310	96	Weighted Average
20,474		10.07% Pervious Area
182,836		89.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
9.9	957	0.0094	1.61	12.11	**Channel Flow, Natural Stream** Area= 7.5 sf Perim= 25.0' r= 0.30' n= 0.040 Winding stream
14.9	957	Total			

Subcatchment 2Sa: POI 2 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 2Sb: POI 2 - SLIP RAMP PRE DEVELOPMENT

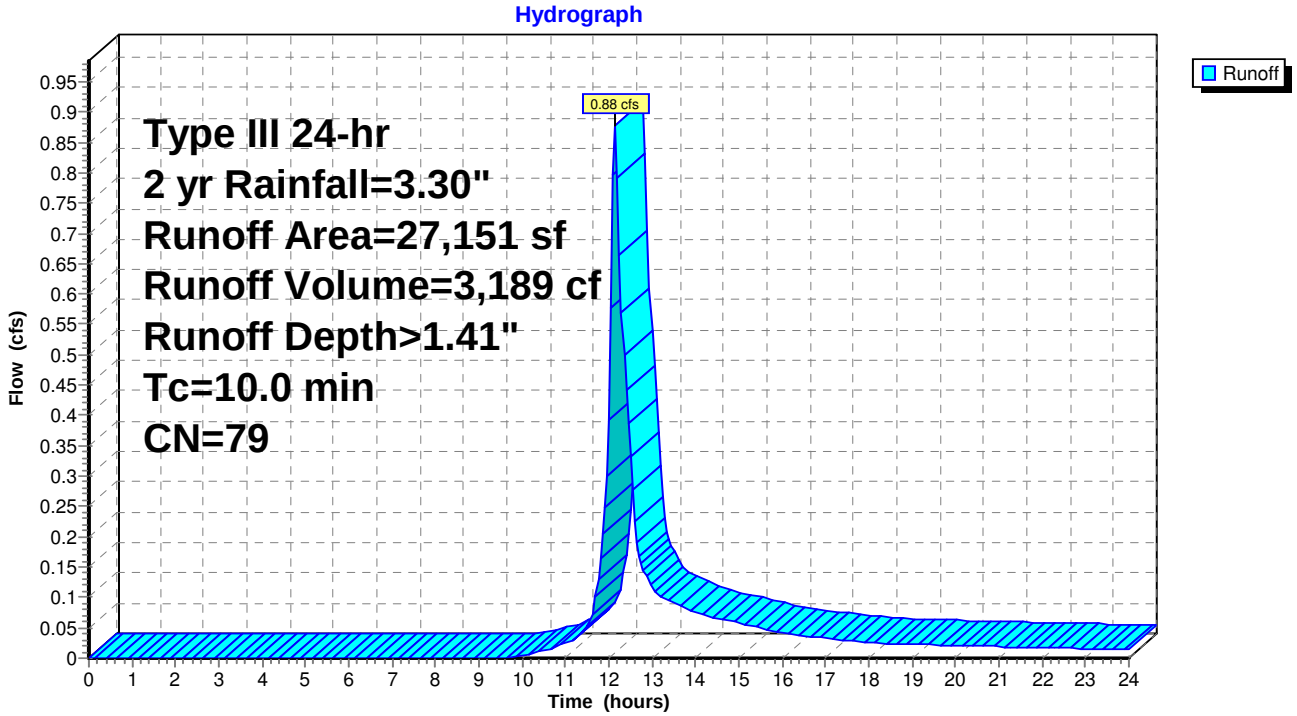
Runoff = 0.88 cfs @ 12.15 hrs, Volume= 3,189 cf, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

	Area (sf)	CN	Description
	2,882	84	50-75% Grass cover, Fair, HSG D
	20,023	79	Woods, Fair, HSG D
*	3,927	77	Wetland
	319	96	Gravel surface, HSG D
	27,151	79	Weighted Average
	27,151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 2Sb: POI 2 - SLIP RAMP PRE DEVELOPMENT



Summary for Subcatchment 2Se: POI 2 - ROUTE 24

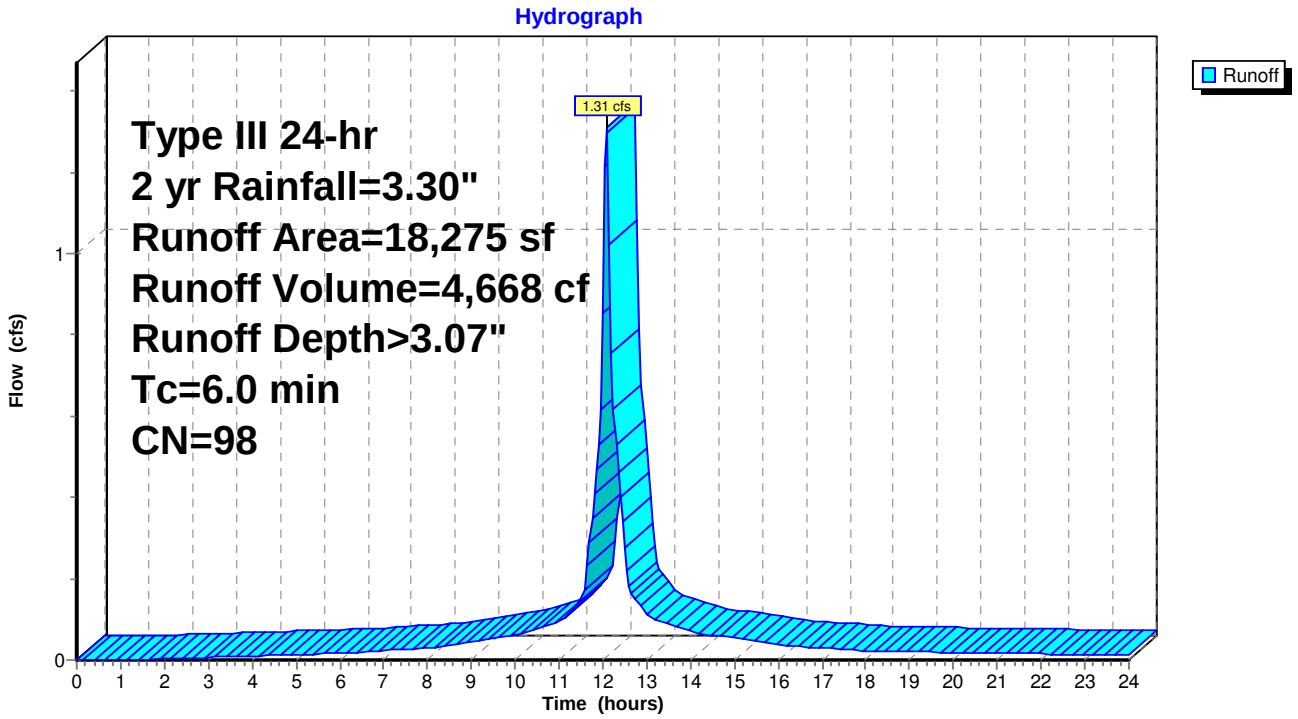
Runoff = 1.31 cfs @ 12.09 hrs, Volume= 4,668 cf, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
18,275	98	Paved roads w/curbs & sewers, HSG C
18,275		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2Se: POI 2 - ROUTE 24



Summary for Subcatchment 3S: POI 3 - OVERLAND DIRECT DISCHARGE

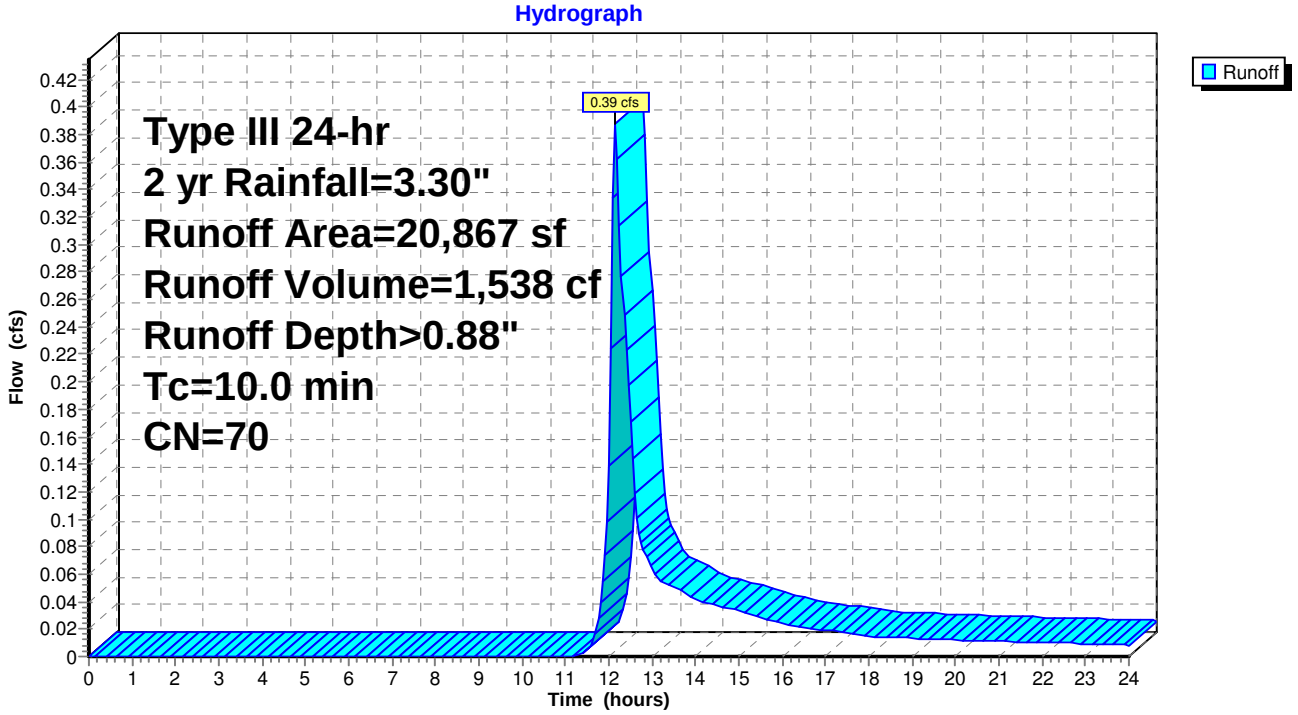
Runoff = 0.39 cfs @ 12.16 hrs, Volume= 1,538 cf, Depth> 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
8,255	79	Woods, Fair, HSG D
4,654	69	50-75% Grass cover, Fair, HSG B
7,958	60	Woods, Fair, HSG B
20,867	70	Weighted Average
20,867		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 3S: POI 3 - OVERLAND DIRECT DISCHARGE

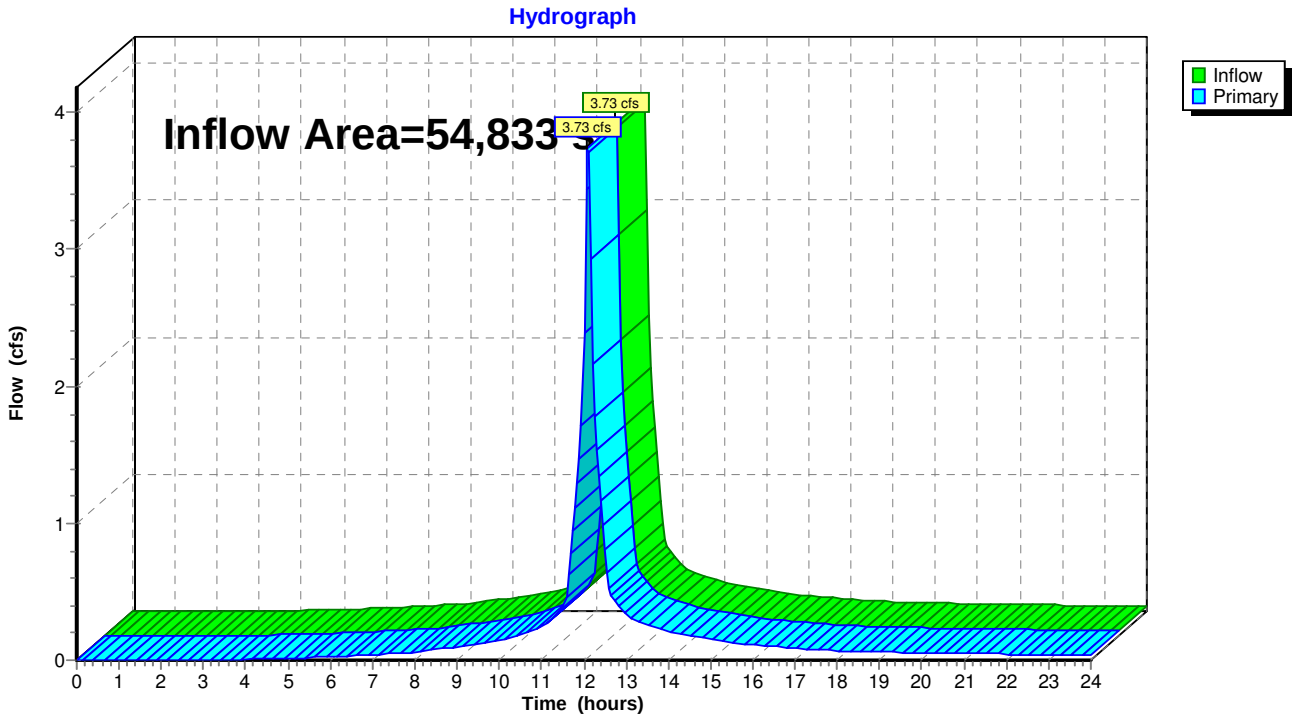


Summary for Link 1L: POI 1

Inflow Area = 54,833 sf, 82.65% Impervious, Inflow Depth > 2.74" for 2 yr event
Inflow = 3.73 cfs @ 12.09 hrs, Volume= 12,525 cf
Primary = 3.73 cfs @ 12.09 hrs, Volume= 12,525 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: POI 1

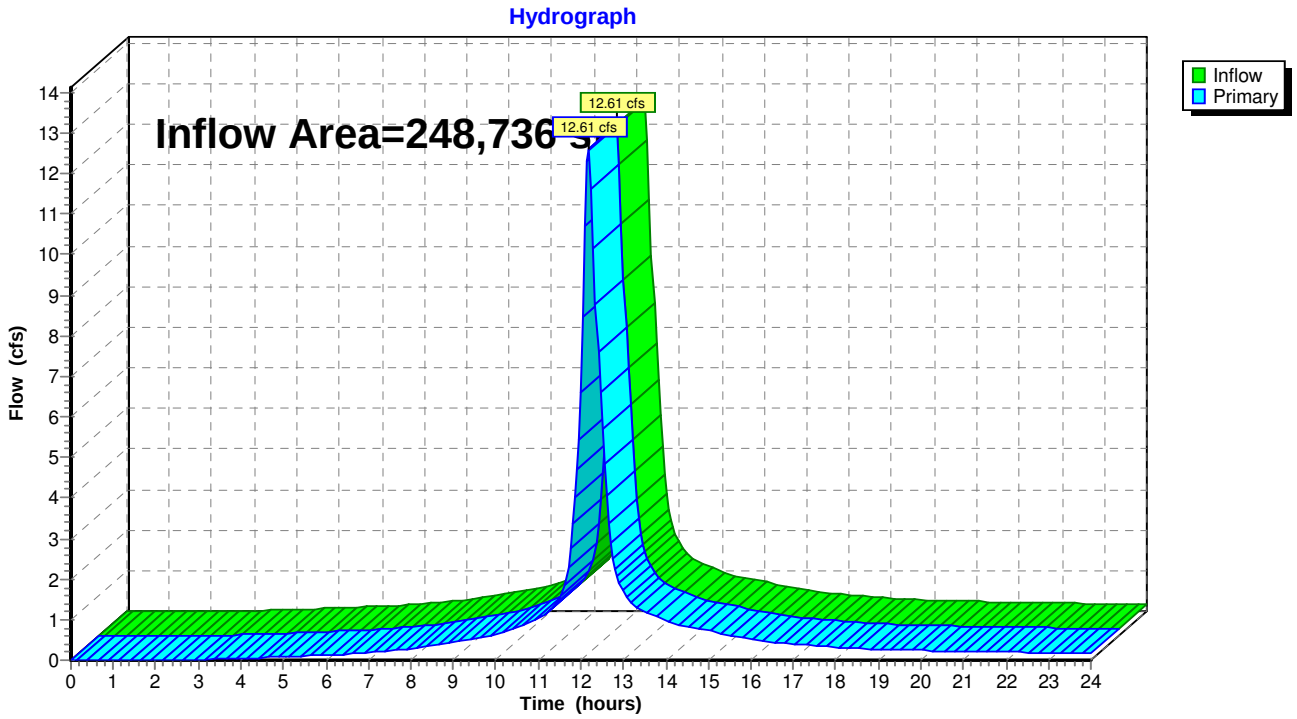


Summary for Link 2L: POI 2

Inflow Area = 248,736 sf, 80.85% Impervious, Inflow Depth > 2.70" for 2 yr event
Inflow = 12.61 cfs @ 12.19 hrs, Volume= 56,008 cf
Primary = 12.61 cfs @ 12.19 hrs, Volume= 56,008 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: POI 2

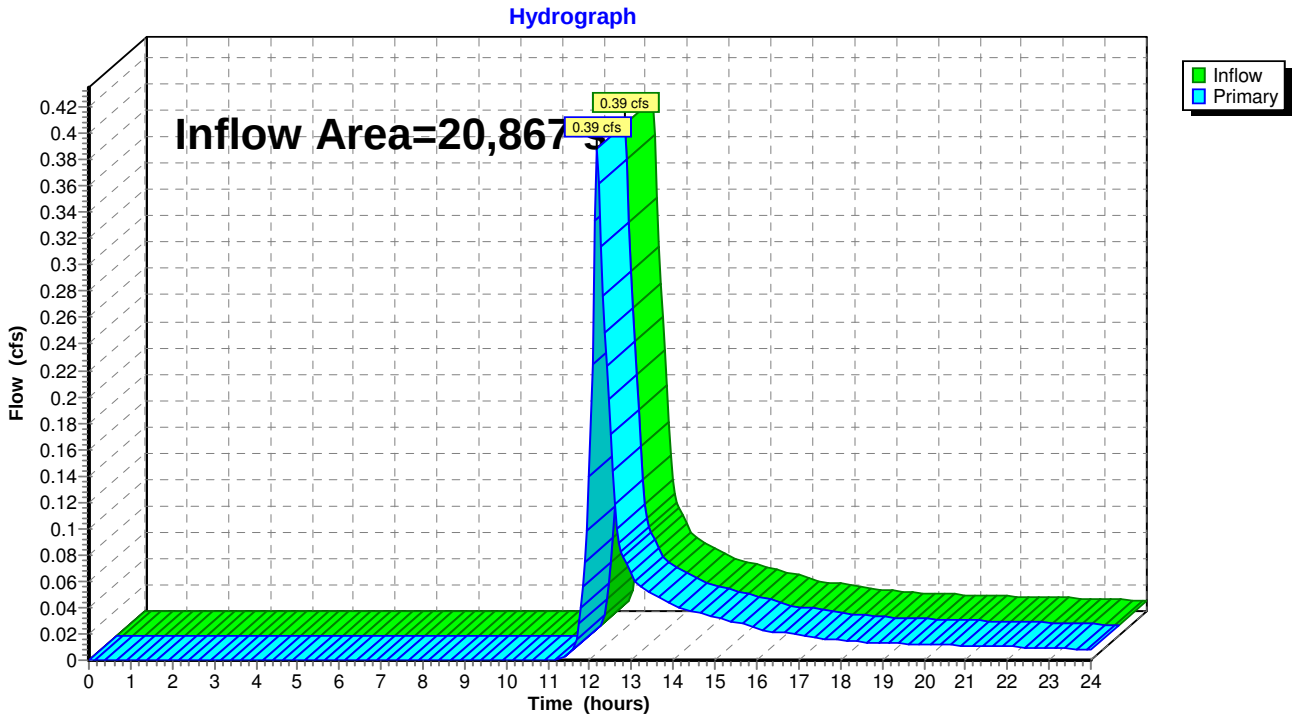


Summary for Link 3L: POI 3

Inflow Area = 20,867 sf, 0.00% Impervious, Inflow Depth > 0.88" for 2 yr event
Inflow = 0.39 cfs @ 12.16 hrs, Volume= 1,538 cf
Primary = 0.39 cfs @ 12.16 hrs, Volume= 1,538 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 3L: POI 3



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: POI 1 - OVERLAND Runoff Area=54,833 sf 82.65% Impervious Runoff Depth>4.12"
Tc=6.0 min CN=95 Runoff=5.48 cfs 18,825 cf

Subcatchment 2Sa: POI 2 - OVERLAND Runoff Area=203,310 sf 89.93% Impervious Runoff Depth>4.23"
Flow Length=957' Slope=0.0094 '/' Tc=14.9 min CN=96 Runoff=16.03 cfs 71,602 cf

Subcatchment 2Sb: POI 2 - SLIP RAMP PRE Runoff Area=27,151 sf 0.00% Impervious Runoff Depth>2.54"
Tc=10.0 min CN=79 Runoff=1.61 cfs 5,749 cf

Subcatchment 2Se: POI 2 - ROUTE 24 Runoff Area=18,275 sf 100.00% Impervious Runoff Depth>4.46"
Tc=6.0 min CN=98 Runoff=1.88 cfs 6,794 cf

Subcatchment 3S: POI 3 - OVERLAND Runoff Area=20,867 sf 0.00% Impervious Runoff Depth>1.81"
Tc=10.0 min CN=70 Runoff=0.86 cfs 3,153 cf

Link 1L: POI 1 Inflow=5.48 cfs 18,825 cf
Primary=5.48 cfs 18,825 cf

Link 2L: POI 2 Inflow=18.63 cfs 84,145 cf
Primary=18.63 cfs 84,145 cf

Link 3L: POI 3 Inflow=0.86 cfs 3,153 cf
Primary=0.86 cfs 3,153 cf

Total Runoff Area = 324,436 sf Runoff Volume = 106,123 cf Average Runoff Depth = 3.93"
24.04% Pervious = 78,004 sf 75.96% Impervious = 246,432 sf

Summary for Subcatchment 1S: POI 1 - OVERLAND DIRECT DISCHARGE

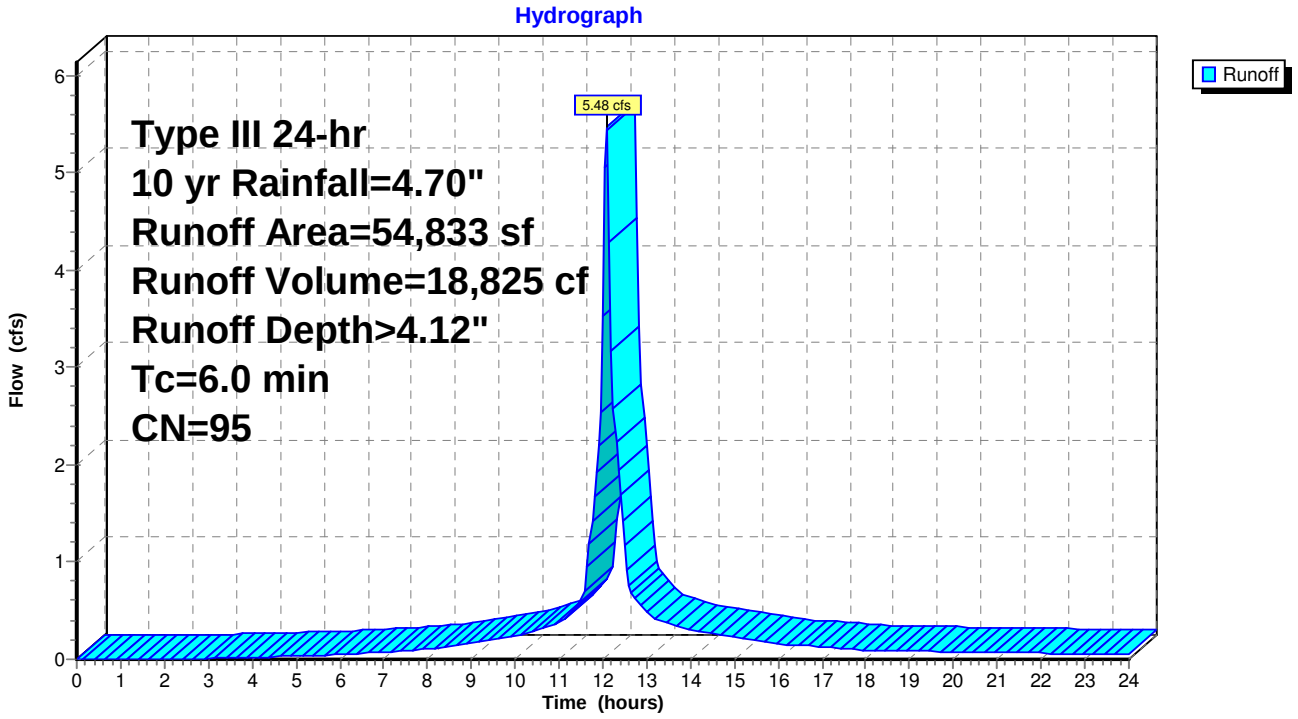
Runoff = 5.48 cfs @ 12.09 hrs, Volume= 18,825 cf, Depth> 4.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
45,321	98	Paved roads w/curbs & sewers, HSG C
9,512	79	50-75% Grass cover, Fair, HSG C
54,833	95	Weighted Average
9,512		17.35% Pervious Area
45,321		82.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: POI 1 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 2Sa: POI 2 - OVERLAND DIRECT DISCHARGE

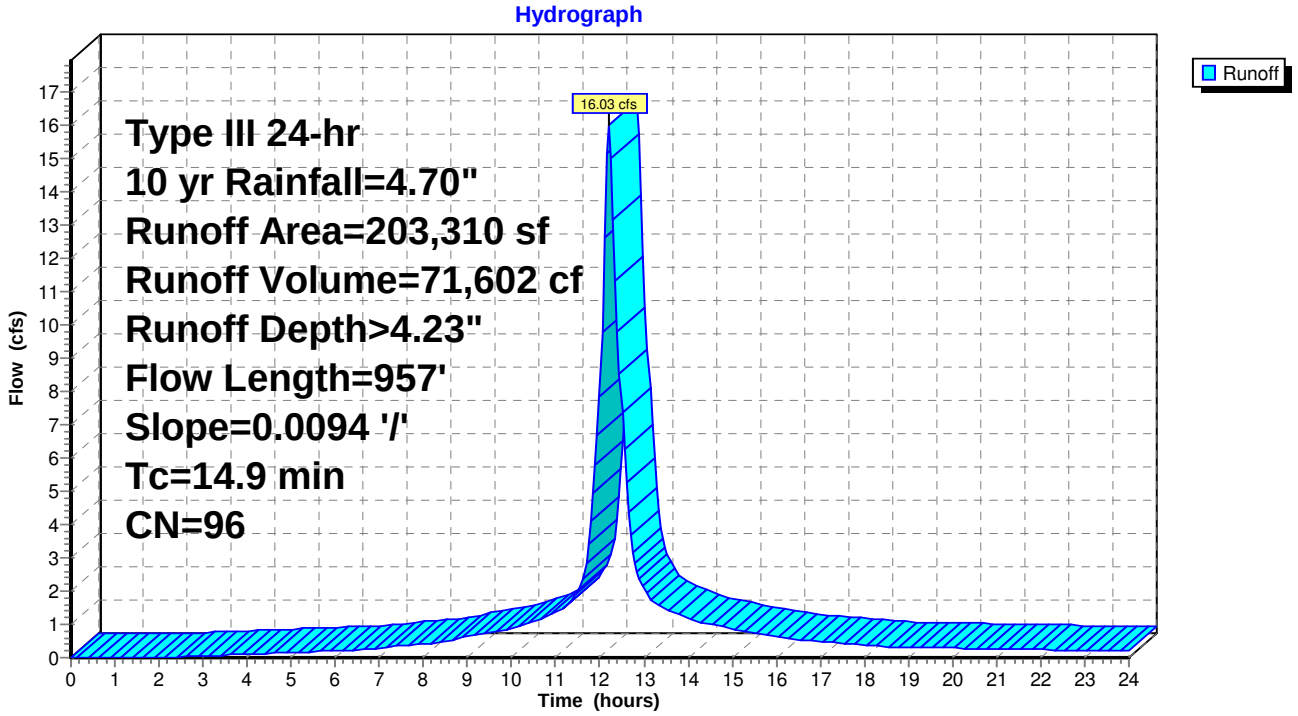
Runoff = 16.03 cfs @ 12.20 hrs, Volume= 71,602 cf, Depth> 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
176,004	98	Paved roads w/curbs & sewers, HSG C
19,306	79	50-75% Grass cover, Fair, HSG C
6,832	98	Paved roads w/curbs & sewers, HSG D
1,168	84	50-75% Grass cover, Fair, HSG D
203,310	96	Weighted Average
20,474		10.07% Pervious Area
182,836		89.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
9.9	957	0.0094	1.61	12.11	**Channel Flow, Natural Stream** Area= 7.5 sf Perim= 25.0' r= 0.30' n= 0.040 Winding stream
14.9	957	Total			

Subcatchment 2Sa: POI 2 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 2Sb: POI 2 - SLIP RAMP PRE DEVELOPMENT

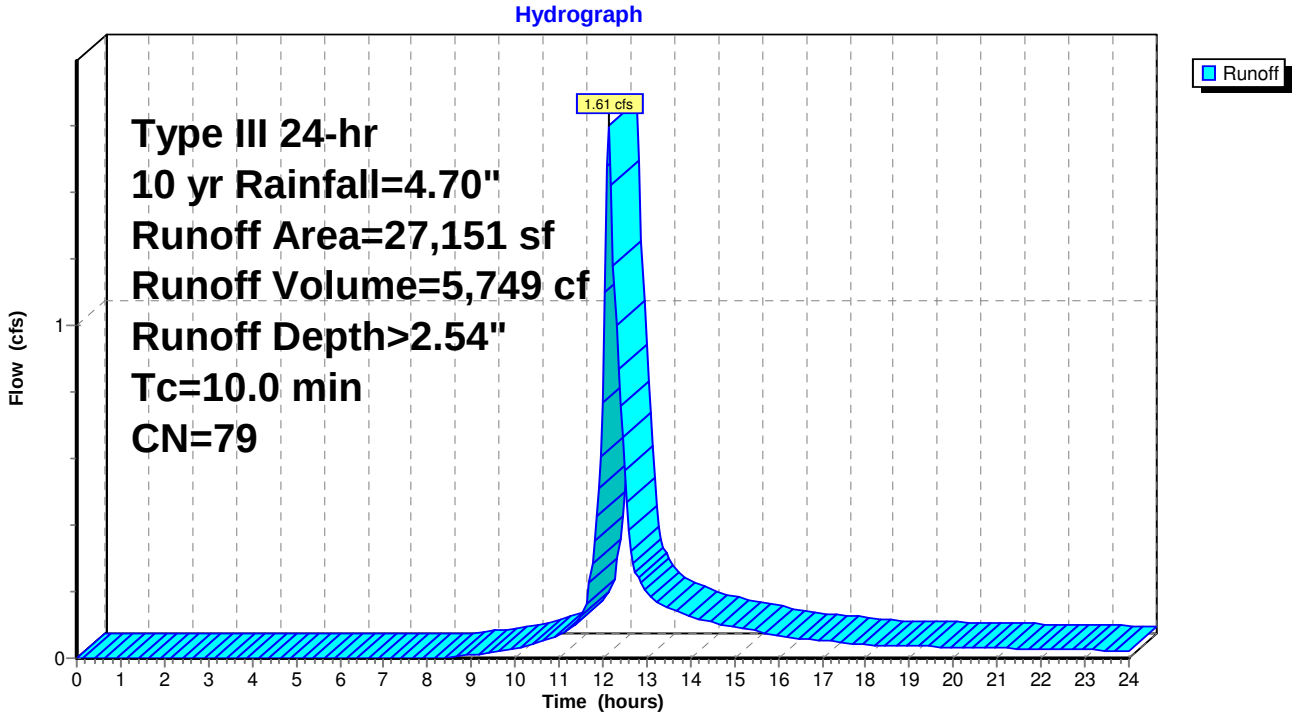
Runoff = 1.61 cfs @ 12.14 hrs, Volume= 5,749 cf, Depth> 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

	Area (sf)	CN	Description
	2,882	84	50-75% Grass cover, Fair, HSG D
	20,023	79	Woods, Fair, HSG D
*	3,927	77	Wetland
	319	96	Gravel surface, HSG D
	27,151	79	Weighted Average
	27,151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 2Sb: POI 2 - SLIP RAMP PRE DEVELOPMENT



Summary for Subcatchment 2Se: POI 2 - ROUTE 24

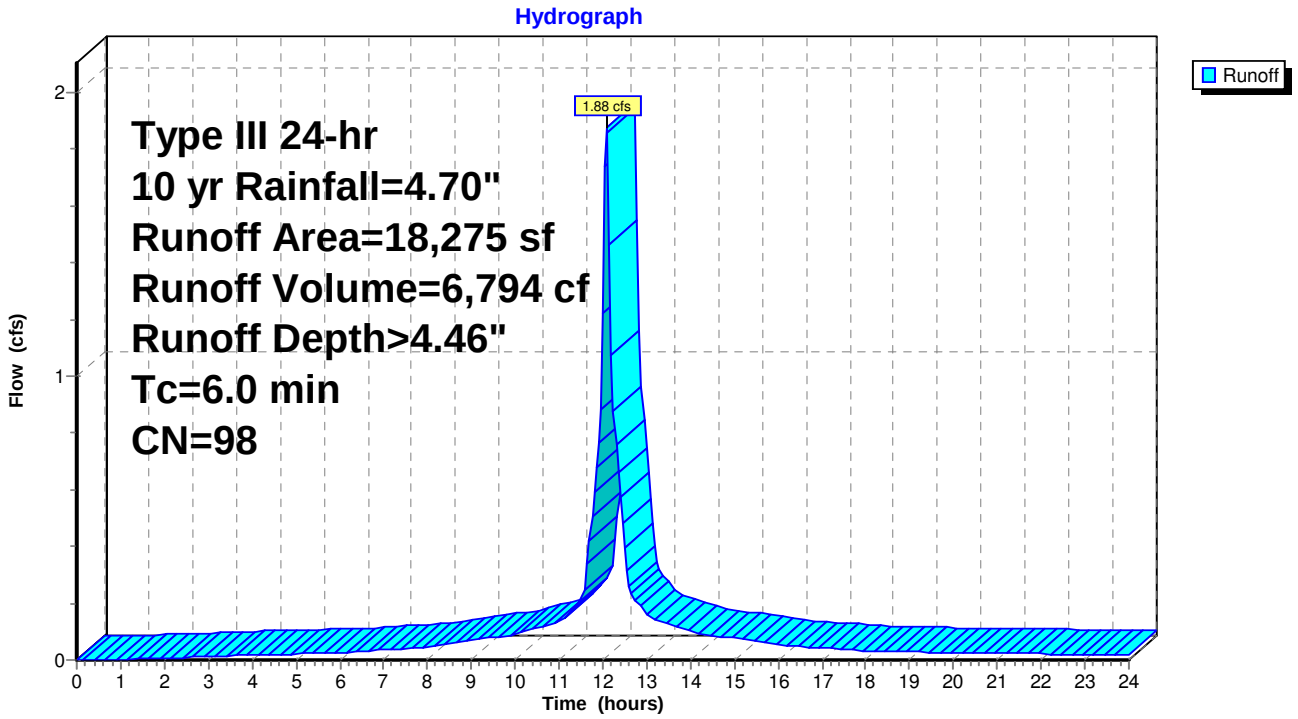
Runoff = 1.88 cfs @ 12.09 hrs, Volume= 6,794 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
18,275	98	Paved roads w/curbs & sewers, HSG C
18,275		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2Se: POI 2 - ROUTE 24



Summary for Subcatchment 3S: POI 3 - OVERLAND DIRECT DISCHARGE

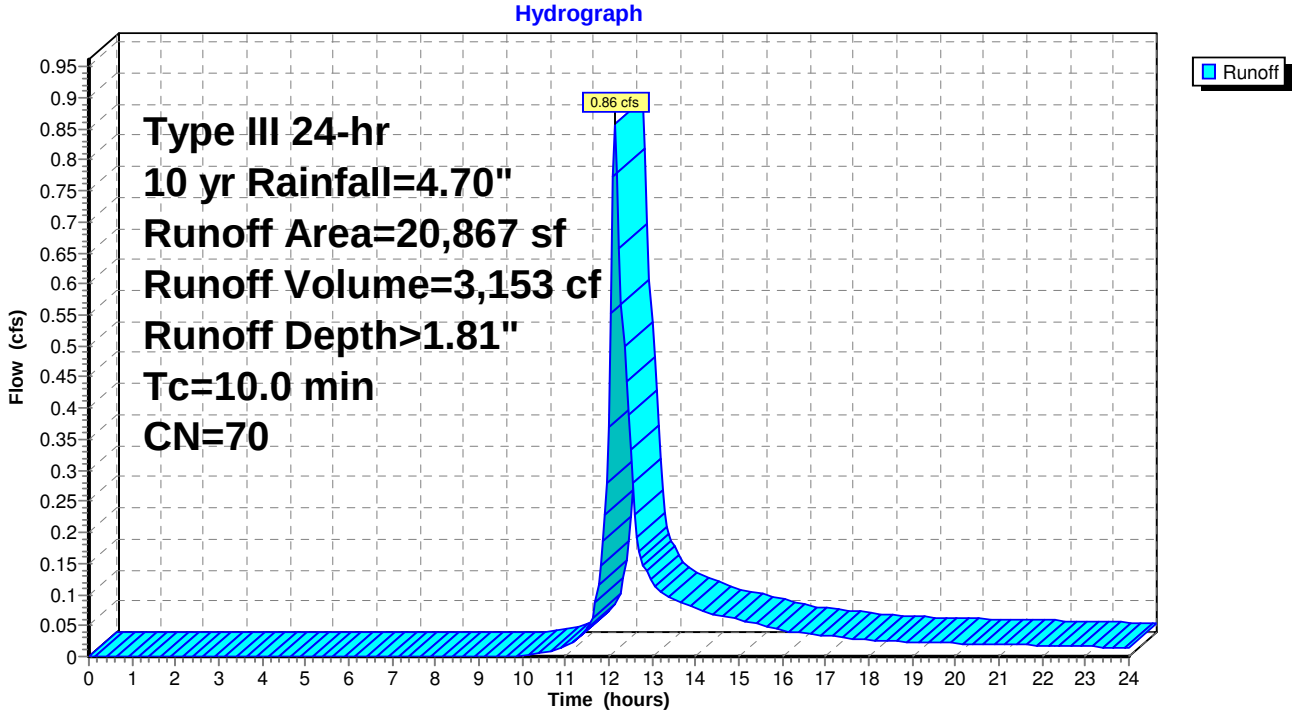
Runoff = 0.86 cfs @ 12.15 hrs, Volume= 3,153 cf, Depth> 1.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
8,255	79	Woods, Fair, HSG D
4,654	69	50-75% Grass cover, Fair, HSG B
7,958	60	Woods, Fair, HSG B
20,867	70	Weighted Average
20,867		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 3S: POI 3 - OVERLAND DIRECT DISCHARGE

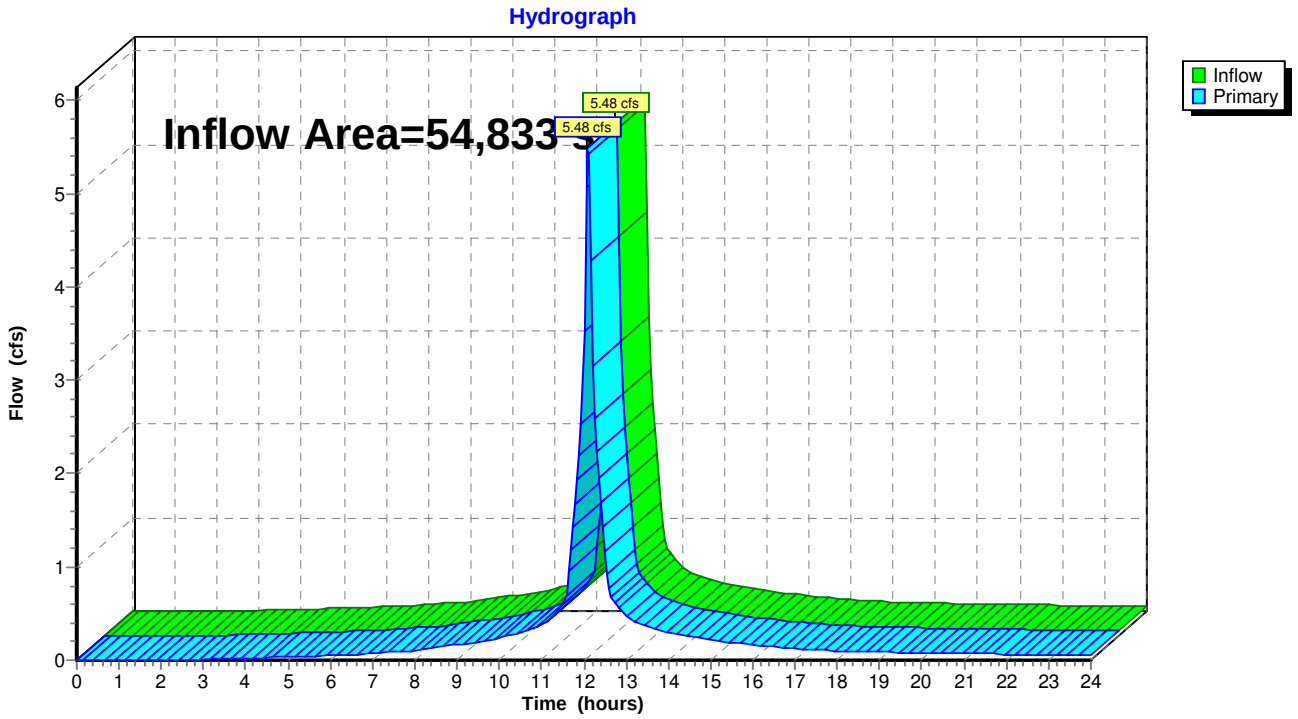


Summary for Link 1L: POI 1

Inflow Area = 54,833 sf, 82.65% Impervious, Inflow Depth > 4.12" for 10 yr event
Inflow = 5.48 cfs @ 12.09 hrs, Volume= 18,825 cf
Primary = 5.48 cfs @ 12.09 hrs, Volume= 18,825 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: POI 1

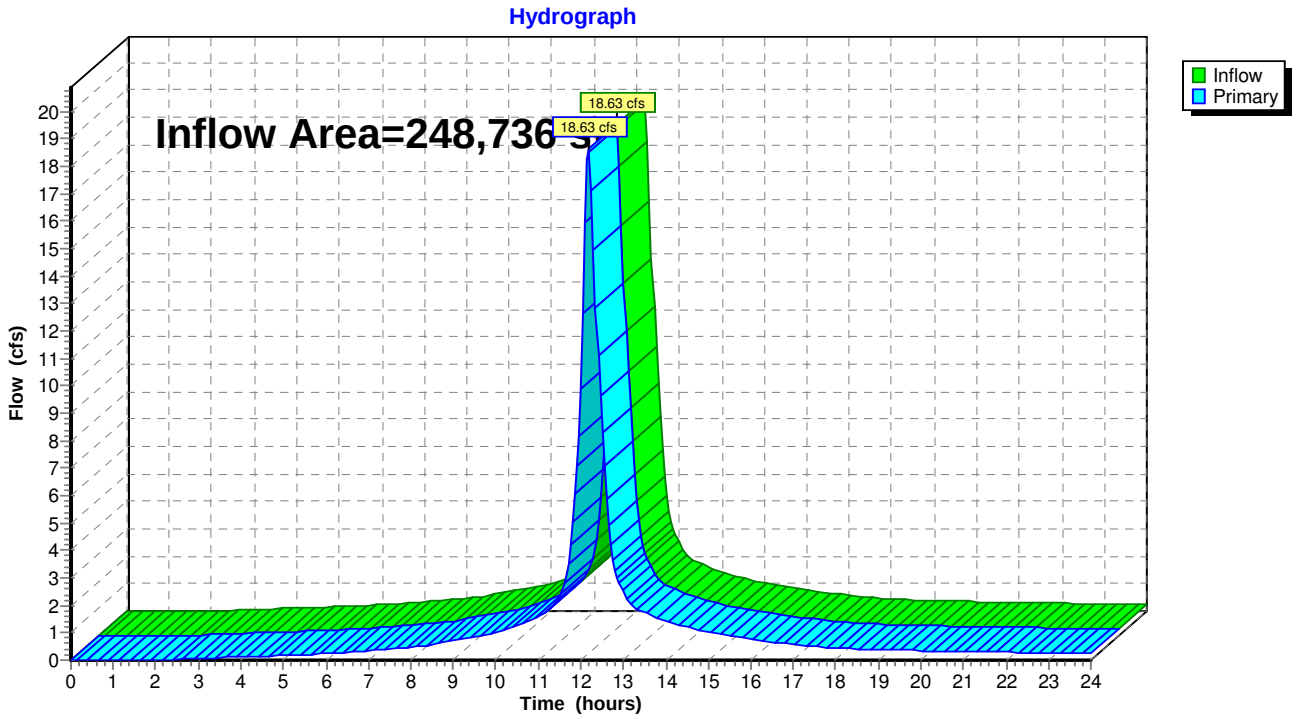


Summary for Link 2L: POI 2

Inflow Area = 248,736 sf, 80.85% Impervious, Inflow Depth > 4.06" for 10 yr event
Inflow = 18.63 cfs @ 12.18 hrs, Volume= 84,145 cf
Primary = 18.63 cfs @ 12.18 hrs, Volume= 84,145 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: POI 2

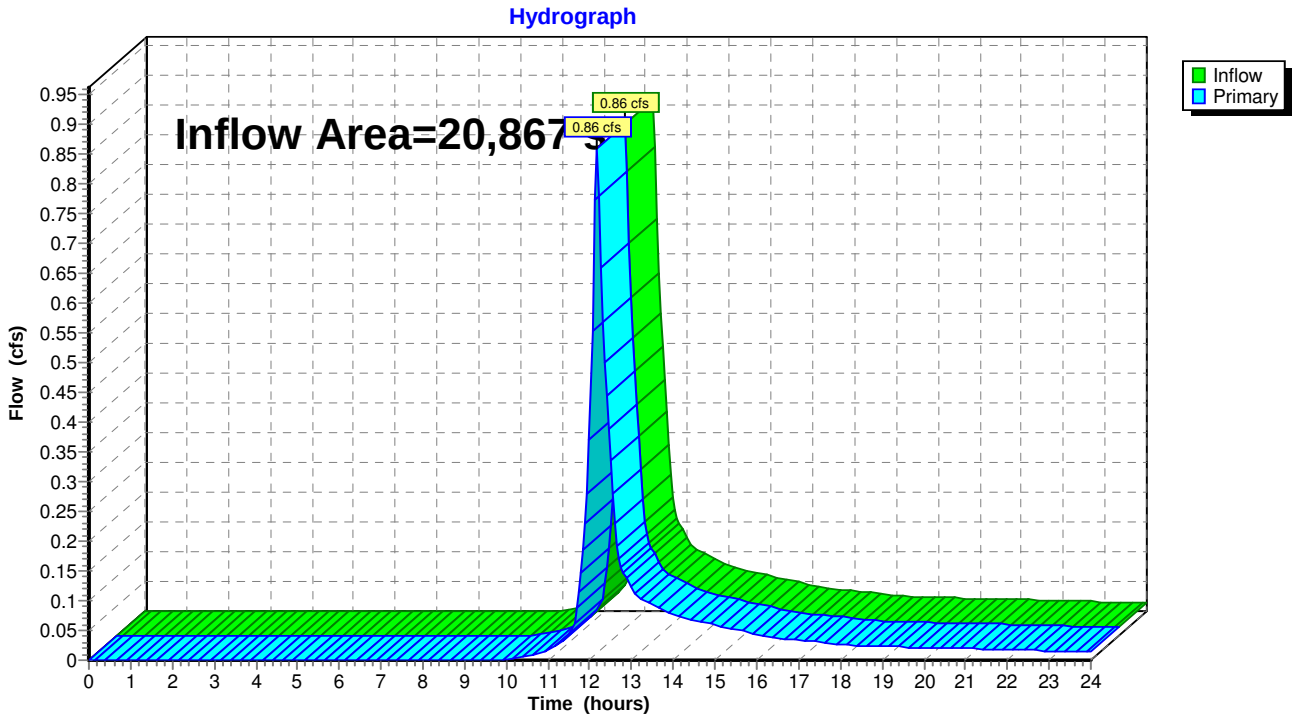


Summary for Link 3L: POI 3

Inflow Area = 20,867 sf, 0.00% Impervious, Inflow Depth > 1.81" for 10 yr event
Inflow = 0.86 cfs @ 12.15 hrs, Volume= 3,153 cf
Primary = 0.86 cfs @ 12.15 hrs, Volume= 3,153 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 3L: POI 3



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: POI 1 - OVERLAND Runoff Area=54,833 sf 82.65% Impervious Runoff Depth>5.01"
Tc=6.0 min CN=95 Runoff=6.59 cfs 22,898 cf

Subcatchment 2Sa: POI 2 - OVERLAND Runoff Area=203,310 sf 89.93% Impervious Runoff Depth>5.12"
Flow Length=957' Slope=0.0094 '/' Tc=14.9 min CN=96 Runoff=19.23 cfs 86,735 cf

Subcatchment 2Sb: POI 2 - SLIP RAMP PRE Runoff Area=27,151 sf 0.00% Impervious Runoff Depth>3.32"
Tc=10.0 min CN=79 Runoff=2.10 cfs 7,510 cf

Subcatchment 2Se: POI 2 - ROUTE 24 Runoff Area=18,275 sf 100.00% Impervious Runoff Depth>5.36"
Tc=6.0 min CN=98 Runoff=2.25 cfs 8,161 cf

Subcatchment 3S: POI 3 - OVERLAND Runoff Area=20,867 sf 0.00% Impervious Runoff Depth>2.49"
Tc=10.0 min CN=70 Runoff=1.20 cfs 4,324 cf

Link 1L: POI 1 Inflow=6.59 cfs 22,898 cf
Primary=6.59 cfs 22,898 cf

Link 2L: POI 2 Inflow=22.49 cfs 102,406 cf
Primary=22.49 cfs 102,406 cf

Link 3L: POI 3 Inflow=1.20 cfs 4,324 cf
Primary=1.20 cfs 4,324 cf

Total Runoff Area = 324,436 sf Runoff Volume = 129,629 cf Average Runoff Depth = 4.79"
24.04% Pervious = 78,004 sf 75.96% Impervious = 246,432 sf

Summary for Subcatchment 1S: POI 1 - OVERLAND DIRECT DISCHARGE

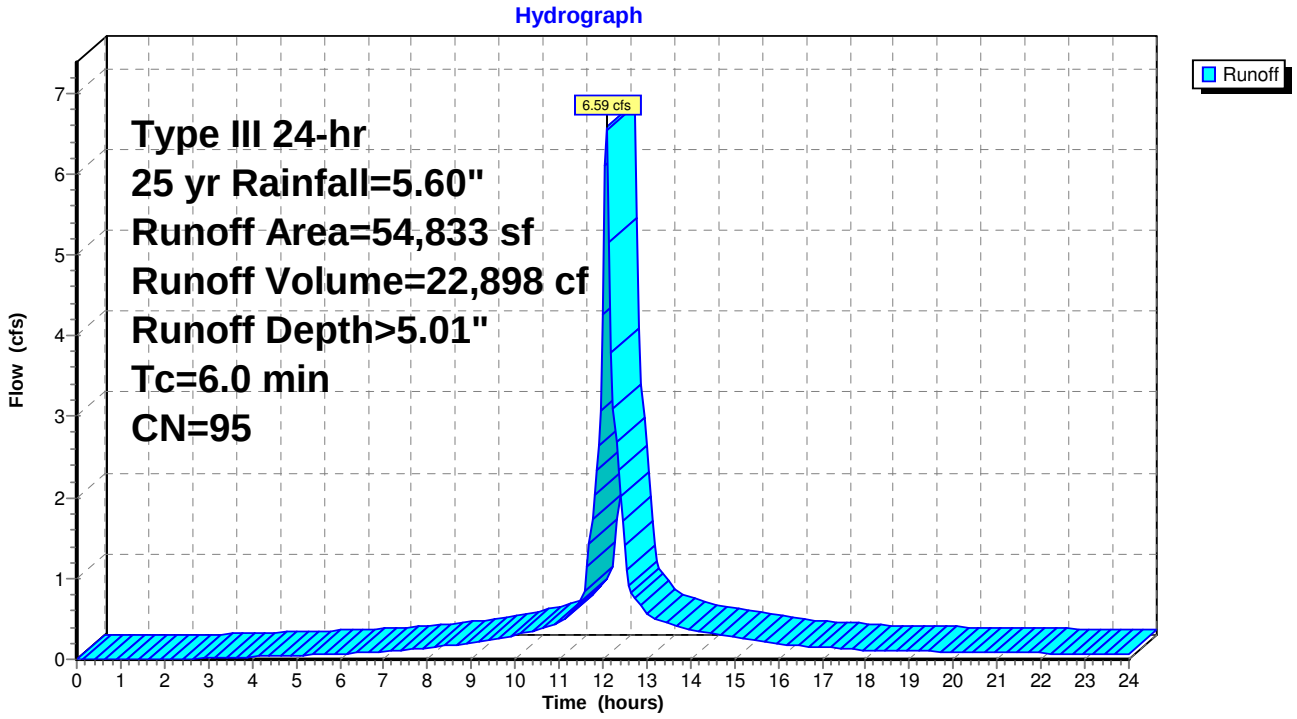
Runoff = 6.59 cfs @ 12.09 hrs, Volume= 22,898 cf, Depth> 5.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
45,321	98	Paved roads w/curbs & sewers, HSG C
9,512	79	50-75% Grass cover, Fair, HSG C
54,833	95	Weighted Average
9,512		17.35% Pervious Area
45,321		82.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: POI 1 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 2Sa: POI 2 - OVERLAND DIRECT DISCHARGE

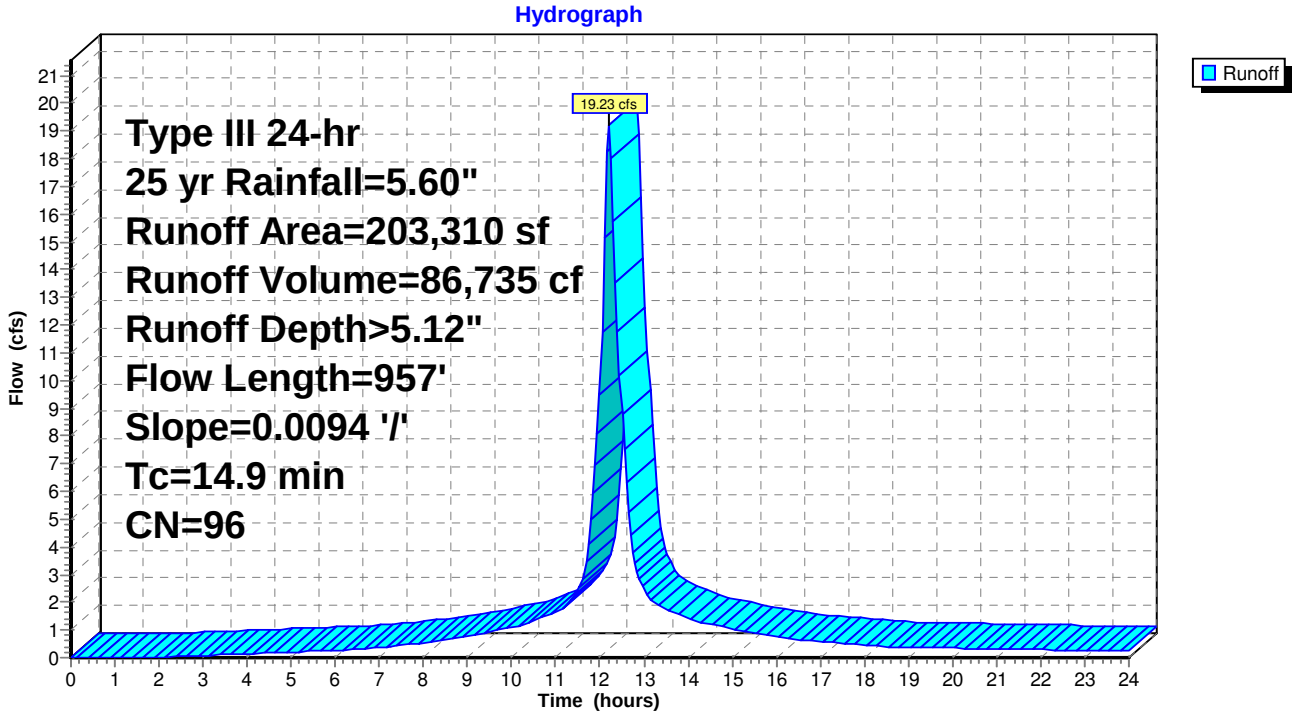
Runoff = 19.23 cfs @ 12.20 hrs, Volume= 86,735 cf, Depth> 5.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
176,004	98	Paved roads w/curbs & sewers, HSG C
19,306	79	50-75% Grass cover, Fair, HSG C
6,832	98	Paved roads w/curbs & sewers, HSG D
1,168	84	50-75% Grass cover, Fair, HSG D
203,310	96	Weighted Average
20,474		10.07% Pervious Area
182,836		89.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
9.9	957	0.0094	1.61	12.11	**Channel Flow, Natural Stream** Area= 7.5 sf Perim= 25.0' r= 0.30' n= 0.040 Winding stream
14.9	957	Total			

Subcatchment 2Sa: POI 2 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 2Sb: POI 2 - SLIP RAMP PRE DEVELOPMENT

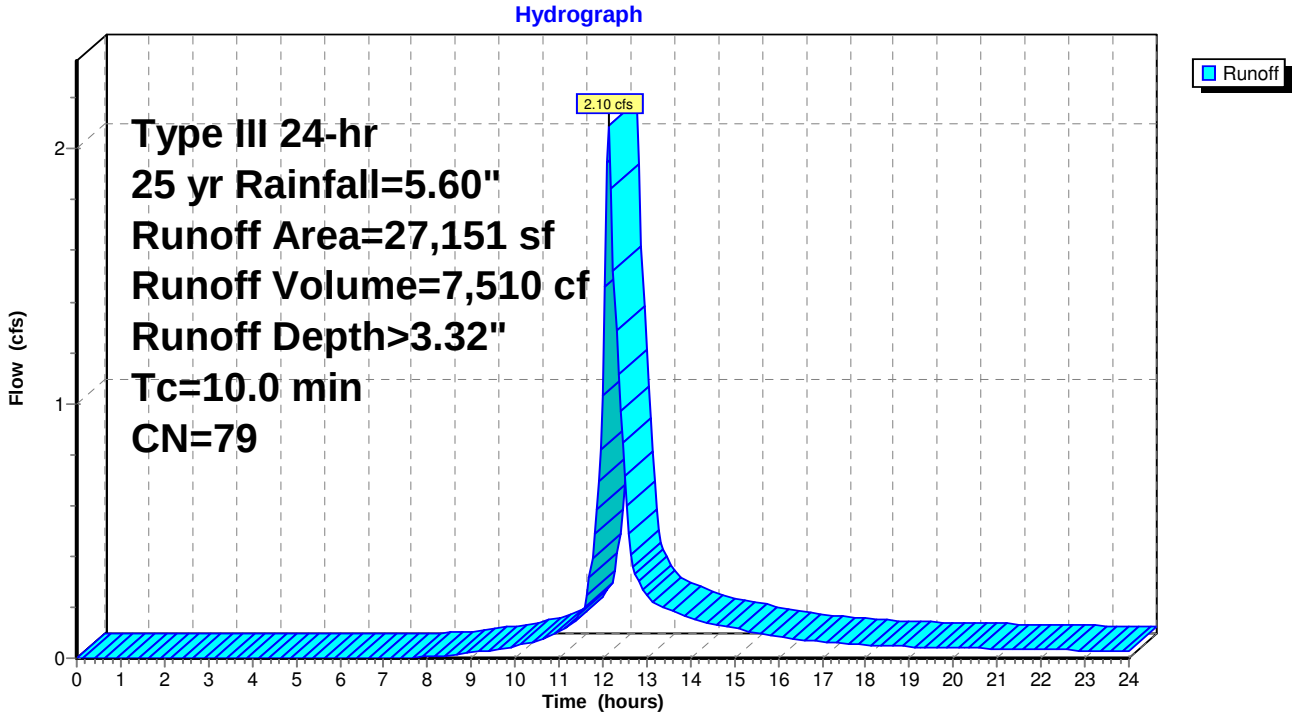
Runoff = 2.10 cfs @ 12.14 hrs, Volume= 7,510 cf, Depth> 3.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

	Area (sf)	CN	Description
	2,882	84	50-75% Grass cover, Fair, HSG D
	20,023	79	Woods, Fair, HSG D
*	3,927	77	Wetland
	319	96	Gravel surface, HSG D
	27,151	79	Weighted Average
	27,151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 2Sb: POI 2 - SLIP RAMP PRE DEVELOPMENT



Summary for Subcatchment 2Se: POI 2 - ROUTE 24

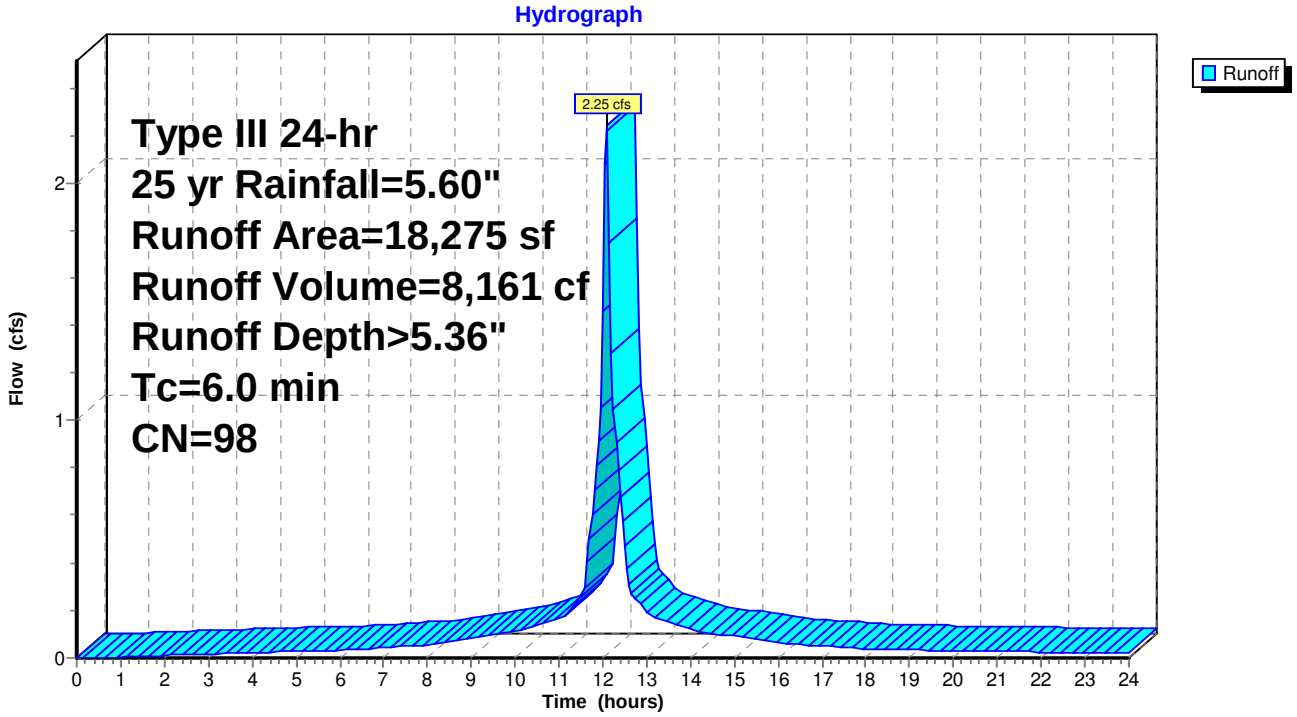
Runoff = 2.25 cfs @ 12.09 hrs, Volume= 8,161 cf, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
18,275	98	Paved roads w/curbs & sewers, HSG C
18,275		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2Se: POI 2 - ROUTE 24



Summary for Subcatchment 3S: POI 3 - OVERLAND DIRECT DISCHARGE

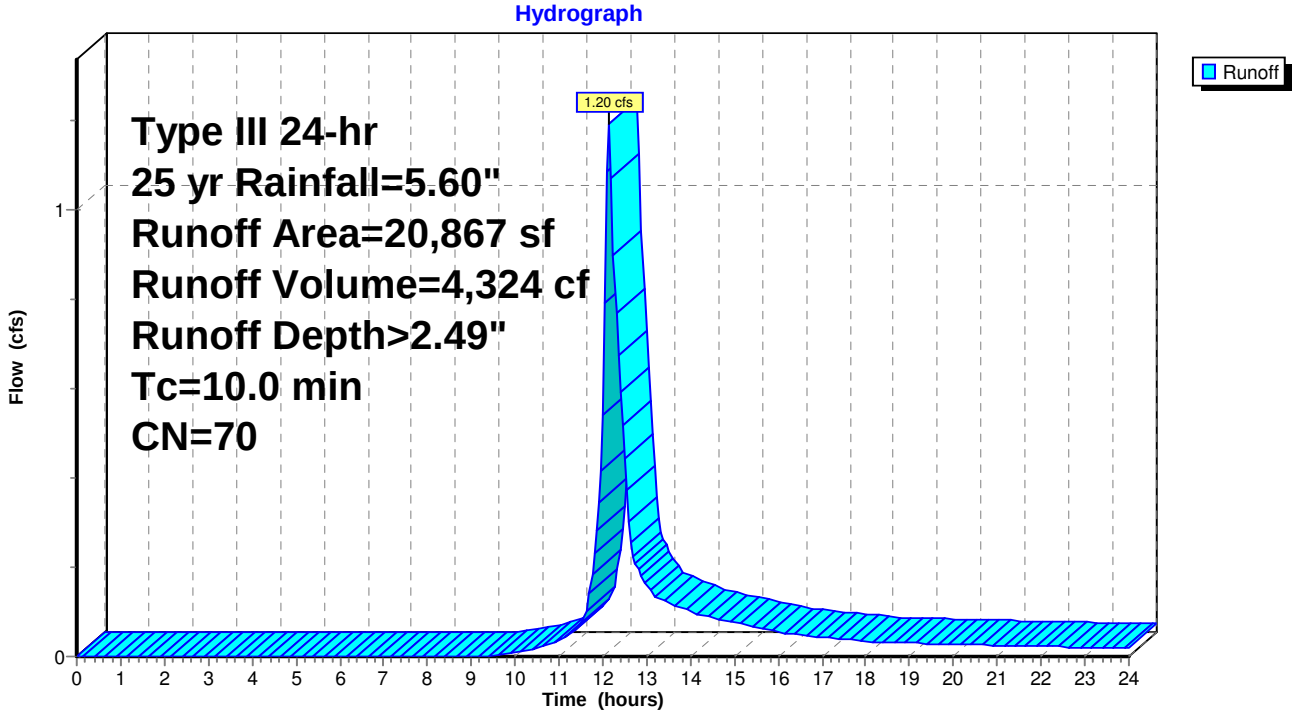
Runoff = 1.20 cfs @ 12.15 hrs, Volume= 4,324 cf, Depth> 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
8,255	79	Woods, Fair, HSG D
4,654	69	50-75% Grass cover, Fair, HSG B
7,958	60	Woods, Fair, HSG B
20,867	70	Weighted Average
20,867		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 3S: POI 3 - OVERLAND DIRECT DISCHARGE

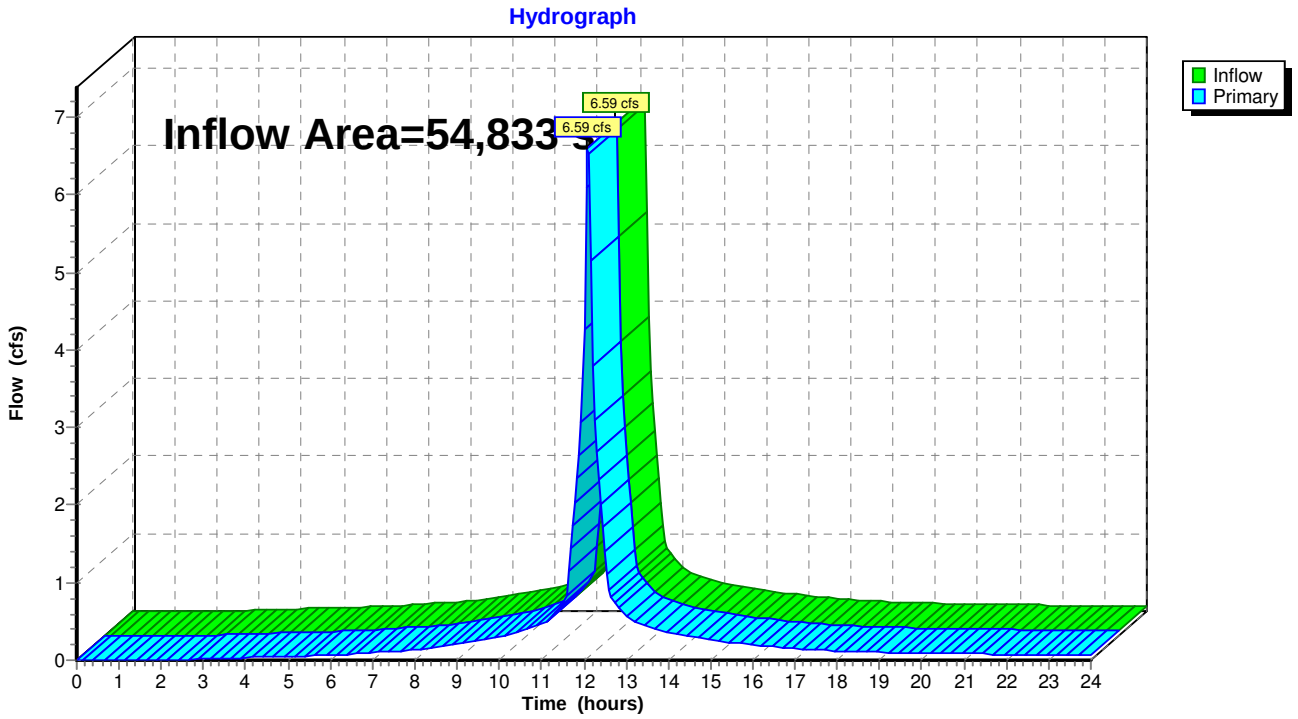


Summary for Link 1L: POI 1

Inflow Area = 54,833 sf, 82.65% Impervious, Inflow Depth > 5.01" for 25 yr event
Inflow = 6.59 cfs @ 12.09 hrs, Volume= 22,898 cf
Primary = 6.59 cfs @ 12.09 hrs, Volume= 22,898 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: POI 1

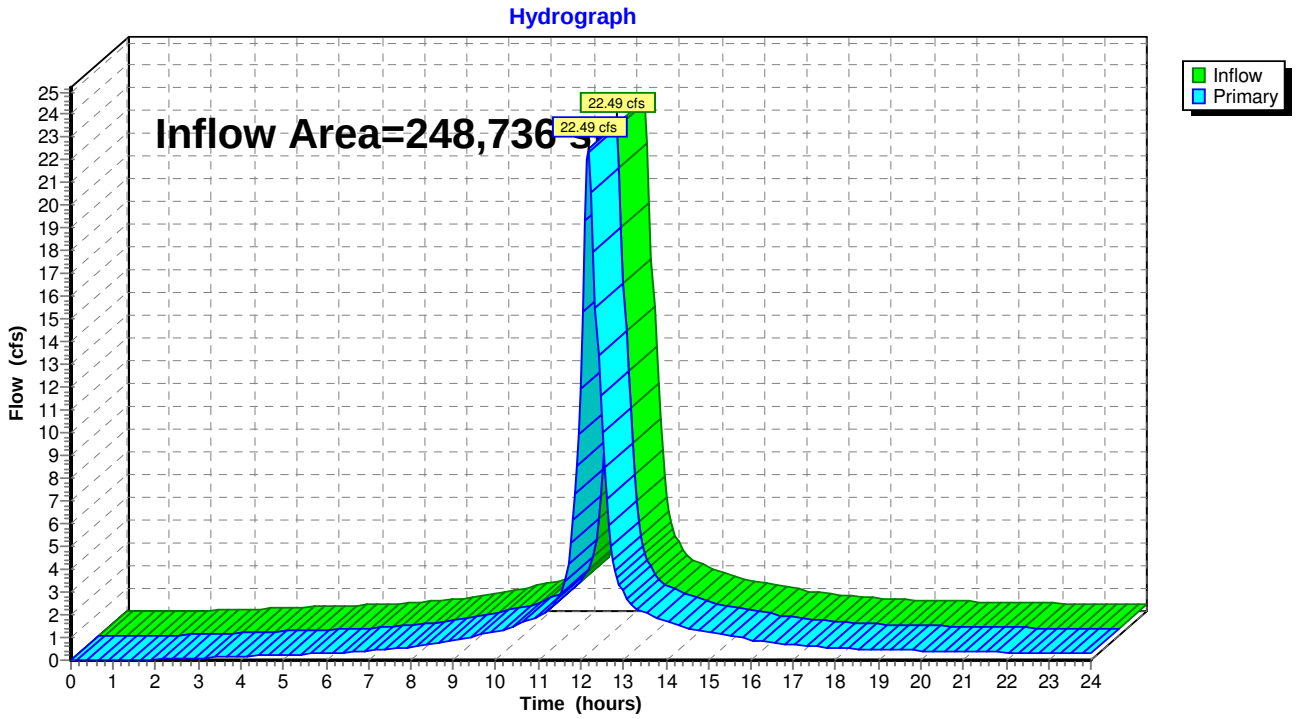


Summary for Link 2L: POI 2

Inflow Area = 248,736 sf, 80.85% Impervious, Inflow Depth > 4.94" for 25 yr event
Inflow = 22.49 cfs @ 12.18 hrs, Volume= 102,406 cf
Primary = 22.49 cfs @ 12.18 hrs, Volume= 102,406 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: POI 2

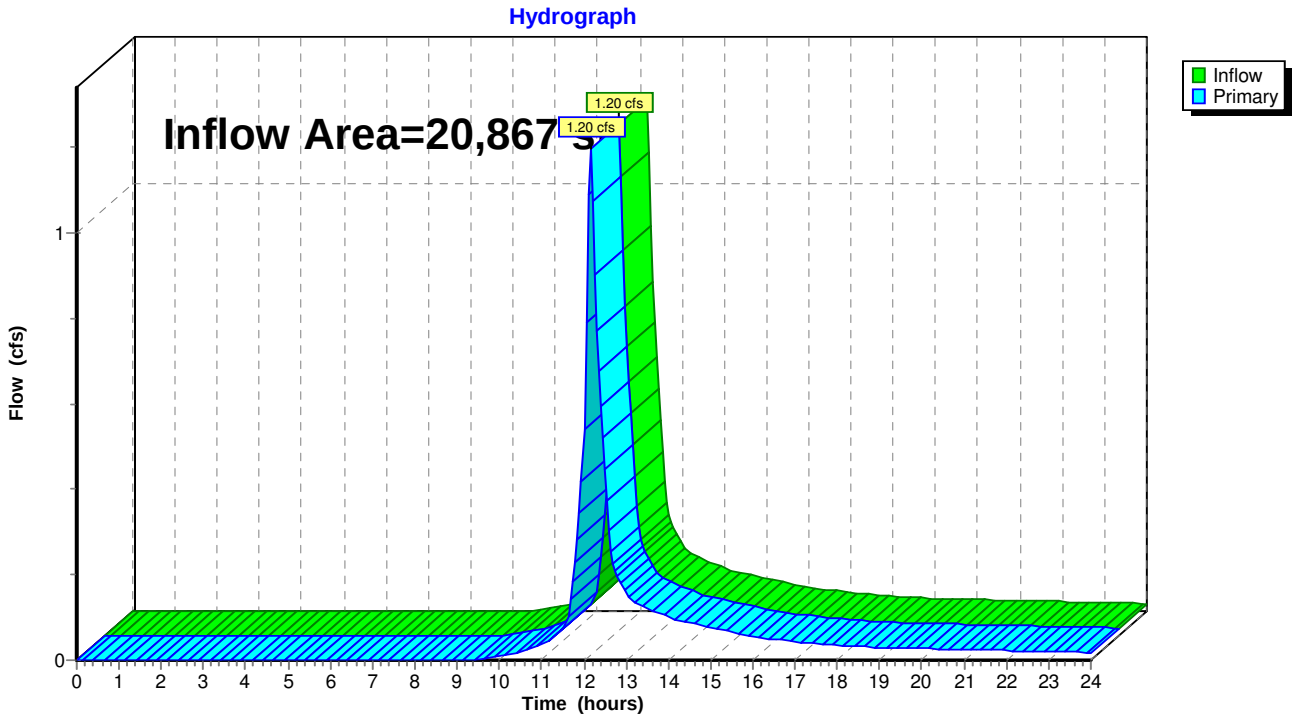


Summary for Link 3L: POI 3

Inflow Area = 20,867 sf, 0.00% Impervious, Inflow Depth > 2.49" for 25 yr event
Inflow = 1.20 cfs @ 12.15 hrs, Volume= 4,324 cf
Primary = 1.20 cfs @ 12.15 hrs, Volume= 4,324 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 3L: POI 3



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: POI 1 - OVERLAND Runoff Area=54,833 sf 82.65% Impervious Runoff Depth>5.61"
Tc=6.0 min CN=95 Runoff=7.33 cfs 25,619 cf

Subcatchment 2Sa: POI 2 - OVERLAND Runoff Area=203,310 sf 89.93% Impervious Runoff Depth>5.72"
Flow Length=957' Slope=0.0094 '/' Tc=14.9 min CN=96 Runoff=21.36 cfs 96,837 cf

Subcatchment 2Sb: POI 2 - SLIP RAMP PRE Runoff Area=27,151 sf 0.00% Impervious Runoff Depth>3.85"
Tc=10.0 min CN=79 Runoff=2.43 cfs 8,717 cf

Subcatchment 2Se: POI 2 - ROUTE 24 Runoff Area=18,275 sf 100.00% Impervious Runoff Depth>5.96"
Tc=6.0 min CN=98 Runoff=2.49 cfs 9,074 cf

Subcatchment 3S: POI 3 - OVERLAND Runoff Area=20,867 sf 0.00% Impervious Runoff Depth>2.96"
Tc=10.0 min CN=70 Runoff=1.43 cfs 5,146 cf

Link 1L: POI 1 Inflow=7.33 cfs 25,619 cf
Primary=7.33 cfs 25,619 cf

Link 2L: POI 2 Inflow=25.07 cfs 114,627 cf
Primary=25.07 cfs 114,627 cf

Link 3L: POI 3 Inflow=1.43 cfs 5,146 cf
Primary=1.43 cfs 5,146 cf

Total Runoff Area = 324,436 sf Runoff Volume = 145,392 cf Average Runoff Depth = 5.38"
24.04% Pervious = 78,004 sf 75.96% Impervious = 246,432 sf

Summary for Subcatchment 1S: POI 1 - OVERLAND DIRECT DISCHARGE

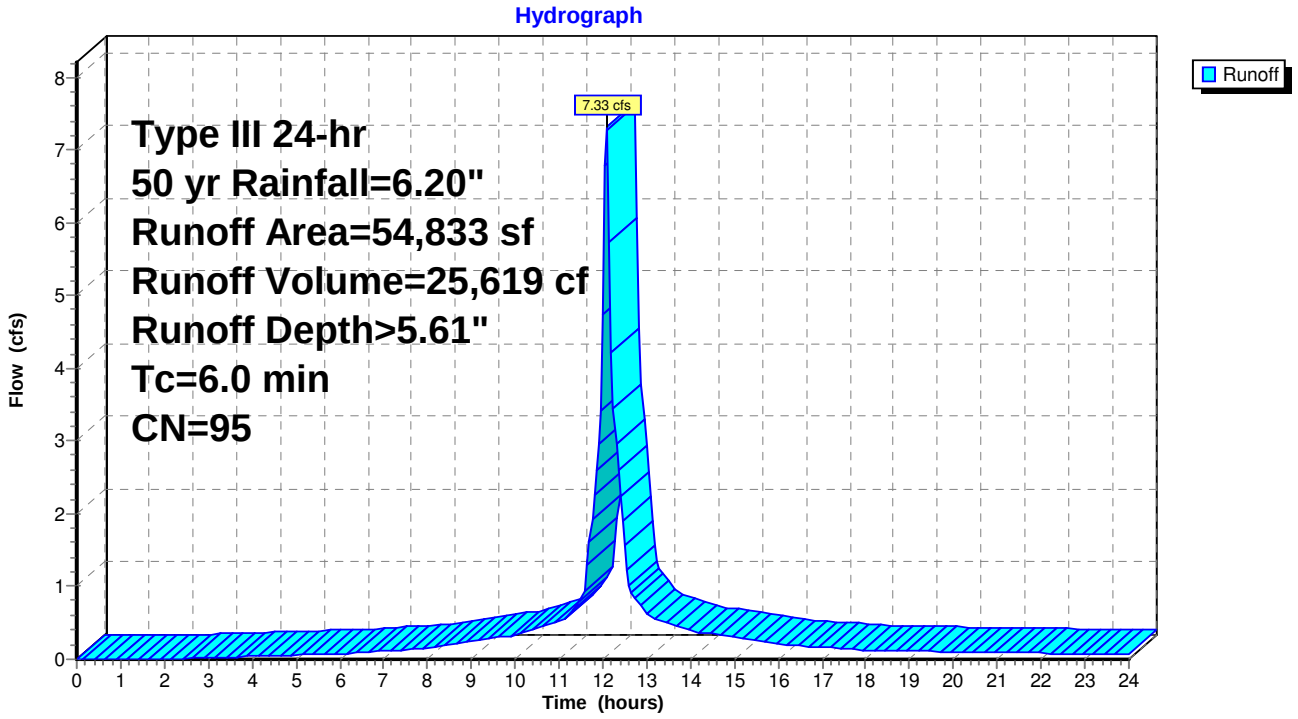
Runoff = 7.33 cfs @ 12.09 hrs, Volume= 25,619 cf, Depth> 5.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
45,321	98	Paved roads w/curbs & sewers, HSG C
9,512	79	50-75% Grass cover, Fair, HSG C
54,833	95	Weighted Average
9,512		17.35% Pervious Area
45,321		82.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: POI 1 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 2Sa: POI 2 - OVERLAND DIRECT DISCHARGE

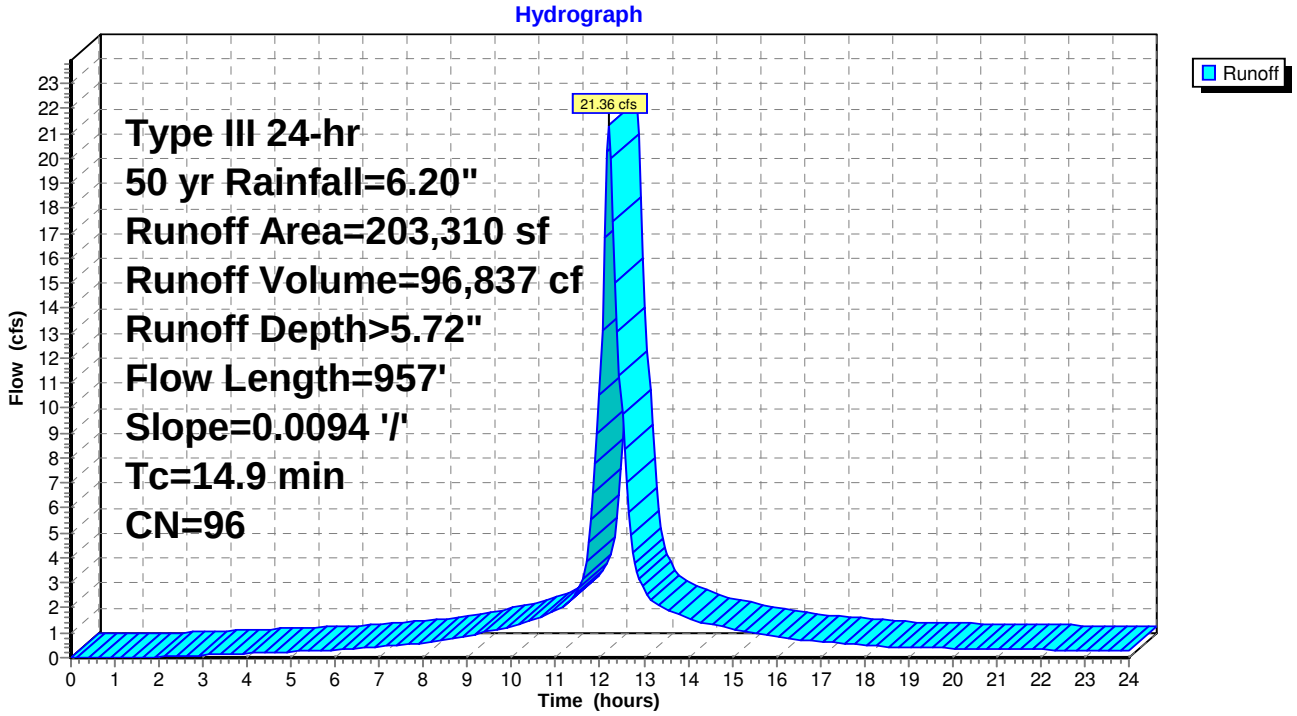
Runoff = 21.36 cfs @ 12.20 hrs, Volume= 96,837 cf, Depth> 5.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
176,004	98	Paved roads w/curbs & sewers, HSG C
19,306	79	50-75% Grass cover, Fair, HSG C
6,832	98	Paved roads w/curbs & sewers, HSG D
1,168	84	50-75% Grass cover, Fair, HSG D
203,310	96	Weighted Average
20,474		10.07% Pervious Area
182,836		89.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
9.9	957	0.0094	1.61	12.11	**Channel Flow, Natural Stream** Area= 7.5 sf Perim= 25.0' r= 0.30' n= 0.040 Winding stream
14.9	957	Total			

Subcatchment 2Sa: POI 2 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 2Sb: POI 2 - SLIP RAMP PRE DEVELOPMENT

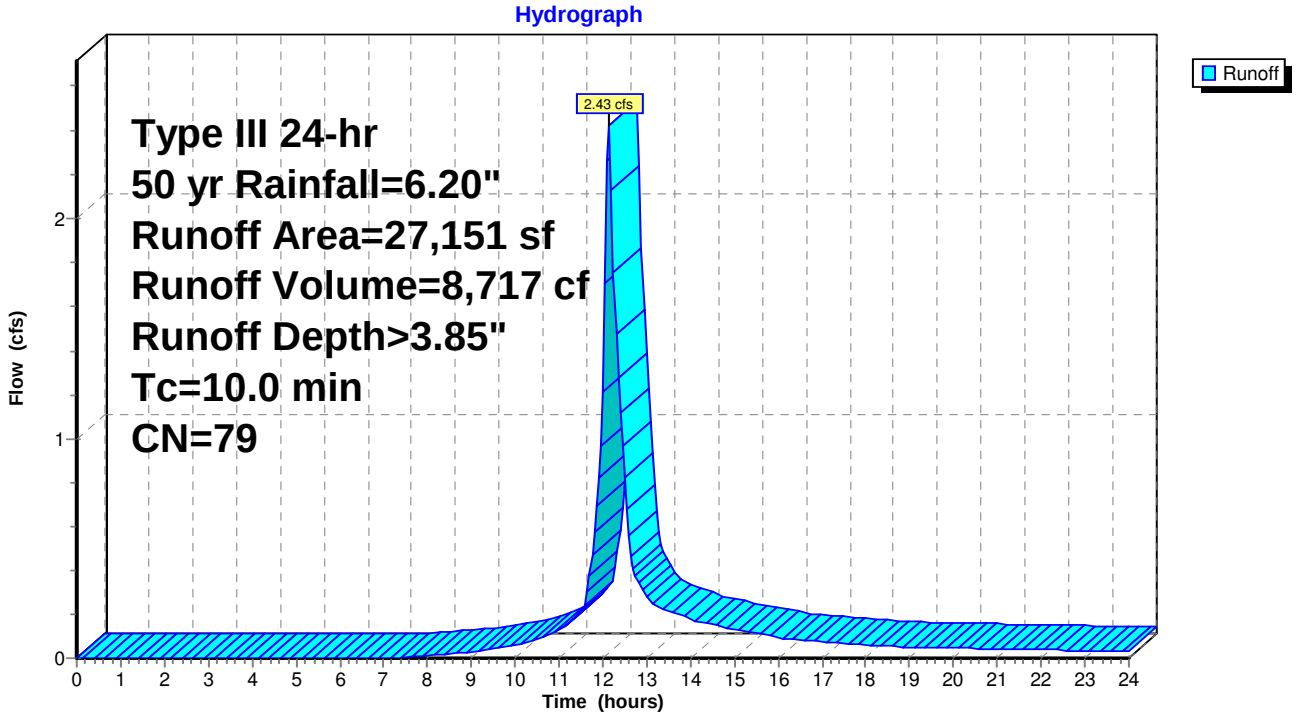
Runoff = 2.43 cfs @ 12.14 hrs, Volume= 8,717 cf, Depth> 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

	Area (sf)	CN	Description
	2,882	84	50-75% Grass cover, Fair, HSG D
	20,023	79	Woods, Fair, HSG D
*	3,927	77	Wetland
	319	96	Gravel surface, HSG D
	27,151	79	Weighted Average
	27,151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 2Sb: POI 2 - SLIP RAMP PRE DEVELOPMENT



Summary for Subcatchment 2Se: POI 2 - ROUTE 24

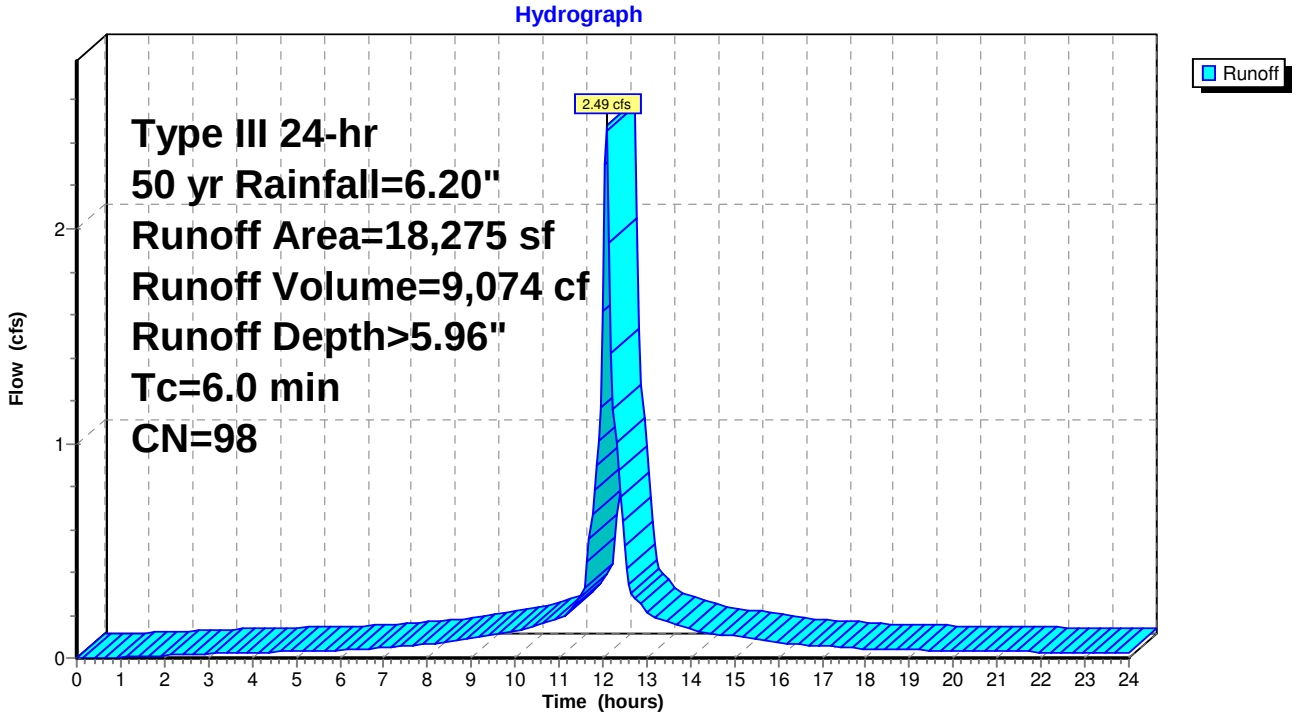
Runoff = 2.49 cfs @ 12.09 hrs, Volume= 9,074 cf, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
18,275	98	Paved roads w/curbs & sewers, HSG C
18,275		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2Se: POI 2 - ROUTE 24



Summary for Subcatchment 3S: POI 3 - OVERLAND DIRECT DISCHARGE

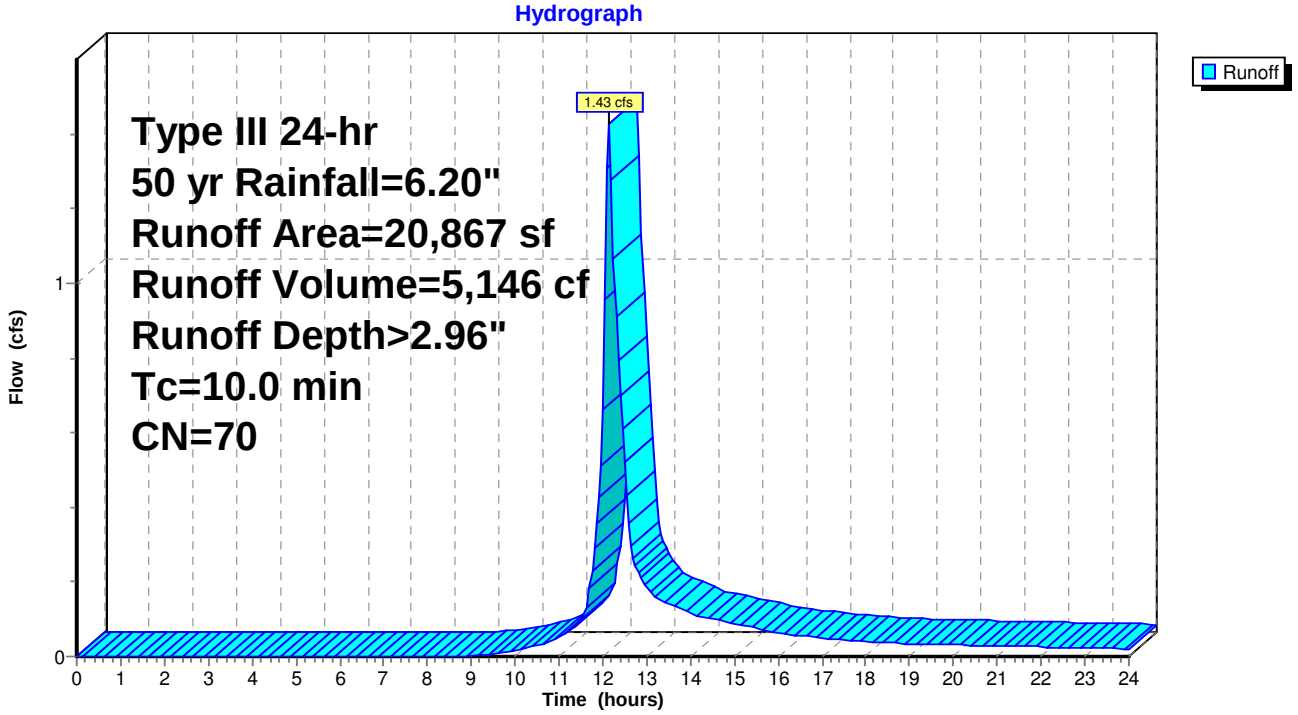
Runoff = 1.43 cfs @ 12.15 hrs, Volume= 5,146 cf, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
8,255	79	Woods, Fair, HSG D
4,654	69	50-75% Grass cover, Fair, HSG B
7,958	60	Woods, Fair, HSG B
20,867	70	Weighted Average
20,867		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 3S: POI 3 - OVERLAND DIRECT DISCHARGE

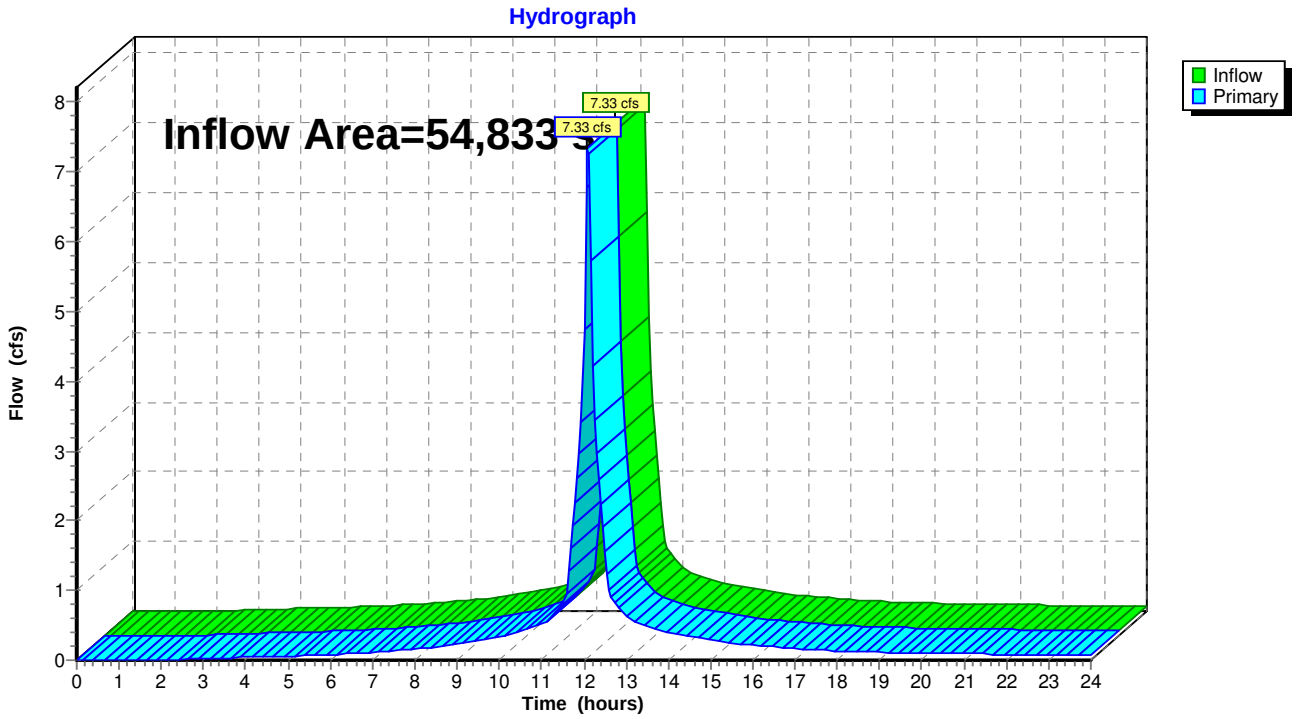


Summary for Link 1L: POI 1

Inflow Area = 54,833 sf, 82.65% Impervious, Inflow Depth > 5.61" for 50 yr event
Inflow = 7.33 cfs @ 12.09 hrs, Volume= 25,619 cf
Primary = 7.33 cfs @ 12.09 hrs, Volume= 25,619 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: POI 1

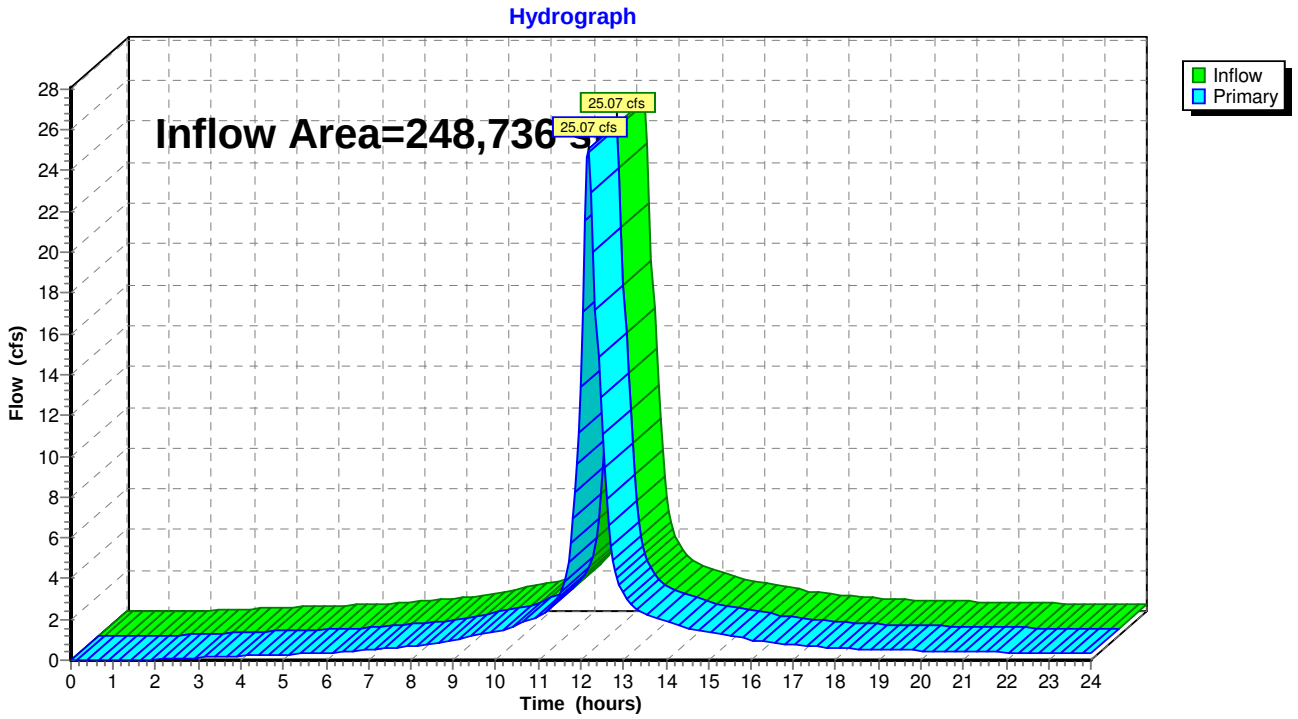


Summary for Link 2L: POI 2

Inflow Area = 248,736 sf, 80.85% Impervious, Inflow Depth > 5.53" for 50 yr event
Inflow = 25.07 cfs @ 12.18 hrs, Volume= 114,627 cf
Primary = 25.07 cfs @ 12.18 hrs, Volume= 114,627 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: POI 2

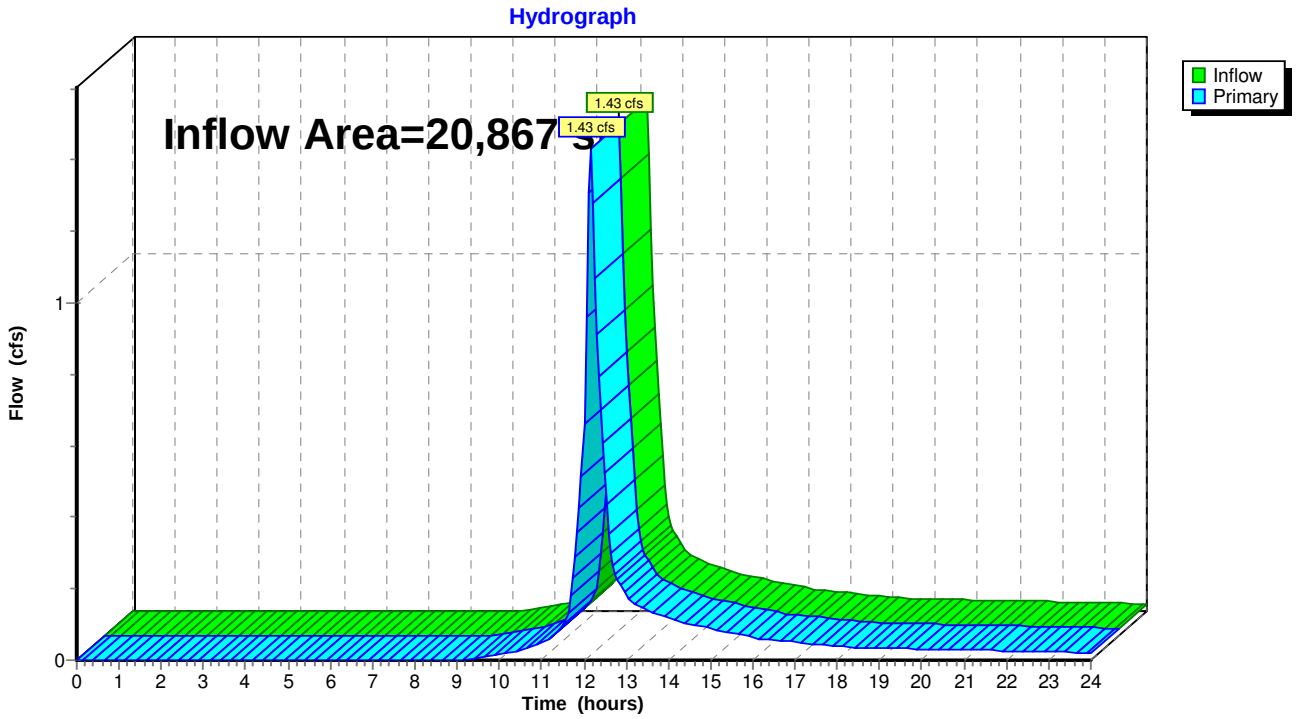


Summary for Link 3L: POI 3

Inflow Area = 20,867 sf, 0.00% Impervious, Inflow Depth > 2.96" for 50 yr event
Inflow = 1.43 cfs @ 12.15 hrs, Volume= 5,146 cf
Primary = 1.43 cfs @ 12.15 hrs, Volume= 5,146 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 3L: POI 3



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: POI 1 - OVERLAND Runoff Area=54,833 sf 82.65% Impervious Runoff Depth>6.30"
Tc=6.0 min CN=95 Runoff=8.19 cfs 28,798 cf

Subcatchment 2Sa: POI 2 - OVERLAND Runoff Area=203,310 sf 89.93% Impervious Runoff Depth>6.41"
Flow Length=957' Slope=0.0094 '/' Tc=14.9 min CN=96 Runoff=23.84 cfs 108,632 cf

Subcatchment 2Sb: POI 2 - SLIP RAMP PRE Runoff Area=27,151 sf 0.00% Impervious Runoff Depth>4.49"
Tc=10.0 min CN=79 Runoff=2.82 cfs 10,150 cf

Subcatchment 2Se: POI 2 - ROUTE 24 Runoff Area=18,275 sf 100.00% Impervious Runoff Depth>6.66"
Tc=6.0 min CN=98 Runoff=2.77 cfs 10,138 cf

Subcatchment 3S: POI 3 - OVERLAND Runoff Area=20,867 sf 0.00% Impervious Runoff Depth>3.53"
Tc=10.0 min CN=70 Runoff=1.71 cfs 6,137 cf

Link 1L: POI 1 Inflow=8.19 cfs 28,798 cf
Primary=8.19 cfs 28,798 cf

Link 2L: POI 2 Inflow=28.07 cfs 128,920 cf
Primary=28.07 cfs 128,920 cf

Link 3L: POI 3 Inflow=1.71 cfs 6,137 cf
Primary=1.71 cfs 6,137 cf

Total Runoff Area = 324,436 sf Runoff Volume = 163,854 cf Average Runoff Depth = 6.06"
24.04% Pervious = 78,004 sf 75.96% Impervious = 246,432 sf

Summary for Subcatchment 1S: POI 1 - OVERLAND DIRECT DISCHARGE

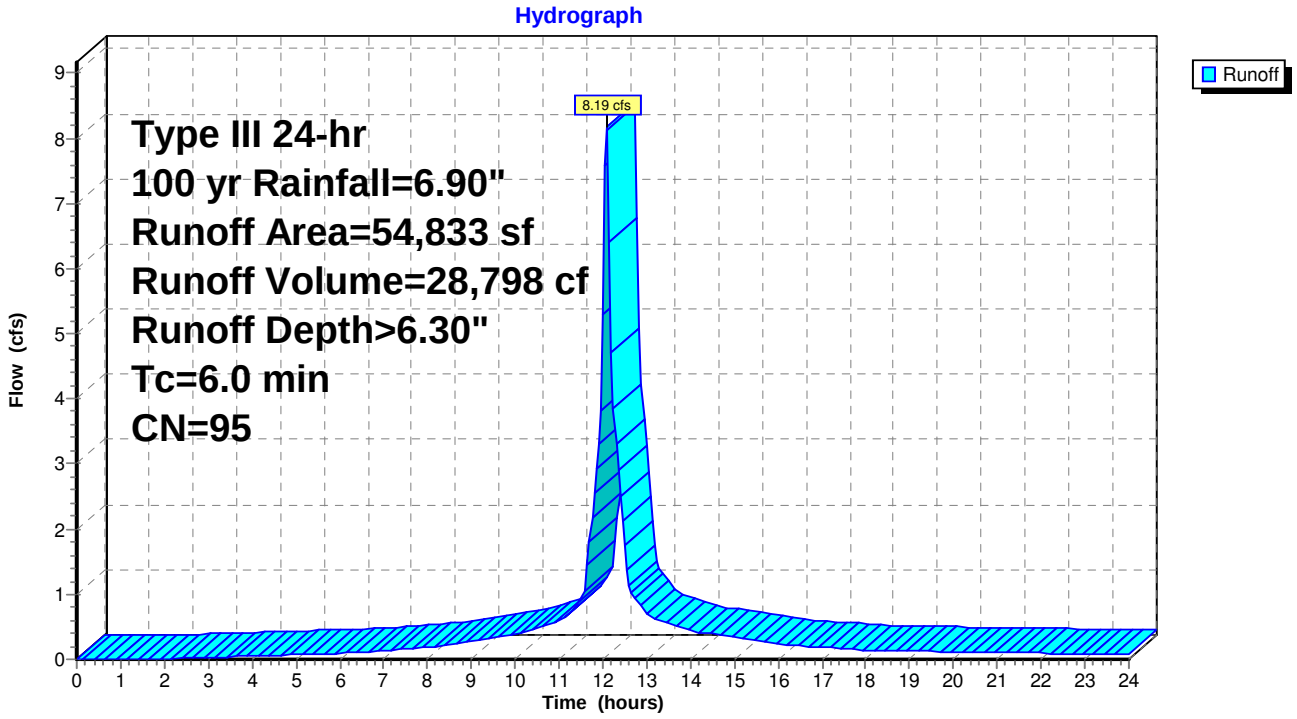
Runoff = 8.19 cfs @ 12.09 hrs, Volume= 28,798 cf, Depth> 6.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
45,321	98	Paved roads w/curbs & sewers, HSG C
9,512	79	50-75% Grass cover, Fair, HSG C
54,833	95	Weighted Average
9,512		17.35% Pervious Area
45,321		82.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1S: POI 1 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 2Sa: POI 2 - OVERLAND DIRECT DISCHARGE

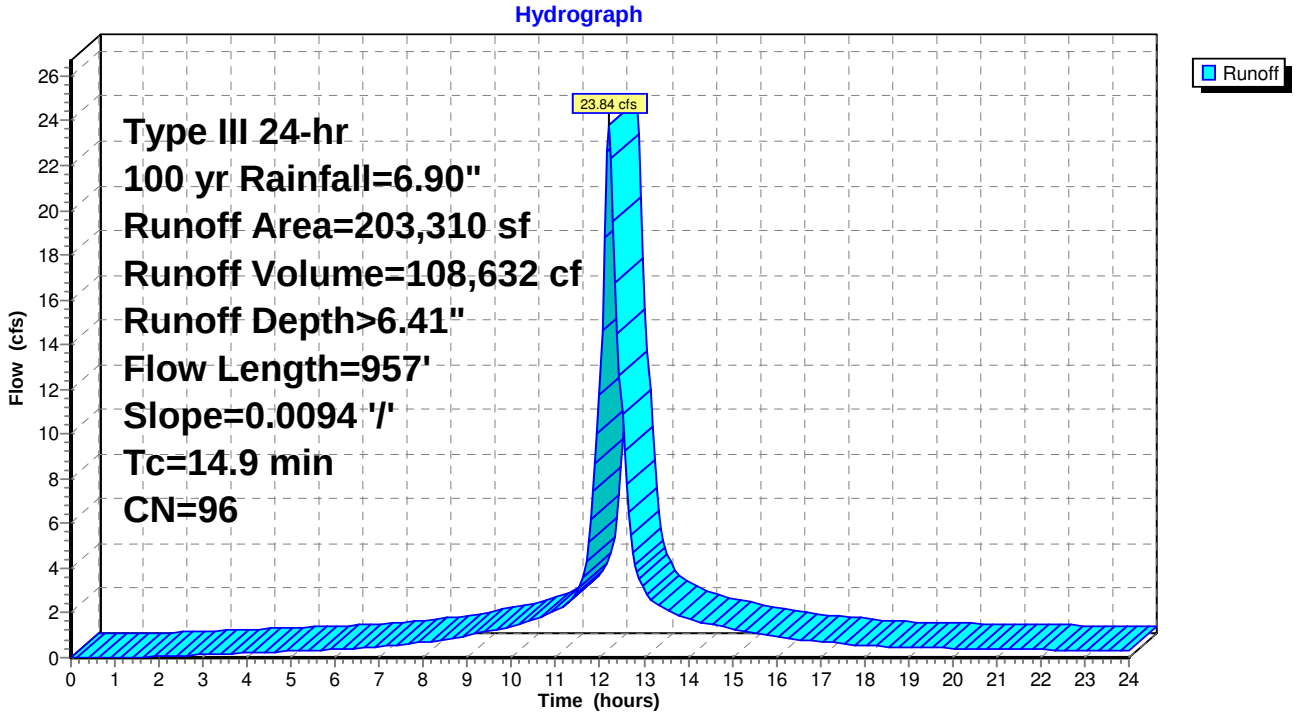
Runoff = 23.84 cfs @ 12.20 hrs, Volume= 108,632 cf, Depth> 6.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
176,004	98	Paved roads w/curbs & sewers, HSG C
19,306	79	50-75% Grass cover, Fair, HSG C
6,832	98	Paved roads w/curbs & sewers, HSG D
1,168	84	50-75% Grass cover, Fair, HSG D
203,310	96	Weighted Average
20,474		10.07% Pervious Area
182,836		89.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
9.9	957	0.0094	1.61	12.11	**Channel Flow, Natural Stream** Area= 7.5 sf Perim= 25.0' r= 0.30' n= 0.040 Winding stream
14.9	957	Total			

Subcatchment 2Sa: POI 2 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 2Sb: POI 2 - SLIP RAMP PRE DEVELOPMENT

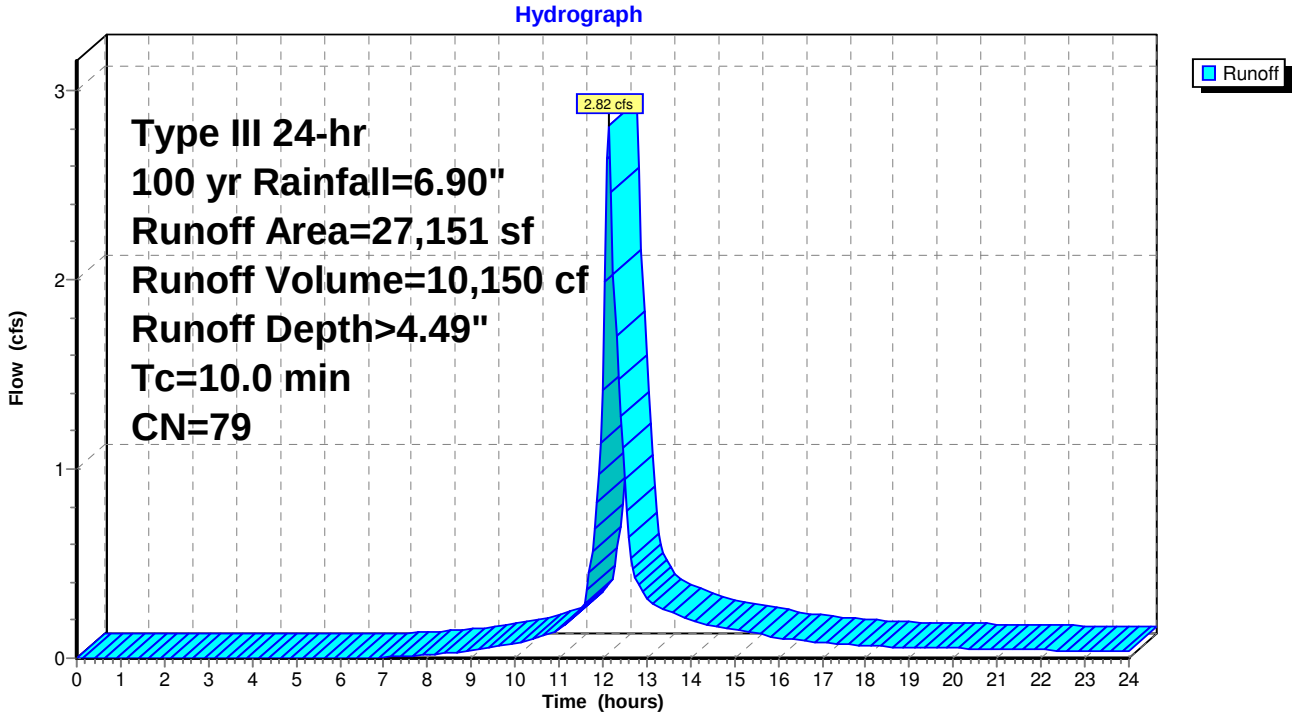
Runoff = 2.82 cfs @ 12.14 hrs, Volume= 10,150 cf, Depth> 4.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

	Area (sf)	CN	Description
	2,882	84	50-75% Grass cover, Fair, HSG D
	20,023	79	Woods, Fair, HSG D
*	3,927	77	Wetland
	319	96	Gravel surface, HSG D
	27,151	79	Weighted Average
	27,151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 2Sb: POI 2 - SLIP RAMP PRE DEVELOPMENT



Summary for Subcatchment 2Se: POI 2 - ROUTE 24

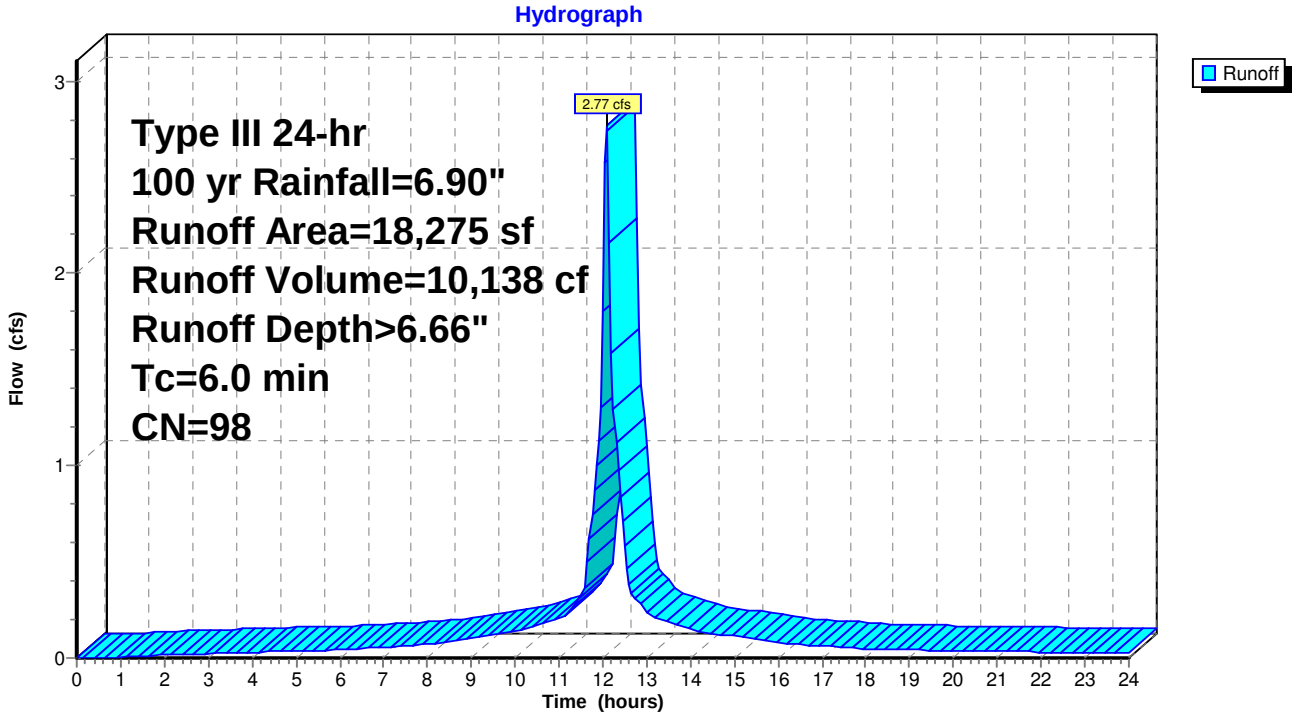
Runoff = 2.77 cfs @ 12.09 hrs, Volume= 10,138 cf, Depth> 6.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
18,275	98	Paved roads w/curbs & sewers, HSG C
18,275		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2Se: POI 2 - ROUTE 24



Summary for Subcatchment 3S: POI 3 - OVERLAND DIRECT DISCHARGE

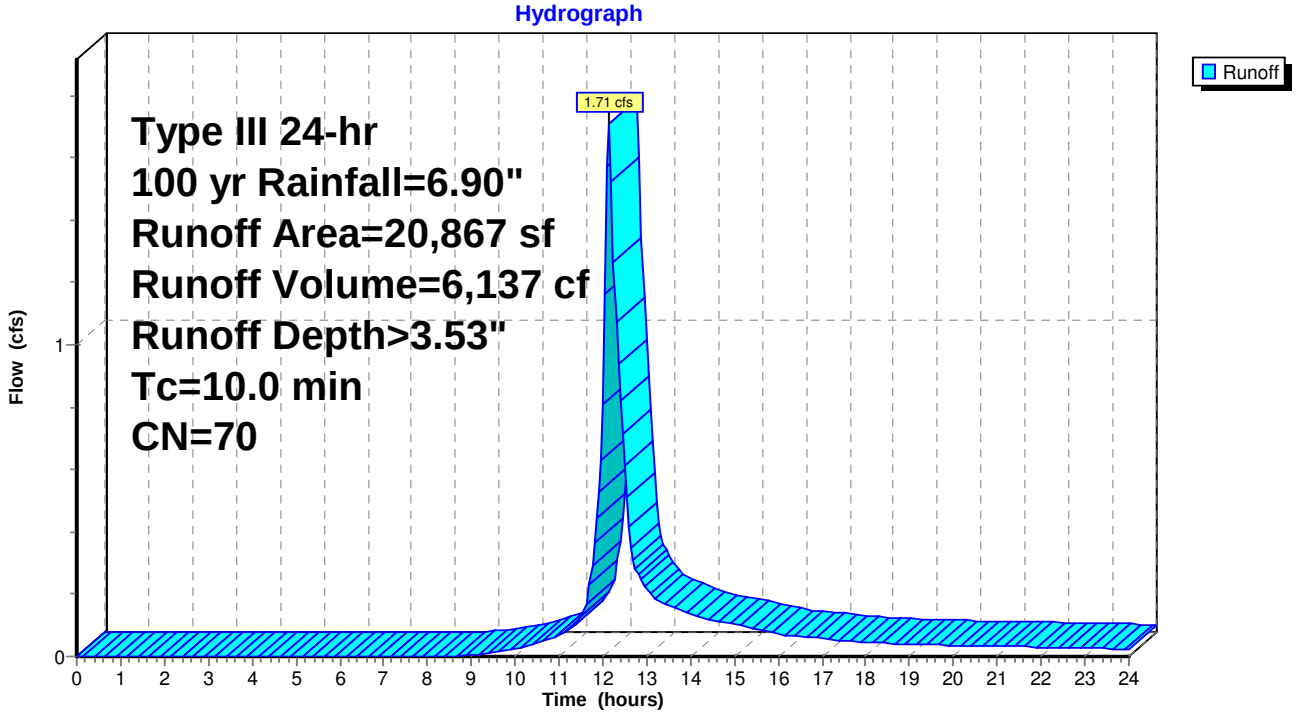
Runoff = 1.71 cfs @ 12.15 hrs, Volume= 6,137 cf, Depth> 3.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
8,255	79	Woods, Fair, HSG D
4,654	69	50-75% Grass cover, Fair, HSG B
7,958	60	Woods, Fair, HSG B
20,867	70	Weighted Average
20,867		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment 3S: POI 3 - OVERLAND DIRECT DISCHARGE

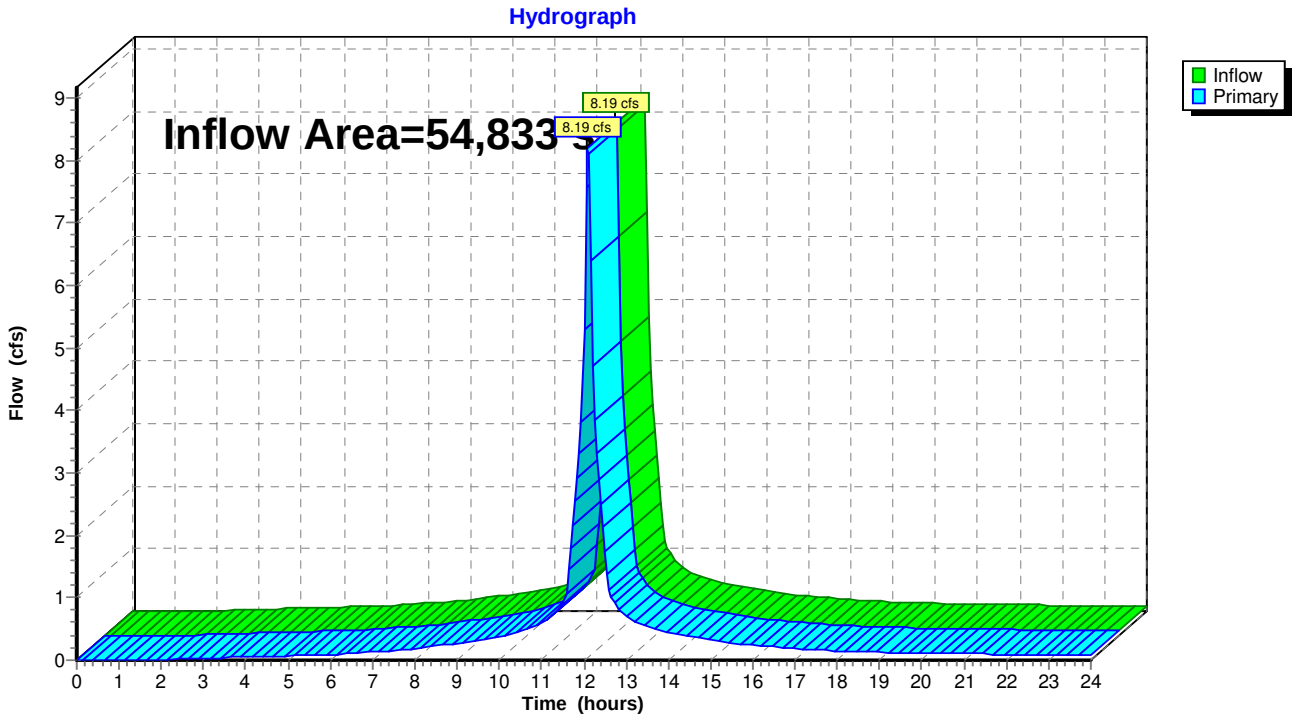


Summary for Link 1L: POI 1

Inflow Area = 54,833 sf, 82.65% Impervious, Inflow Depth > 6.30" for 100 yr event
Inflow = 8.19 cfs @ 12.09 hrs, Volume= 28,798 cf
Primary = 8.19 cfs @ 12.09 hrs, Volume= 28,798 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: POI 1

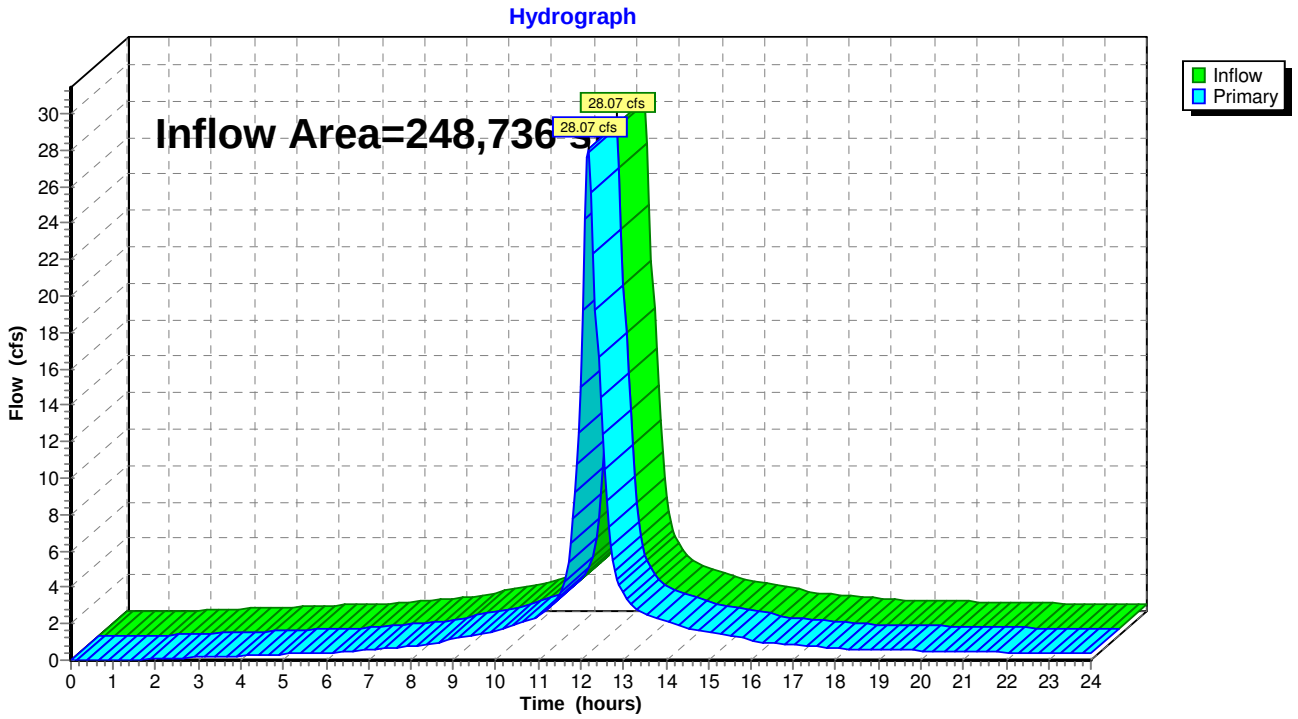


Summary for Link 2L: POI 2

Inflow Area = 248,736 sf, 80.85% Impervious, Inflow Depth > 6.22" for 100 yr event
Inflow = 28.07 cfs @ 12.18 hrs, Volume= 128,920 cf
Primary = 28.07 cfs @ 12.18 hrs, Volume= 128,920 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: POI 2

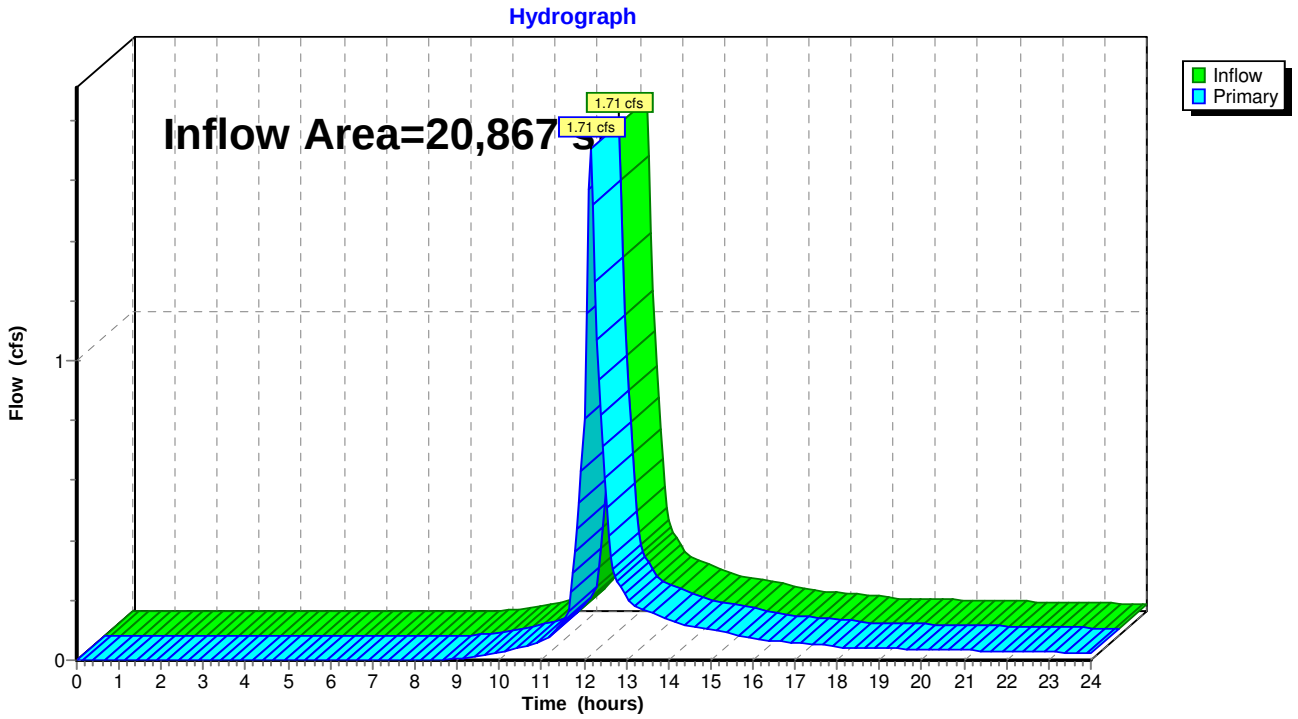


Summary for Link 3L: POI 3

Inflow Area = 20,867 sf, 0.00% Impervious, Inflow Depth > 3.53" for 100 yr event
Inflow = 1.71 cfs @ 12.15 hrs, Volume= 6,137 cf
Primary = 1.71 cfs @ 12.15 hrs, Volume= 6,137 cf, Atten= 0%, Lag= 0.0 min

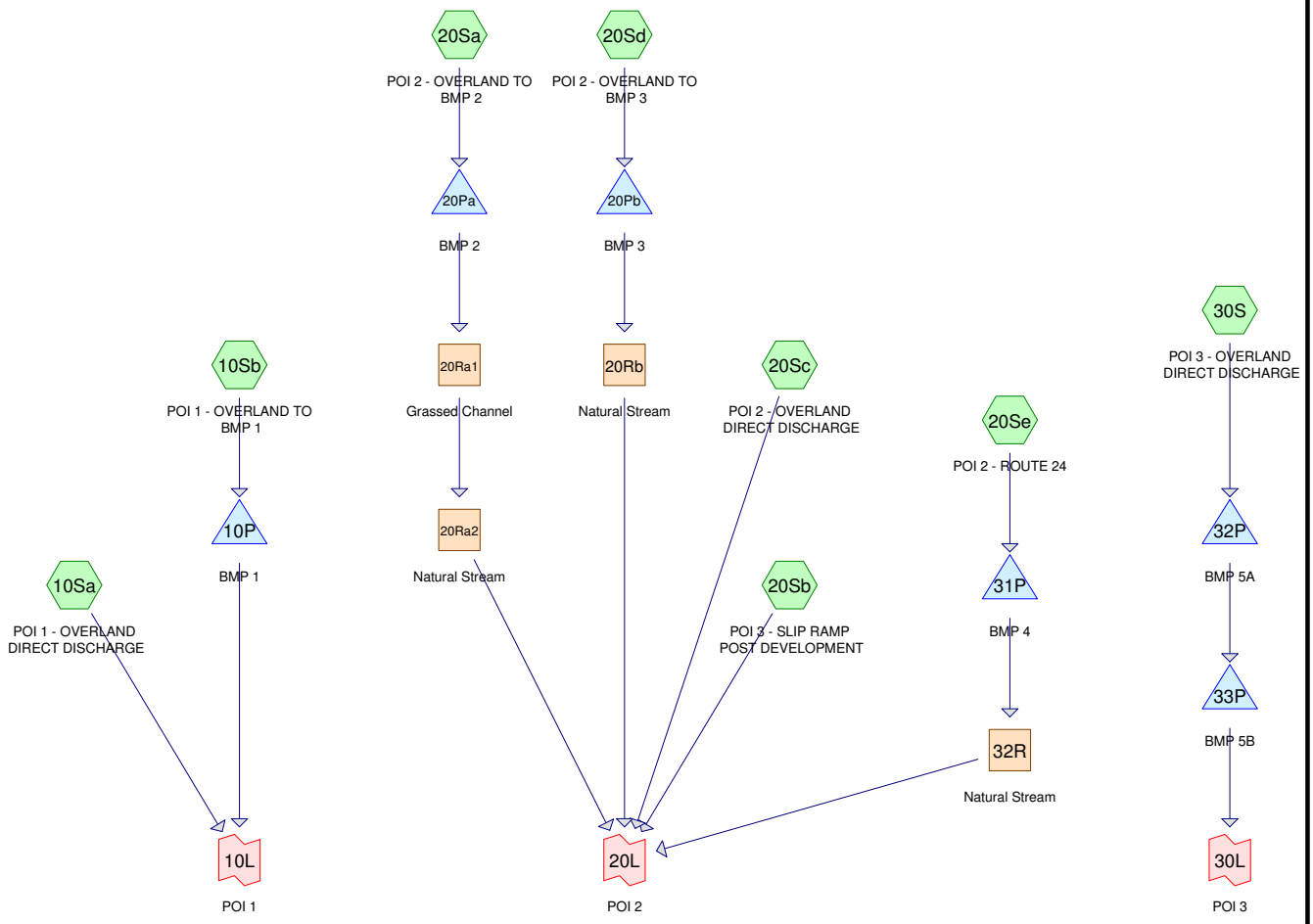
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

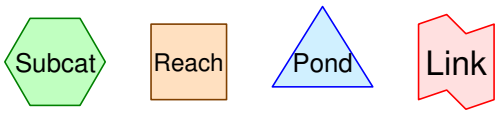
Link 3L: POI 3



PROPOSED CONDITIONS

ROUTES 140/24 IMPROVEMENTS





Routing Diagram for TAUNTON RTE 140 POST DEVELOPMENT
Prepared by Hewlett-Packard Company, Printed 6/23/2014
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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10Sa: POI 1 - OVERLAND Runoff Area=22,715 sf 100.00% Impervious Runoff Depth>3.07"
Tc=5.0 min CN=98 Runoff=1.68 cfs 5,803 cf

Subcatchment 10Sb: POI 1 - OVERLAND Runoff Area=32,125 sf 100.00% Impervious Runoff Depth>3.07"
Tc=5.0 min CN=98 Runoff=2.38 cfs 8,207 cf

Subcatchment 20Sa: POI 2 - OVERLAND Runoff Area=69,875 sf 100.00% Impervious Runoff Depth>3.07"
Tc=5.0 min CN=98 Runoff=5.18 cfs 17,851 cf

Subcatchment 20Sb: POI 3 - SLIP RAMP Runoff Area=27,151 sf 100.00% Impervious Runoff Depth>3.07"
Tc=5.0 min CN=98 Runoff=2.01 cfs 6,936 cf

Subcatchment 20Sc: POI 2 - OVERLAND Runoff Area=114,189 sf 98.28% Impervious Runoff Depth>3.06"
Flow Length=957' Slope=0.0094 '/' Tc=14.9 min CN=98 Runoff=6.40 cfs 29,130 cf

Subcatchment 20Sd: POI 2 - OVERLAND Runoff Area=19,243 sf 100.00% Impervious Runoff Depth>3.07"
Tc=5.0 min CN=98 Runoff=1.43 cfs 4,916 cf

Subcatchment 20Se: POI 2 - ROUTE 24 Runoff Area=18,275 sf 100.00% Impervious Runoff Depth>3.07"
Tc=5.0 min CN=98 Runoff=1.35 cfs 4,669 cf

Subcatchment 30S: POI 3 - OVERLAND Runoff Area=20,867 sf 100.00% Impervious Runoff Depth>3.07"
Tc=5.0 min CN=98 Runoff=1.55 cfs 5,331 cf

Reach 20Ra1: Grassed Channel Avg. Flow Depth=0.20' Max Vel=2.44 fps Inflow=2.84 cfs 14,767 cf
n=0.022 L=436.0' S=0.0161 '/' Capacity=16.40 cfs Outflow=2.67 cfs 14,722 cf

Reach 20Ra2: Natural Stream Avg. Flow Depth=0.23' Max Vel=1.06 fps Inflow=2.67 cfs 14,722 cf
n=0.040 L=600.0' S=0.0100 '/' Capacity=12.48 cfs Outflow=2.27 cfs 14,599 cf

Reach 20Rb: Natural Stream Avg. Flow Depth=0.12' Max Vel=0.85 fps Inflow=1.04 cfs 4,244 cf
n=0.040 L=1,006.0' S=0.0129 '/' Capacity=14.18 cfs Outflow=0.74 cfs 4,161 cf

Reach 32R: Natural Stream Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0 cf
n=0.040 L=400.0' S=0.0100 '/' Capacity=12.48 cfs Outflow=0.00 cfs 0 cf

Pond 10P: BMP 1 Peak Elev=38.51' Storage=1,590 cf Inflow=2.38 cfs 8,207 cf
Outflow=1.54 cfs 7,452 cf

Pond 20Pa: BMP 2 Peak Elev=38.92' Storage=6,173 cf Inflow=5.18 cfs 17,851 cf
Outflow=2.84 cfs 14,767 cf

Pond 20Pb: BMP 3 Peak Elev=39.72' Storage=1,150 cf Inflow=1.43 cfs 4,916 cf
Outflow=1.04 cfs 4,244 cf

Pond 31P: BMP 4 Peak Elev=57.18' Storage=4,667 cf Inflow=1.35 cfs 4,669 cf
Outflow=0.00 cfs 0 cf

Pond 32P: BMP 5A Peak Elev=101.52' Storage=3,957 cf Inflow=1.55 cfs 5,331 cf
Outflow=0.10 cfs 1,429 cf

Pond 33P: BMP 5B Peak Elev=98.75' Storage=1,428 cf Inflow=0.10 cfs 1,429 cf
Outflow=0.00 cfs 0 cf

Link 10L: POI 1 Inflow=3.06 cfs 13,255 cf
Primary=3.06 cfs 13,255 cf

Link 20L: POI 2 Inflow=8.61 cfs 54,827 cf
Primary=8.61 cfs 54,827 cf

Link 30L: POI 3 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 324,440 sf Runoff Volume = 82,844 cf Average Runoff Depth = 3.06"
0.61% Pervious = 1,968 sf 99.39% Impervious = 322,472 sf

Summary for Subcatchment 10Sa: POI 1 - OVERLAND DIRECT DISCHARGE

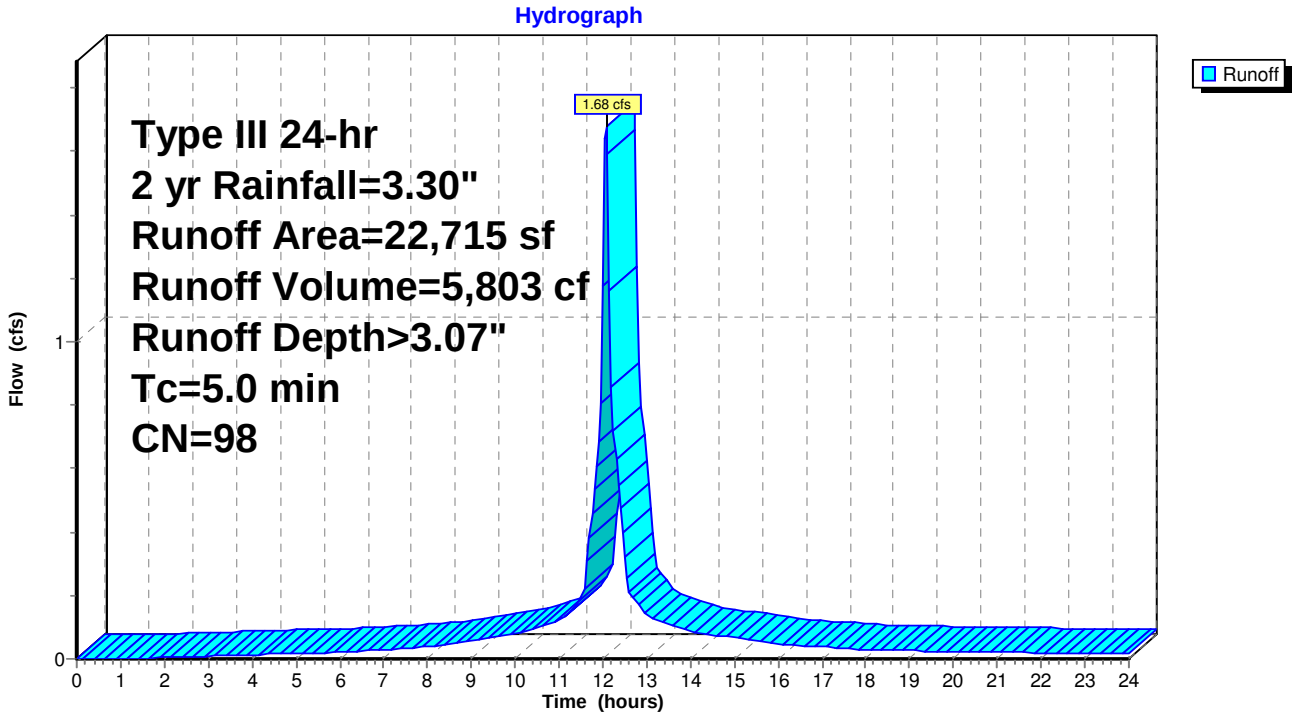
Runoff = 1.68 cfs @ 12.07 hrs, Volume= 5,803 cf, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
22,715	98	Paved roads w/curbs & sewers, HSG C
22,715		100.00% Impervious Area

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

Subcatchment 10Sa: POI 1 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 10Sb: POI 1 - OVERLAND TO BMP 1

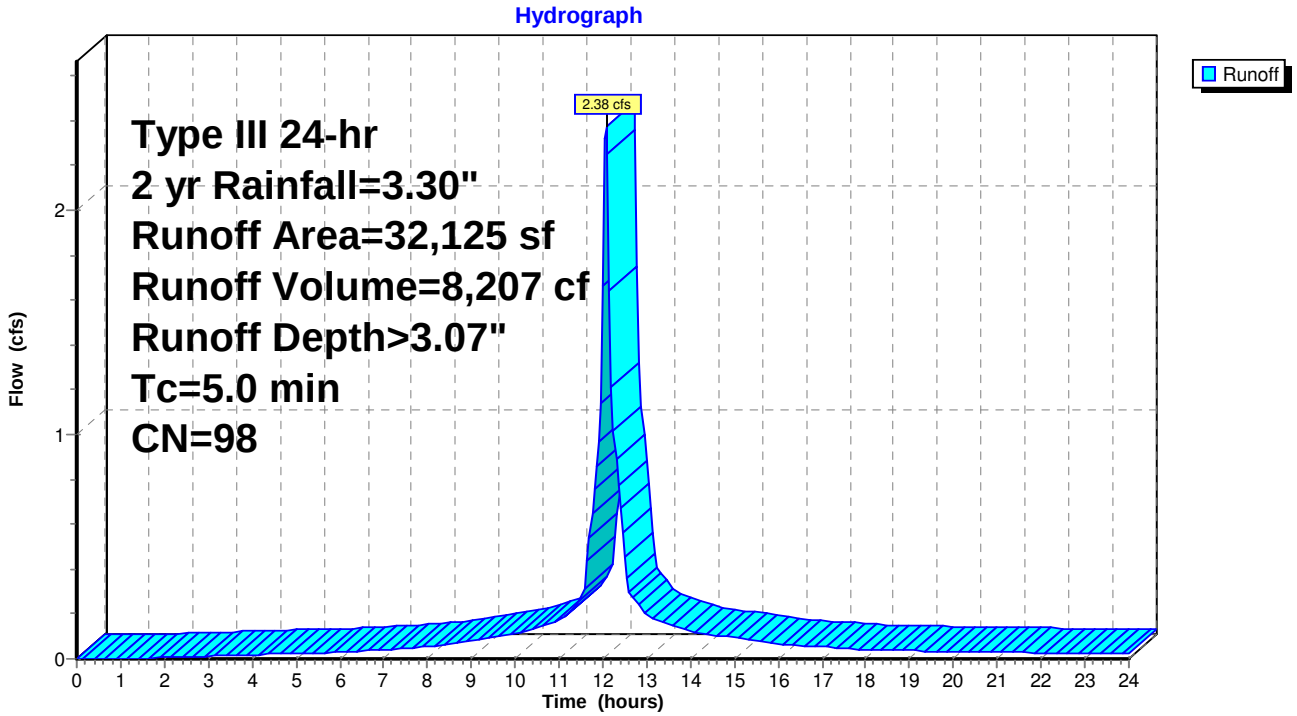
Runoff = 2.38 cfs @ 12.07 hrs, Volume= 8,207 cf, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
32,125	98	Paved roads w/curbs & sewers, HSG C
32,125		100.00% Impervious Area

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

Subcatchment 10Sb: POI 1 - OVERLAND TO BMP 1



Summary for Subcatchment 20Sa: POI 2 - OVERLAND TO BMP 2

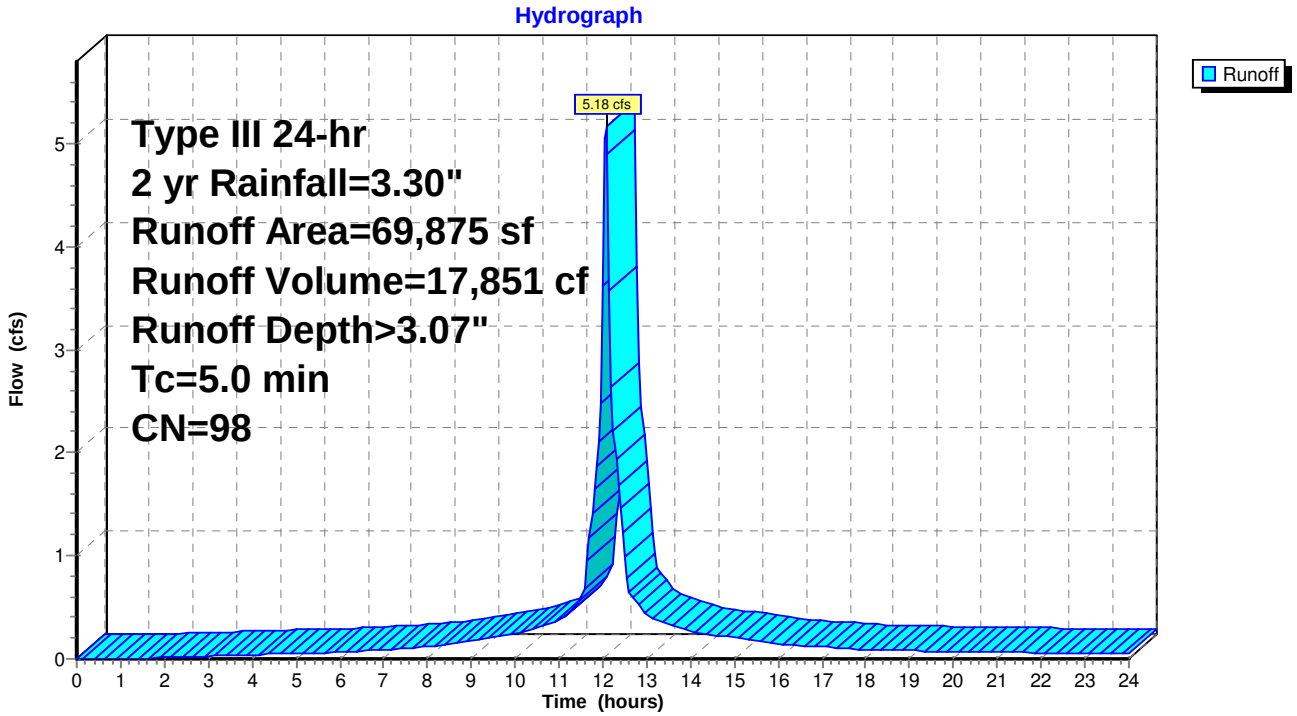
Runoff = 5.18 cfs @ 12.07 hrs, Volume= 17,851 cf, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
69,875	98	Paved roads w/curbs & sewers, HSG C
69,875		100.00% Impervious Area

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

Subcatchment 20Sa: POI 2 - OVERLAND TO BMP 2



Summary for Subcatchment 20Sb: POI 3 - SLIP RAMP POST DEVELOPMENT

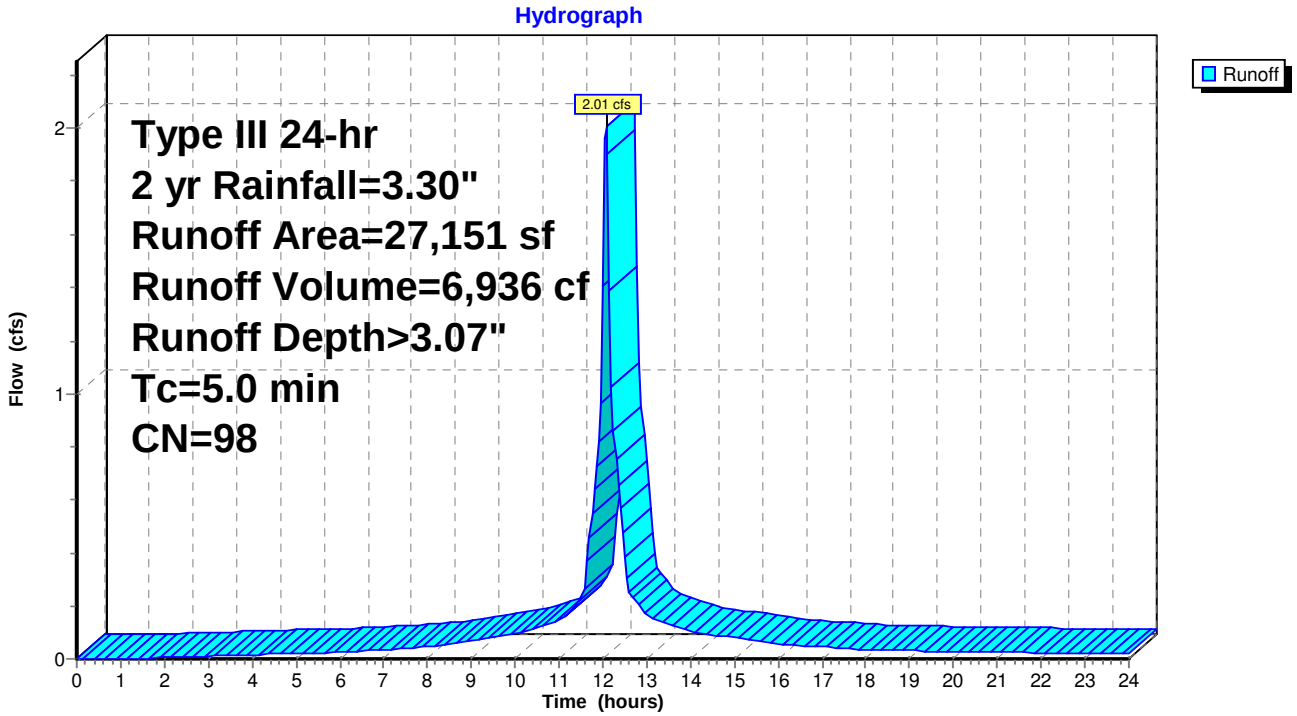
Runoff = 2.01 cfs @ 12.07 hrs, Volume= 6,936 cf, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
27,151	98	Paved roads w/curbs & sewers, HSG D
27,151		100.00% Impervious Area

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

Subcatchment 20Sb: POI 3 - SLIP RAMP POST DEVELOPMENT



Summary for Subcatchment 20Sc: POI 2 - OVERLAND DIRECT DISCHARGE

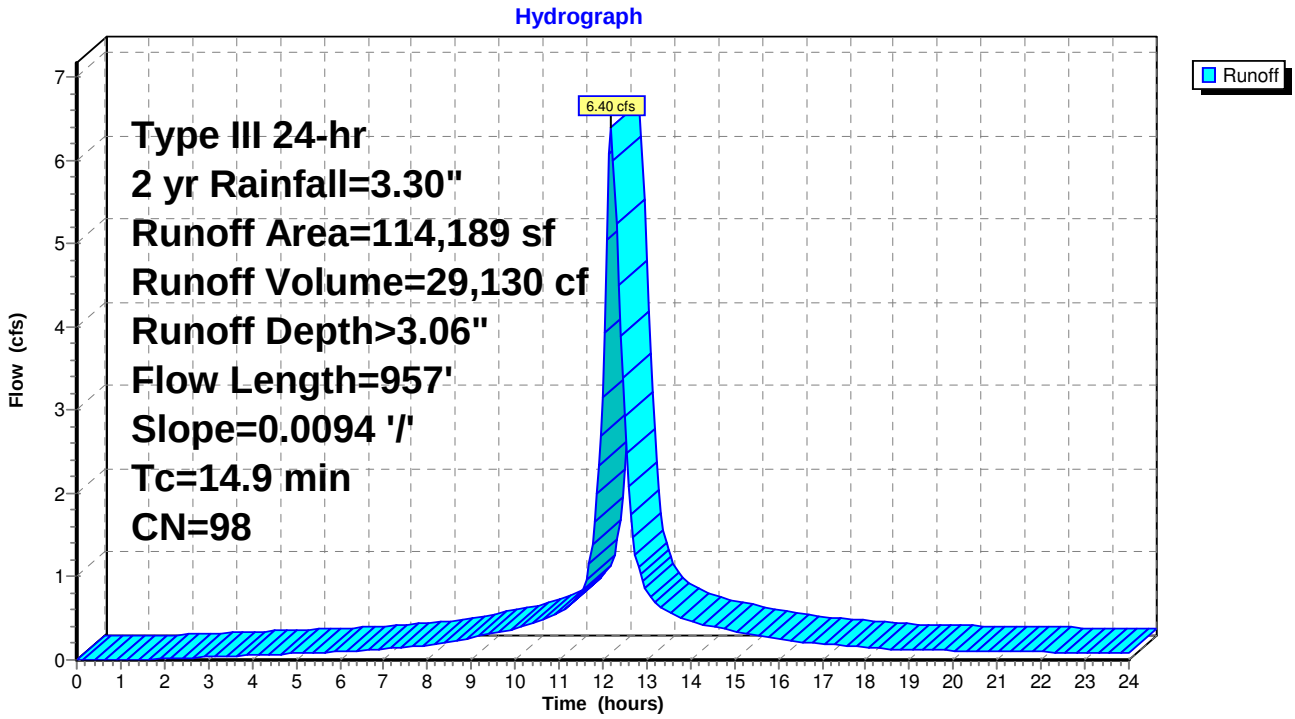
Runoff = 6.40 cfs @ 12.20 hrs, Volume= 29,130 cf, Depth> 3.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
103,199	98	Paved roads w/curbs & sewers, HSG C
1,968	79	50-75% Grass cover, Fair, HSG C
7,934	98	Paved roads w/curbs & sewers, HSG D
1,088	98	Paved roads w/curbs & sewers, HSG B
114,189	98	Weighted Average
1,968		1.72% Pervious Area
112,221		98.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
9.9	957	0.0094	1.61	12.11	**Channel Flow, Natural Stream** Area= 7.5 sf Perim= 25.0' r= 0.30' n= 0.040 Winding stream
14.9	957	Total			

Subcatchment 20Sc: POI 2 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 20Sd: POI 2 - OVERLAND TO BMP 3

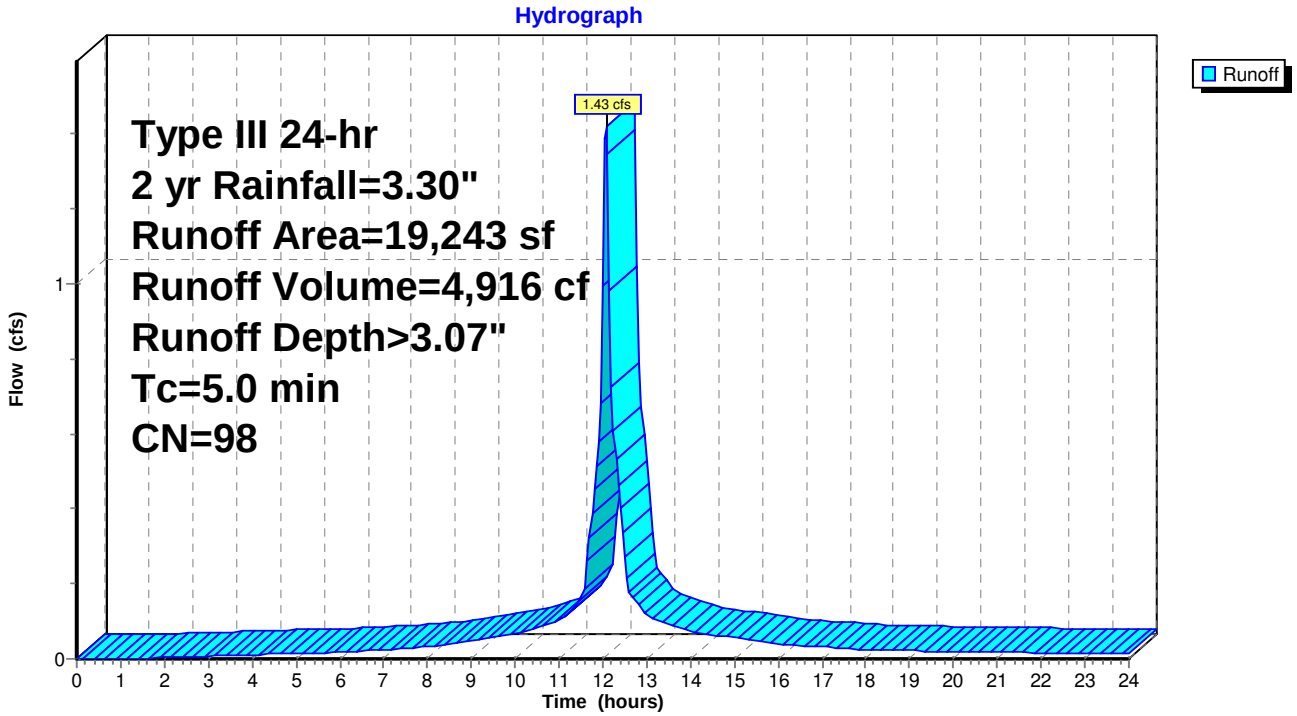
Runoff = 1.43 cfs @ 12.07 hrs, Volume= 4,916 cf, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
19,243	98	Paved roads w/curbs & sewers, HSG C
19,243		100.00% Impervious Area

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

Subcatchment 20Sd: POI 2 - OVERLAND TO BMP 3



Summary for Subcatchment 20Se: POI 2 - ROUTE 24

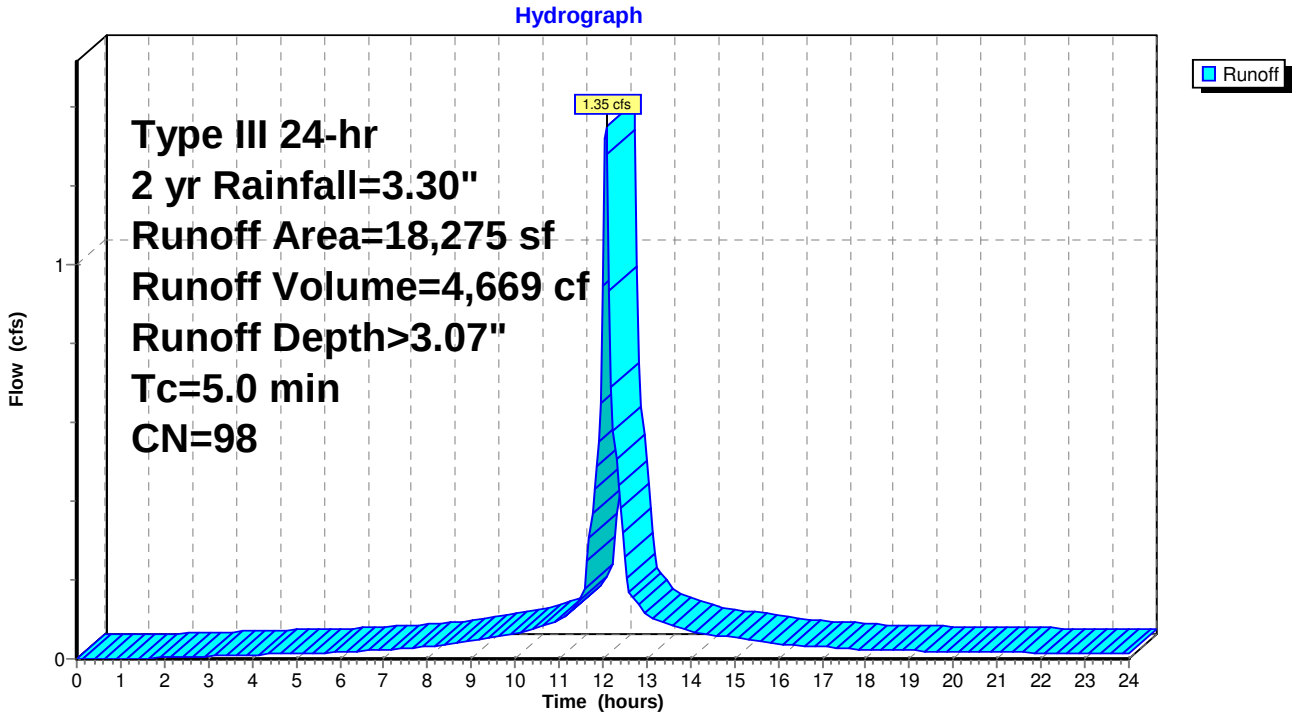
Runoff = 1.35 cfs @ 12.07 hrs, Volume= 4,669 cf, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
18,275	98	Paved roads w/curbs & sewers, HSG C
18,275		100.00% Impervious Area

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

Subcatchment 20Se: POI 2 - ROUTE 24



Summary for Subcatchment 30S: POI 3 - OVERLAND DIRECT DISCHARGE

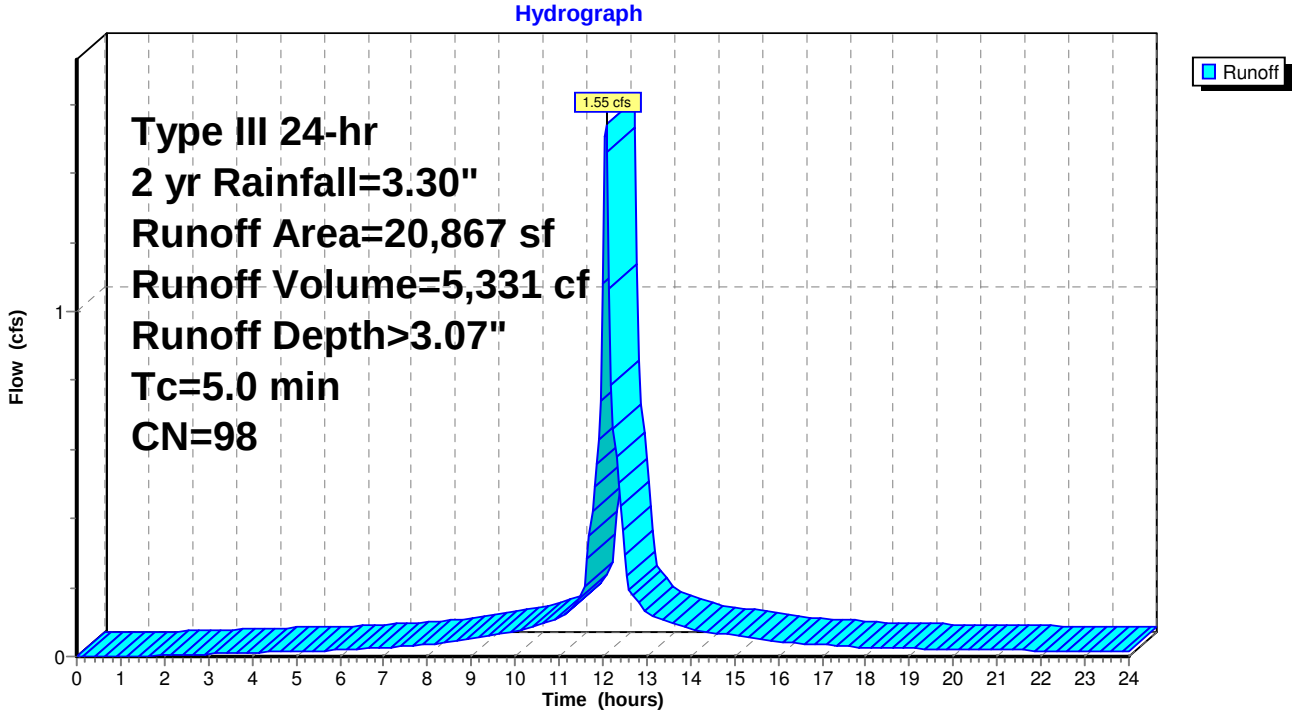
Runoff = 1.55 cfs @ 12.07 hrs, Volume= 5,331 cf, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.30"

Area (sf)	CN	Description
8,256	98	Paved roads w/curbs & sewers, HSG D
12,611	98	Paved roads w/curbs & sewers, HSG B
20,867	98	Weighted Average
20,867		100.00% Impervious Area

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

Subcatchment 30S: POI 3 - OVERLAND DIRECT DISCHARGE



Summary for Reach 20Ra1: Grassed Channel

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 2.54" for 2 yr event
Inflow = 2.84 cfs @ 12.21 hrs, Volume= 14,767 cf
Outflow = 2.67 cfs @ 12.30 hrs, Volume= 14,722 cf, Atten= 6%, Lag= 5.3 min

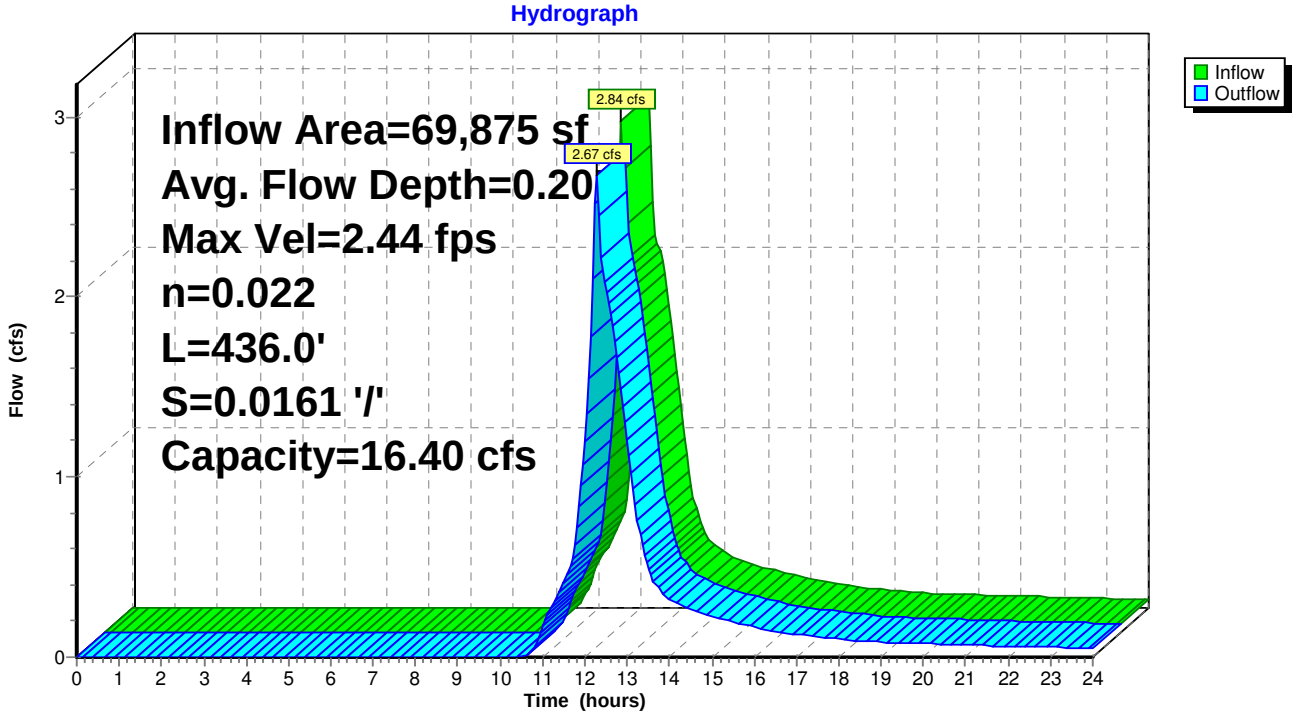
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.44 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 0.98 fps, Avg. Travel Time= 7.4 min

Peak Storage= 477 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 0.50' Flow Area= 4.0 sf, Capacity= 16.40 cfs

4.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 8.0 '/' Top Width= 12.00'
Length= 436.0' Slope= 0.0161 '/'
Inlet Invert= 36.00', Outlet Invert= 29.00'

‡

Reach 20Ra1: Grassed Channel



Summary for Reach 20Ra2: Natural Stream

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 2.53" for 2 yr event
Inflow = 2.67 cfs @ 12.30 hrs, Volume= 14,722 cf
Outflow = 2.27 cfs @ 12.56 hrs, Volume= 14,599 cf, Atten= 15%, Lag= 15.6 min

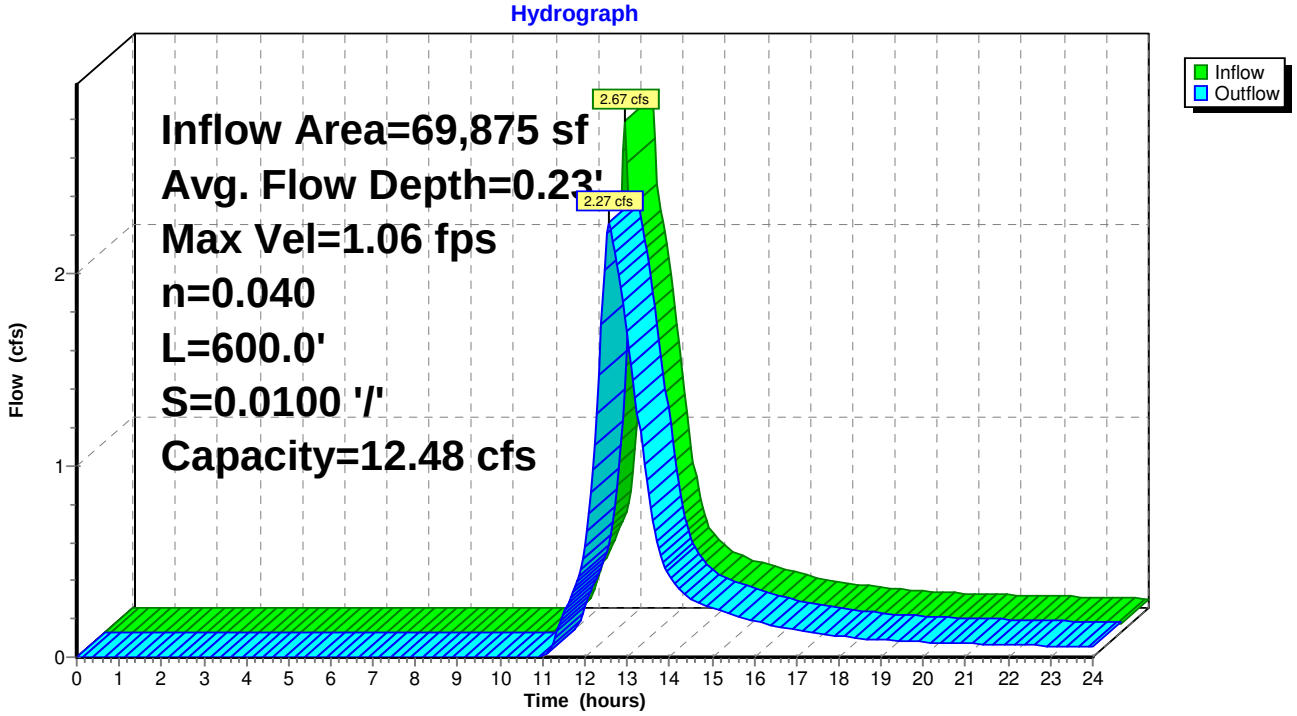
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.06 fps, Min. Travel Time= 9.4 min
Avg. Velocity = 0.49 fps, Avg. Travel Time= 20.4 min

Peak Storage= 1,285 cf @ 12.40 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 12.48 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 600.0' Slope= 0.0100 '/'
Inlet Invert= 29.00', Outlet Invert= 23.00'

‡

Reach 20Ra2: Natural Stream



Summary for Reach 20Rb: Natural Stream

Inflow Area = 19,243 sf,100.00% Impervious, Inflow Depth > 2.65" for 2 yr event
Inflow = 1.04 cfs @ 12.15 hrs, Volume= 4,244 cf
Outflow = 0.74 cfs @ 12.66 hrs, Volume= 4,161 cf, Atten= 29%, Lag= 30.6 min

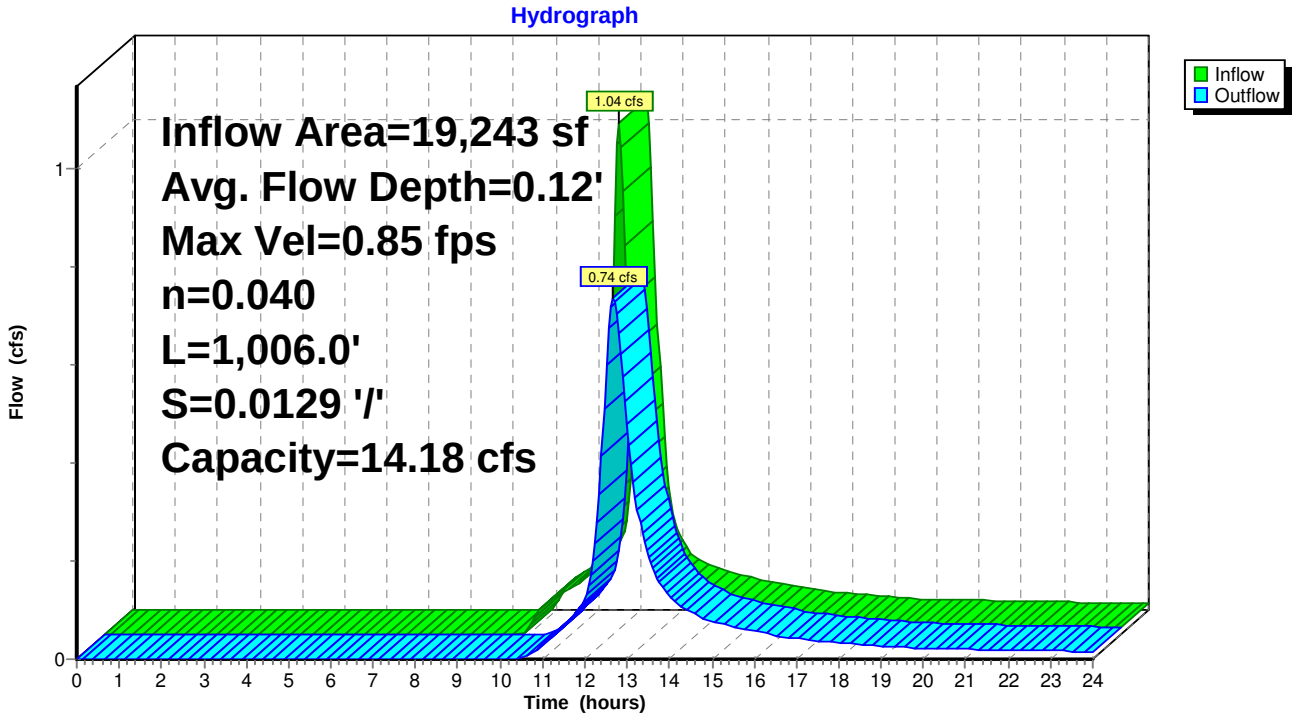
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.85 fps, Min. Travel Time= 19.8 min
Avg. Velocity = 0.35 fps, Avg. Travel Time= 48.3 min

Peak Storage= 879 cf @ 12.32 hrs
Average Depth at Peak Storage= 0.12'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 14.18 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 1,006.0' Slope= 0.0129 '/'
Inlet Invert= 36.00', Outlet Invert= 23.00'

‡

Reach 20Rb: Natural Stream



Summary for Reach 32R: Natural Stream

Inflow Area = 18,275 sf,100.00% Impervious, Inflow Depth = 0.00" for 2 yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

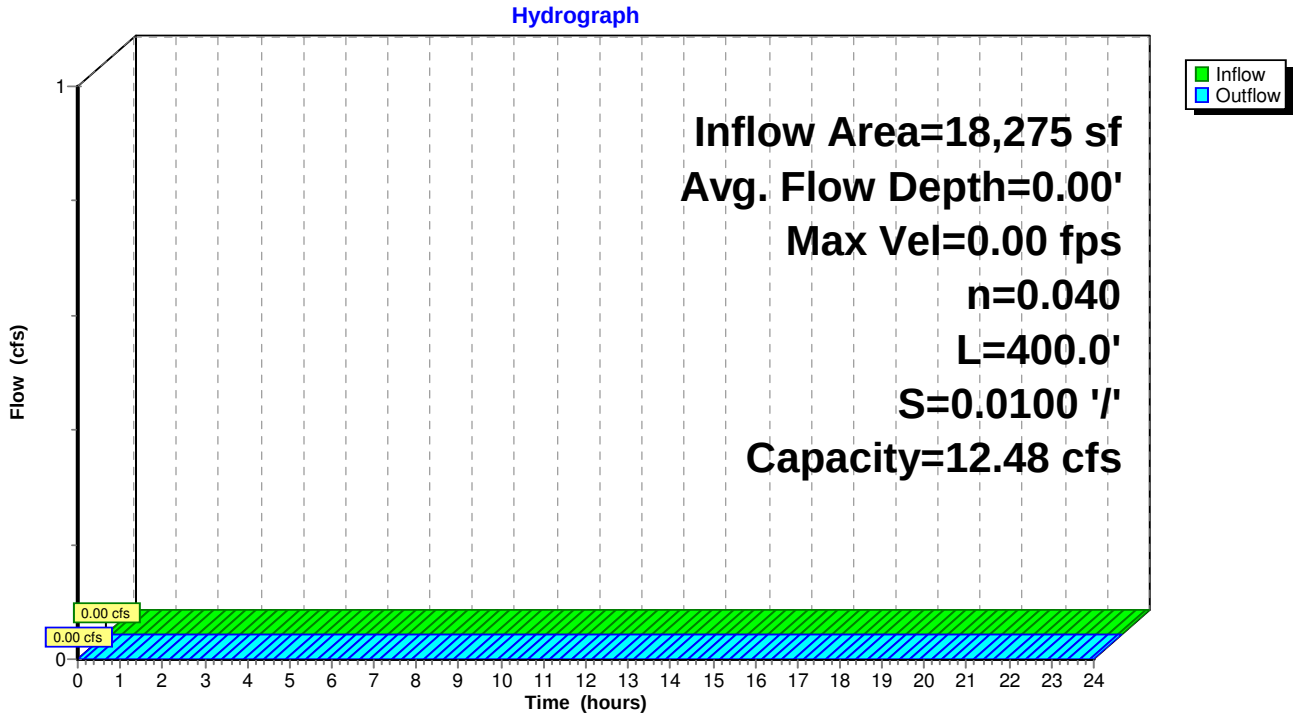
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 12.48 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 400.0' Slope= 0.0100 '/'
Inlet Invert= 27.00', Outlet Invert= 23.00'

‡

Reach 32R: Natural Stream



Summary for Pond 10P: BMP 1

Inflow Area = 32,125 sf,100.00% Impervious, Inflow Depth > 3.07" for 2 yr event
Inflow = 2.38 cfs @ 12.07 hrs, Volume= 8,207 cf
Outflow = 1.54 cfs @ 12.17 hrs, Volume= 7,452 cf, Atten= 35%, Lag= 5.7 min
Primary = 1.54 cfs @ 12.17 hrs, Volume= 7,452 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 38.51' @ 12.17 hrs Surf.Area= 947 sf Storage= 1,590 cf

Plug-Flow detention time= 89.8 min calculated for 7,437 cf (91% of inflow)
Center-of-Mass det. time= 44.3 min (798.8 - 754.5)

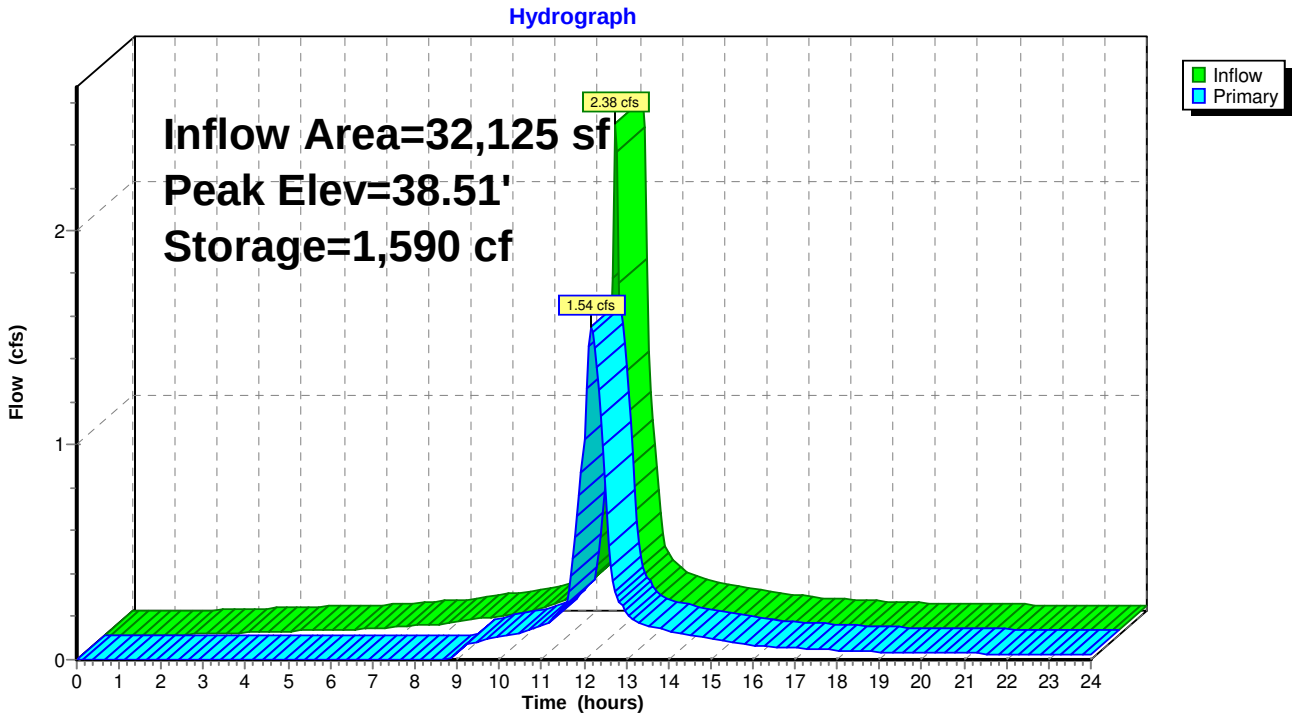
Volume	Invert	Avail.Storage	Storage Description
#1	35.00'	3,463 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
35.00	110	0	0	110
36.00	257	178	178	264
37.00	476	361	539	493
38.00	768	616	1,156	798
39.00	1,139	947	2,103	1,185
40.00	1,593	1,360	3,463	1,657

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round RCP_Round 12"** L= 172.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 35.28' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	37.33'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	39.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.53 cfs @ 12.17 hrs HW=38.50' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 1.53 cfs of 3.77 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.53 cfs @ 4.39 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 10P: BMP 1



Summary for Pond 20Pa: BMP 2

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 3.07" for 2 yr event
Inflow = 5.18 cfs @ 12.07 hrs, Volume= 17,851 cf
Outflow = 2.84 cfs @ 12.21 hrs, Volume= 14,767 cf, Atten= 45%, Lag= 8.2 min
Primary = 2.84 cfs @ 12.21 hrs, Volume= 14,767 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 38.92' @ 12.21 hrs Surf.Area= 2,018 sf Storage= 6,173 cf

Plug-Flow detention time= 140.9 min calculated for 14,736 cf (83% of inflow)
Center-of-Mass det. time= 72.2 min (826.7 - 754.5)

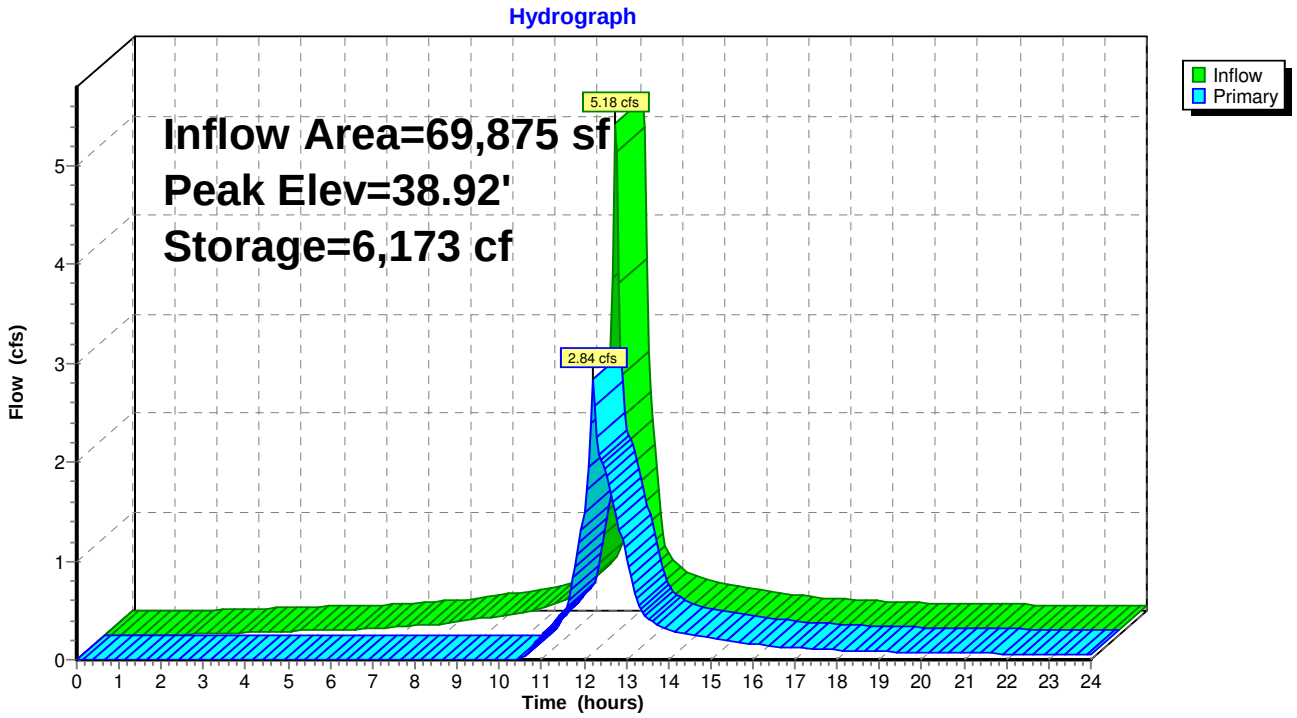
Volume	Invert	Avail.Storage	Storage Description
#1	34.00'	8,560 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
34.00	612	0	0	612
35.00	837	722	722	856
36.00	1,094	963	1,684	1,136
37.00	1,384	1,236	2,920	1,451
38.00	1,703	1,541	4,461	1,799
39.00	2,046	1,872	6,333	2,175
40.00	2,414	2,227	8,560	2,579

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round RCP_Round 12"** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	37.00'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	38.83'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	39.50'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.79 cfs @ 12.21 hrs HW=38.92' (Free Discharge)
- **1=RCP_Round 12"** (Passes 2.79 cfs of 4.45 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 2.12 cfs @ 6.06 fps)
  - **3=Orifice/Grate** (Weir Controls 0.68 cfs @ 0.97 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 20Pa: BMP 2



Summary for Pond 20Pb: BMP 3

Inflow Area = 19,243 sf,100.00% Impervious, Inflow Depth > 3.07" for 2 yr event
Inflow = 1.43 cfs @ 12.07 hrs, Volume= 4,916 cf
Outflow = 1.04 cfs @ 12.15 hrs, Volume= 4,244 cf, Atten= 27%, Lag= 4.7 min
Primary = 1.04 cfs @ 12.15 hrs, Volume= 4,244 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 39.72' @ 12.15 hrs Surf.Area= 843 sf Storage= 1,150 cf

Plug-Flow detention time= 116.7 min calculated for 4,235 cf (86% of inflow)
Center-of-Mass det. time= 57.2 min (811.7 - 754.5)

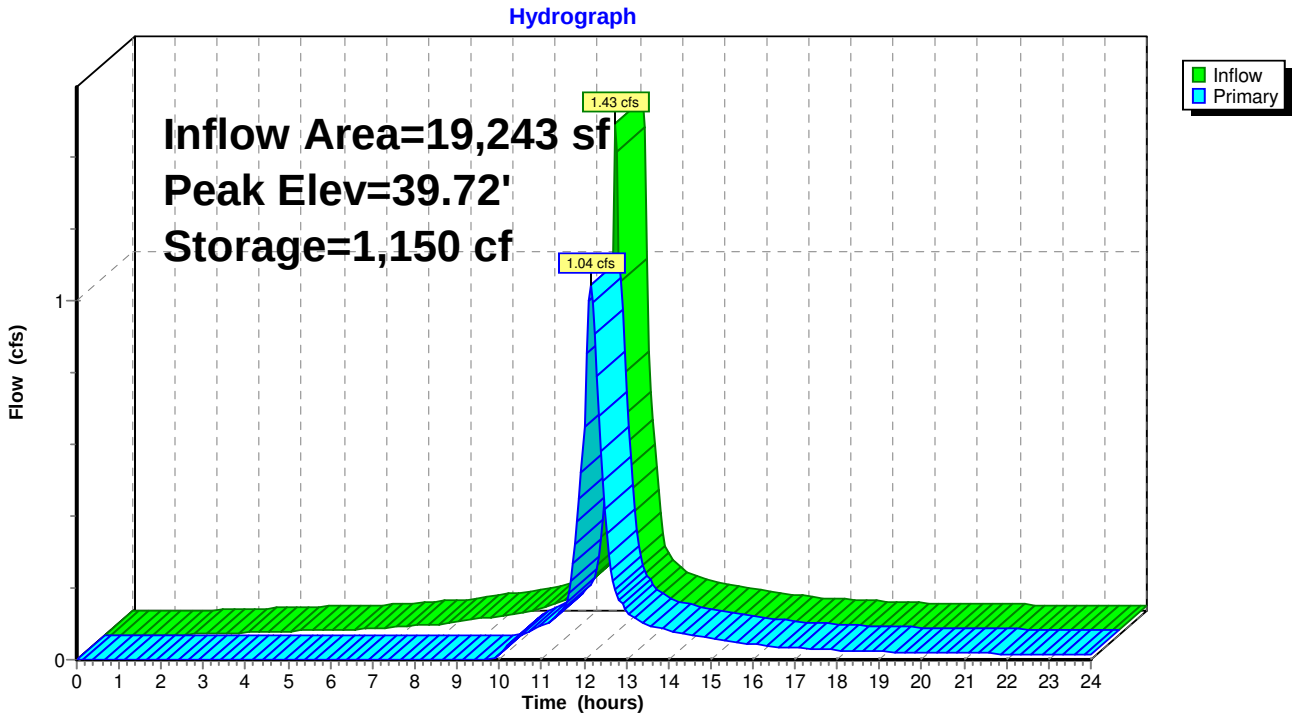
Volume	Invert	Avail.Storage	Storage Description
#1	37.00'	2,560 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
37.00	111	0	0	111
38.00	303	199	199	309
39.00	590	439	638	606
40.00	954	765	1,402	983
41.00	1,373	1,157	2,560	1,419

Device	Routing	Invert	Outlet Devices
#1	Primary	39.00'	**12.0" Round RCP_Round 12"** L= 81.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.00' / 38.00' S= 0.0122 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	39.00'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	40.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.04 cfs @ 12.15 hrs HW=39.72' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 1.04 cfs of 1.74 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.04 cfs @ 2.98 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 20Pb: BMP 3



Summary for Pond 31P: BMP 4

Inflow Area = 18,275 sf,100.00% Impervious, Inflow Depth > 3.07" for 2 yr event
Inflow = 1.35 cfs @ 12.07 hrs, Volume= 4,669 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 57.18' @ 24.00 hrs Surf.Area= 2,342 sf Storage= 4,667 cf

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

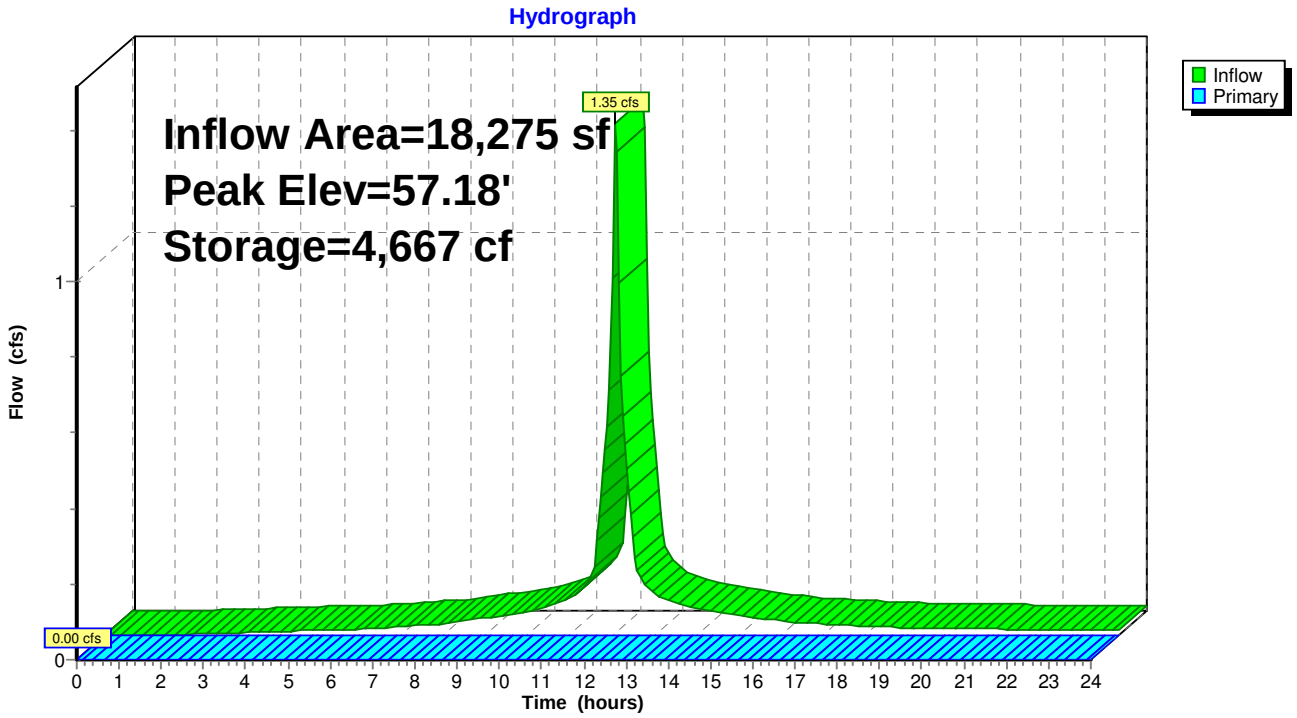
Volume	Invert	Avail.Storage	Storage Description
#1	54.00'	10,022 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
54.00	729	0	0	729
55.00	1,147	930	930	1,161
56.00	1,658	1,395	2,325	1,689
57.00	2,236	1,940	4,265	2,287
58.00	2,871	2,547	6,812	2,947
59.00	3,563	3,211	10,022	3,667

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**10.0" Round Culvert** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 55.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.55 sf
#2	Device 1	57.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	58.50'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=54.00' (Free Discharge)
- **1=Culvert** (Controls 0.00 cfs)
  - **2=Orifice/Grate** (Controls 0.00 cfs)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 31P: BMP 4



Summary for Pond 32P: BMP 5A

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 3.07" for 2 yr event
Inflow = 1.55 cfs @ 12.07 hrs, Volume= 5,331 cf
Outflow = 0.10 cfs @ 13.58 hrs, Volume= 1,429 cf, Atten= 94%, Lag= 90.4 min
Primary = 0.10 cfs @ 13.58 hrs, Volume= 1,429 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 101.52' @ 13.58 hrs Surf.Area= 4,048 sf Storage= 3,957 cf

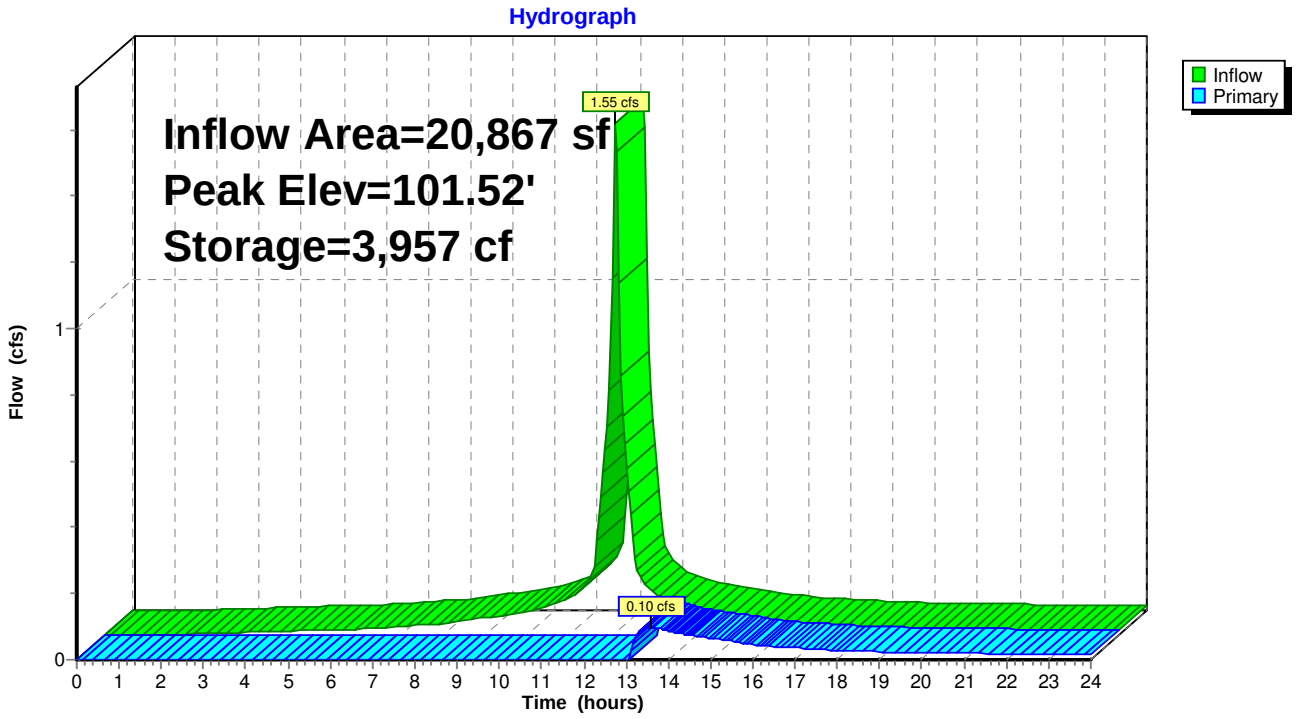
Plug-Flow detention time= 448.6 min calculated for 1,426 cf (27% of inflow)
Center-of-Mass det. time= 249.3 min (1,003.8 - 754.5)

Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	12,132 cf	**4.00'W x 300.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	101.50'	**13.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.07 cfs @ 13.58 hrs HW=101.52' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.07 cfs @ 0.34 fps)

Pond 32P: BMP 5A



Summary for Pond 33P: BMP 5B

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 0.82" for 2 yr event
Inflow = 0.10 cfs @ 13.58 hrs, Volume= 1,429 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 98.75' @ 24.00 hrs Surf.Area= 2,595 sf Storage= 1,428 cf

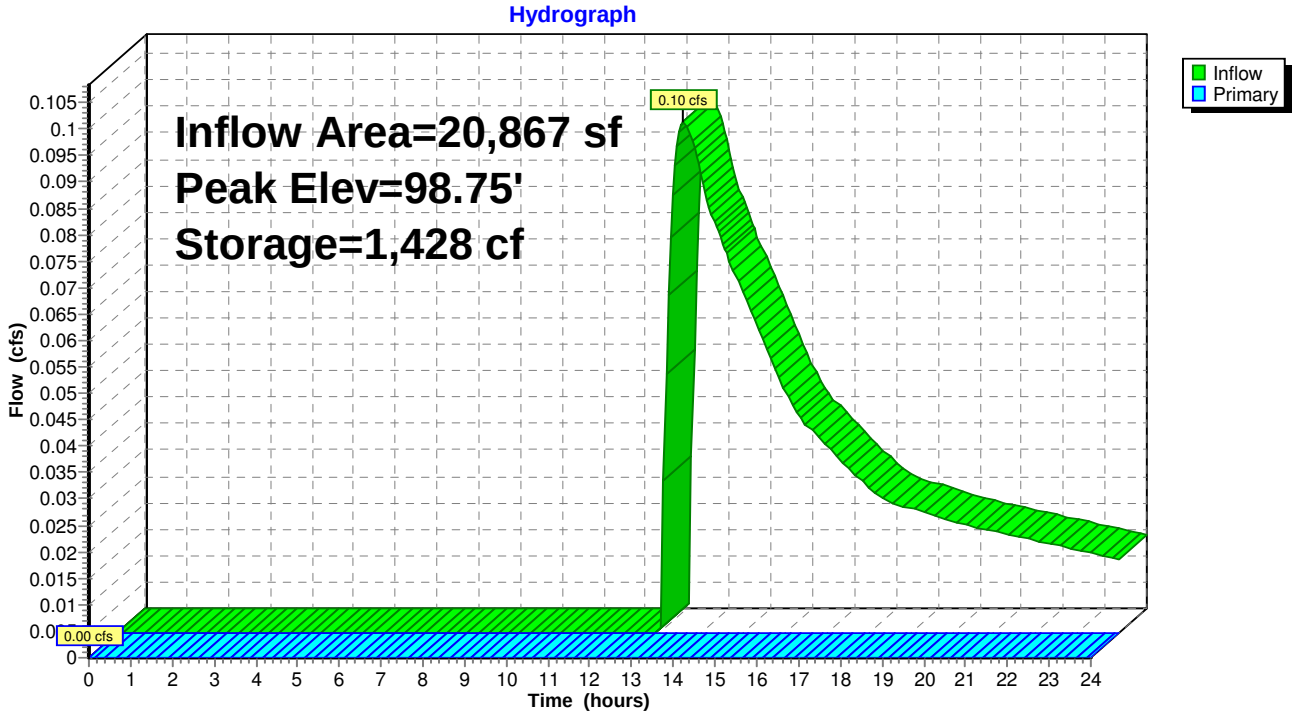
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	98.00'	12,132 cf	**4.00'W x 300.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	99.50'	**13.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=98.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 33P: BMP 5B

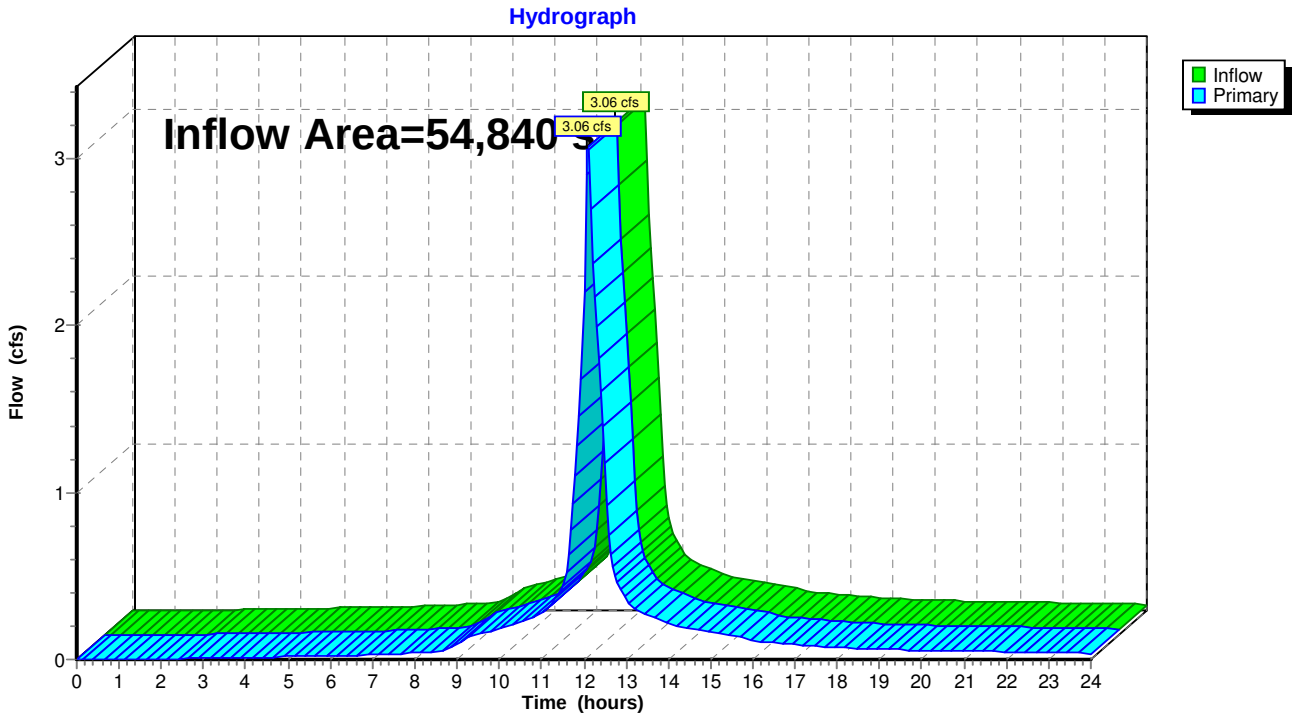


Summary for Link 10L: POI 1

Inflow Area = 54,840 sf,100.00% Impervious, Inflow Depth > 2.90" for 2 yr event
Inflow = 3.06 cfs @ 12.09 hrs, Volume= 13,255 cf
Primary = 3.06 cfs @ 12.09 hrs, Volume= 13,255 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 10L: POI 1

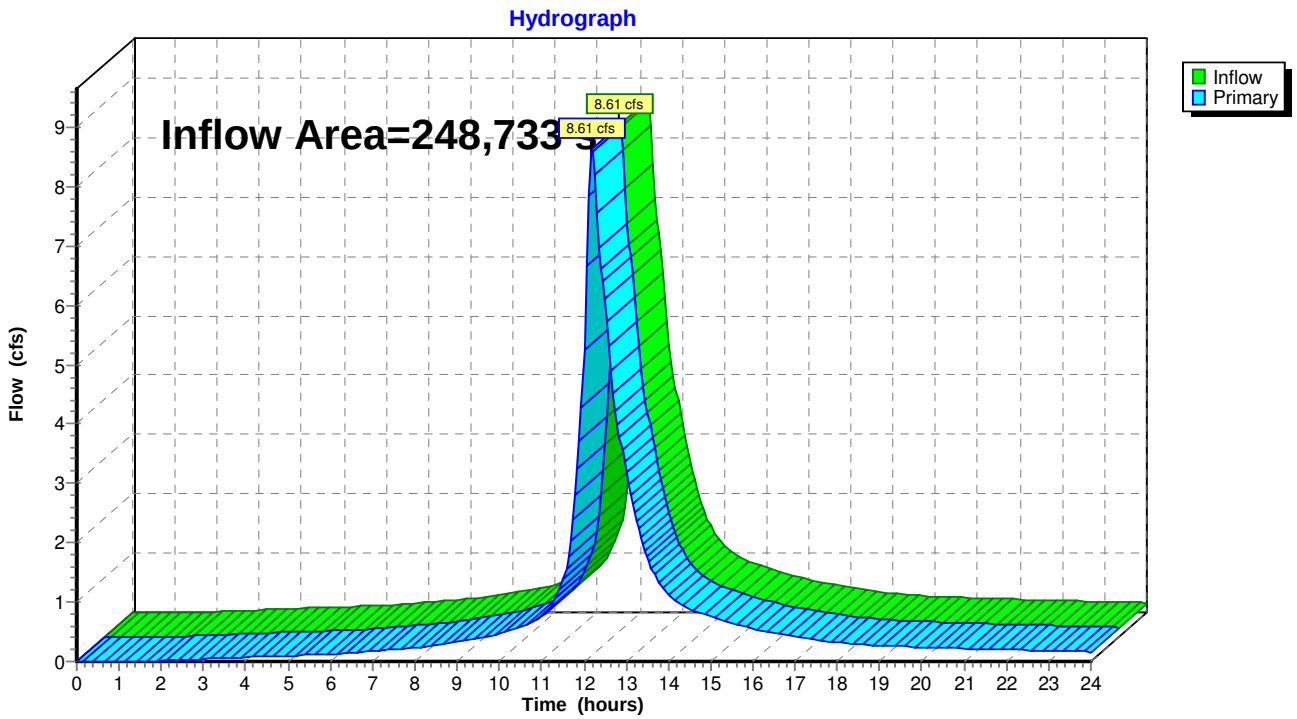


Summary for Link 20L: POI 2

Inflow Area = 248,733 sf, 99.21% Impervious, Inflow Depth > 2.65" for 2 yr event
Inflow = 8.61 cfs @ 12.19 hrs, Volume= 54,827 cf
Primary = 8.61 cfs @ 12.19 hrs, Volume= 54,827 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 20L: POI 2

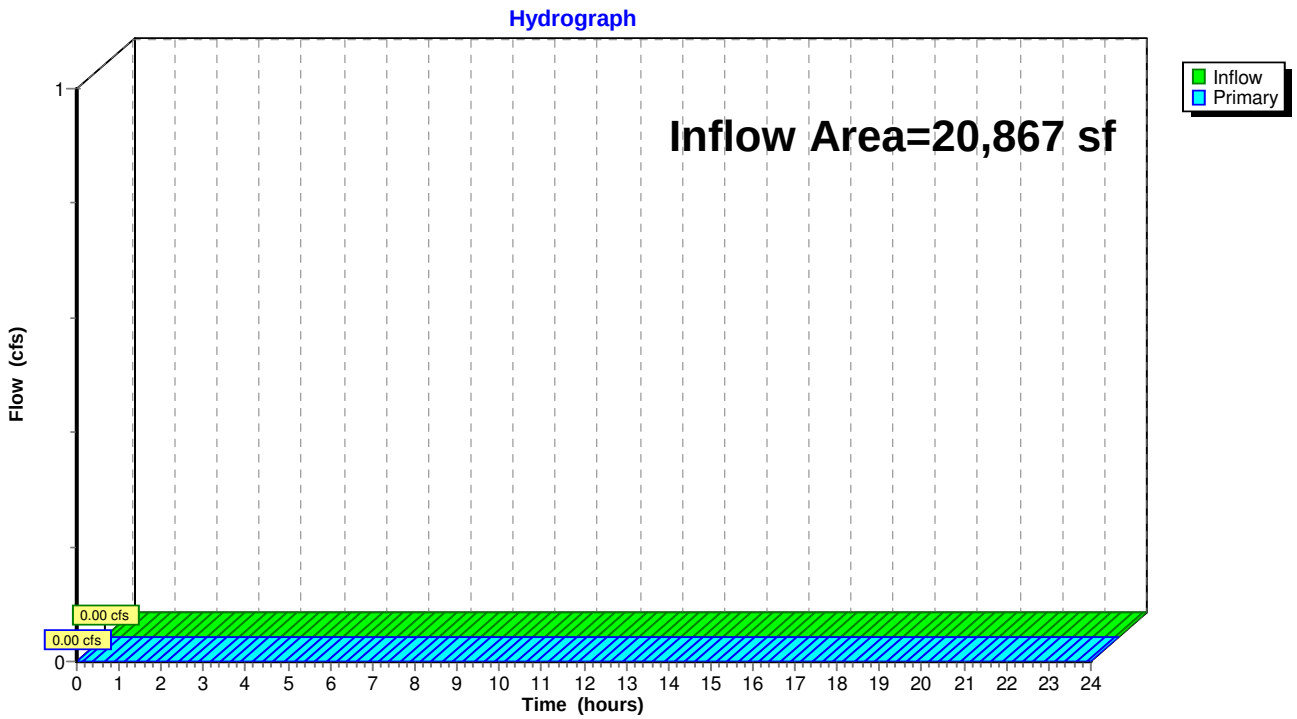


Summary for Link 30L: POI 3

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth = 0.00" for 2 yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 30L: POI 3



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10Sa: POI 1 - OVERLAND Runoff Area=22,715 sf 100.00% Impervious Runoff Depth>4.46"
Tc=5.0 min CN=98 Runoff=2.41 cfs 8,445 cf

Subcatchment 10Sb: POI 1 - OVERLAND Runoff Area=32,125 sf 100.00% Impervious Runoff Depth>4.46"
Tc=5.0 min CN=98 Runoff=3.41 cfs 11,944 cf

Subcatchment 20Sa: POI 2 - OVERLAND Runoff Area=69,875 sf 100.00% Impervious Runoff Depth>4.46"
Tc=5.0 min CN=98 Runoff=7.42 cfs 25,979 cf

Subcatchment 20Sb: POI 3 - SLIP RAMP Runoff Area=27,151 sf 100.00% Impervious Runoff Depth>4.46"
Tc=5.0 min CN=98 Runoff=2.88 cfs 10,095 cf

Subcatchment 20Sc: POI 2 - OVERLAND Runoff Area=114,189 sf 98.28% Impervious Runoff Depth>4.46"
Flow Length=957' Slope=0.0094 '/' Tc=14.9 min CN=98 Runoff=9.17 cfs 42,396 cf

Subcatchment 20Sd: POI 2 - OVERLAND Runoff Area=19,243 sf 100.00% Impervious Runoff Depth>4.46"
Tc=5.0 min CN=98 Runoff=2.04 cfs 7,154 cf

Subcatchment 20Se: POI 2 - ROUTE 24 Runoff Area=18,275 sf 100.00% Impervious Runoff Depth>4.46"
Tc=5.0 min CN=98 Runoff=1.94 cfs 6,795 cf

Subcatchment 30S: POI 3 - OVERLAND Runoff Area=20,867 sf 100.00% Impervious Runoff Depth>4.46"
Tc=5.0 min CN=98 Runoff=2.22 cfs 7,758 cf

Reach 20Ra1: Grassed Channel Avg. Flow Depth=0.27' Max Vel=2.94 fps Inflow=5.02 cfs 22,865 cf
n=0.022 L=436.0' S=0.0161 '/' Capacity=16.40 cfs Outflow=4.96 cfs 22,811 cf

Reach 20Ra2: Natural Stream Avg. Flow Depth=0.31' Max Vel=1.26 fps Inflow=4.96 cfs 22,811 cf
n=0.040 L=600.0' S=0.0100 '/' Capacity=12.48 cfs Outflow=4.30 cfs 22,658 cf

Reach 20Rb: Natural Stream Avg. Flow Depth=0.14' Max Vel=0.94 fps Inflow=1.37 cfs 6,474 cf
n=0.040 L=1,006.0' S=0.0129 '/' Capacity=14.18 cfs Outflow=1.06 cfs 6,371 cf

Reach 32R: Natural Stream Avg. Flow Depth=0.04' Max Vel=0.38 fps Inflow=0.09 cfs 1,328 cf
n=0.040 L=400.0' S=0.0100 '/' Capacity=12.48 cfs Outflow=0.08 cfs 1,277 cf

Pond 10P: BMP 1 Peak Elev=39.01' Storage=2,114 cf Inflow=3.41 cfs 11,944 cf
Outflow=1.98 cfs 11,181 cf

Pond 20Pa: BMP 2 Peak Elev=39.30' Storage=6,968 cf Inflow=7.42 cfs 25,979 cf
Outflow=5.02 cfs 22,865 cf

Pond 20Pb: BMP 3 Peak Elev=39.99' Storage=1,397 cf Inflow=2.04 cfs 7,154 cf
Outflow=1.37 cfs 6,474 cf

Pond 31P: BMP 4 Peak Elev=57.51' Storage=5,496 cf Inflow=1.94 cfs 6,795 cf
Outflow=0.09 cfs 1,328 cf

Pond 32P: BMP 5A Peak Elev=101.59' Storage=4,270 cf Inflow=2.22 cfs 7,758 cf
Outflow=0.98 cfs 3,853 cf

Pond 33P: BMP 5B Peak Elev=99.49' Storage=3,851 cf Inflow=0.98 cfs 3,853 cf
Outflow=0.00 cfs 0 cf

Link 10L: POI 1 Inflow=4.13 cfs 19,626 cf
Primary=4.13 cfs 19,626 cf

Link 20L: POI 2 Inflow=12.46 cfs 82,796 cf
Primary=12.46 cfs 82,796 cf

Link 30L: POI 3 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 324,440 sf Runoff Volume = 120,567 cf Average Runoff Depth = 4.46"
0.61% Pervious = 1,968 sf 99.39% Impervious = 322,472 sf

Summary for Subcatchment 10Sa: POI 1 - OVERLAND DIRECT DISCHARGE

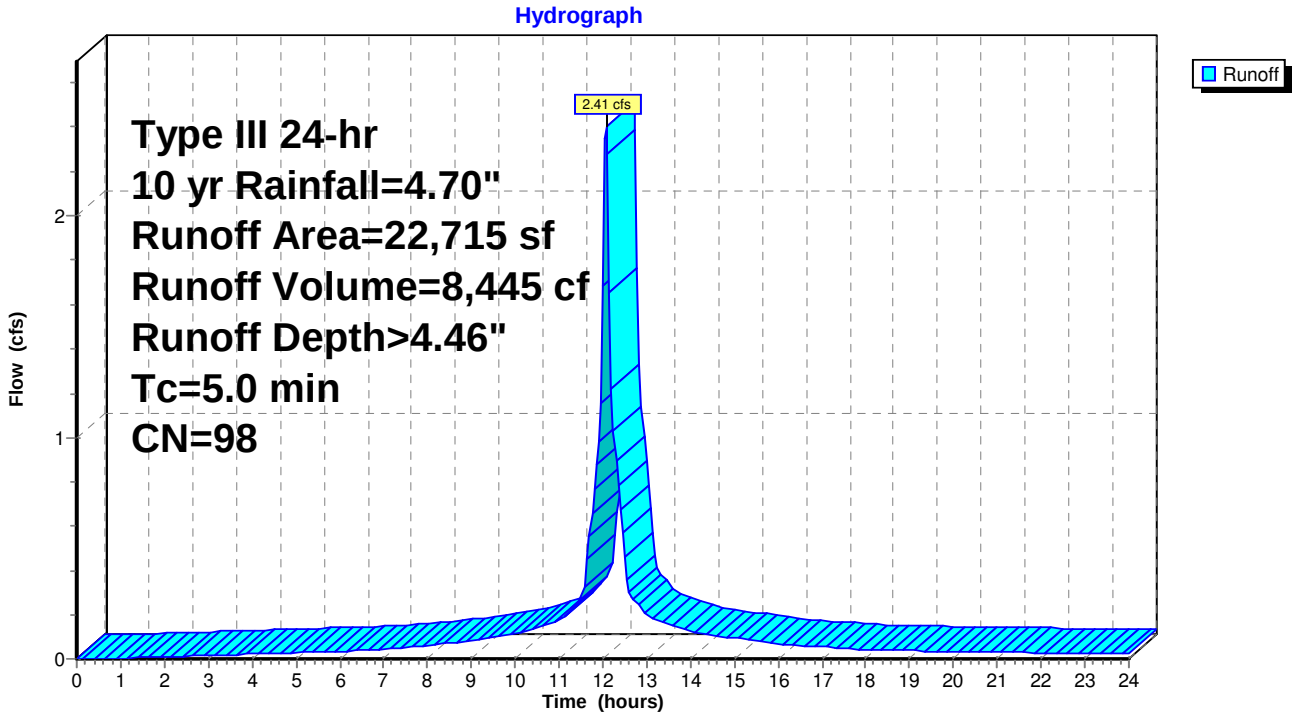
Runoff = 2.41 cfs @ 12.07 hrs, Volume= 8,445 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
22,715	98	Paved roads w/curbs & sewers, HSG C
22,715		100.00% Impervious Area

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

Subcatchment 10Sa: POI 1 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 10Sb: POI 1 - OVERLAND TO BMP 1

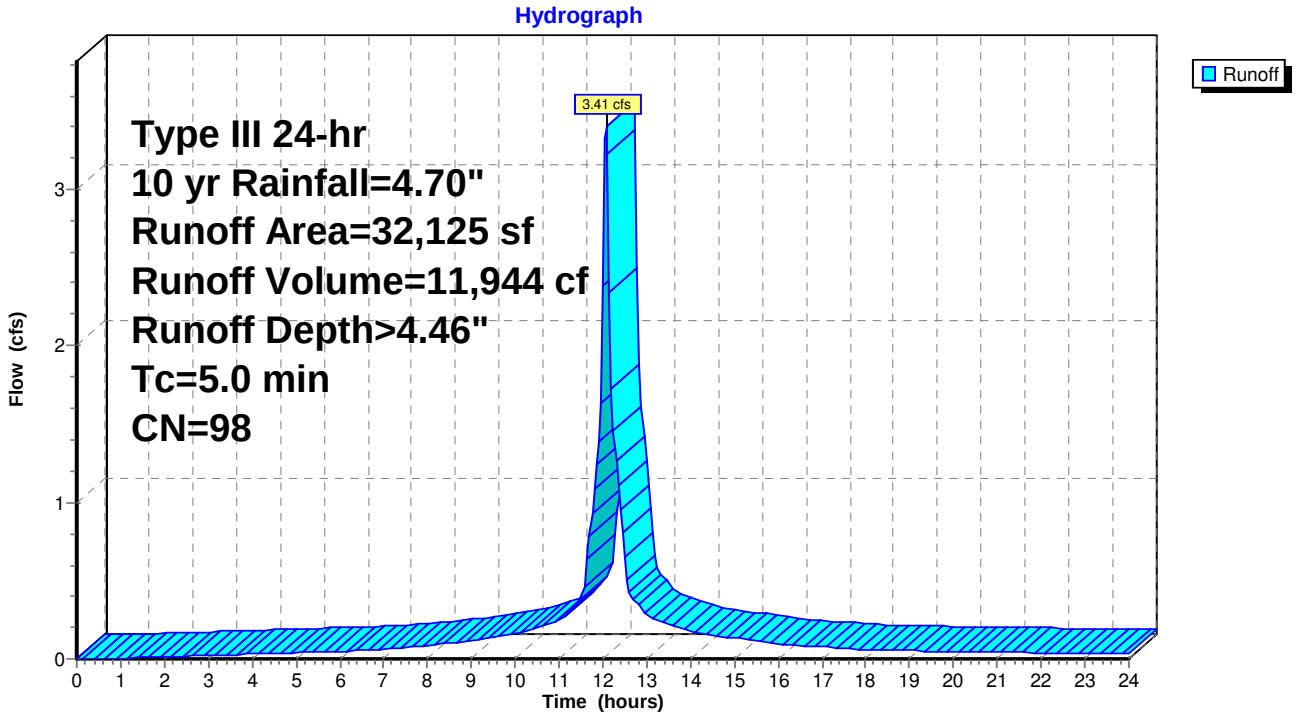
Runoff = 3.41 cfs @ 12.07 hrs, Volume= 11,944 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
32,125	98	Paved roads w/curbs & sewers, HSG C
32,125		100.00% Impervious Area

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

Subcatchment 10Sb: POI 1 - OVERLAND TO BMP 1



Summary for Subcatchment 20Sa: POI 2 - OVERLAND TO BMP 2

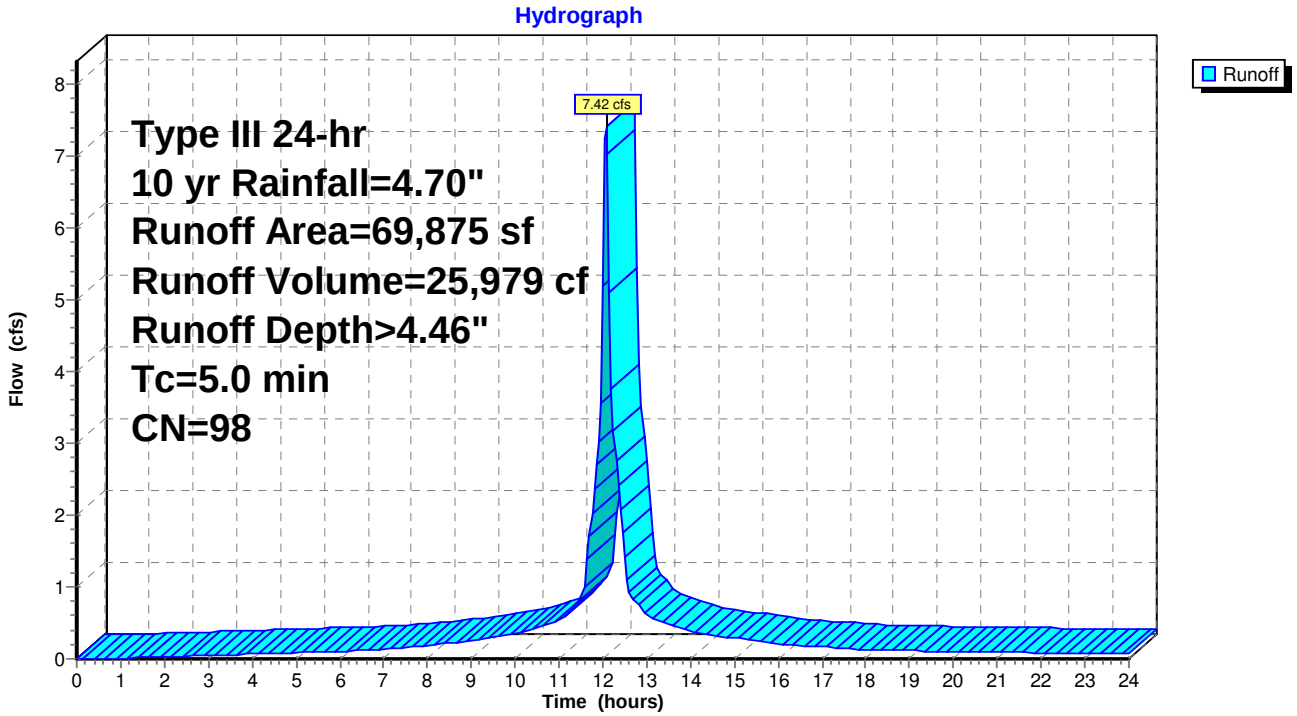
Runoff = 7.42 cfs @ 12.07 hrs, Volume= 25,979 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
69,875	98	Paved roads w/curbs & sewers, HSG C
69,875		100.00% Impervious Area

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

Subcatchment 20Sa: POI 2 - OVERLAND TO BMP 2



Summary for Subcatchment 20Sb: POI 3 - SLIP RAMP POST DEVELOPMENT

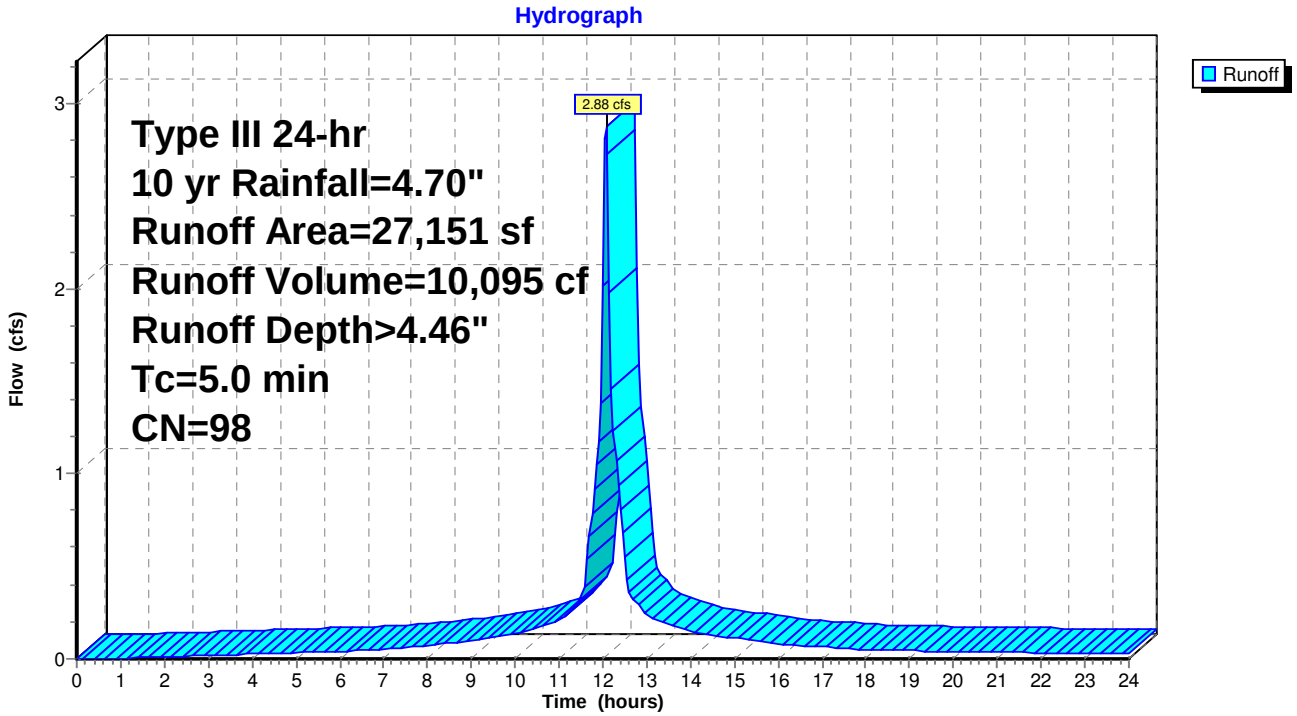
Runoff = 2.88 cfs @ 12.07 hrs, Volume= 10,095 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
27,151	98	Paved roads w/curbs & sewers, HSG D
27,151		100.00% Impervious Area

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

Subcatchment 20Sb: POI 3 - SLIP RAMP POST DEVELOPMENT



Summary for Subcatchment 20Sc: POI 2 - OVERLAND DIRECT DISCHARGE

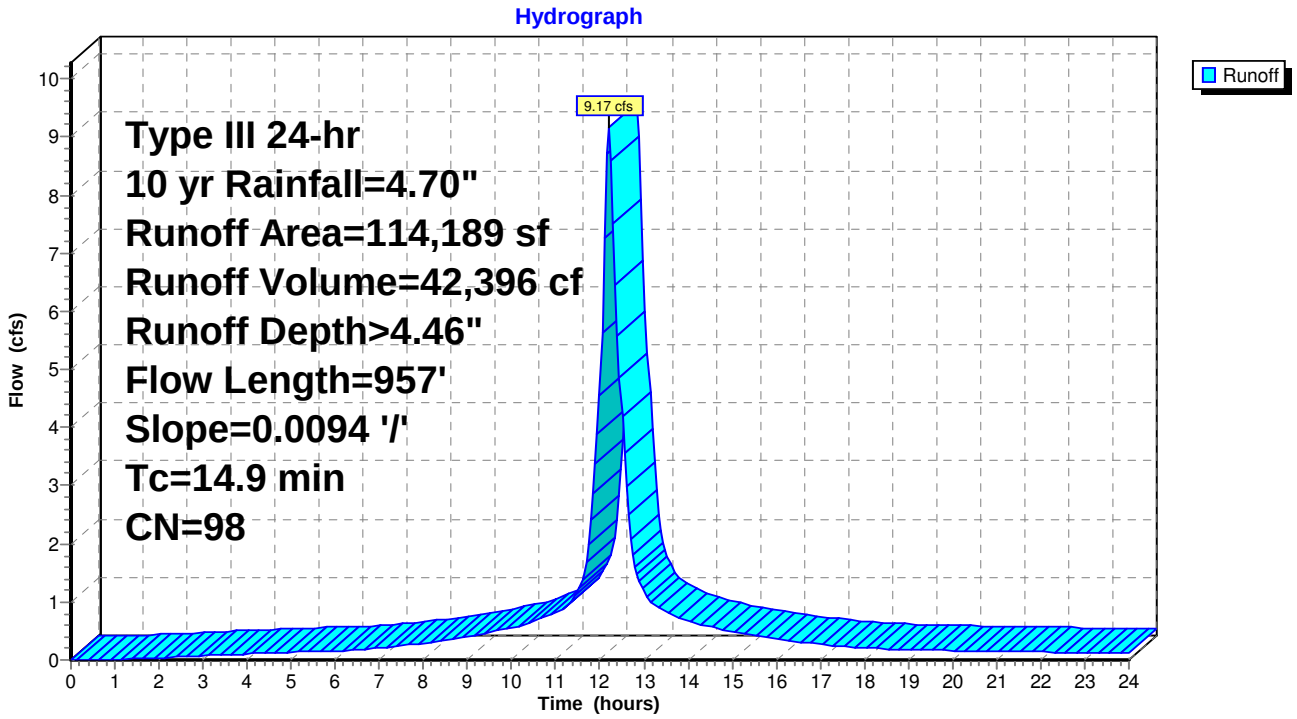
Runoff = 9.17 cfs @ 12.20 hrs, Volume= 42,396 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
103,199	98	Paved roads w/curbs & sewers, HSG C
1,968	79	50-75% Grass cover, Fair, HSG C
7,934	98	Paved roads w/curbs & sewers, HSG D
1,088	98	Paved roads w/curbs & sewers, HSG B
114,189	98	Weighted Average
1,968		1.72% Pervious Area
112,221		98.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
9.9	957	0.0094	1.61	12.11	**Channel Flow, Natural Stream** Area= 7.5 sf Perim= 25.0' r= 0.30' n= 0.040 Winding stream
14.9	957	Total			

Subcatchment 20Sc: POI 2 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 20Sd: POI 2 - OVERLAND TO BMP 3

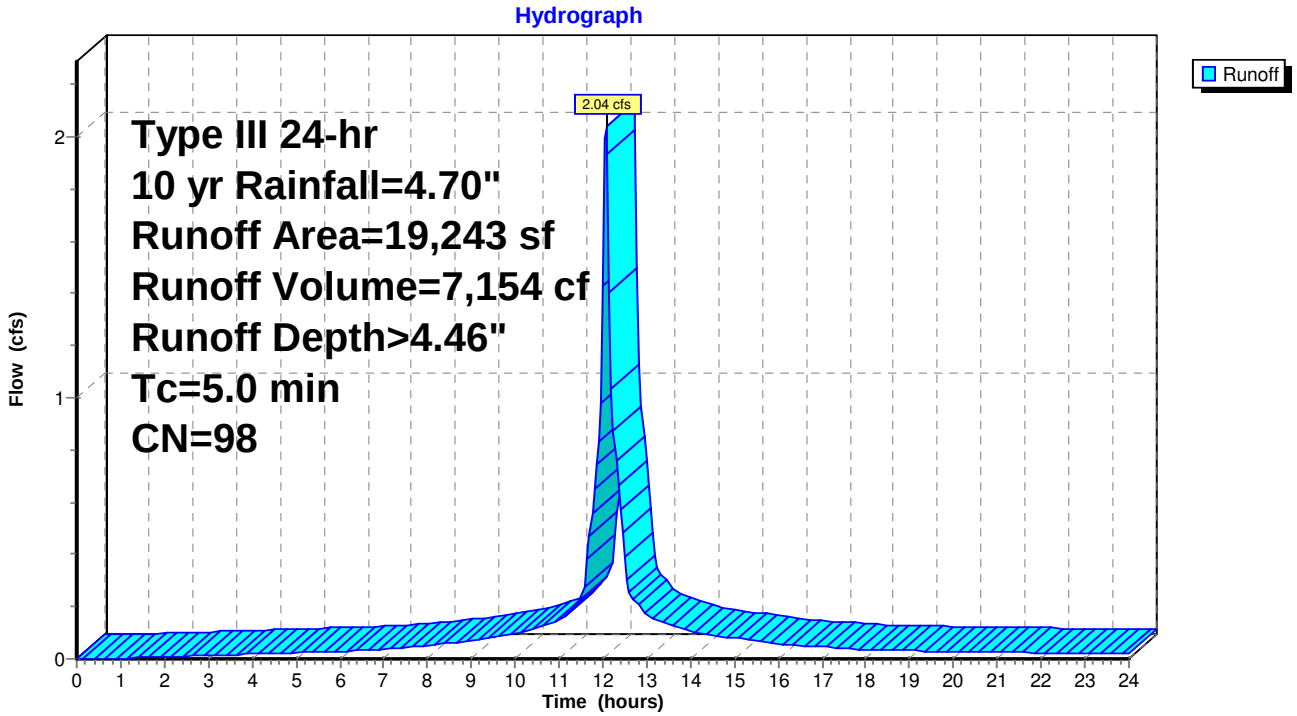
Runoff = 2.04 cfs @ 12.07 hrs, Volume= 7,154 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
19,243	98	Paved roads w/curbs & sewers, HSG C
19,243		100.00% Impervious Area

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

Subcatchment 20Sd: POI 2 - OVERLAND TO BMP 3



Summary for Subcatchment 20Se: POI 2 - ROUTE 24

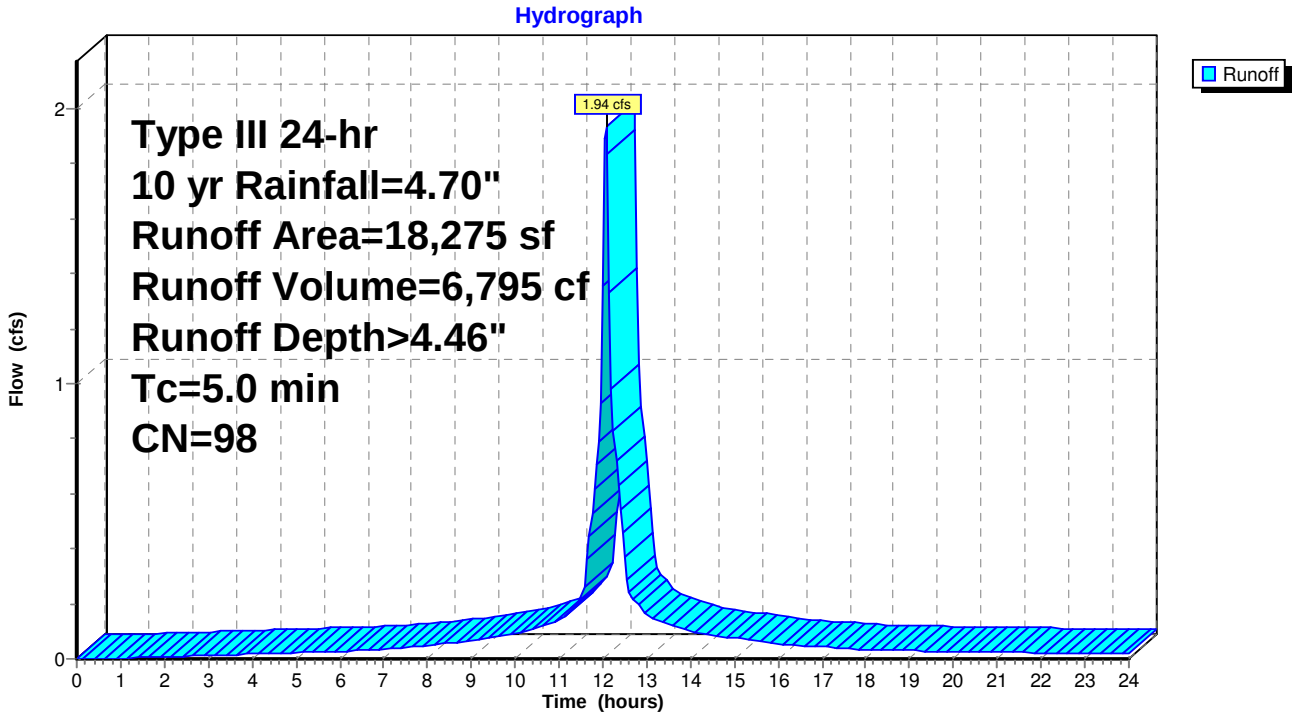
Runoff = 1.94 cfs @ 12.07 hrs, Volume= 6,795 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
18,275	98	Paved roads w/curbs & sewers, HSG C
18,275		100.00% Impervious Area

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

Subcatchment 20Se: POI 2 - ROUTE 24



Summary for Subcatchment 30S: POI 3 - OVERLAND DIRECT DISCHARGE

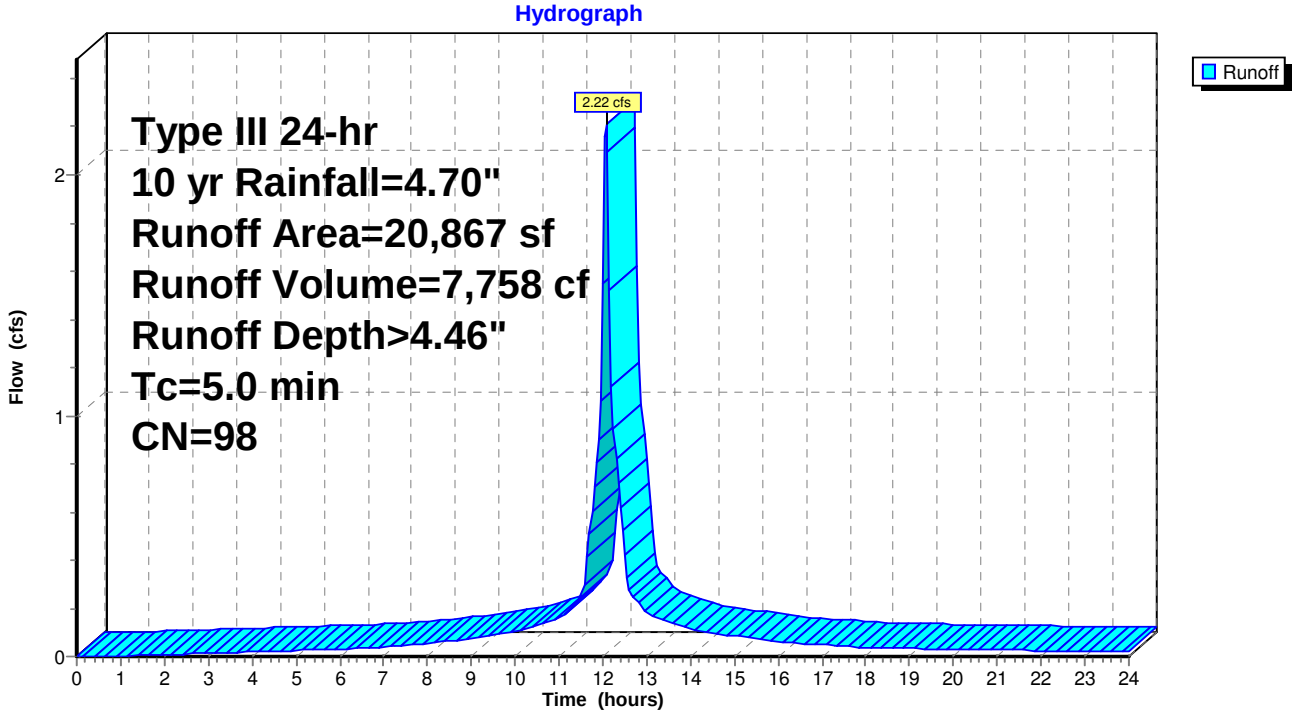
Runoff = 2.22 cfs @ 12.07 hrs, Volume= 7,758 cf, Depth> 4.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.70"

Area (sf)	CN	Description
8,256	98	Paved roads w/curbs & sewers, HSG D
12,611	98	Paved roads w/curbs & sewers, HSG B
20,867	98	Weighted Average
20,867		100.00% Impervious Area

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

Subcatchment 30S: POI 3 - OVERLAND DIRECT DISCHARGE



Summary for Reach 20Ra1: Grassed Channel

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 3.93" for 10 yr event
Inflow = 5.02 cfs @ 12.16 hrs, Volume= 22,865 cf
Outflow = 4.96 cfs @ 12.25 hrs, Volume= 22,811 cf, Atten= 1%, Lag= 5.2 min

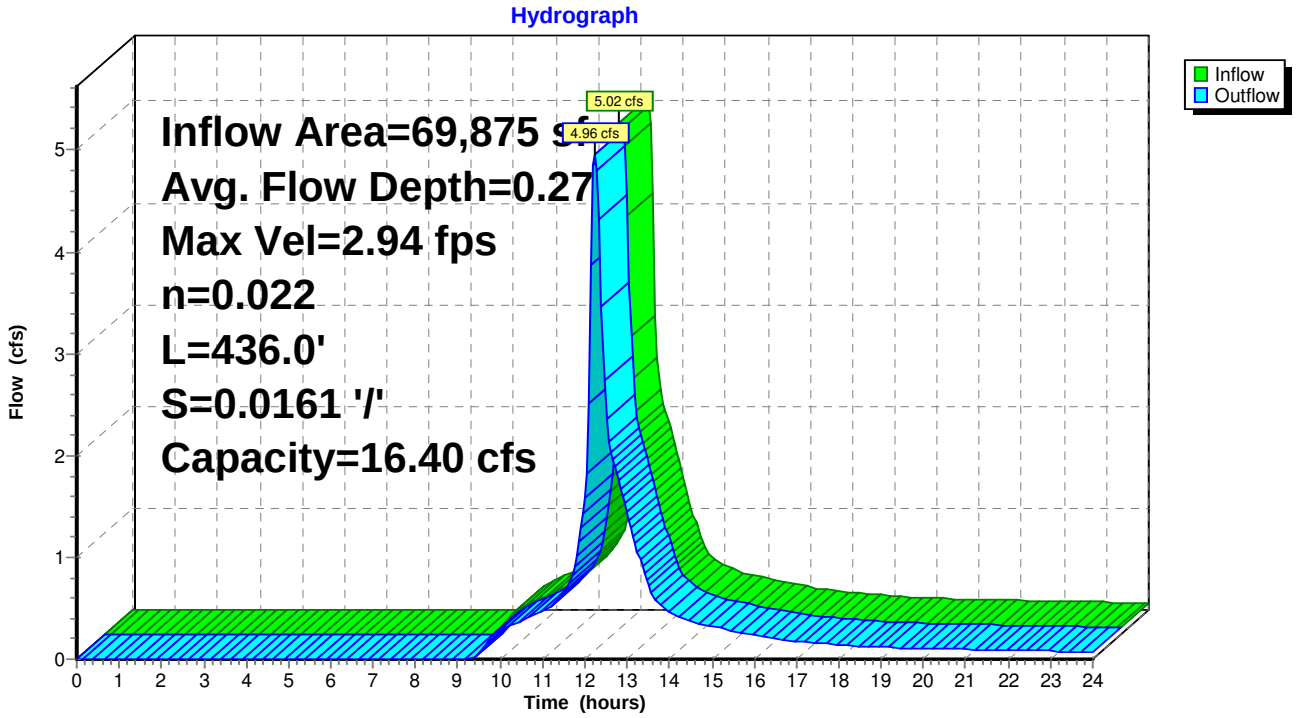
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.94 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 1.12 fps, Avg. Travel Time= 6.5 min

Peak Storage= 738 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 0.50' Flow Area= 4.0 sf, Capacity= 16.40 cfs

4.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 8.0 '/' Top Width= 12.00'
Length= 436.0' Slope= 0.0161 '/'
Inlet Invert= 36.00', Outlet Invert= 29.00'

‡

Reach 20Ra1: Grassed Channel



Summary for Reach 20Ra2: Natural Stream

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 3.92" for 10 yr event
Inflow = 4.96 cfs @ 12.25 hrs, Volume= 22,811 cf
Outflow = 4.30 cfs @ 12.48 hrs, Volume= 22,658 cf, Atten= 13%, Lag= 14.1 min

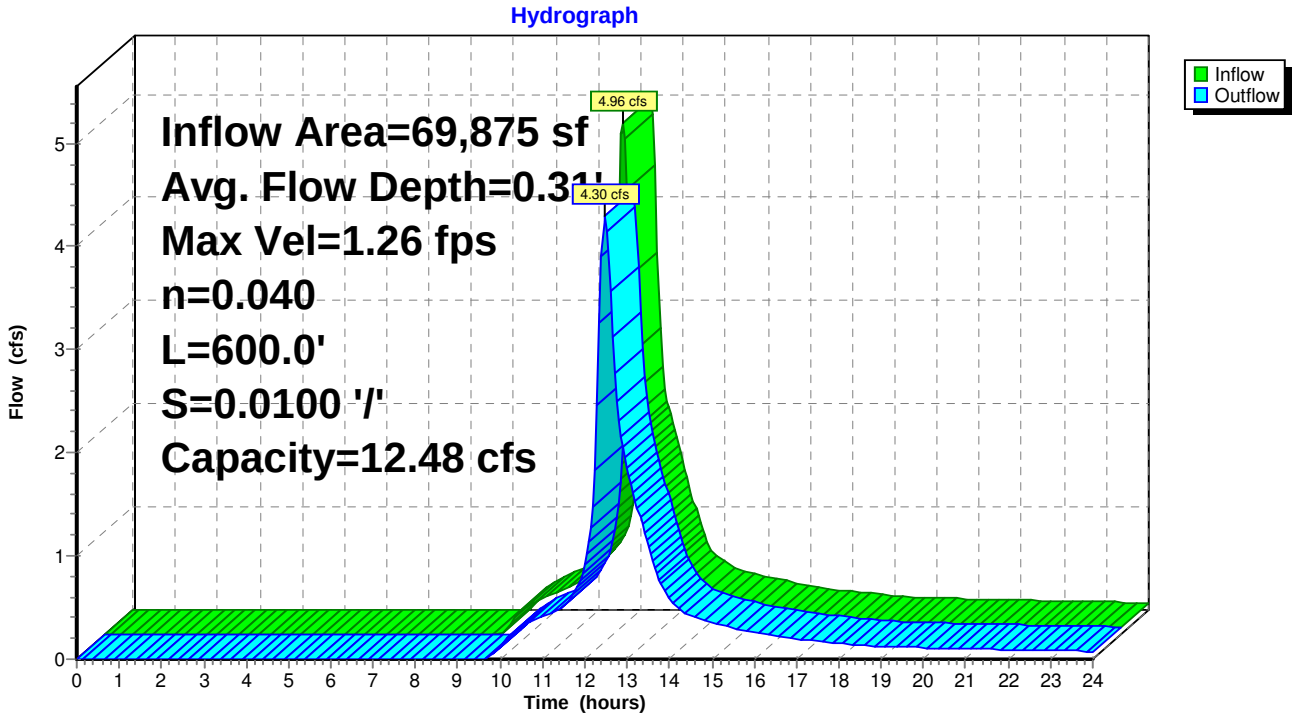
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.26 fps, Min. Travel Time= 7.9 min
Avg. Velocity = 0.55 fps, Avg. Travel Time= 18.1 min

Peak Storage= 2,064 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 12.48 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 600.0' Slope= 0.0100 '/'
Inlet Invert= 29.00', Outlet Invert= 23.00'

‡

Reach 20Ra2: Natural Stream



Summary for Reach 20Rb: Natural Stream

Inflow Area = 19,243 sf,100.00% Impervious, Inflow Depth > 4.04" for 10 yr event
Inflow = 1.37 cfs @ 12.16 hrs, Volume= 6,474 cf
Outflow = 1.06 cfs @ 12.65 hrs, Volume= 6,371 cf, Atten= 22%, Lag= 29.4 min

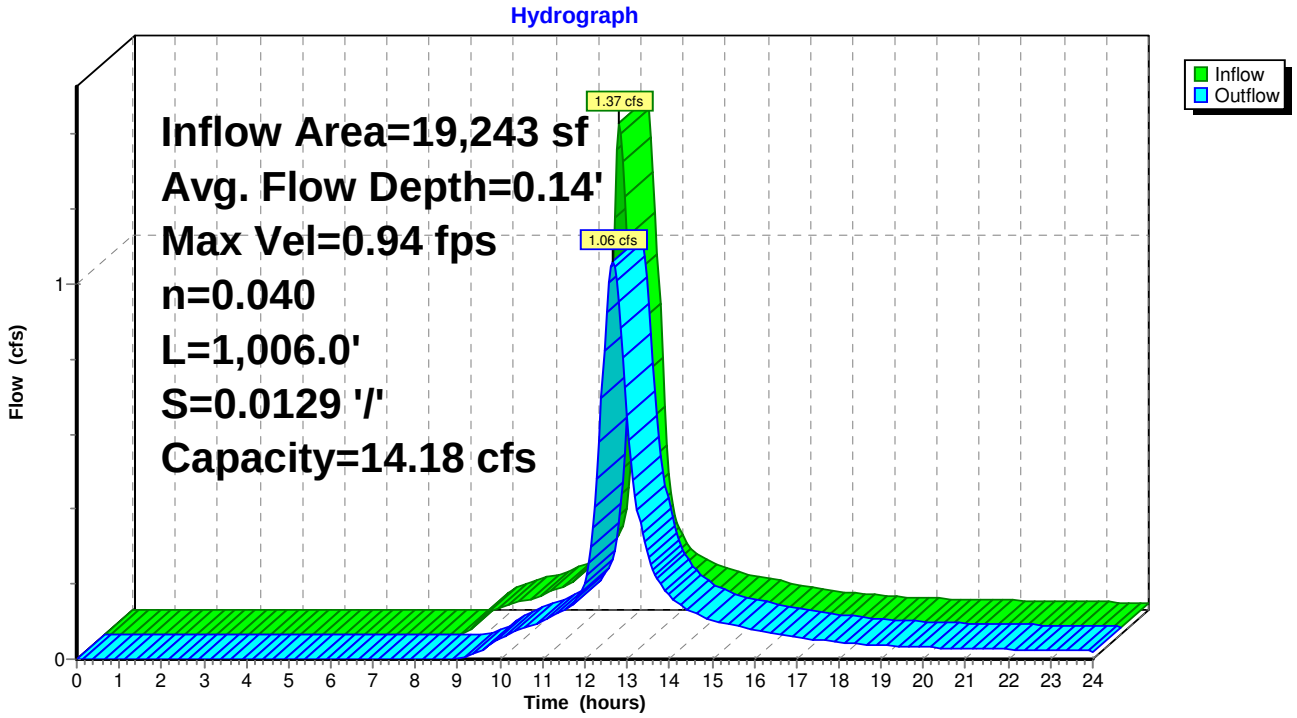
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.94 fps, Min. Travel Time= 17.8 min
Avg. Velocity = 0.39 fps, Avg. Travel Time= 42.8 min

Peak Storage= 1,136 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.14'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 14.18 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 1,006.0' Slope= 0.0129 '/'
Inlet Invert= 36.00', Outlet Invert= 23.00'

‡

Reach 20Rb: Natural Stream



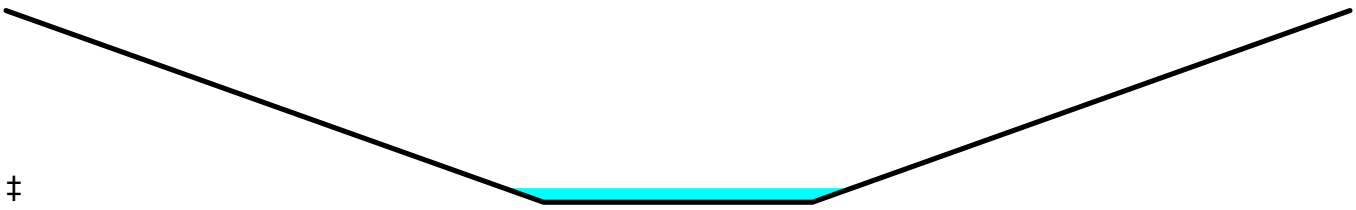
Summary for Reach 32R: Natural Stream

Inflow Area = 18,275 sf,100.00% Impervious, Inflow Depth > 0.87" for 10 yr event
Inflow = 0.09 cfs @ 14.54 hrs, Volume= 1,328 cf
Outflow = 0.08 cfs @ 15.26 hrs, Volume= 1,277 cf, Atten= 8%, Lag= 42.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.38 fps, Min. Travel Time= 17.6 min
Avg. Velocity = 0.28 fps, Avg. Travel Time= 23.9 min

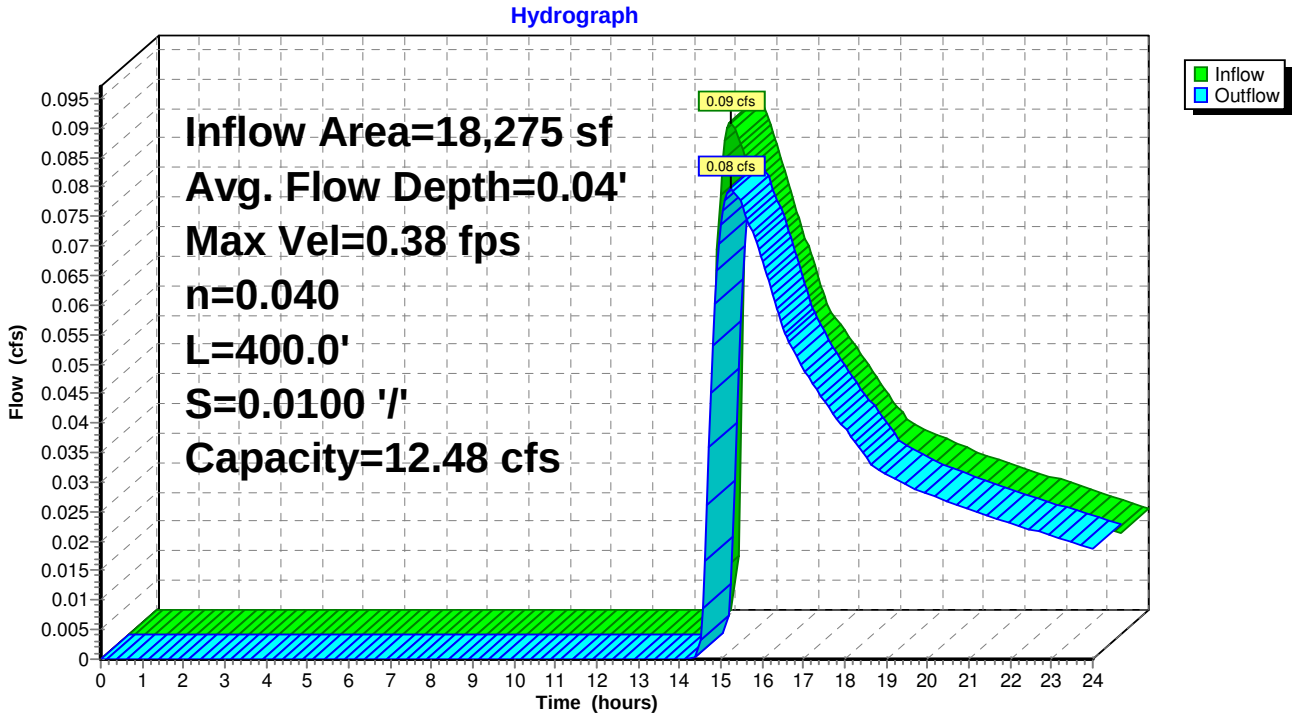
Peak Storage= 84 cf @ 14.96 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 12.48 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 400.0' Slope= 0.0100 '/'
Inlet Invert= 27.00', Outlet Invert= 23.00'



‡

Reach 32R: Natural Stream



Summary for Pond 10P: BMP 1

Inflow Area = 32,125 sf,100.00% Impervious, Inflow Depth > 4.46" for 10 yr event
Inflow = 3.41 cfs @ 12.07 hrs, Volume= 11,944 cf
Outflow = 1.98 cfs @ 12.19 hrs, Volume= 11,181 cf, Atten= 42%, Lag= 7.4 min
Primary = 1.98 cfs @ 12.19 hrs, Volume= 11,181 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 39.01' @ 12.18 hrs Surf.Area= 1,143 sf Storage= 2,114 cf

Plug-Flow detention time= 72.4 min calculated for 11,158 cf (93% of inflow)
Center-of-Mass det. time= 37.6 min (785.4 - 747.8)

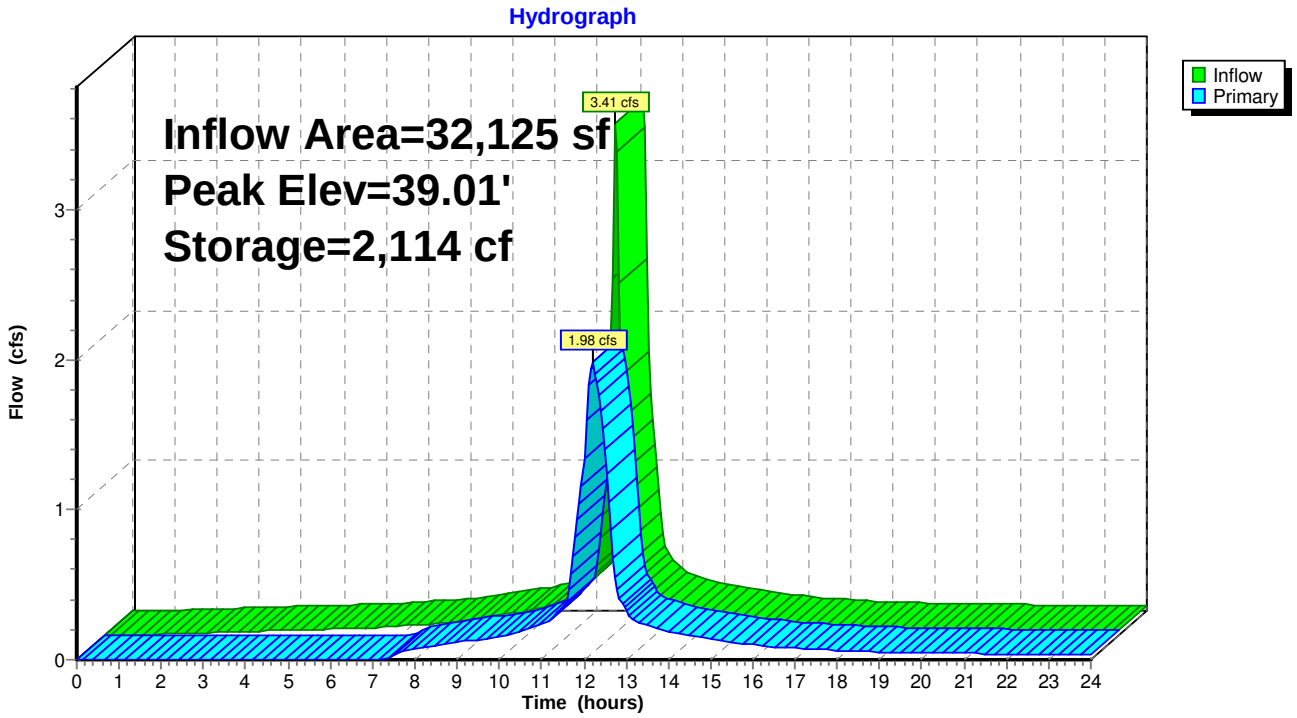
Volume	Invert	Avail.Storage	Storage Description
#1	35.00'	3,463 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
35.00	110	0	0	110
36.00	257	178	178	264
37.00	476	361	539	493
38.00	768	616	1,156	798
39.00	1,139	947	2,103	1,185
40.00	1,593	1,360	3,463	1,657

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round RCP_Round 12"** L= 172.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 35.28' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	37.33'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	39.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.95 cfs @ 12.19 hrs HW=39.00' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 1.95 cfs of 4.21 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.95 cfs @ 5.58 fps)
  └─**3=Orifice/Grate** (Weir Controls 0.01 cfs @ 0.21 fps)

Pond 10P: BMP 1



Summary for Pond 20Pa: BMP 2

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 4.46" for 10 yr event
Inflow = 7.42 cfs @ 12.07 hrs, Volume= 25,979 cf
Outflow = 5.02 cfs @ 12.16 hrs, Volume= 22,865 cf, Atten= 32%, Lag= 5.3 min
Primary = 5.02 cfs @ 12.16 hrs, Volume= 22,865 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 39.30' @ 12.16 hrs Surf.Area= 2,154 sf Storage= 6,968 cf

Plug-Flow detention time= 116.0 min calculated for 22,817 cf (88% of inflow)
Center-of-Mass det. time= 61.0 min (808.8 - 747.8)

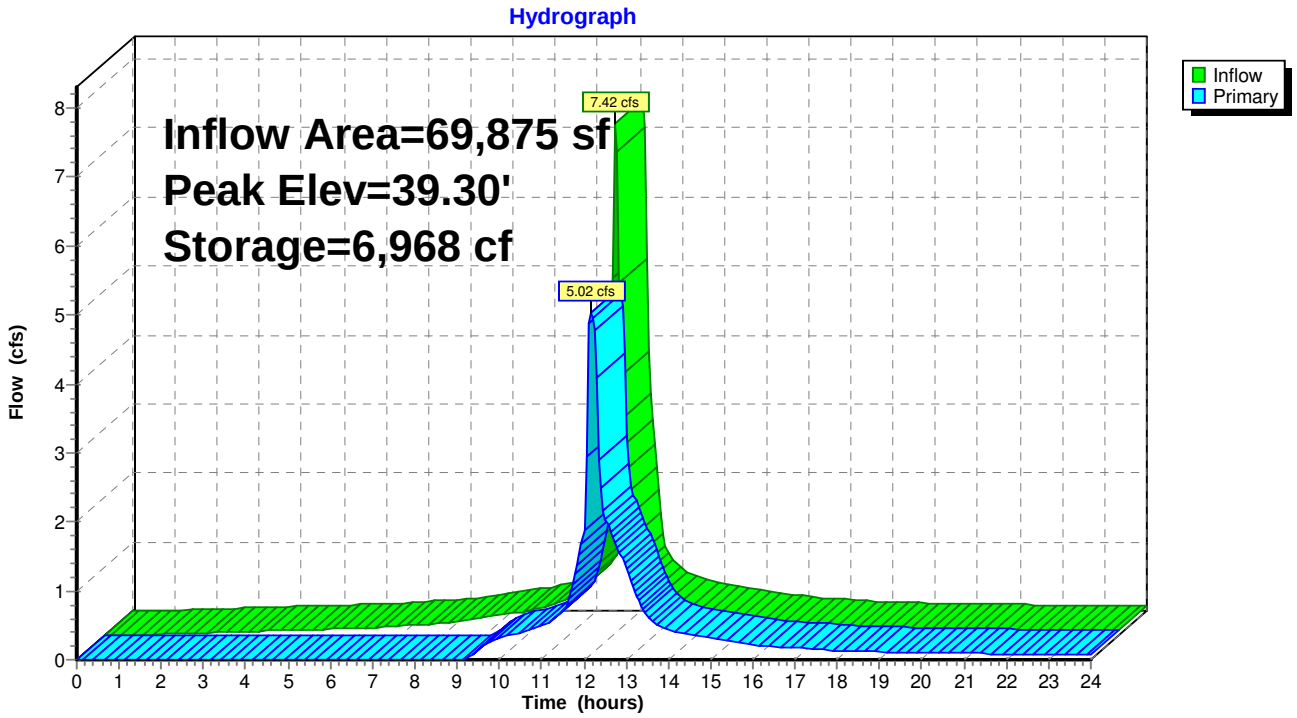
Volume	Invert	Avail.Storage	Storage Description
#1	34.00'	8,560 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
34.00	612	0	0	612
35.00	837	722	722	856
36.00	1,094	963	1,684	1,136
37.00	1,384	1,236	2,920	1,451
38.00	1,703	1,541	4,461	1,799
39.00	2,046	1,872	6,333	2,175
40.00	2,414	2,227	8,560	2,579

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round RCP_Round 12"** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	37.00'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	38.83'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	39.50'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.01 cfs @ 12.16 hrs HW=39.29' (Free Discharge)
- **1=RCP_Round 12"** (Barrel Controls 5.01 cfs @ 6.38 fps)
  - **2=Orifice/Grate** (Passes < 2.35 cfs potential flow)
  - **3=Orifice/Grate** (Passes < 8.24 cfs potential flow)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 20Pa: BMP 2



Summary for Pond 20Pb: BMP 3

Inflow Area = 19,243 sf,100.00% Impervious, Inflow Depth > 4.46" for 10 yr event
Inflow = 2.04 cfs @ 12.07 hrs, Volume= 7,154 cf
Outflow = 1.37 cfs @ 12.16 hrs, Volume= 6,474 cf, Atten= 33%, Lag= 5.5 min
Primary = 1.37 cfs @ 12.16 hrs, Volume= 6,474 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 39.99' @ 12.16 hrs Surf.Area= 951 sf Storage= 1,397 cf

Plug-Flow detention time= 95.8 min calculated for 6,474 cf (90% of inflow)
Center-of-Mass det. time= 48.3 min (796.1 - 747.8)

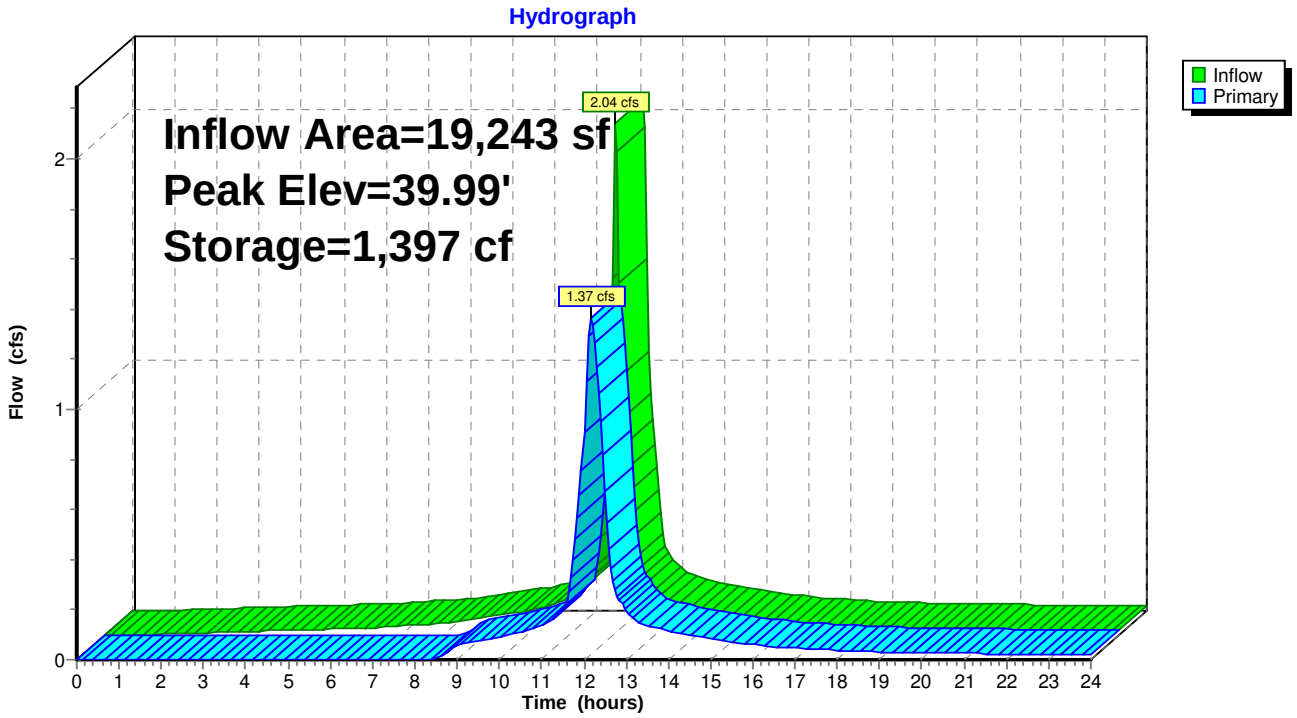
Volume	Invert	Avail.Storage	Storage Description
#1	37.00'	2,560 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
37.00	111	0	0	111
38.00	303	199	199	309
39.00	590	439	638	606
40.00	954	765	1,402	983
41.00	1,373	1,157	2,560	1,419

Device	Routing	Invert	Outlet Devices
#1	Primary	39.00'	**12.0" Round RCP_Round 12"** L= 81.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.00' / 38.00' S= 0.0122 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	39.00'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	40.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.36 cfs @ 12.16 hrs HW=39.99' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 1.36 cfs of 2.65 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.36 cfs @ 3.89 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 20Pb: BMP 3



Summary for Pond 31P: BMP 4

Inflow Area = 18,275 sf,100.00% Impervious, Inflow Depth > 4.46" for 10 yr event
Inflow = 1.94 cfs @ 12.07 hrs, Volume= 6,795 cf
Outflow = 0.09 cfs @ 14.54 hrs, Volume= 1,328 cf, Atten= 96%, Lag= 148.4 min
Primary = 0.09 cfs @ 14.54 hrs, Volume= 1,328 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 57.51' @ 14.54 hrs Surf.Area= 2,553 sf Storage= 5,496 cf

Plug-Flow detention time= 578.8 min calculated for 1,326 cf (20% of inflow)
Center-of-Mass det. time= 316.1 min (1,063.9 - 747.8)

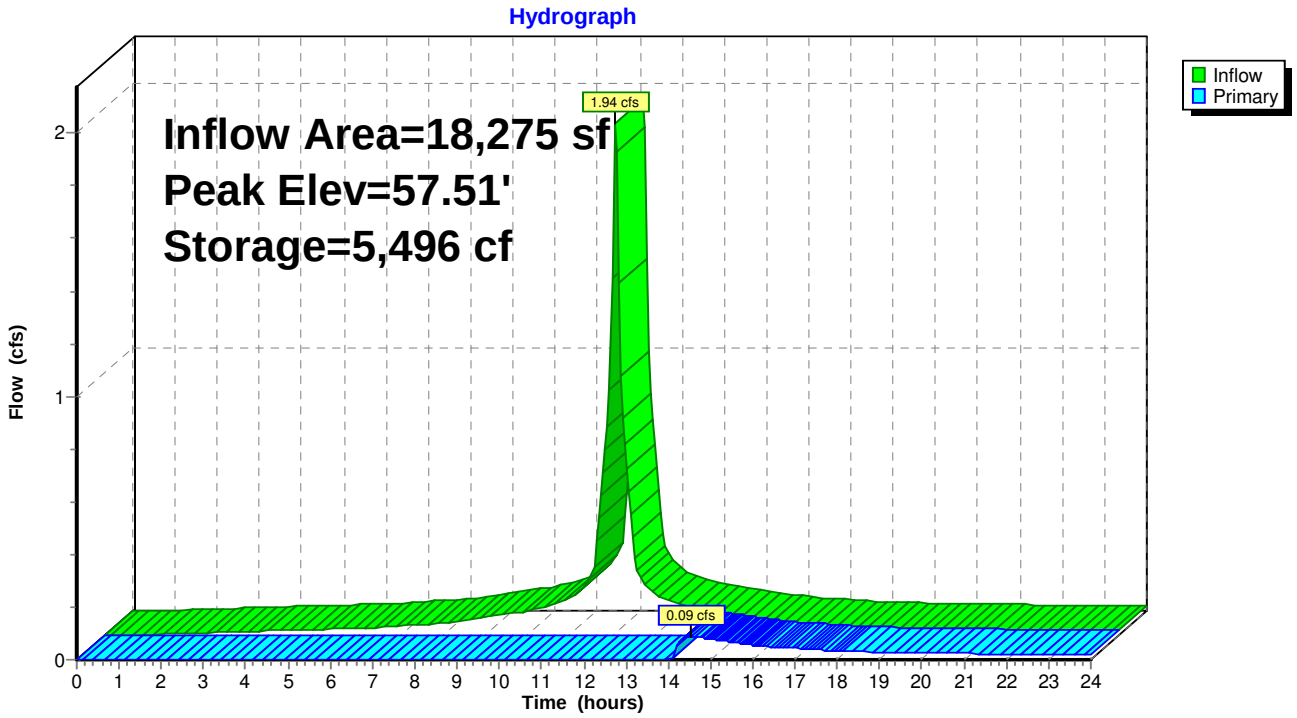
Volume	Invert	Avail.Storage	Storage Description
#1	54.00'	10,022 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
54.00	729	0	0	729
55.00	1,147	930	930	1,161
56.00	1,658	1,395	2,325	1,689
57.00	2,236	1,940	4,265	2,287
58.00	2,871	2,547	6,812	2,947
59.00	3,563	3,211	10,022	3,667

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**10.0" Round Culvert** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 55.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.55 sf
#2	Device 1	57.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	58.50'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.05 cfs @ 14.54 hrs HW=57.51' (Free Discharge)
- **1=Culvert** (Passes 0.05 cfs of 2.66 cfs potential flow)
  - **2=Orifice/Grate** (Weir Controls 0.05 cfs @ 0.40 fps)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 31P: BMP 4



Summary for Pond 32P: BMP 5A

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 4.46" for 10 yr event
Inflow = 2.22 cfs @ 12.07 hrs, Volume= 7,758 cf
Outflow = 0.98 cfs @ 12.25 hrs, Volume= 3,853 cf, Atten= 56%, Lag= 10.9 min
Primary = 0.98 cfs @ 12.25 hrs, Volume= 3,853 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 101.59' @ 12.25 hrs Surf.Area= 4,195 sf Storage= 4,270 cf

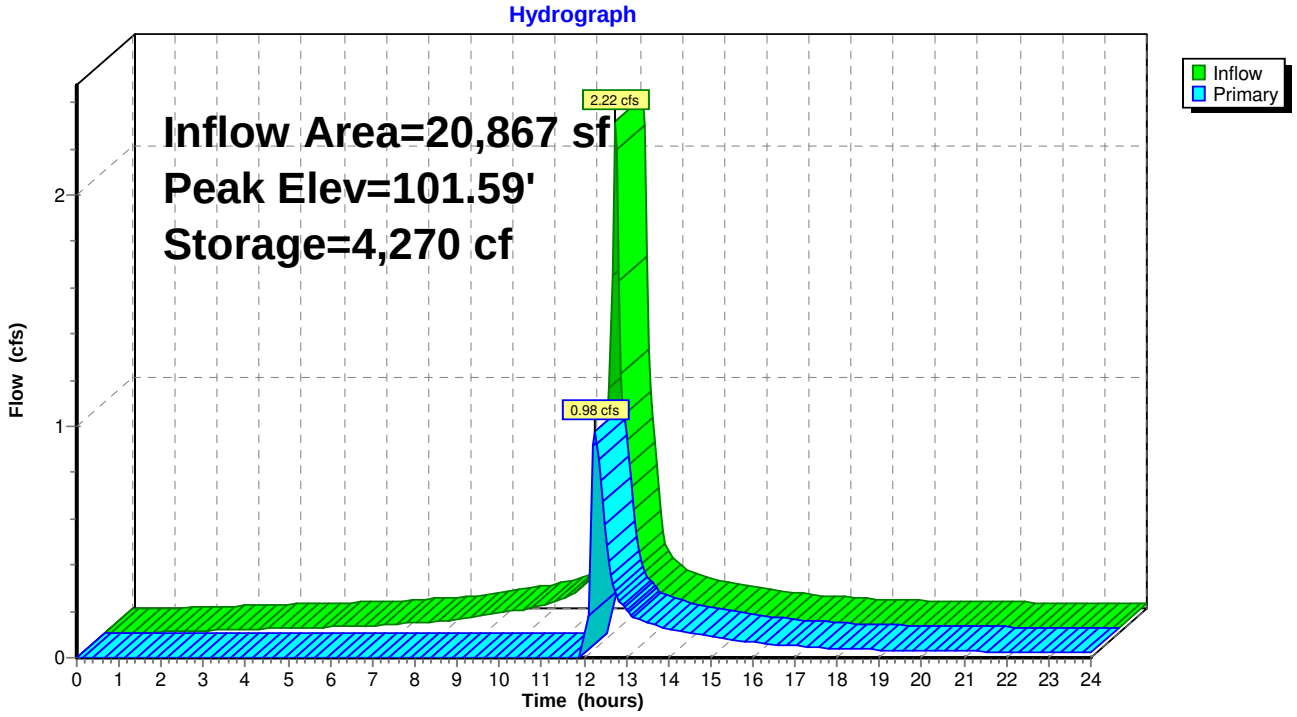
Plug-Flow detention time= 265.7 min calculated for 3,853 cf (50% of inflow)
Center-of-Mass det. time= 136.9 min (884.7 - 747.8)

Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	12,132 cf	**4.00'W x 300.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	101.50'	**13.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.97 cfs @ 12.25 hrs HW=101.59' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.97 cfs @ 0.81 fps)

Pond 32P: BMP 5A



Summary for Pond 33P: BMP 5B

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 2.22" for 10 yr event
Inflow = 0.98 cfs @ 12.25 hrs, Volume= 3,853 cf
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 99.49' @ 24.00 hrs Surf.Area= 3,997 sf Storage= 3,851 cf

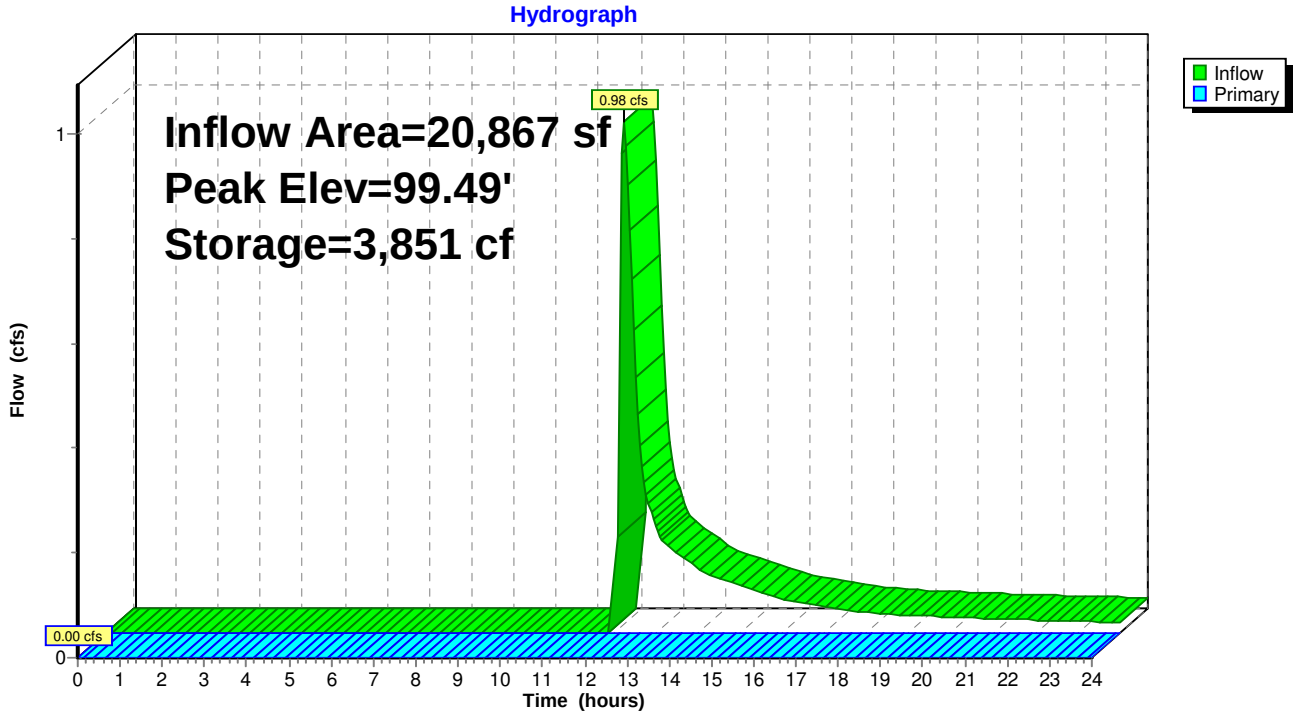
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	98.00'	12,132 cf	**4.00'W x 300.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	99.50'	**13.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=98.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 33P: BMP 5B

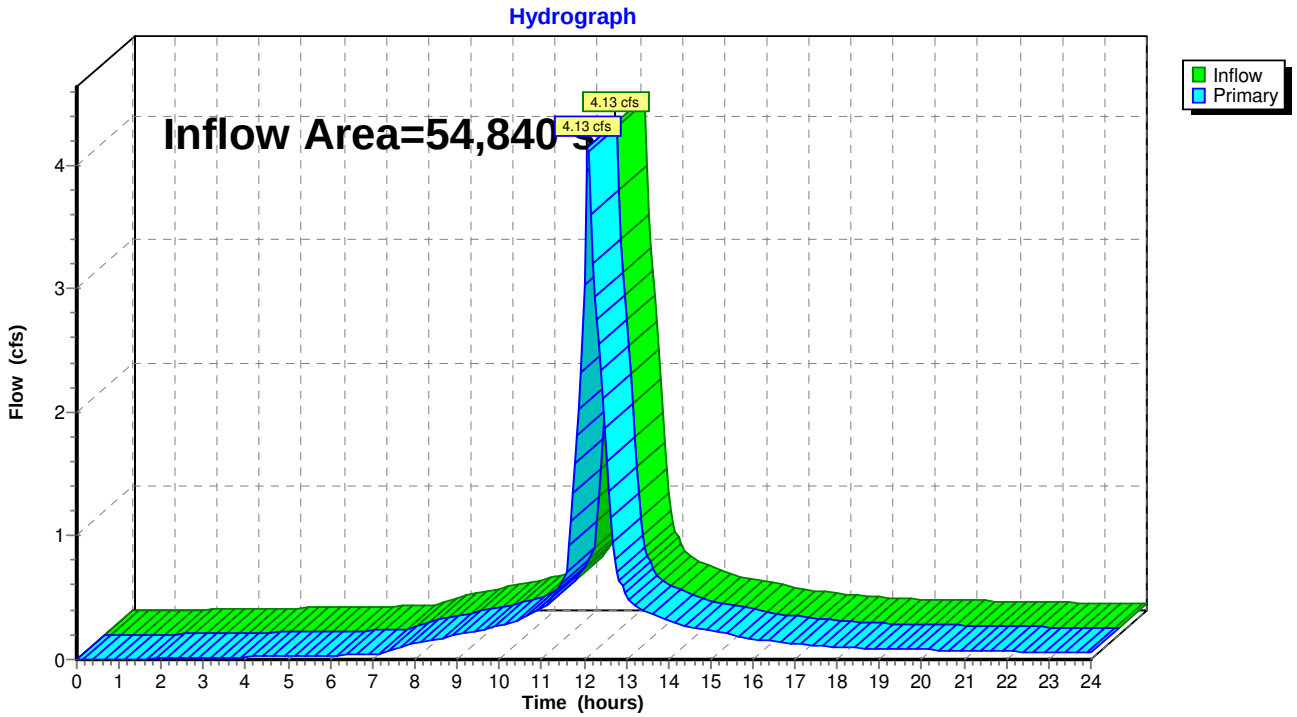


Summary for Link 10L: POI 1

Inflow Area = 54,840 sf,100.00% Impervious, Inflow Depth > 4.29" for 10 yr event
Inflow = 4.13 cfs @ 12.09 hrs, Volume= 19,626 cf
Primary = 4.13 cfs @ 12.09 hrs, Volume= 19,626 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 10L: POI 1

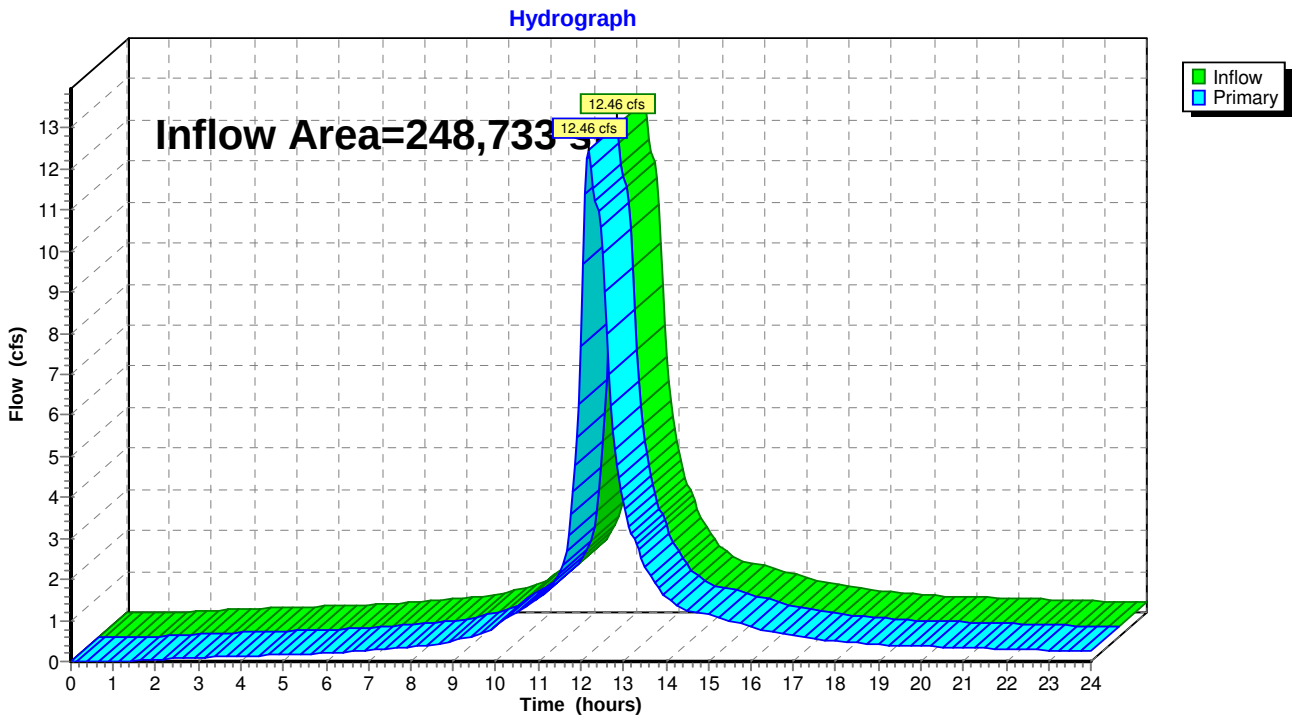


Summary for Link 20L: POI 2

Inflow Area = 248,733 sf, 99.21% Impervious, Inflow Depth > 3.99" for 10 yr event
Inflow = 12.46 cfs @ 12.19 hrs, Volume= 82,796 cf
Primary = 12.46 cfs @ 12.19 hrs, Volume= 82,796 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 20L: POI 2

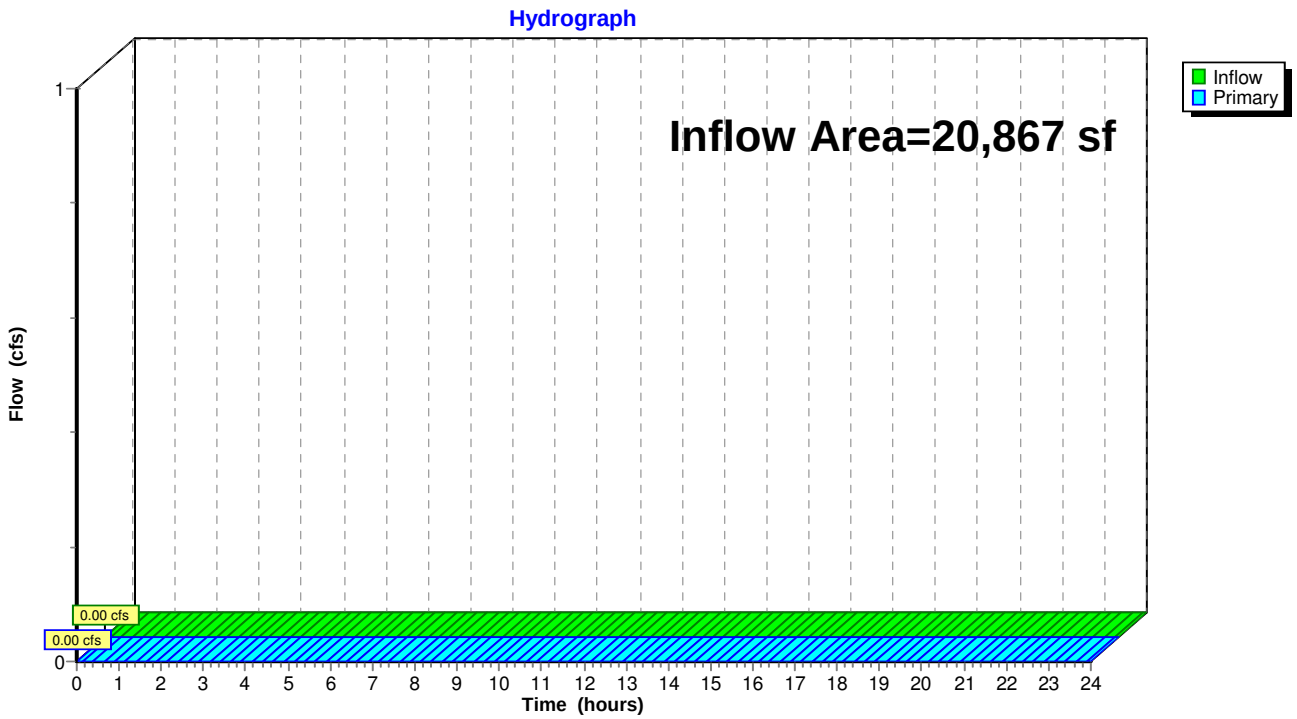


Summary for Link 30L: POI 3

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth = 0.00" for 10 yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 30L: POI 3



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10Sa: POI 1 - OVERLAND Runoff Area=22,715 sf 100.00% Impervious Runoff Depth>5.36"
Tc=5.0 min CN=98 Runoff=2.88 cfs 10,146 cf

Subcatchment 10Sb: POI 1 - OVERLAND Runoff Area=32,125 sf 100.00% Impervious Runoff Depth>5.36"
Tc=5.0 min CN=98 Runoff=4.07 cfs 14,349 cf

Subcatchment 20Sa: POI 2 - OVERLAND Runoff Area=69,875 sf 100.00% Impervious Runoff Depth>5.36"
Tc=5.0 min CN=98 Runoff=8.86 cfs 31,210 cf

Subcatchment 20Sb: POI 3 - SLIP RAMP Runoff Area=27,151 sf 100.00% Impervious Runoff Depth>5.36"
Tc=5.0 min CN=98 Runoff=3.44 cfs 12,127 cf

Subcatchment 20Sc: POI 2 - OVERLAND Runoff Area=114,189 sf 98.28% Impervious Runoff Depth>5.35"
Flow Length=957' Slope=0.0094 '/' Tc=14.9 min CN=98 Runoff=10.95 cfs 50,932 cf

Subcatchment 20Sd: POI 2 - OVERLAND Runoff Area=19,243 sf 100.00% Impervious Runoff Depth>5.36"
Tc=5.0 min CN=98 Runoff=2.44 cfs 8,595 cf

Subcatchment 20Se: POI 2 - ROUTE 24 Runoff Area=18,275 sf 100.00% Impervious Runoff Depth>5.36"
Tc=5.0 min CN=98 Runoff=2.32 cfs 8,163 cf

Subcatchment 30S: POI 3 - OVERLAND Runoff Area=20,867 sf 100.00% Impervious Runoff Depth>5.36"
Tc=5.0 min CN=98 Runoff=2.64 cfs 9,320 cf

Reach 20Ra1: Grassed Channel Avg. Flow Depth=0.30' Max Vel=3.09 fps Inflow=6.18 cfs 28,076 cf
n=0.022 L=436.0' S=0.0161 '/' Capacity=16.40 cfs Outflow=5.84 cfs 28,016 cf

Reach 20Ra2: Natural Stream Avg. Flow Depth=0.33' Max Vel=1.32 fps Inflow=5.84 cfs 28,016 cf
n=0.040 L=600.0' S=0.0100 '/' Capacity=12.48 cfs Outflow=5.12 cfs 27,844 cf

Reach 20Rb: Natural Stream Avg. Flow Depth=0.16' Max Vel=0.98 fps Inflow=1.55 cfs 7,910 cf
n=0.040 L=1,006.0' S=0.0129 '/' Capacity=14.18 cfs Outflow=1.25 cfs 7,795 cf

Reach 32R: Natural Stream Avg. Flow Depth=0.07' Max Vel=0.53 fps Inflow=0.26 cfs 2,695 cf
n=0.040 L=400.0' S=0.0100 '/' Capacity=12.48 cfs Outflow=0.22 cfs 2,643 cf

Pond 10P: BMP 1 Peak Elev=39.13' Storage=2,259 cf Inflow=4.07 cfs 14,349 cf
Outflow=3.33 cfs 13,580 cf

Pond 20Pa: BMP 2 Peak Elev=39.61' Storage=7,653 cf Inflow=8.86 cfs 31,210 cf
Outflow=6.18 cfs 28,076 cf

Pond 20Pb: BMP 3 Peak Elev=40.18' Storage=1,580 cf Inflow=2.44 cfs 8,595 cf
Outflow=1.55 cfs 7,910 cf

Pond 31P: BMP 4 Peak Elev=57.54' Storage=5,572 cf Inflow=2.32 cfs 8,163 cf
Outflow=0.26 cfs 2,695 cf

Pond 32P: BMP 5A Peak Elev=101.64' Storage=4,495 cf Inflow=2.64 cfs 9,320 cf
Outflow=1.93 cfs 5,412 cf

Pond 33P: BMP 5B Peak Elev=99.52' Storage=3,955 cf Inflow=1.93 cfs 5,412 cf
Outflow=0.09 cfs 1,503 cf

Link 10L: POI 1 Inflow=5.48 cfs 23,726 cf
Primary=5.48 cfs 23,726 cf

Link 20L: POI 2 Inflow=14.99 cfs 101,341 cf
Primary=14.99 cfs 101,341 cf

Link 30L: POI 3 Inflow=0.09 cfs 1,503 cf
Primary=0.09 cfs 1,503 cf

Total Runoff Area = 324,440 sf Runoff Volume = 144,841 cf Average Runoff Depth = 5.36"
0.61% Pervious = 1,968 sf 99.39% Impervious = 322,472 sf

Summary for Subcatchment 10Sa: POI 1 - OVERLAND DIRECT DISCHARGE

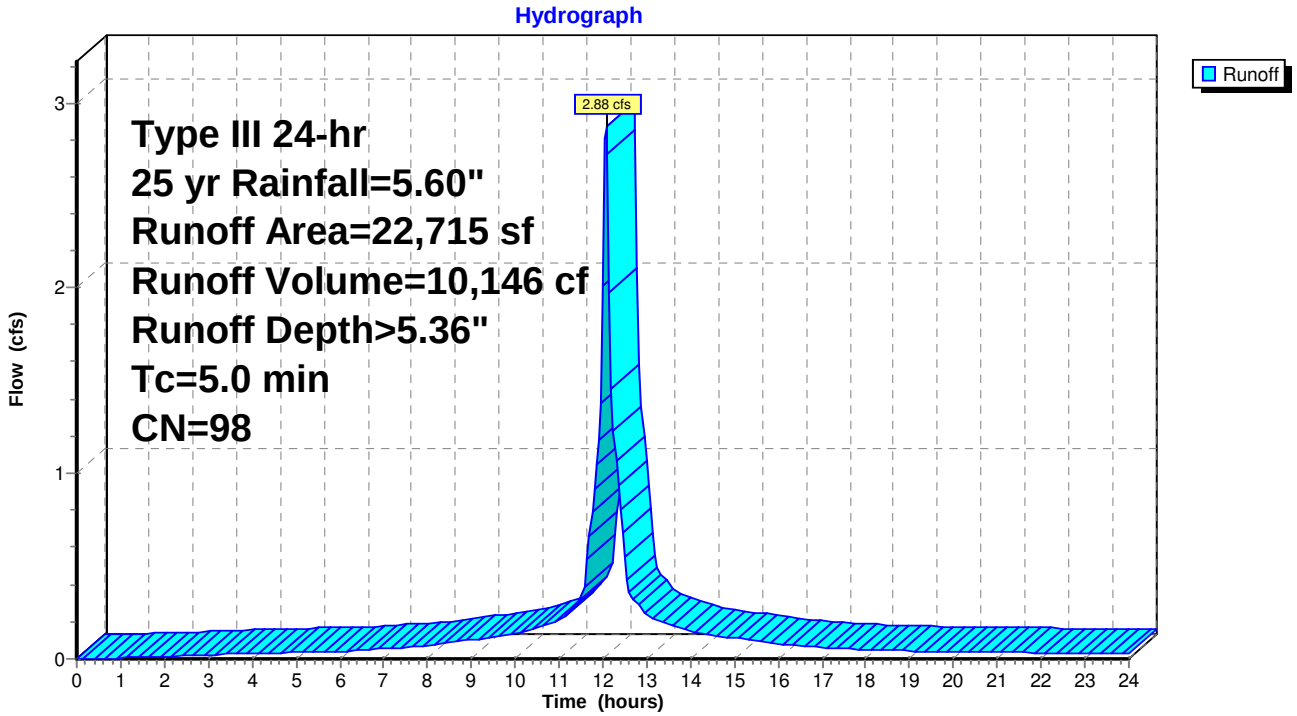
Runoff = 2.88 cfs @ 12.07 hrs, Volume= 10,146 cf, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
22,715	98	Paved roads w/curbs & sewers, HSG C
22,715		100.00% Impervious Area

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

Subcatchment 10Sa: POI 1 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 10Sb: POI 1 - OVERLAND TO BMP 1

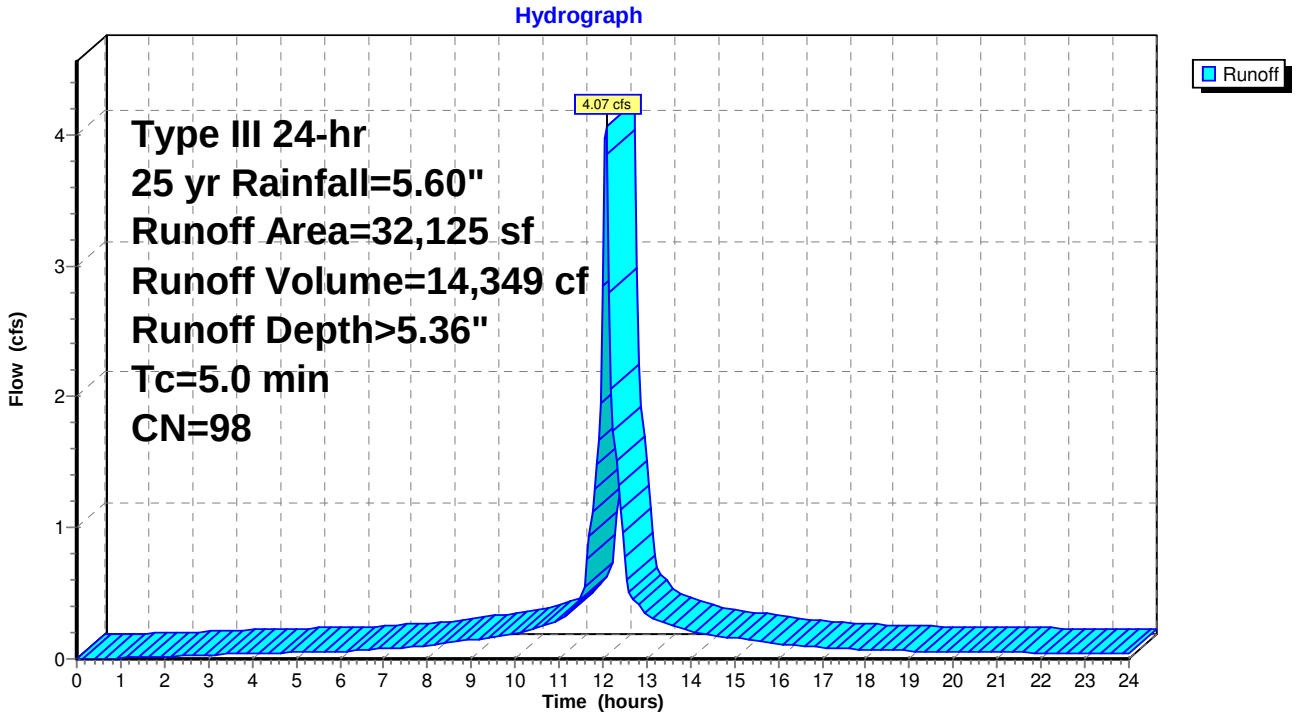
Runoff = 4.07 cfs @ 12.07 hrs, Volume= 14,349 cf, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
32,125	98	Paved roads w/curbs & sewers, HSG C
32,125		100.00% Impervious Area

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

Subcatchment 10Sb: POI 1 - OVERLAND TO BMP 1



Summary for Subcatchment 20Sa: POI 2 - OVERLAND TO BMP 2

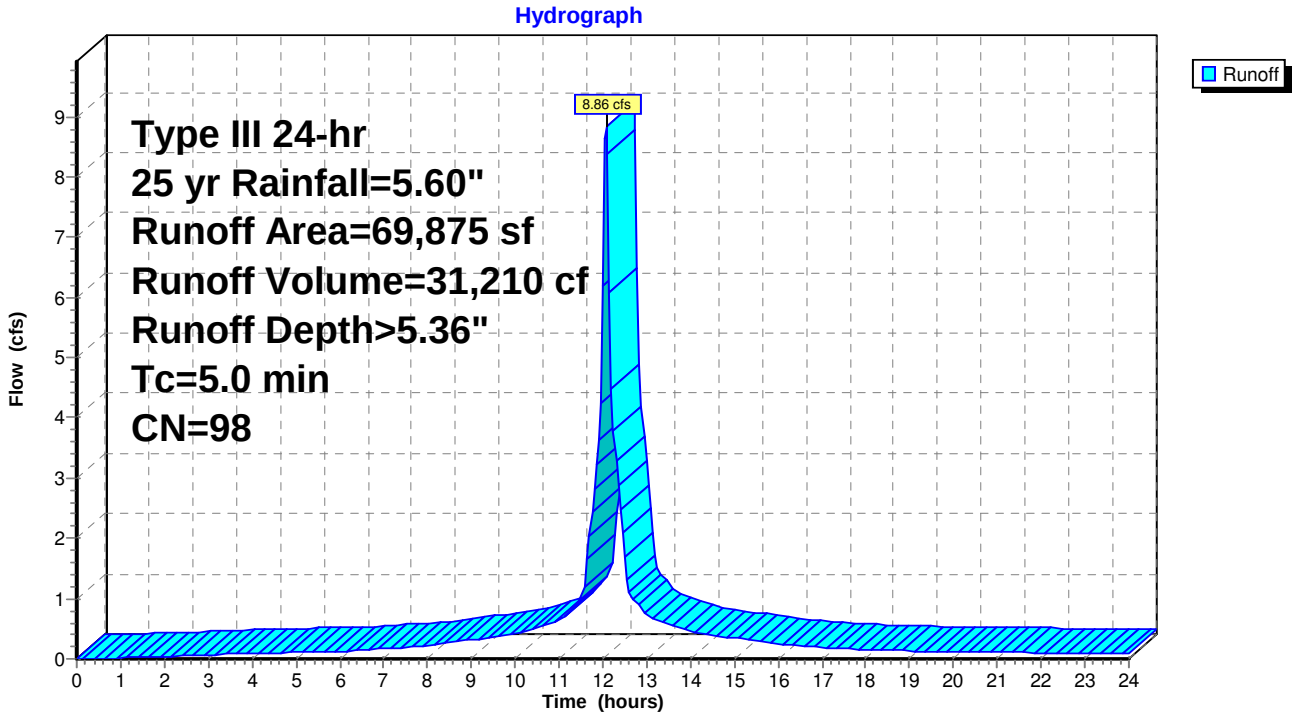
Runoff = 8.86 cfs @ 12.07 hrs, Volume= 31,210 cf, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
69,875	98	Paved roads w/curbs & sewers, HSG C
69,875		100.00% Impervious Area

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

Subcatchment 20Sa: POI 2 - OVERLAND TO BMP 2



Summary for Subcatchment 20Sb: POI 3 - SLIP RAMP POST DEVELOPMENT

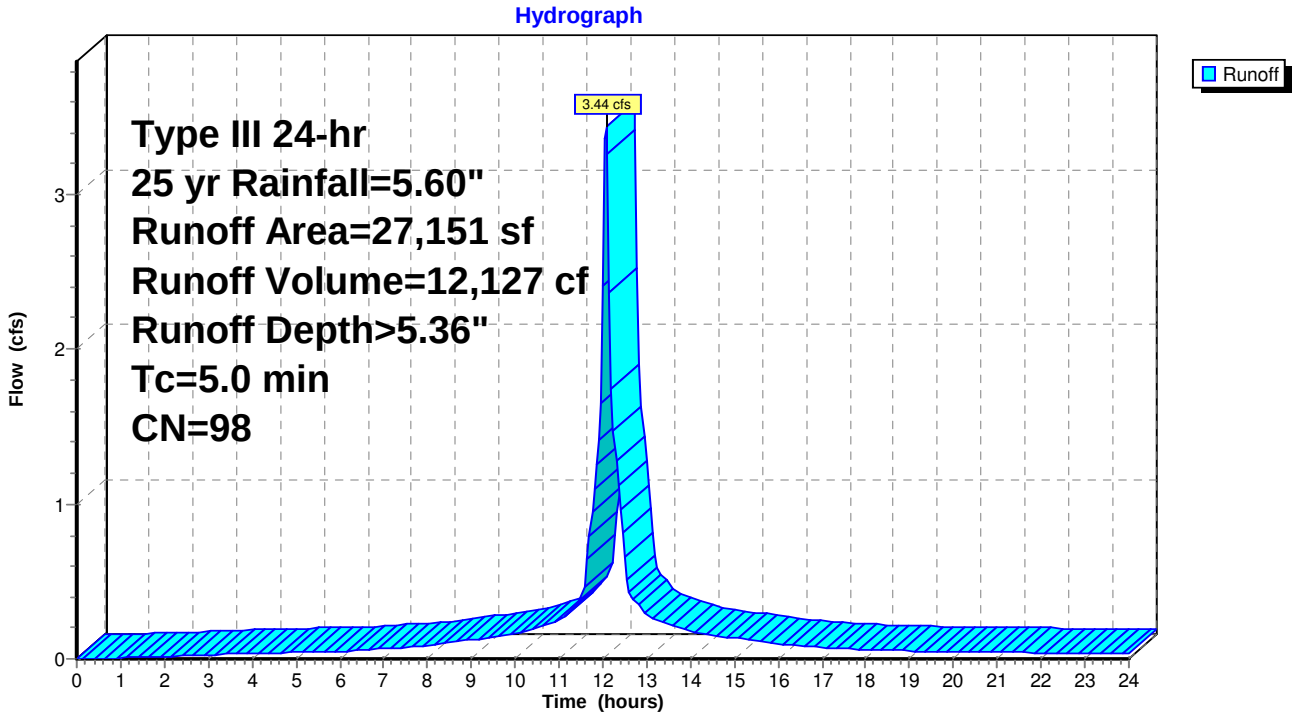
Runoff = 3.44 cfs @ 12.07 hrs, Volume= 12,127 cf, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
27,151	98	Paved roads w/curbs & sewers, HSG D
27,151		100.00% Impervious Area

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

Subcatchment 20Sb: POI 3 - SLIP RAMP POST DEVELOPMENT



Summary for Subcatchment 20Sc: POI 2 - OVERLAND DIRECT DISCHARGE

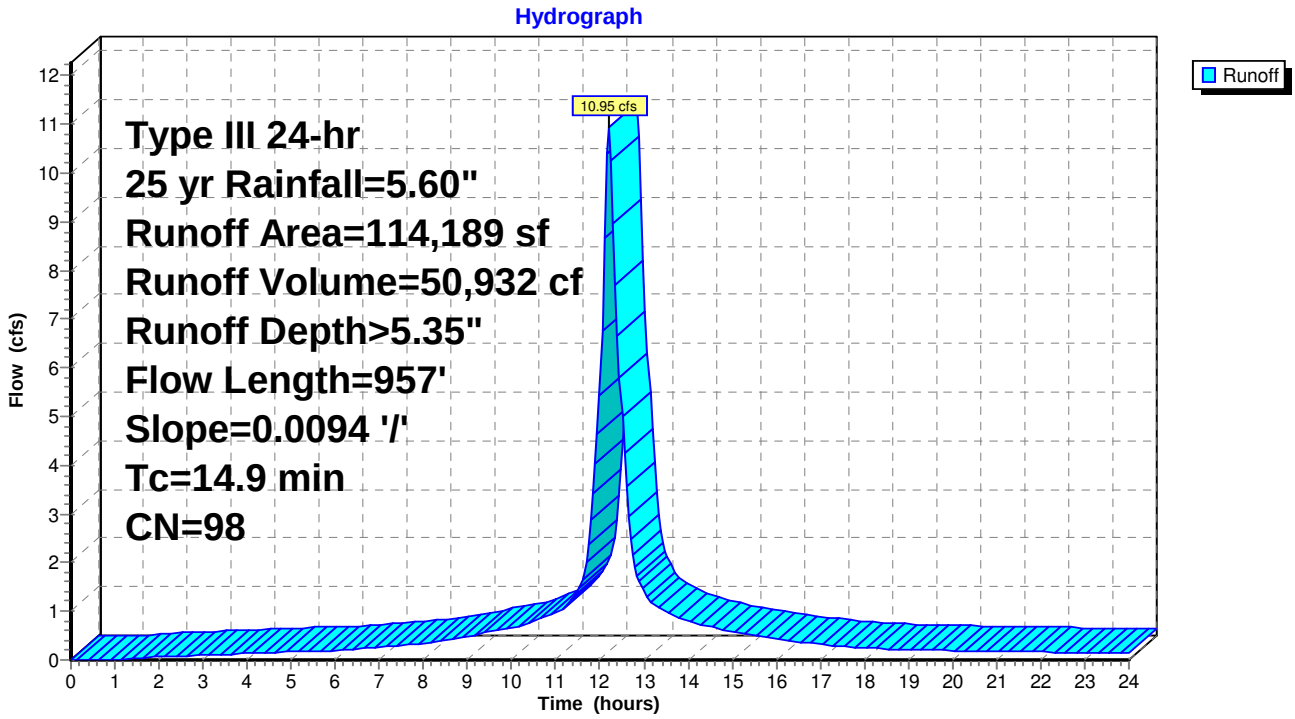
Runoff = 10.95 cfs @ 12.20 hrs, Volume= 50,932 cf, Depth> 5.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
103,199	98	Paved roads w/curbs & sewers, HSG C
1,968	79	50-75% Grass cover, Fair, HSG C
7,934	98	Paved roads w/curbs & sewers, HSG D
1,088	98	Paved roads w/curbs & sewers, HSG B
114,189	98	Weighted Average
1,968		1.72% Pervious Area
112,221		98.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
9.9	957	0.0094	1.61	12.11	**Channel Flow, Natural Stream** Area= 7.5 sf Perim= 25.0' r= 0.30' n= 0.040 Winding stream
14.9	957	Total			

Subcatchment 20Sc: POI 2 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 20Sd: POI 2 - OVERLAND TO BMP 3

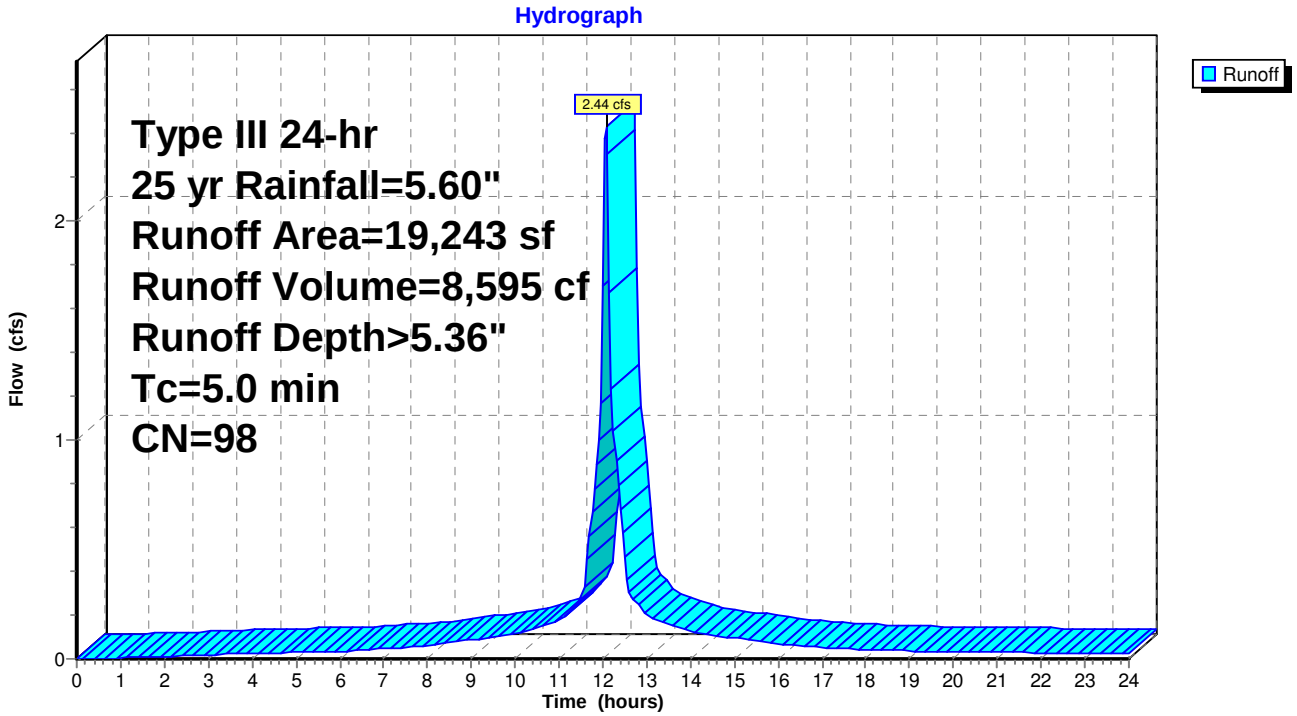
Runoff = 2.44 cfs @ 12.07 hrs, Volume= 8,595 cf, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
19,243	98	Paved roads w/curbs & sewers, HSG C
19,243		100.00% Impervious Area

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

Subcatchment 20Sd: POI 2 - OVERLAND TO BMP 3



Summary for Subcatchment 20Se: POI 2 - ROUTE 24

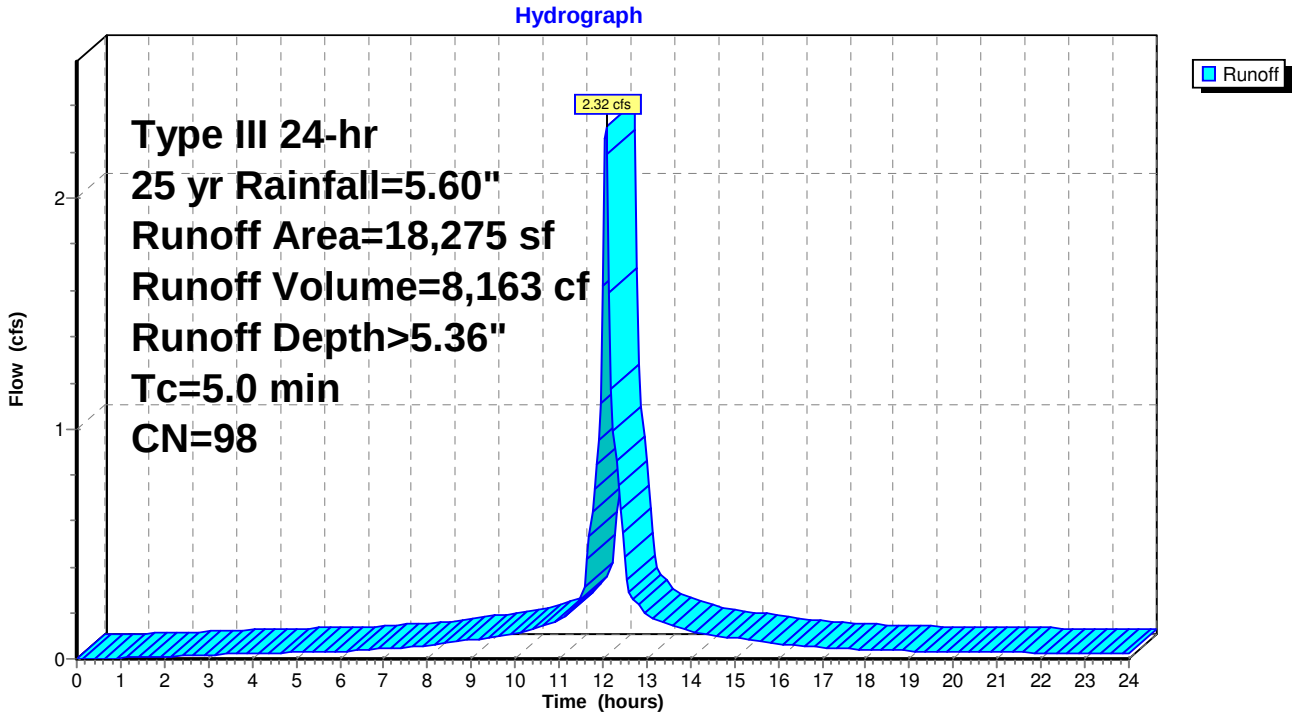
Runoff = 2.32 cfs @ 12.07 hrs, Volume= 8,163 cf, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
18,275	98	Paved roads w/curbs & sewers, HSG C
18,275		100.00% Impervious Area

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

Subcatchment 20Se: POI 2 - ROUTE 24



Summary for Subcatchment 30S: POI 3 - OVERLAND DIRECT DISCHARGE

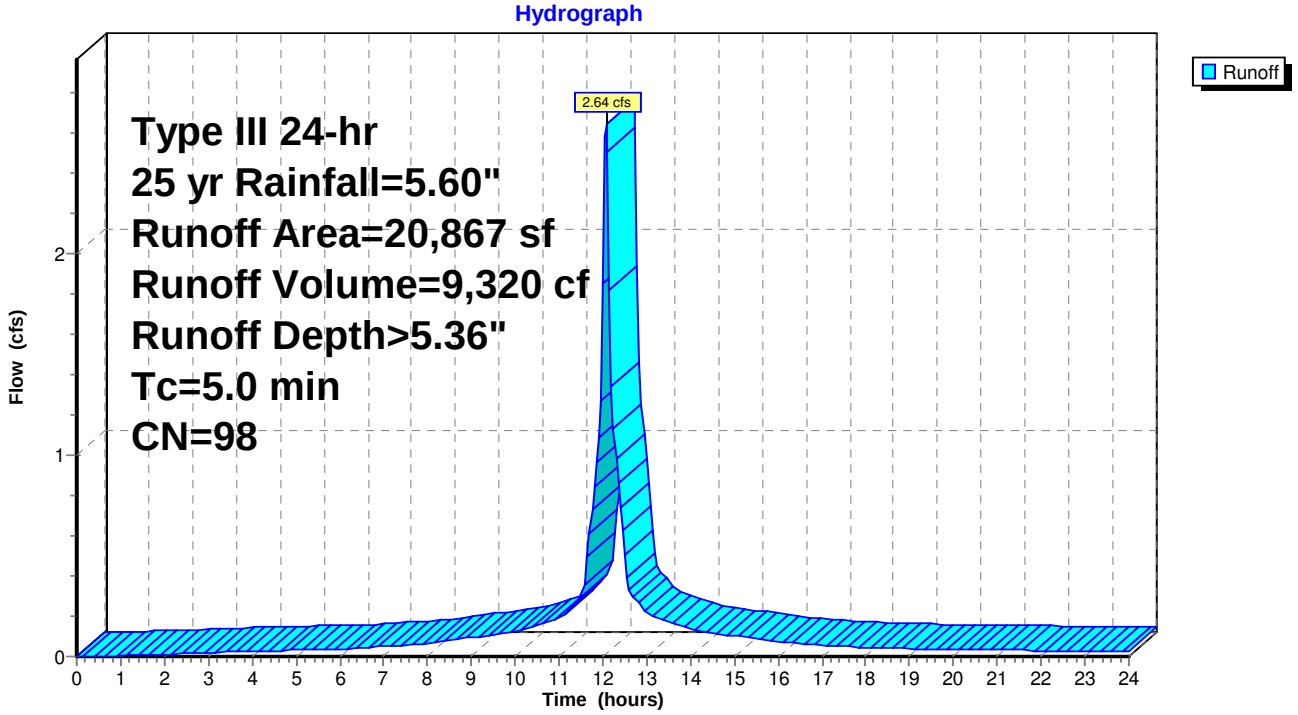
Runoff = 2.64 cfs @ 12.07 hrs, Volume= 9,320 cf, Depth> 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=5.60"

Area (sf)	CN	Description
8,256	98	Paved roads w/curbs & sewers, HSG D
12,611	98	Paved roads w/curbs & sewers, HSG B
20,867	98	Weighted Average
20,867		100.00% Impervious Area

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

Subcatchment 30S: POI 3 - OVERLAND DIRECT DISCHARGE



Summary for Reach 20Ra1: Grassed Channel

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 4.82" for 25 yr event
Inflow = 6.18 cfs @ 12.16 hrs, Volume= 28,076 cf
Outflow = 5.84 cfs @ 12.23 hrs, Volume= 28,016 cf, Atten= 6%, Lag= 4.7 min

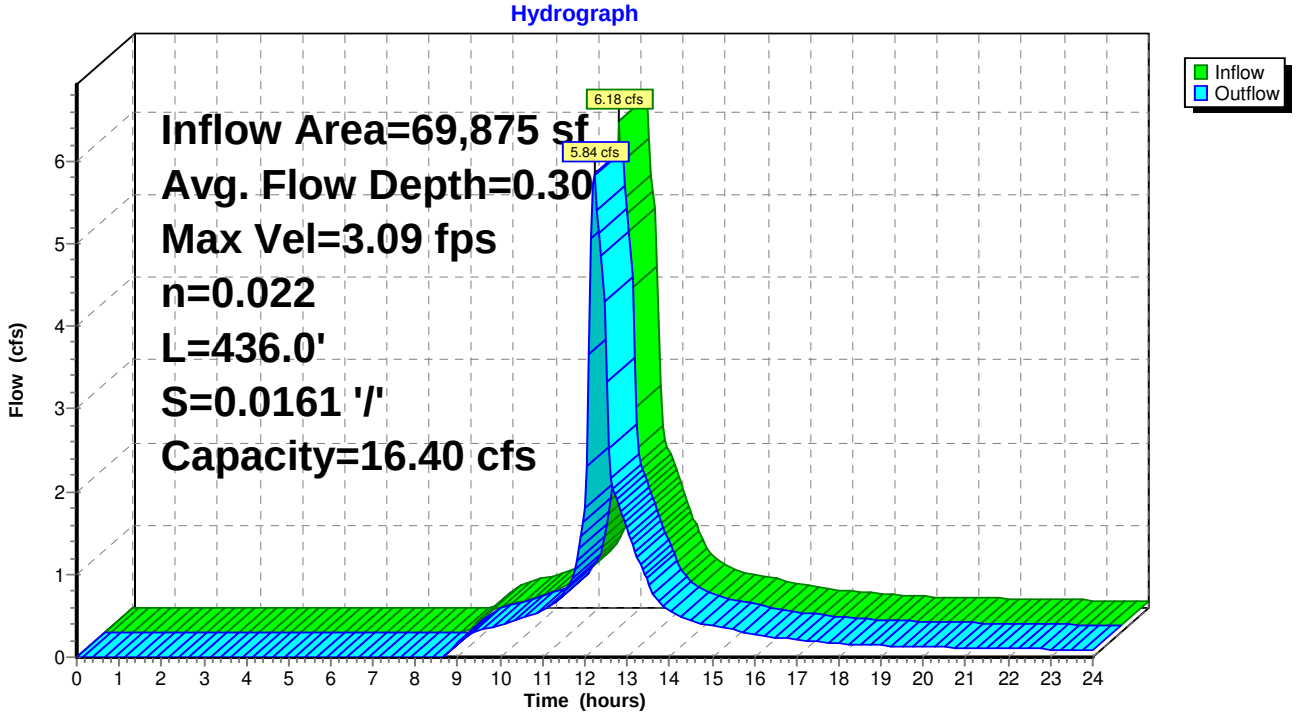
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.09 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 1.19 fps, Avg. Travel Time= 6.1 min

Peak Storage= 834 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 0.50' Flow Area= 4.0 sf, Capacity= 16.40 cfs

4.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 8.0 '/' Top Width= 12.00'
Length= 436.0' Slope= 0.0161 '/'
Inlet Invert= 36.00', Outlet Invert= 29.00'

‡

Reach 20Ra1: Grassed Channel



Summary for Reach 20Ra2: Natural Stream

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 4.81" for 25 yr event
Inflow = 5.84 cfs @ 12.23 hrs, Volume= 28,016 cf
Outflow = 5.12 cfs @ 12.48 hrs, Volume= 27,844 cf, Atten= 12%, Lag= 14.7 min

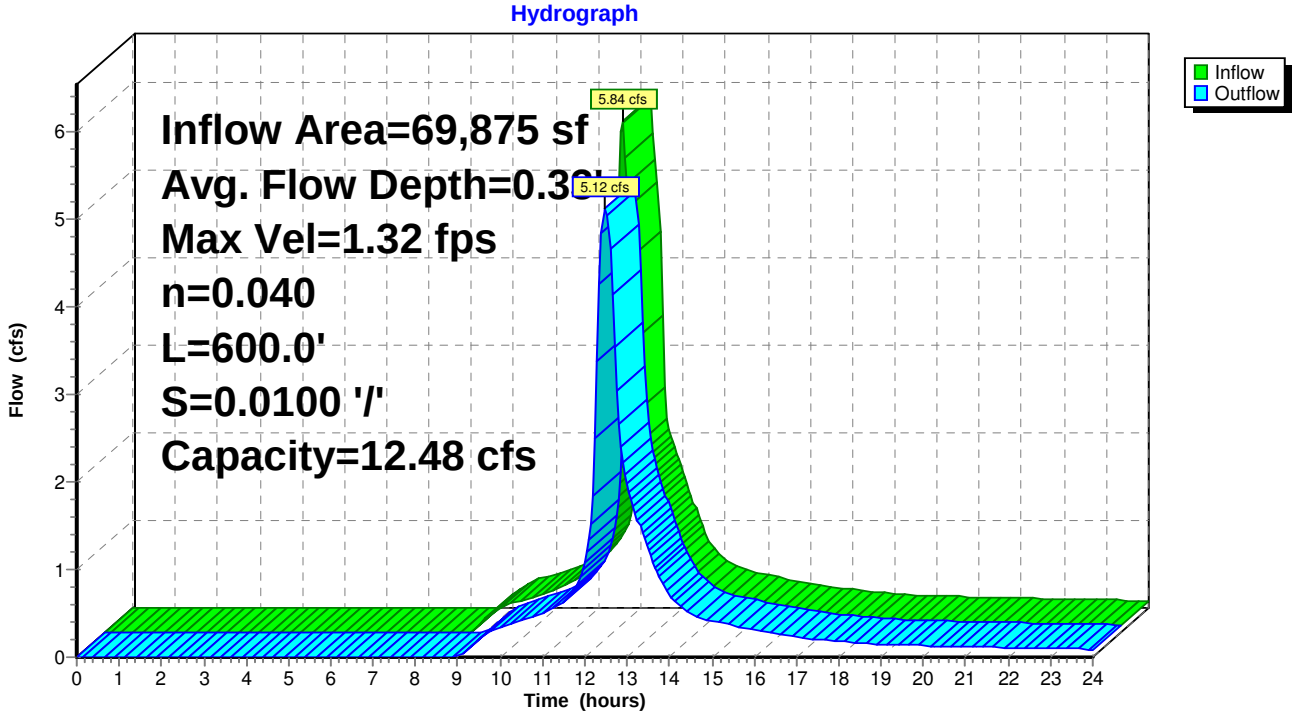
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.32 fps, Min. Travel Time= 7.6 min
Avg. Velocity = 0.58 fps, Avg. Travel Time= 17.2 min

Peak Storage= 2,336 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 12.48 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 600.0' Slope= 0.0100 '/'
Inlet Invert= 29.00', Outlet Invert= 23.00'

‡

Reach 20Ra2: Natural Stream



Summary for Reach 20Rb: Natural Stream

Inflow Area = 19,243 sf,100.00% Impervious, Inflow Depth > 4.93" for 25 yr event
Inflow = 1.55 cfs @ 12.17 hrs, Volume= 7,910 cf
Outflow = 1.25 cfs @ 12.65 hrs, Volume= 7,795 cf, Atten= 19%, Lag= 29.1 min

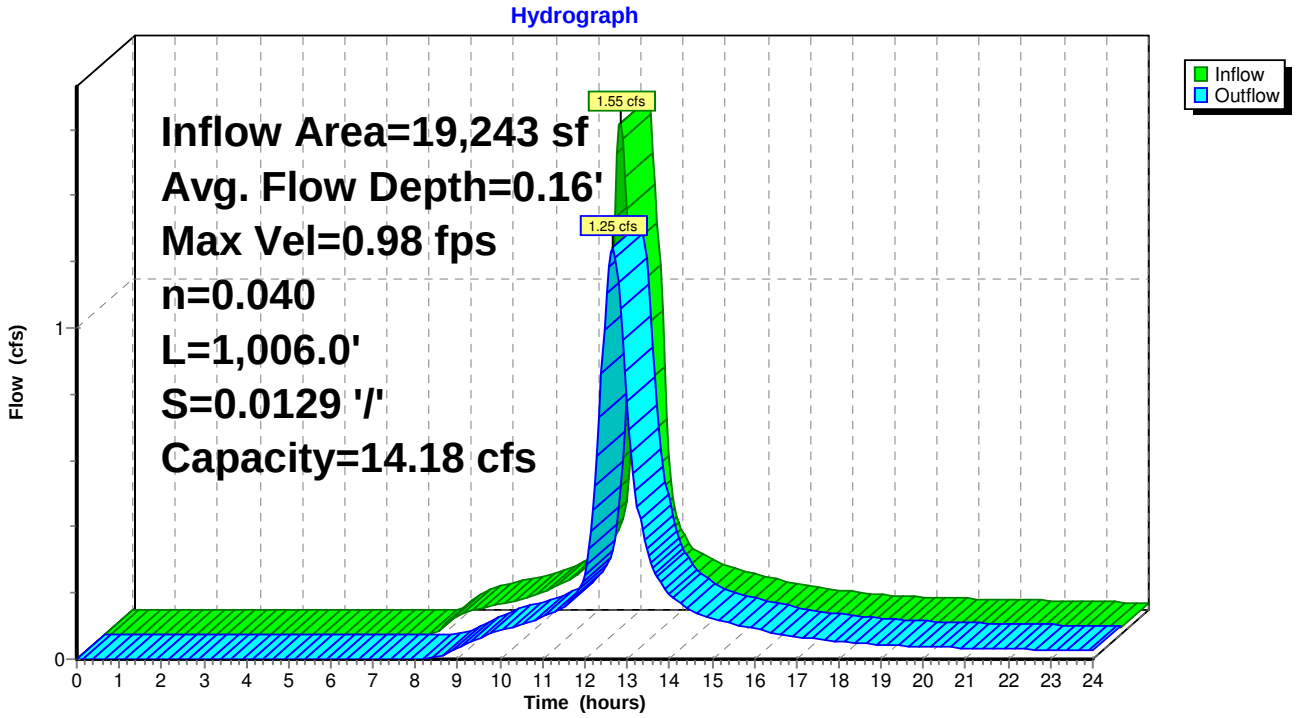
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.98 fps, Min. Travel Time= 17.0 min
Avg. Velocity = 0.41 fps, Avg. Travel Time= 40.6 min

Peak Storage= 1,275 cf @ 12.37 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 14.18 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 1,006.0' Slope= 0.0129 '/'
Inlet Invert= 36.00', Outlet Invert= 23.00'

‡

Reach 20Rb: Natural Stream



Summary for Reach 32R: Natural Stream

Inflow Area = 18,275 sf,100.00% Impervious, Inflow Depth > 1.77" for 25 yr event
Inflow = 0.26 cfs @ 12.68 hrs, Volume= 2,695 cf
Outflow = 0.22 cfs @ 13.17 hrs, Volume= 2,643 cf, Atten= 14%, Lag= 28.9 min

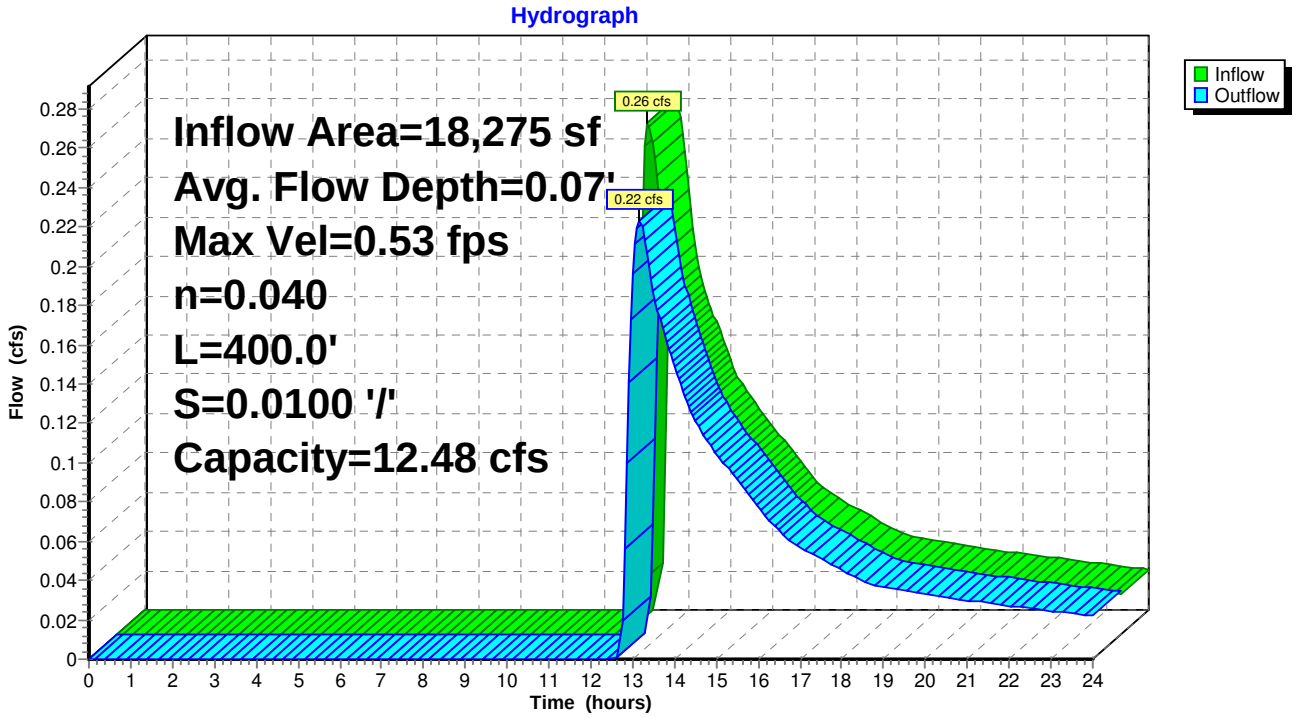
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.53 fps, Min. Travel Time= 12.5 min
Avg. Velocity = 0.33 fps, Avg. Travel Time= 20.3 min

Peak Storage= 167 cf @ 12.96 hrs
Average Depth at Peak Storage= 0.07'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 12.48 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 400.0' Slope= 0.0100 '/'
Inlet Invert= 27.00', Outlet Invert= 23.00'

‡

Reach 32R: Natural Stream



Summary for Pond 10P: BMP 1

Inflow Area = 32,125 sf,100.00% Impervious, Inflow Depth > 5.36" for 25 yr event
Inflow = 4.07 cfs @ 12.07 hrs, Volume= 14,349 cf
Outflow = 3.33 cfs @ 12.15 hrs, Volume= 13,580 cf, Atten= 18%, Lag= 4.7 min
Primary = 3.33 cfs @ 12.15 hrs, Volume= 13,580 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 39.13' @ 12.15 hrs Surf.Area= 1,195 sf Storage= 2,259 cf

Plug-Flow detention time= 64.3 min calculated for 13,552 cf (94% of inflow)
Center-of-Mass det. time= 34.1 min (779.1 - 744.9)

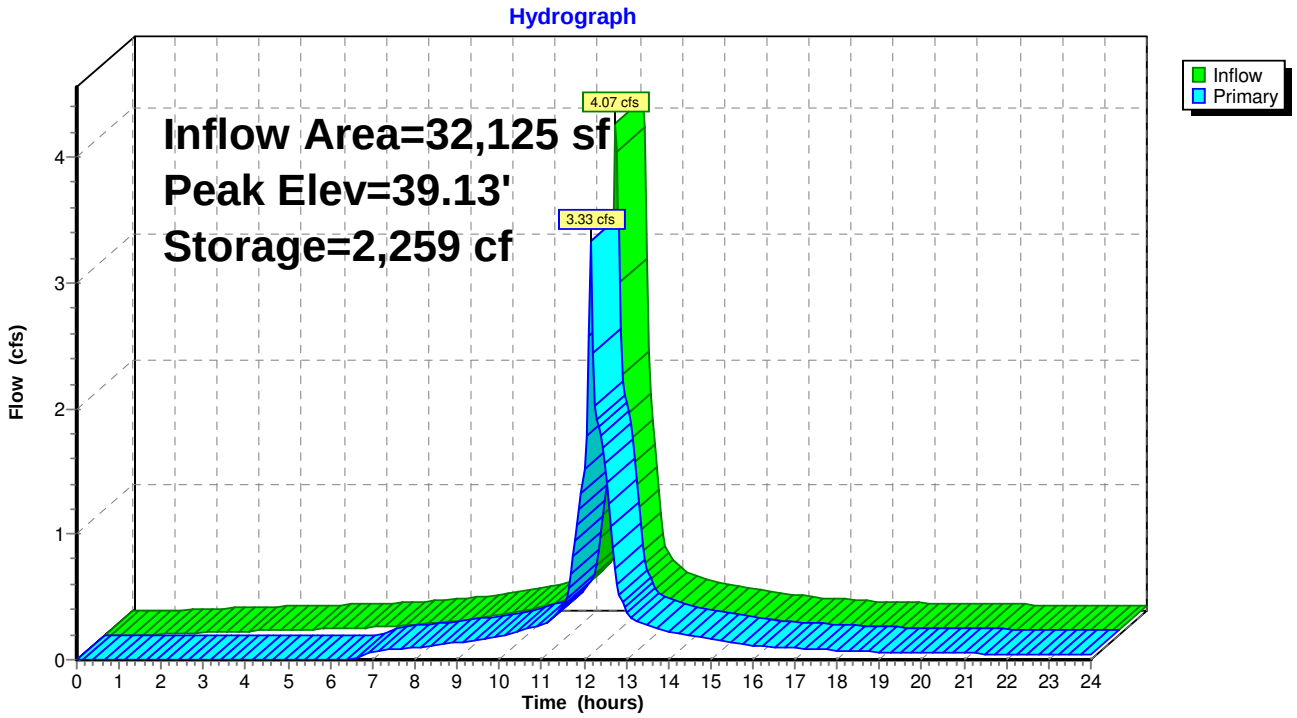
Volume	Invert	Avail.Storage	Storage Description
#1	35.00'	3,463 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
35.00	110	0	0	110
36.00	257	178	178	264
37.00	476	361	539	493
38.00	768	616	1,156	798
39.00	1,139	947	2,103	1,185
40.00	1,593	1,360	3,463	1,657

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round RCP_Round 12"** L= 172.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 35.28' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	37.33'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	39.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.28 cfs @ 12.15 hrs HW=39.13' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 3.28 cfs of 4.31 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.04 cfs @ 5.83 fps)
  └─**3=Orifice/Grate** (Weir Controls 1.24 cfs @ 1.18 fps)

Pond 10P: BMP 1



Summary for Pond 20Pa: BMP 2

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 5.36" for 25 yr event
Inflow = 8.86 cfs @ 12.07 hrs, Volume= 31,210 cf
Outflow = 6.18 cfs @ 12.16 hrs, Volume= 28,076 cf, Atten= 30%, Lag= 5.2 min
Primary = 6.18 cfs @ 12.16 hrs, Volume= 28,076 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 39.61' @ 12.16 hrs Surf.Area= 2,268 sf Storage= 7,653 cf

Plug-Flow detention time= 105.0 min calculated for 28,018 cf (90% of inflow)
Center-of-Mass det. time= 56.0 min (801.0 - 744.9)

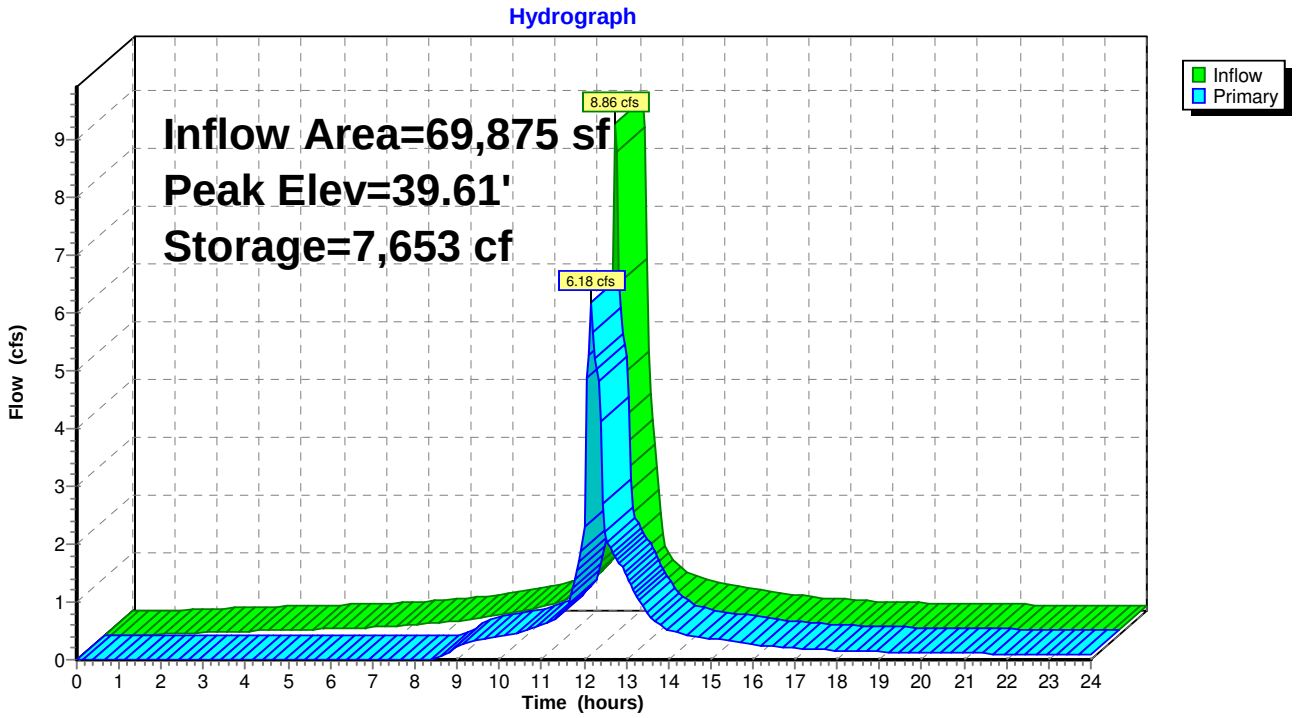
Volume	Invert	Avail.Storage	Storage Description
#1	34.00'	8,560 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
34.00	612	0	0	612
35.00	837	722	722	856
36.00	1,094	963	1,684	1,136
37.00	1,384	1,236	2,920	1,451
38.00	1,703	1,541	4,461	1,799
39.00	2,046	1,872	6,333	2,175
40.00	2,414	2,227	8,560	2,579

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round RCP_Round 12"** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	37.00'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	38.83'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	39.50'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=6.07 cfs @ 12.16 hrs HW=39.60' (Free Discharge)
- **1=RCP_Round 12"** (Barrel Controls 5.42 cfs @ 6.91 fps)
  - **2=Orifice/Grate** (Passes < 2.53 cfs potential flow)
  - **3=Orifice/Grate** (Passes < 16.92 cfs potential flow)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 0.64 cfs @ 0.79 fps)

Pond 20Pa: BMP 2



Summary for Pond 20Pb: BMP 3

Inflow Area = 19,243 sf,100.00% Impervious, Inflow Depth > 5.36" for 25 yr event
Inflow = 2.44 cfs @ 12.07 hrs, Volume= 8,595 cf
Outflow = 1.55 cfs @ 12.17 hrs, Volume= 7,910 cf, Atten= 37%, Lag= 5.9 min
Primary = 1.55 cfs @ 12.17 hrs, Volume= 7,910 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 40.18' @ 12.17 hrs Surf.Area= 1,024 sf Storage= 1,580 cf

Plug-Flow detention time= 86.2 min calculated for 7,910 cf (92% of inflow)
Center-of-Mass det. time= 44.2 min (789.1 - 744.9)

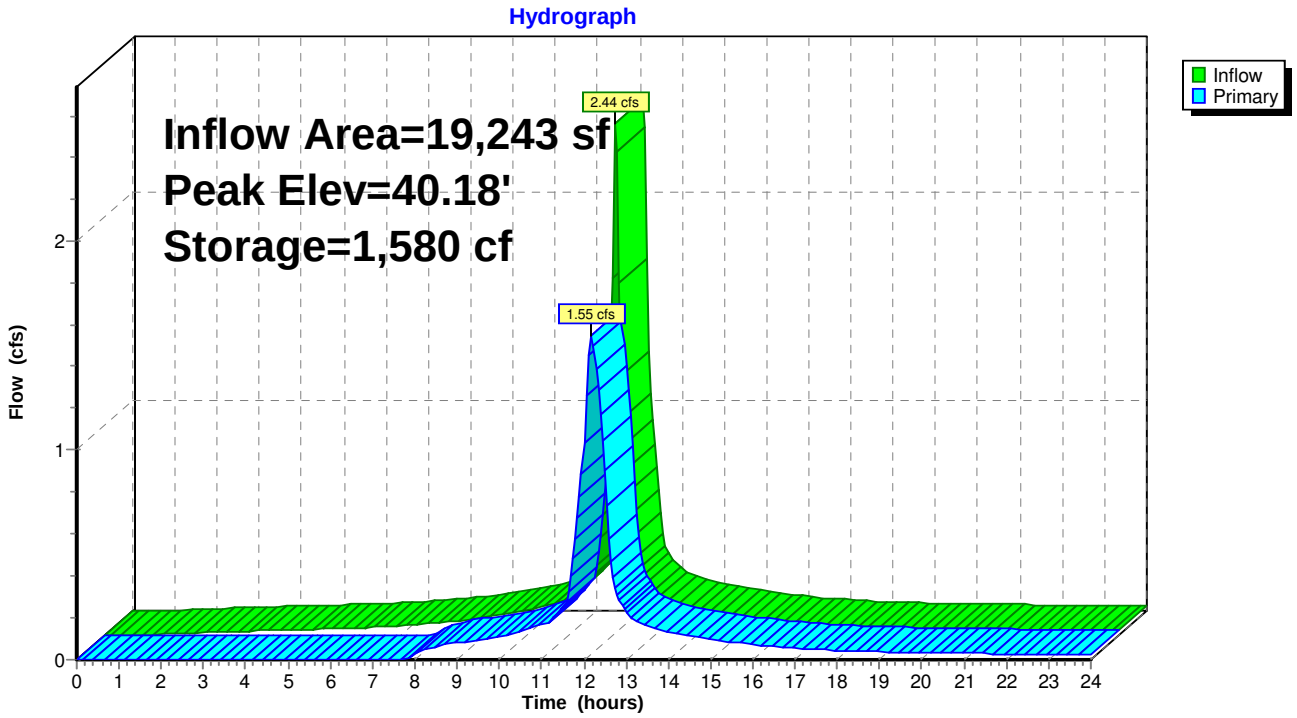
Volume	Invert	Avail.Storage	Storage Description
#1	37.00'	2,560 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
37.00	111	0	0	111
38.00	303	199	199	309
39.00	590	439	638	606
40.00	954	765	1,402	983
41.00	1,373	1,157	2,560	1,419

Device	Routing	Invert	Outlet Devices
#1	Primary	39.00'	**12.0" Round RCP_Round 12"** L= 81.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.00' / 38.00' S= 0.0122 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	39.00'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	40.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.53 cfs @ 12.17 hrs HW=40.17' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 1.53 cfs of 3.09 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.53 cfs @ 4.40 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 20Pb: BMP 3



Summary for Pond 31P: BMP 4

Inflow Area = 18,275 sf,100.00% Impervious, Inflow Depth > 5.36" for 25 yr event
Inflow = 2.32 cfs @ 12.07 hrs, Volume= 8,163 cf
Outflow = 0.26 cfs @ 12.68 hrs, Volume= 2,695 cf, Atten= 89%, Lag= 36.9 min
Primary = 0.26 cfs @ 12.68 hrs, Volume= 2,695 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 57.54' @ 12.68 hrs Surf.Area= 2,572 sf Storage= 5,572 cf

Plug-Flow detention time= 391.7 min calculated for 2,695 cf (33% of inflow)
Center-of-Mass det. time= 208.0 min (952.9 - 744.9)

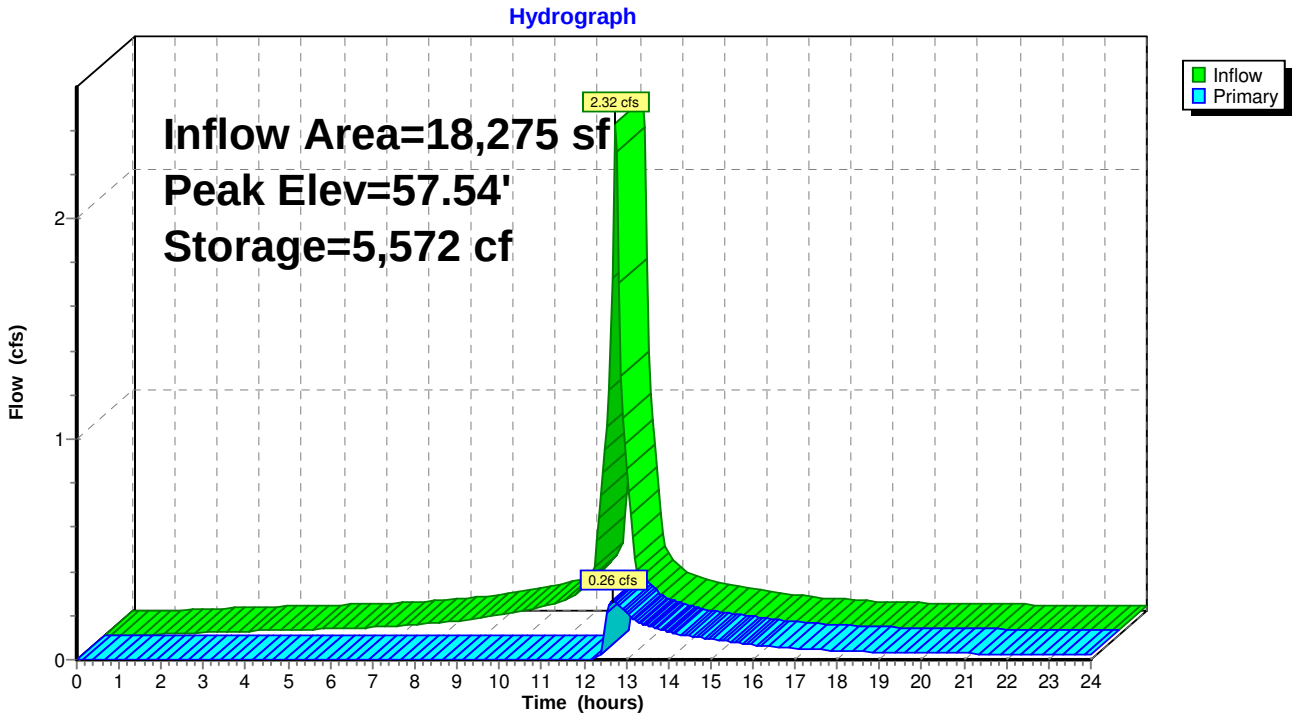
Volume	Invert	Avail.Storage	Storage Description
#1	54.00'	10,022 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
54.00	729	0	0	729
55.00	1,147	930	930	1,161
56.00	1,658	1,395	2,325	1,689
57.00	2,236	1,940	4,265	2,287
58.00	2,871	2,547	6,812	2,947
59.00	3,563	3,211	10,022	3,667

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**10.0" Round Culvert** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 55.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.55 sf
#2	Device 1	57.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	58.50'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.24 cfs @ 12.68 hrs HW=57.54' (Free Discharge)
└─**1=Culvert** (Passes 0.24 cfs of 2.69 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 0.24 cfs @ 0.69 fps)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 31P: BMP 4



Summary for Pond 32P: BMP 5A

Inflow Area =	20,867 sf,100.00% Impervious,	Inflow Depth >	5.36"	for	25 yr event
Inflow =	2.64 cfs @	12.07 hrs,	Volume=	9,320 cf	
Outflow =	1.93 cfs @	12.16 hrs,	Volume=	5,412 cf,	Atten= 27%, Lag= 5.1 min
Primary =	1.93 cfs @	12.16 hrs,	Volume=	5,412 cf	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 101.64' @ 12.16 hrs Surf.Area= 4,298 sf Storage= 4,495 cf

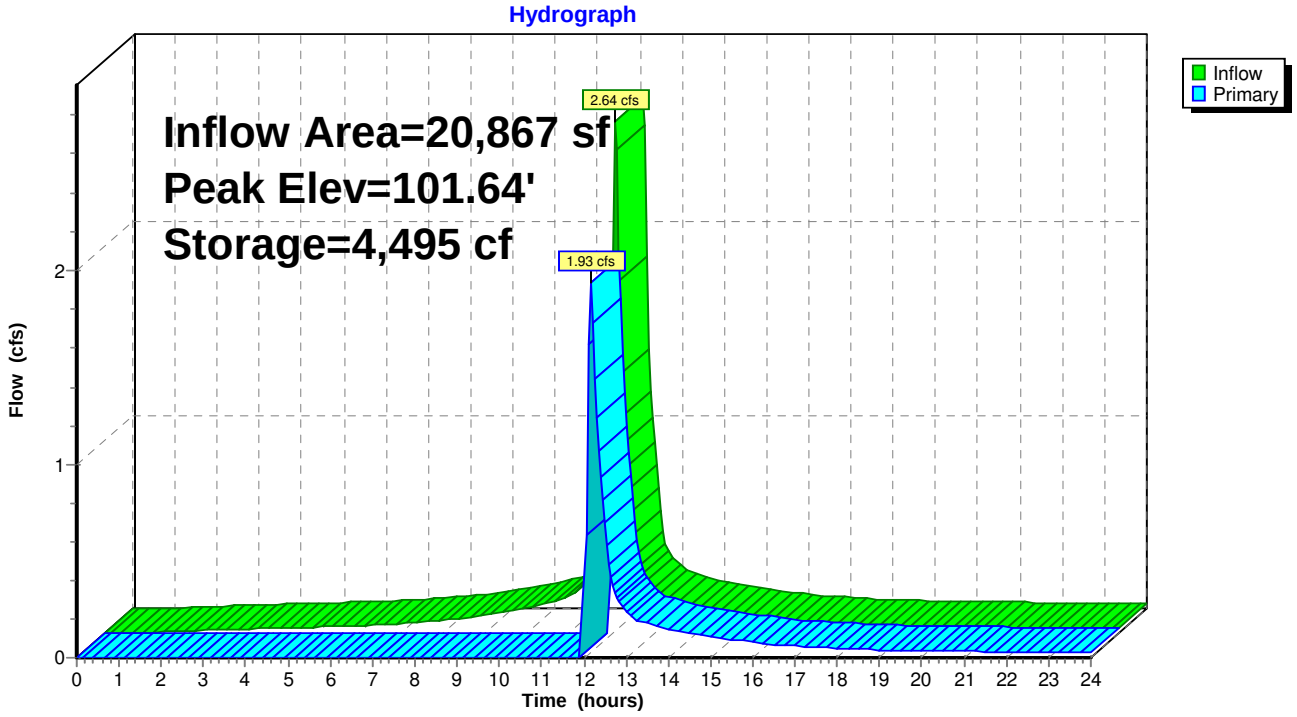
Plug-Flow detention time= 229.8 min calculated for 5,412 cf (58% of inflow)
Center-of-Mass det. time= 115.9 min (860.9 - 744.9)

Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	12,132 cf	**4.00'W x 300.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	101.50'	**13.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=1.91 cfs @ 12.16 hrs HW=101.64' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.91 cfs @ 1.02 fps)

Pond 32P: BMP 5A



Summary for Pond 33P: BMP 5B

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 3.11" for 25 yr event
Inflow = 1.93 cfs @ 12.16 hrs, Volume= 5,412 cf
Outflow = 0.09 cfs @ 15.51 hrs, Volume= 1,503 cf, Atten= 95%, Lag= 201.1 min
Primary = 0.09 cfs @ 15.51 hrs, Volume= 1,503 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 99.52' @ 15.51 hrs Surf.Area= 4,047 sf Storage= 3,955 cf

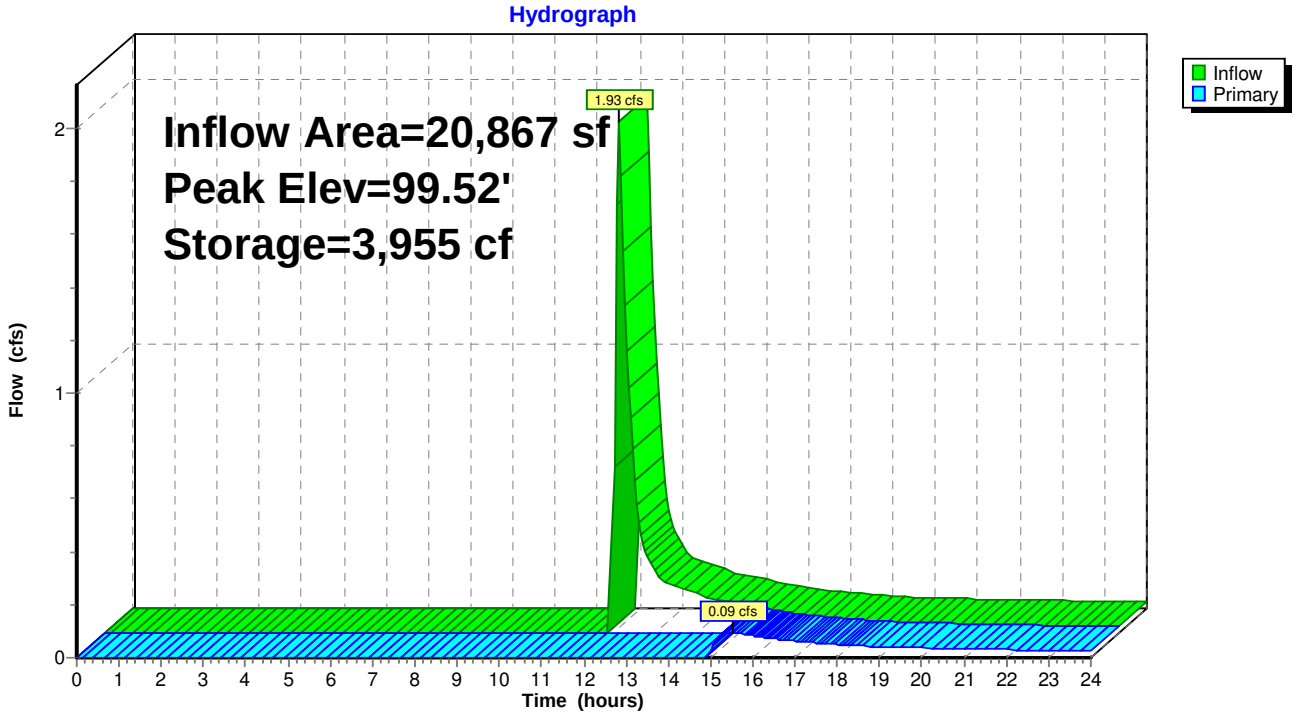
Plug-Flow detention time= 378.9 min calculated for 1,503 cf (28% of inflow)
Center-of-Mass det. time= 248.9 min (1,109.8 - 860.9)

Volume	Invert	Avail.Storage	Storage Description
#1	98.00'	12,132 cf	**4.00'W x 300.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	99.50'	**13.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.07 cfs @ 15.51 hrs HW=99.52' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.07 cfs @ 0.33 fps)

Pond 33P: BMP 5B

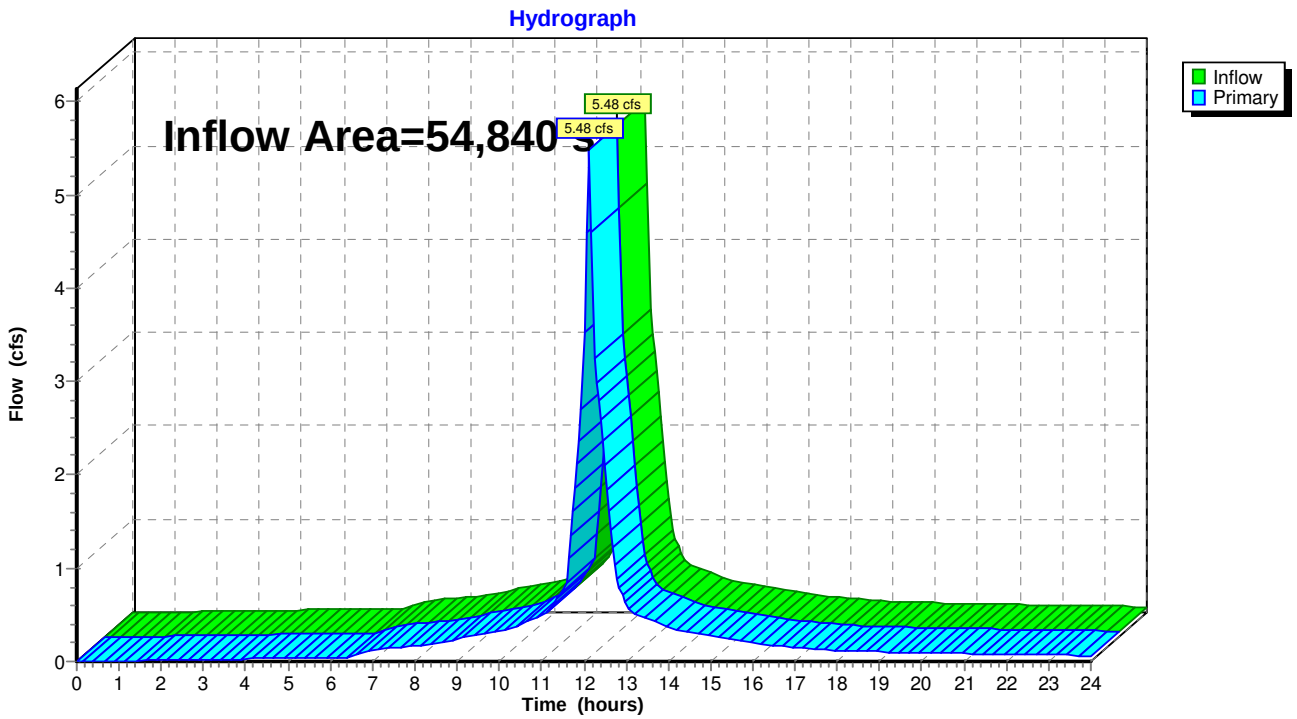


Summary for Link 10L: POI 1

Inflow Area = 54,840 sf,100.00% Impervious, Inflow Depth > 5.19" for 25 yr event
Inflow = 5.48 cfs @ 12.13 hrs, Volume= 23,726 cf
Primary = 5.48 cfs @ 12.13 hrs, Volume= 23,726 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 10L: POI 1

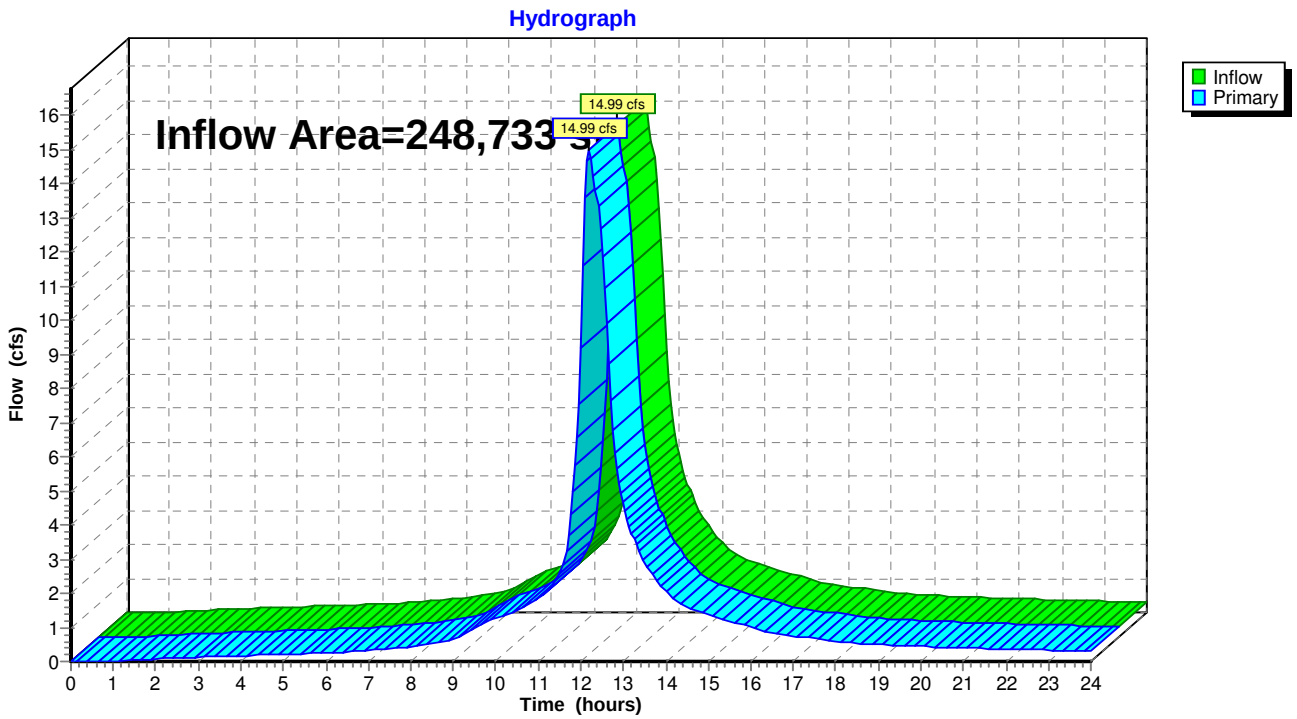


Summary for Link 20L: POI 2

Inflow Area = 248,733 sf, 99.21% Impervious, Inflow Depth > 4.89" for 25 yr event
Inflow = 14.99 cfs @ 12.20 hrs, Volume= 101,341 cf
Primary = 14.99 cfs @ 12.20 hrs, Volume= 101,341 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 20L: POI 2

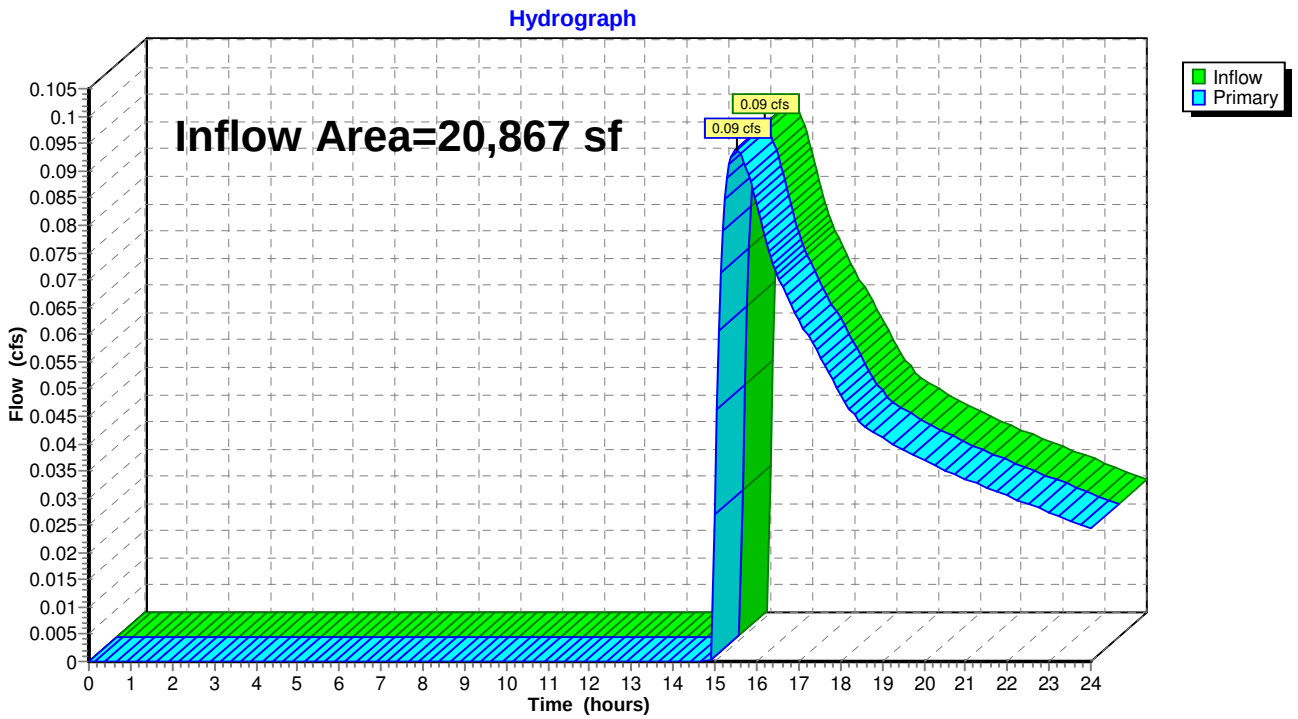


Summary for Link 30L: POI 3

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 0.86" for 25 yr event
Inflow = 0.09 cfs @ 15.51 hrs, Volume= 1,503 cf
Primary = 0.09 cfs @ 15.51 hrs, Volume= 1,503 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 30L: POI 3



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10Sa: POI 1 - OVERLAND Runoff Area=22,715 sf 100.00% Impervious Runoff Depth>5.96"
Tc=5.0 min CN=98 Runoff=3.19 cfs 11,280 cf

Subcatchment 10Sb: POI 1 - OVERLAND Runoff Area=32,125 sf 100.00% Impervious Runoff Depth>5.96"
Tc=5.0 min CN=98 Runoff=4.51 cfs 15,952 cf

Subcatchment 20Sa: POI 2 - OVERLAND Runoff Area=69,875 sf 100.00% Impervious Runoff Depth>5.96"
Tc=5.0 min CN=98 Runoff=9.81 cfs 34,698 cf

Subcatchment 20Sb: POI 3 - SLIP RAMP Runoff Area=27,151 sf 100.00% Impervious Runoff Depth>5.96"
Tc=5.0 min CN=98 Runoff=3.81 cfs 13,482 cf

Subcatchment 20Sc: POI 2 - OVERLAND Runoff Area=114,189 sf 98.28% Impervious Runoff Depth>5.95"
Flow Length=957' Slope=0.0094 '/' Tc=14.9 min CN=98 Runoff=12.14 cfs 56,625 cf

Subcatchment 20Sd: POI 2 - OVERLAND Runoff Area=19,243 sf 100.00% Impervious Runoff Depth>5.96"
Tc=5.0 min CN=98 Runoff=2.70 cfs 9,556 cf

Subcatchment 20Se: POI 2 - ROUTE 24 Runoff Area=18,275 sf 100.00% Impervious Runoff Depth>5.96"
Tc=5.0 min CN=98 Runoff=2.57 cfs 9,075 cf

Subcatchment 30S: POI 3 - OVERLAND Runoff Area=20,867 sf 100.00% Impervious Runoff Depth>5.96"
Tc=5.0 min CN=98 Runoff=2.93 cfs 10,362 cf

Reach 20Ra1: Grassed Channel Avg. Flow Depth=0.33' Max Vel=3.23 fps Inflow=7.48 cfs 31,552 cf
n=0.022 L=436.0' S=0.0161 '/' Capacity=16.40 cfs Outflow=6.92 cfs 31,488 cf

Reach 20Ra2: Natural Stream Avg. Flow Depth=0.35' Max Vel=1.37 fps Inflow=6.92 cfs 31,488 cf
n=0.040 L=600.0' S=0.0100 '/' Capacity=12.48 cfs Outflow=5.80 cfs 31,304 cf

Reach 20Rb: Natural Stream Avg. Flow Depth=0.16' Max Vel=1.01 fps Inflow=1.66 cfs 8,868 cf
n=0.040 L=1,006.0' S=0.0129 '/' Capacity=14.18 cfs Outflow=1.36 cfs 8,746 cf

Reach 32R: Natural Stream Avg. Flow Depth=0.11' Max Vel=0.70 fps Inflow=0.72 cfs 3,606 cf
n=0.040 L=400.0' S=0.0100 '/' Capacity=12.48 cfs Outflow=0.52 cfs 3,554 cf

Pond 10P: BMP 1 Peak Elev=39.19' Storage=2,330 cf Inflow=4.51 cfs 15,952 cf
Outflow=4.06 cfs 15,181 cf

Pond 20Pa: BMP 2 Peak Elev=39.71' Storage=7,875 cf Inflow=9.81 cfs 34,698 cf
Outflow=7.48 cfs 31,552 cf

Pond 20Pb: BMP 3 Peak Elev=40.30' Storage=1,711 cf Inflow=2.70 cfs 9,556 cf
Outflow=1.66 cfs 8,868 cf

Pond 31P: BMP 4 Peak Elev=57.59' Storage=5,690 cf Inflow=2.57 cfs 9,075 cf
Outflow=0.72 cfs 3,606 cf

Pond 32P: BMP 5A Peak Elev=101.67' Storage=4,592 cf Inflow=2.93 cfs 10,362 cf
Outflow=2.40 cfs 6,452 cf

Pond 33P: BMP 5B Peak Elev=99.53' Storage=4,005 cf Inflow=2.40 cfs 6,452 cf
Outflow=0.17 cfs 2,542 cf

Link 10L: POI 1 Inflow=6.93 cfs 26,460 cf
Primary=6.93 cfs 26,460 cf

Link 20L: POI 2 Inflow=16.94 cfs 113,712 cf
Primary=16.94 cfs 113,712 cf

Link 30L: POI 3 Inflow=0.17 cfs 2,542 cf
Primary=0.17 cfs 2,542 cf

Total Runoff Area = 324,440 sf Runoff Volume = 161,030 cf Average Runoff Depth = 5.96"
0.61% Pervious = 1,968 sf 99.39% Impervious = 322,472 sf

Summary for Subcatchment 10Sa: POI 1 - OVERLAND DIRECT DISCHARGE

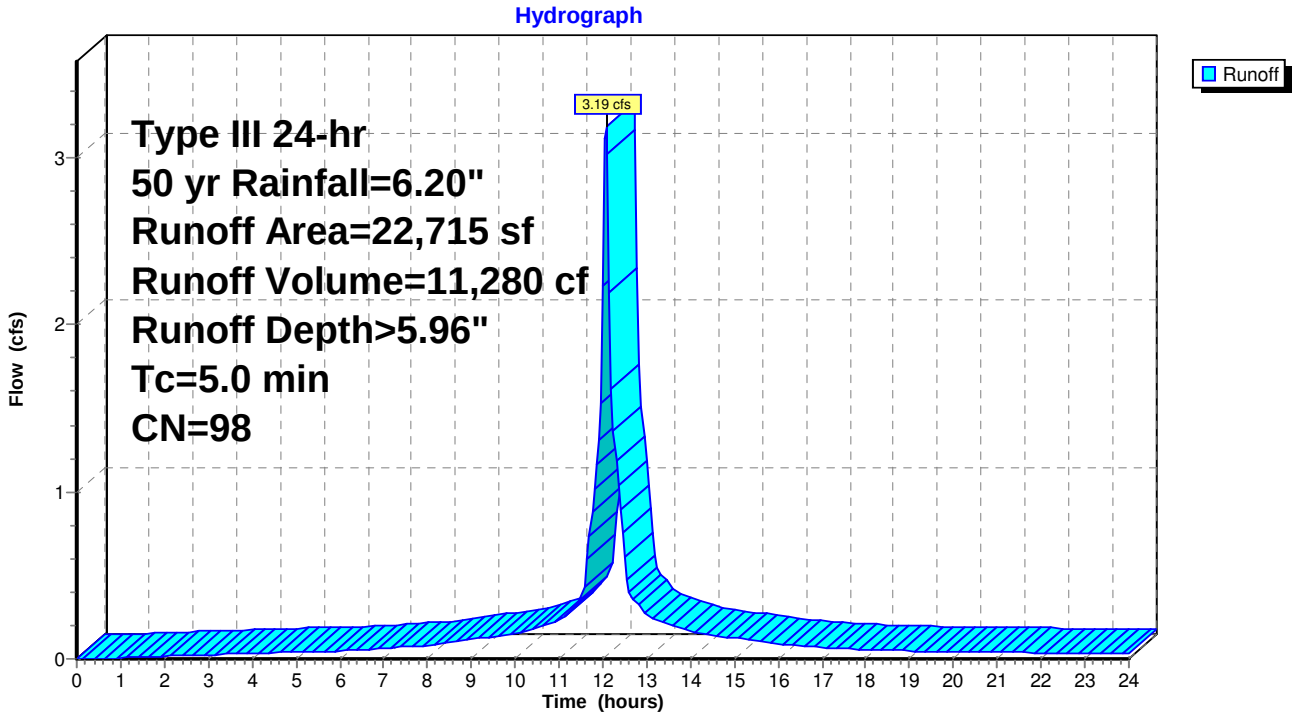
Runoff = 3.19 cfs @ 12.07 hrs, Volume= 11,280 cf, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
22,715	98	Paved roads w/curbs & sewers, HSG C
22,715		100.00% Impervious Area

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

Subcatchment 10Sa: POI 1 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 10Sb: POI 1 - OVERLAND TO BMP 1

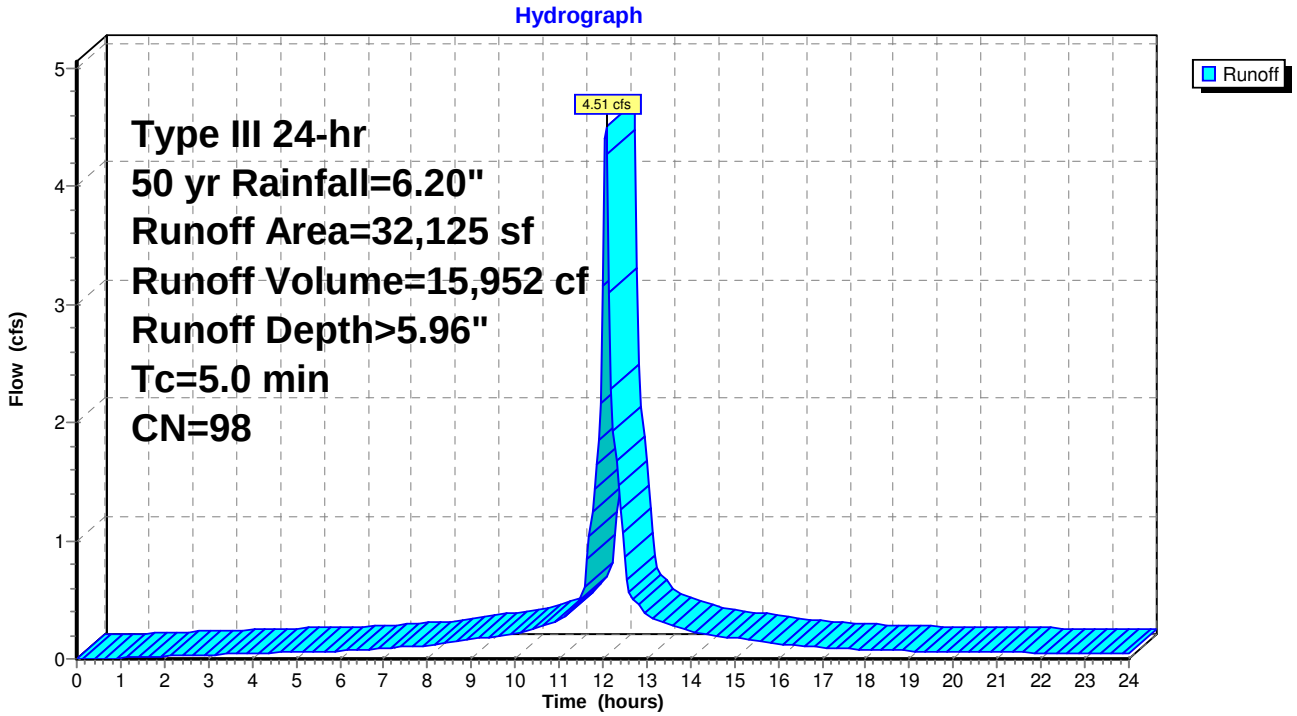
Runoff = 4.51 cfs @ 12.07 hrs, Volume= 15,952 cf, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
32,125	98	Paved roads w/curbs & sewers, HSG C
32,125		100.00% Impervious Area

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

Subcatchment 10Sb: POI 1 - OVERLAND TO BMP 1



Summary for Subcatchment 20Sa: POI 2 - OVERLAND TO BMP 2

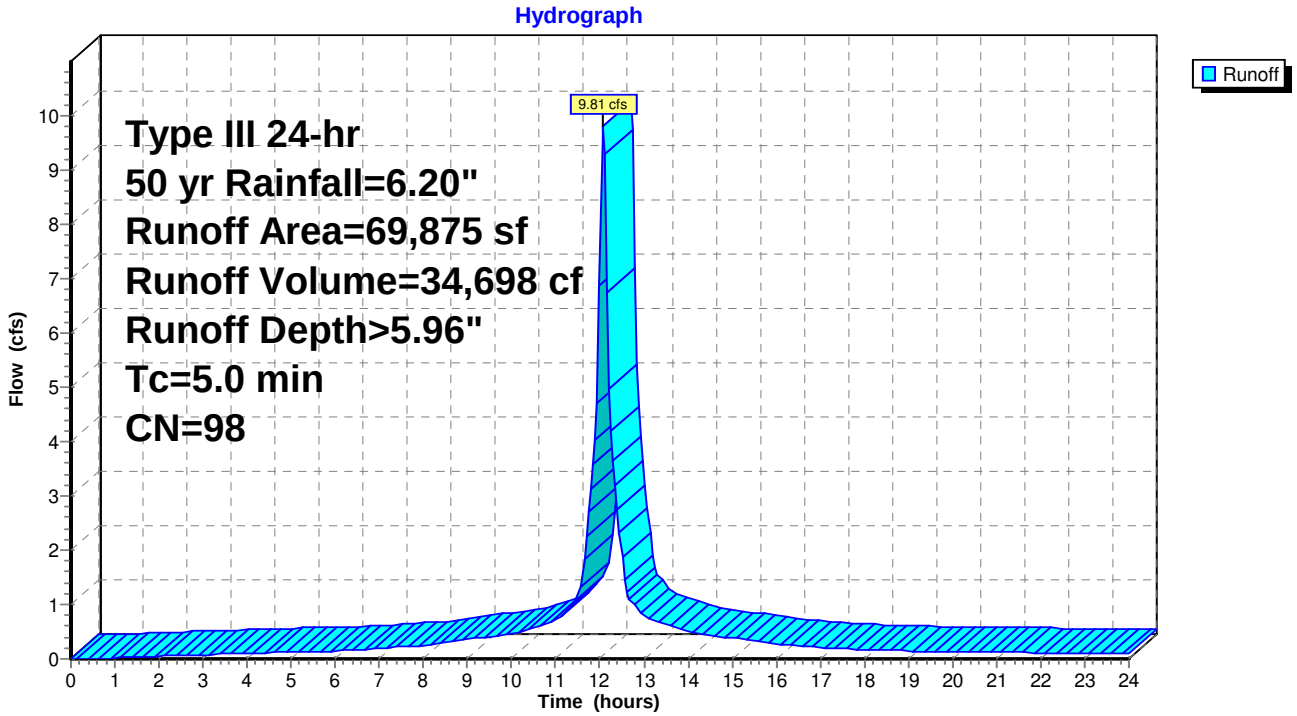
Runoff = 9.81 cfs @ 12.07 hrs, Volume= 34,698 cf, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
69,875	98	Paved roads w/curbs & sewers, HSG C
69,875		100.00% Impervious Area

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

Subcatchment 20Sa: POI 2 - OVERLAND TO BMP 2



Summary for Subcatchment 20Sb: POI 3 - SLIP RAMP POST DEVELOPMENT

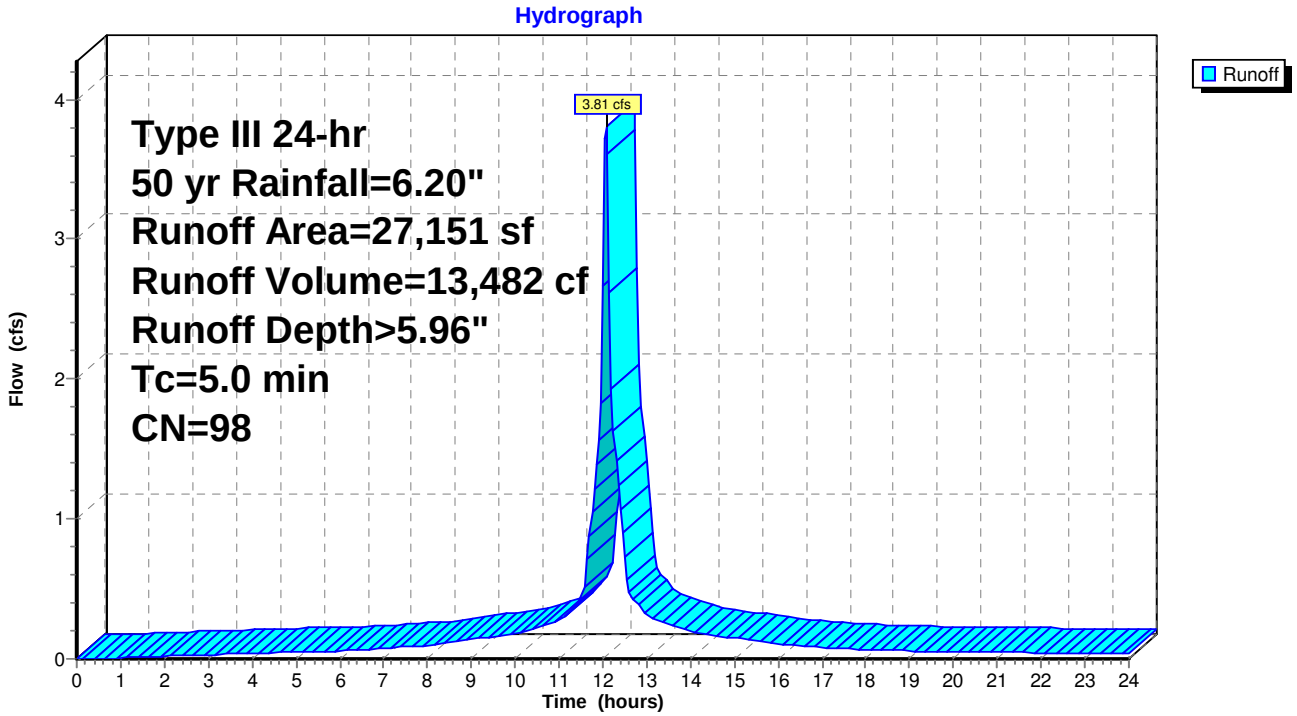
Runoff = 3.81 cfs @ 12.07 hrs, Volume= 13,482 cf, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
27,151	98	Paved roads w/curbs & sewers, HSG D
27,151		100.00% Impervious Area

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

Subcatchment 20Sb: POI 3 - SLIP RAMP POST DEVELOPMENT



Summary for Subcatchment 20Sc: POI 2 - OVERLAND DIRECT DISCHARGE

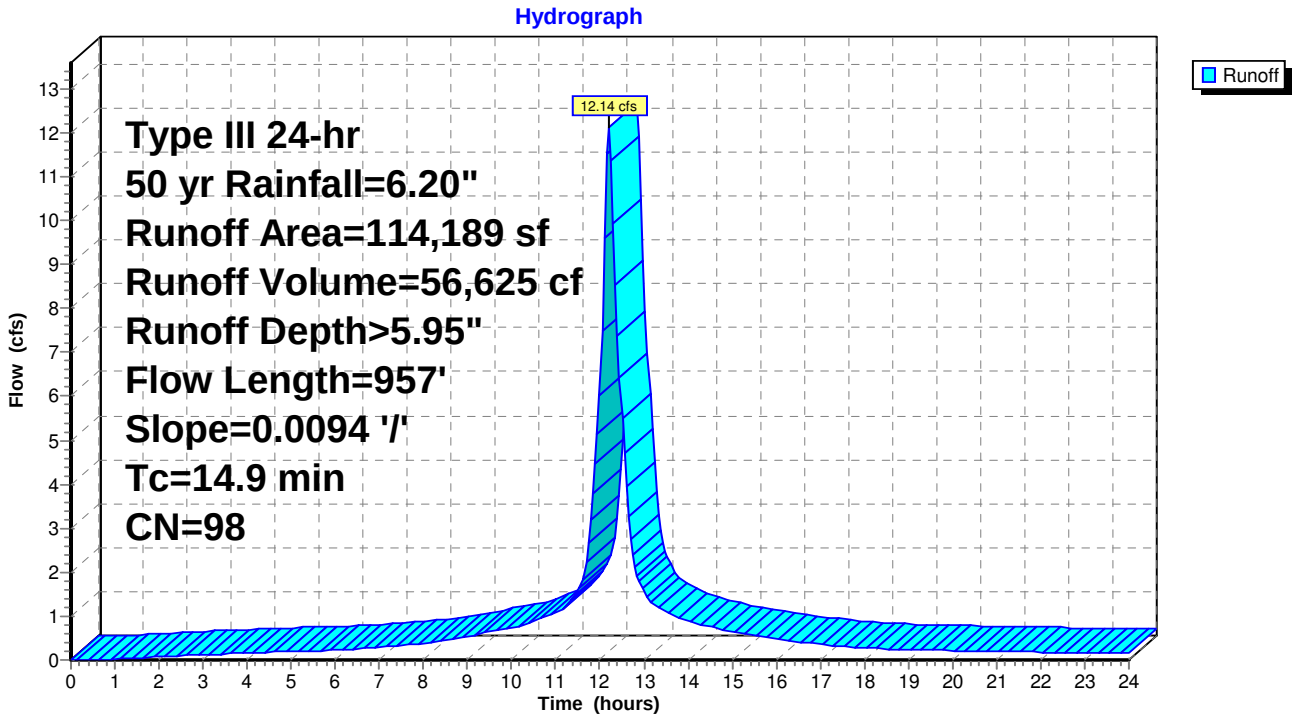
Runoff = 12.14 cfs @ 12.20 hrs, Volume= 56,625 cf, Depth> 5.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
103,199	98	Paved roads w/curbs & sewers, HSG C
1,968	79	50-75% Grass cover, Fair, HSG C
7,934	98	Paved roads w/curbs & sewers, HSG D
1,088	98	Paved roads w/curbs & sewers, HSG B
114,189	98	Weighted Average
1,968		1.72% Pervious Area
112,221		98.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
9.9	957	0.0094	1.61	12.11	**Channel Flow, Natural Stream** Area= 7.5 sf Perim= 25.0' r= 0.30' n= 0.040 Winding stream
14.9	957	Total			

Subcatchment 20Sc: POI 2 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 20Sd: POI 2 - OVERLAND TO BMP 3

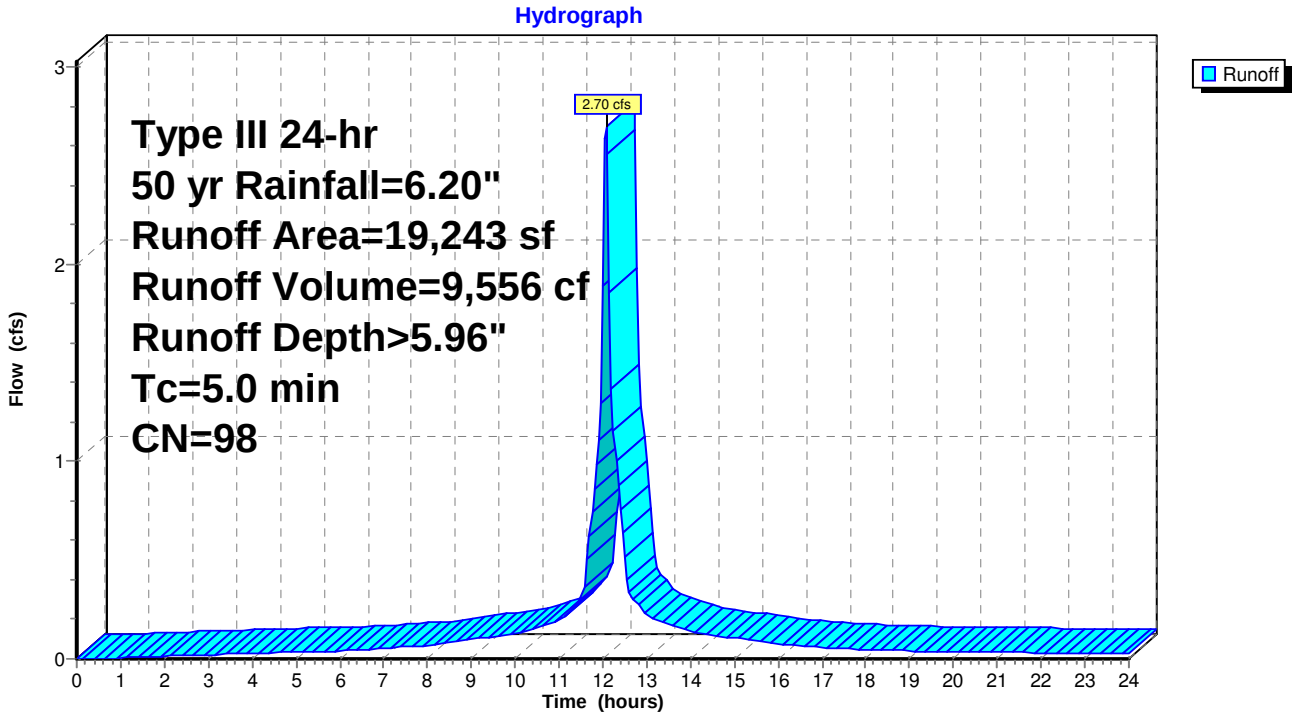
Runoff = 2.70 cfs @ 12.07 hrs, Volume= 9,556 cf, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
19,243	98	Paved roads w/curbs & sewers, HSG C
19,243		100.00% Impervious Area

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

Subcatchment 20Sd: POI 2 - OVERLAND TO BMP 3



Summary for Subcatchment 20Se: POI 2 - ROUTE 24

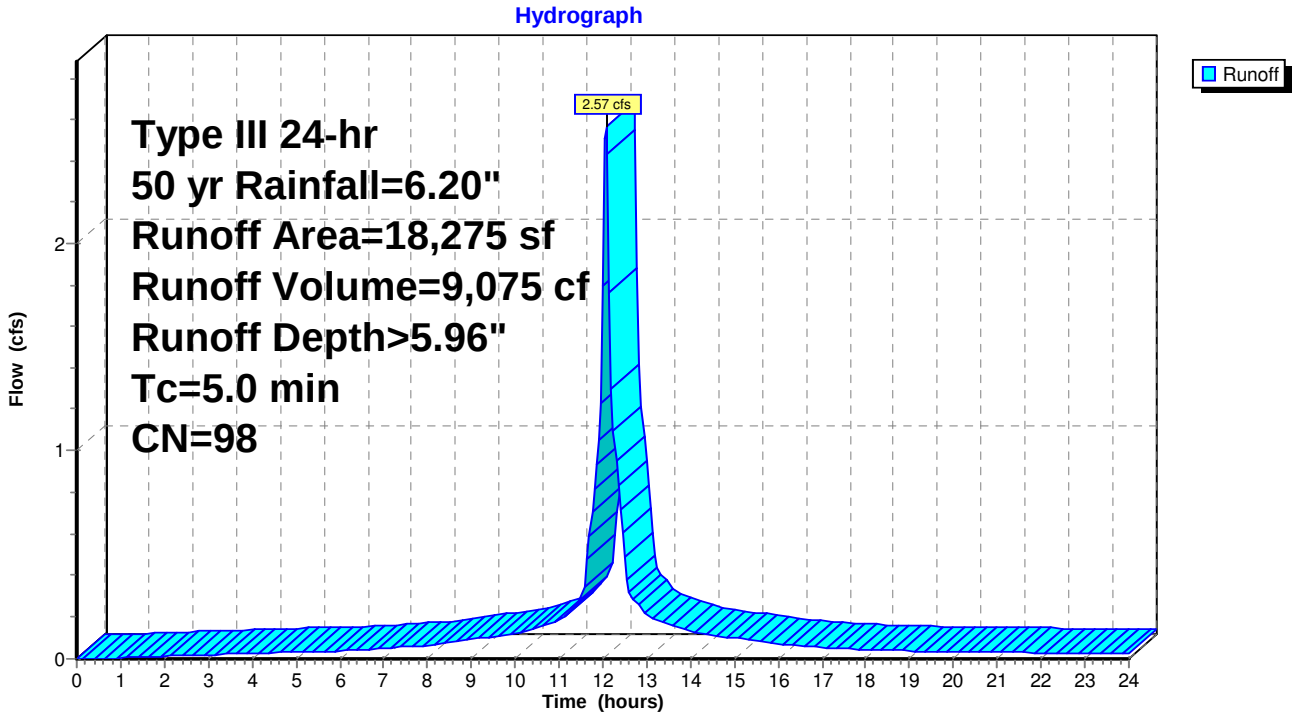
Runoff = 2.57 cfs @ 12.07 hrs, Volume= 9,075 cf, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
18,275	98	Paved roads w/curbs & sewers, HSG C
18,275		100.00% Impervious Area

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

Subcatchment 20Se: POI 2 - ROUTE 24



Summary for Subcatchment 30S: POI 3 - OVERLAND DIRECT DISCHARGE

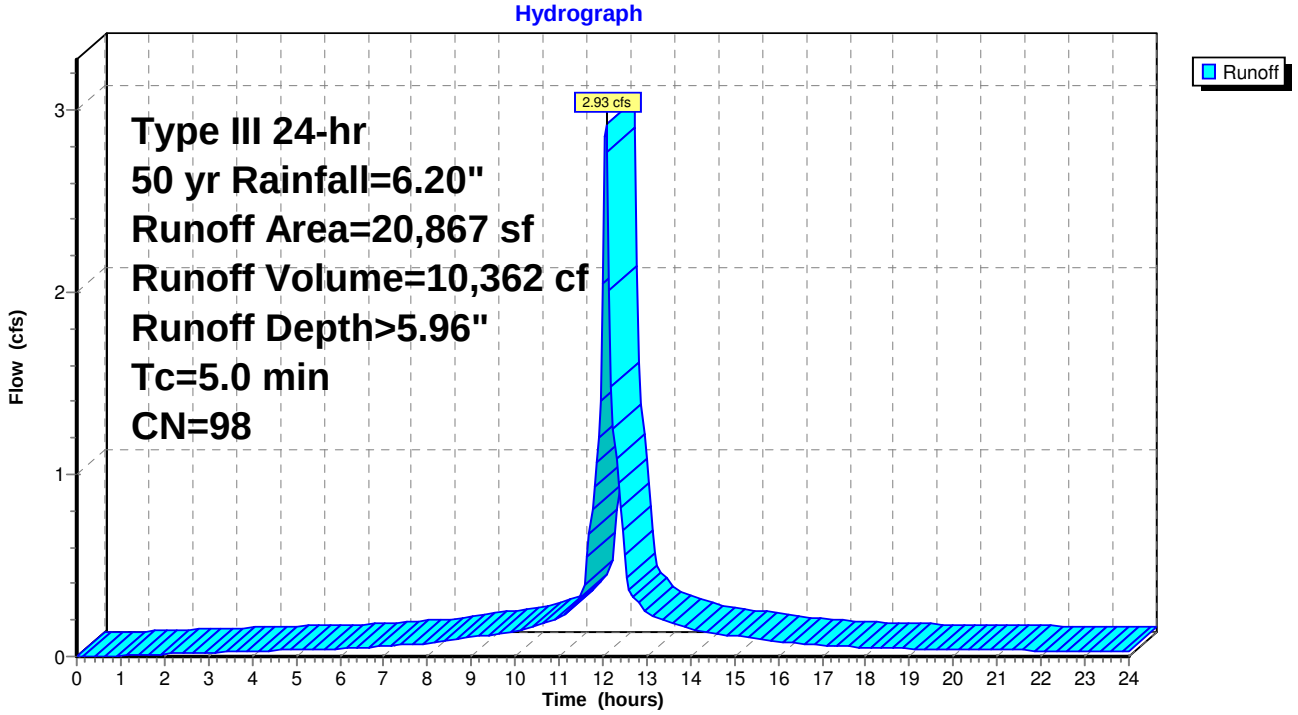
Runoff = 2.93 cfs @ 12.07 hrs, Volume= 10,362 cf, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 yr Rainfall=6.20"

Area (sf)	CN	Description
8,256	98	Paved roads w/curbs & sewers, HSG D
12,611	98	Paved roads w/curbs & sewers, HSG B
20,867	98	Weighted Average
20,867		100.00% Impervious Area

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

Subcatchment 30S: POI 3 - OVERLAND DIRECT DISCHARGE



Summary for Reach 20Ra1: Grassed Channel

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 5.42" for 50 yr event
Inflow = 7.48 cfs @ 12.15 hrs, Volume= 31,552 cf
Outflow = 6.92 cfs @ 12.22 hrs, Volume= 31,488 cf, Atten= 8%, Lag= 4.0 min

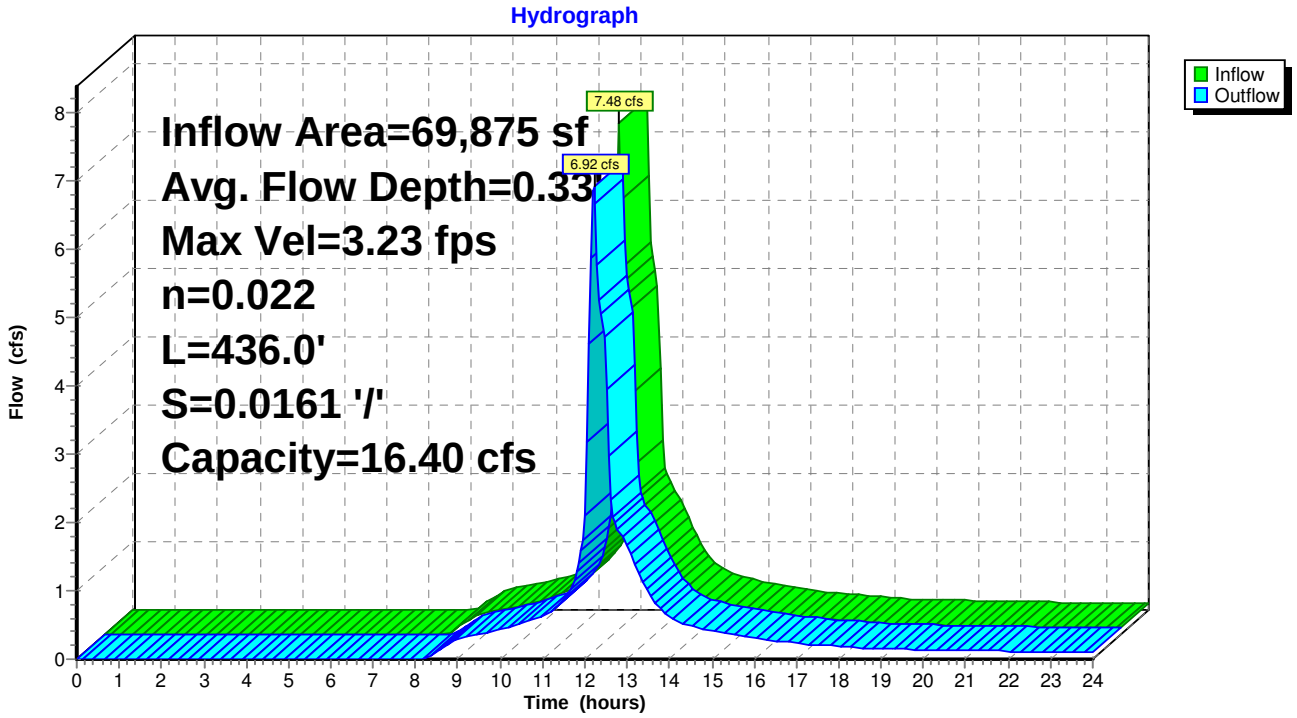
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.23 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 1.23 fps, Avg. Travel Time= 5.9 min

Peak Storage= 943 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 0.50' Flow Area= 4.0 sf, Capacity= 16.40 cfs

4.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 8.0 '/' Top Width= 12.00'
Length= 436.0' Slope= 0.0161 '/'
Inlet Invert= 36.00', Outlet Invert= 29.00'

‡

Reach 20Ra1: Grassed Channel



Summary for Reach 20Ra2: Natural Stream

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 5.41" for 50 yr event
Inflow = 6.92 cfs @ 12.22 hrs, Volume= 31,488 cf
Outflow = 5.80 cfs @ 12.43 hrs, Volume= 31,304 cf, Atten= 16%, Lag= 12.9 min

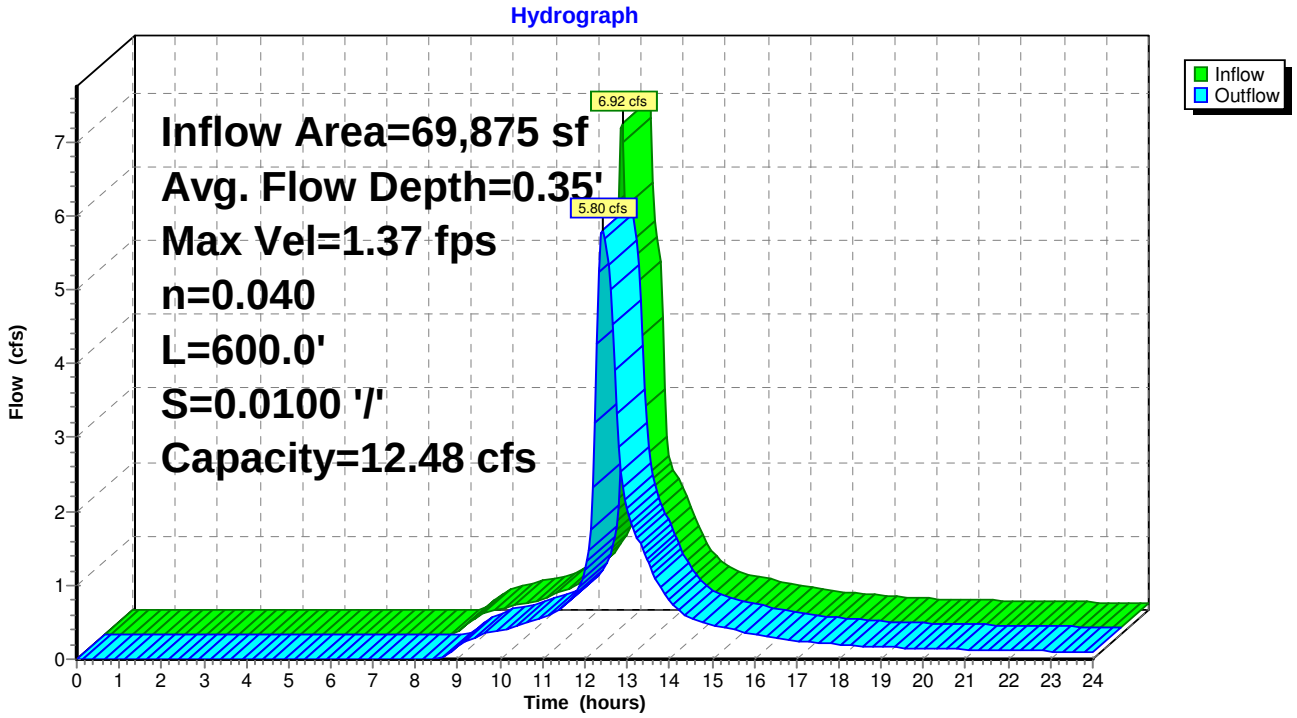
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.37 fps, Min. Travel Time= 7.3 min
Avg. Velocity = 0.60 fps, Avg. Travel Time= 16.7 min

Peak Storage= 2,576 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 12.48 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 600.0' Slope= 0.0100 '/'
Inlet Invert= 29.00', Outlet Invert= 23.00'

‡

Reach 20Ra2: Natural Stream



Summary for Reach 20Rb: Natural Stream

Inflow Area = 19,243 sf,100.00% Impervious, Inflow Depth > 5.53" for 50 yr event
Inflow = 1.66 cfs @ 12.17 hrs, Volume= 8,868 cf
Outflow = 1.36 cfs @ 12.66 hrs, Volume= 8,746 cf, Atten= 18%, Lag= 29.0 min

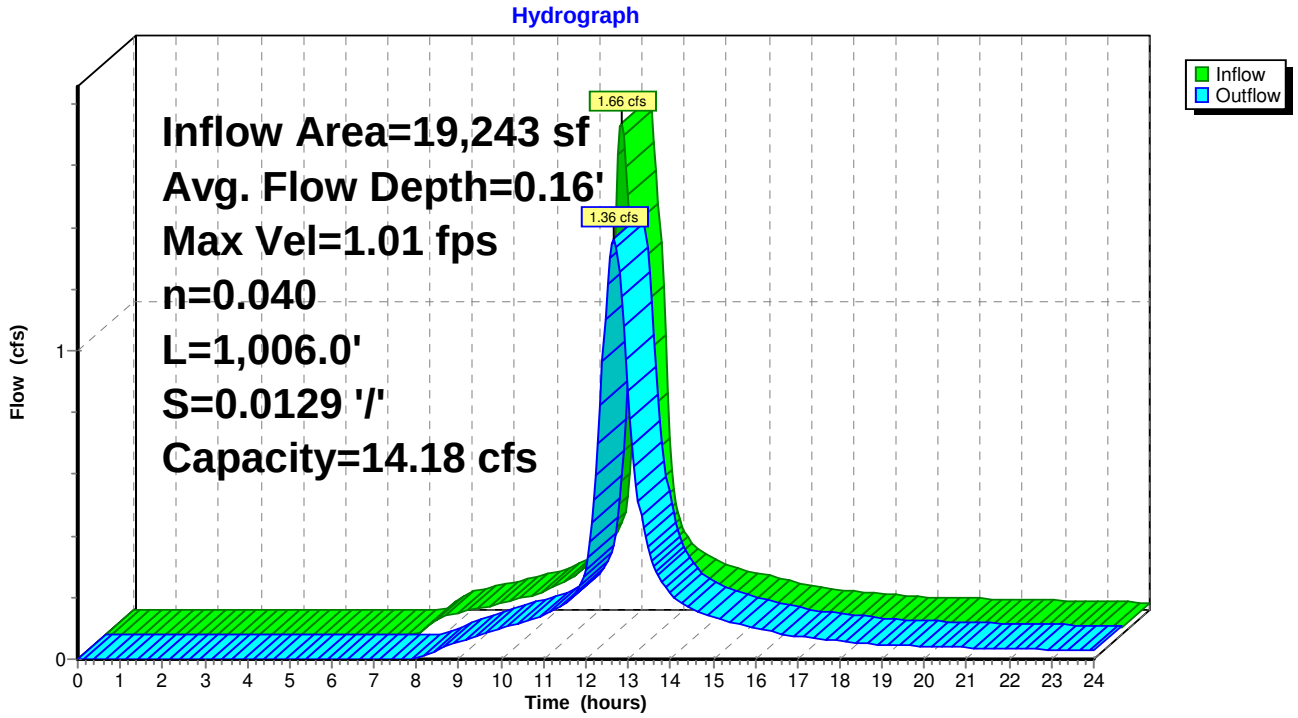
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.01 fps, Min. Travel Time= 16.6 min
Avg. Velocity = 0.43 fps, Avg. Travel Time= 39.4 min

Peak Storage= 1,359 cf @ 12.38 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 14.18 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 1,006.0' Slope= 0.0129 '/'
Inlet Invert= 36.00', Outlet Invert= 23.00'

‡

Reach 20Rb: Natural Stream



Summary for Reach 32R: Natural Stream

Inflow Area = 18,275 sf,100.00% Impervious, Inflow Depth > 2.37" for 50 yr event
Inflow = 0.72 cfs @ 12.41 hrs, Volume= 3,606 cf
Outflow = 0.52 cfs @ 12.71 hrs, Volume= 3,554 cf, Atten= 27%, Lag= 18.1 min

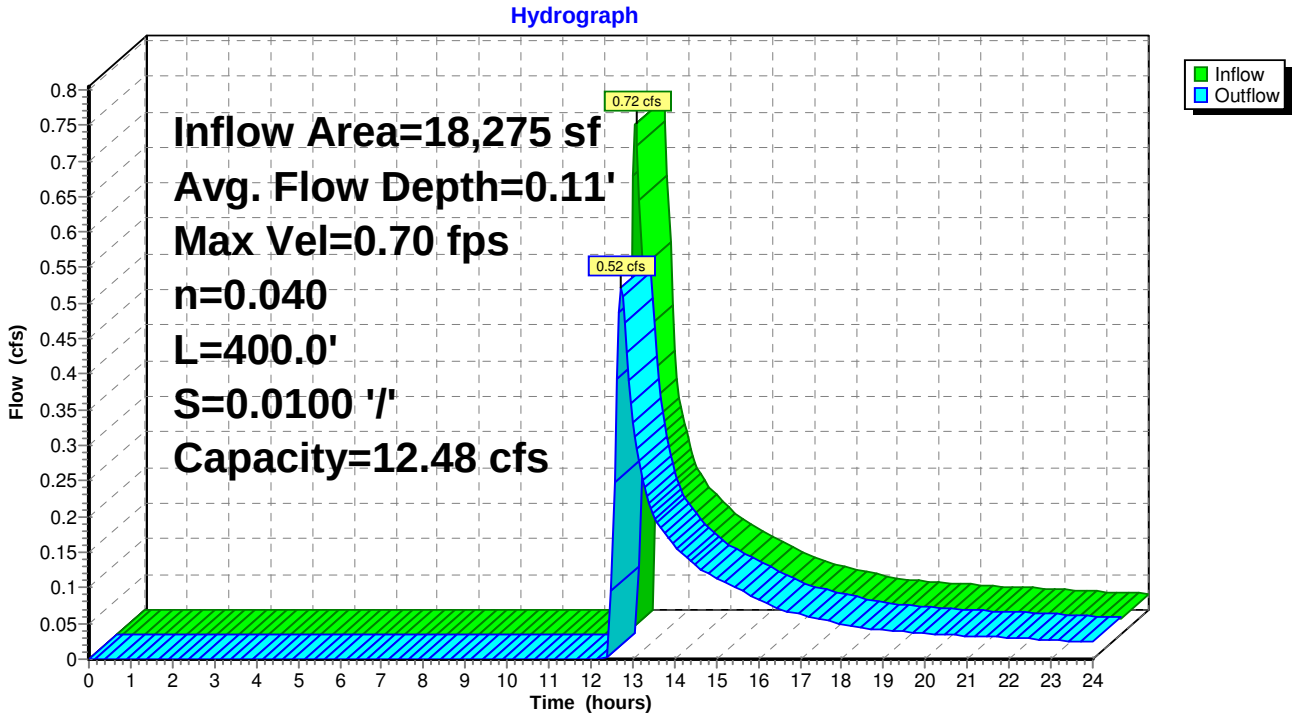
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.70 fps, Min. Travel Time= 9.6 min
Avg. Velocity = 0.35 fps, Avg. Travel Time= 18.9 min

Peak Storage= 301 cf @ 12.55 hrs
Average Depth at Peak Storage= 0.11'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 12.48 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 400.0' Slope= 0.0100 '/'
Inlet Invert= 27.00', Outlet Invert= 23.00'

‡

Reach 32R: Natural Stream



Summary for Pond 10P: BMP 1

Inflow Area = 32,125 sf,100.00% Impervious, Inflow Depth > 5.96" for 50 yr event
Inflow = 4.51 cfs @ 12.07 hrs, Volume= 15,952 cf
Outflow = 4.06 cfs @ 12.12 hrs, Volume= 15,181 cf, Atten= 10%, Lag= 3.0 min
Primary = 4.06 cfs @ 12.12 hrs, Volume= 15,181 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 39.19' @ 12.12 hrs Surf.Area= 1,221 sf Storage= 2,330 cf

Plug-Flow detention time= 60.0 min calculated for 15,149 cf (95% of inflow)
Center-of-Mass det. time= 32.1 min (775.6 - 743.4)

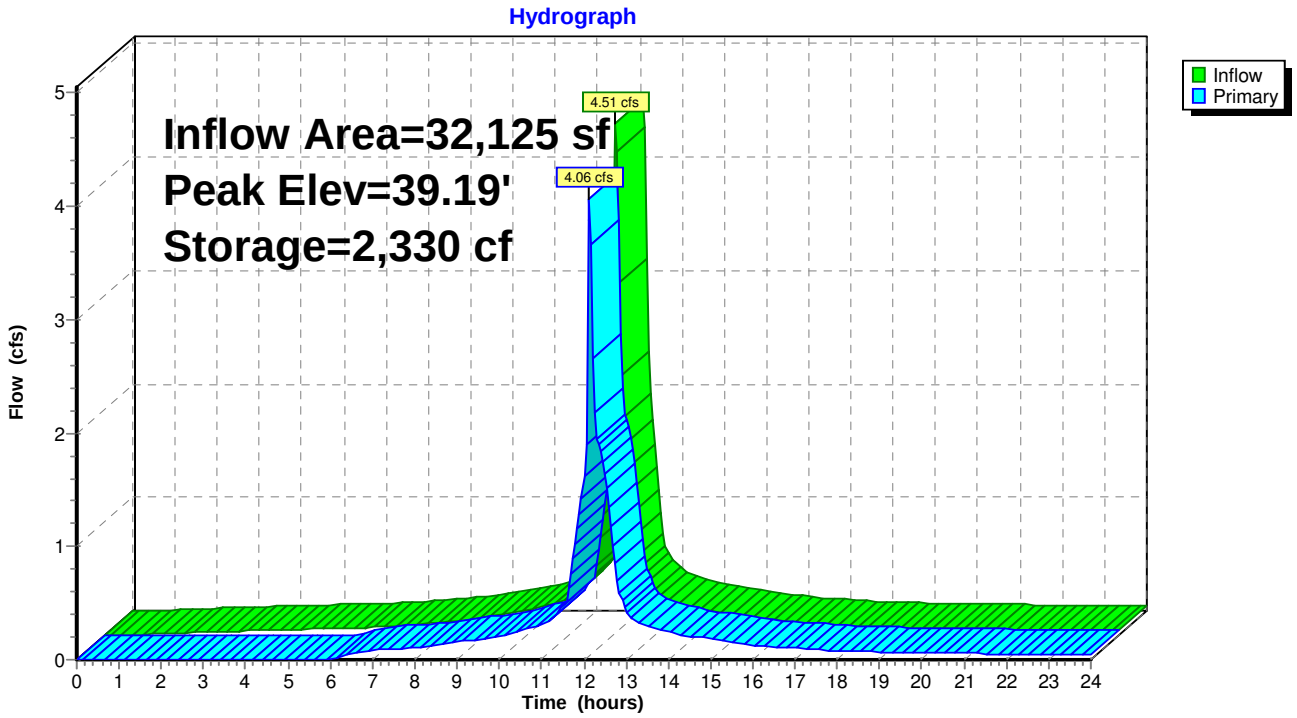
Volume	Invert	Avail.Storage	Storage Description
#1	35.00'	3,463 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
35.00	110	0	0	110
36.00	257	178	178	264
37.00	476	361	539	493
38.00	768	616	1,156	798
39.00	1,139	947	2,103	1,185
40.00	1,593	1,360	3,463	1,657

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round RCP_Round 12"** L= 172.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 35.28' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	37.33'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	39.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.80 cfs @ 12.12 hrs HW=39.16' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 3.80 cfs of 4.33 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.06 cfs @ 5.90 fps)
  └─**3=Orifice/Grate** (Weir Controls 1.74 cfs @ 1.33 fps)

Pond 10P: BMP 1



Summary for Pond 20Pa: BMP 2

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 5.96" for 50 yr event
Inflow = 9.81 cfs @ 12.07 hrs, Volume= 34,698 cf
Outflow = 7.48 cfs @ 12.15 hrs, Volume= 31,552 cf, Atten= 24%, Lag= 4.8 min
Primary = 7.48 cfs @ 12.15 hrs, Volume= 31,552 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 39.71' @ 12.15 hrs Surf.Area= 2,304 sf Storage= 7,875 cf

Plug-Flow detention time= 99.4 min calculated for 31,552 cf (91% of inflow)
Center-of-Mass det. time= 53.1 min (796.6 - 743.4)

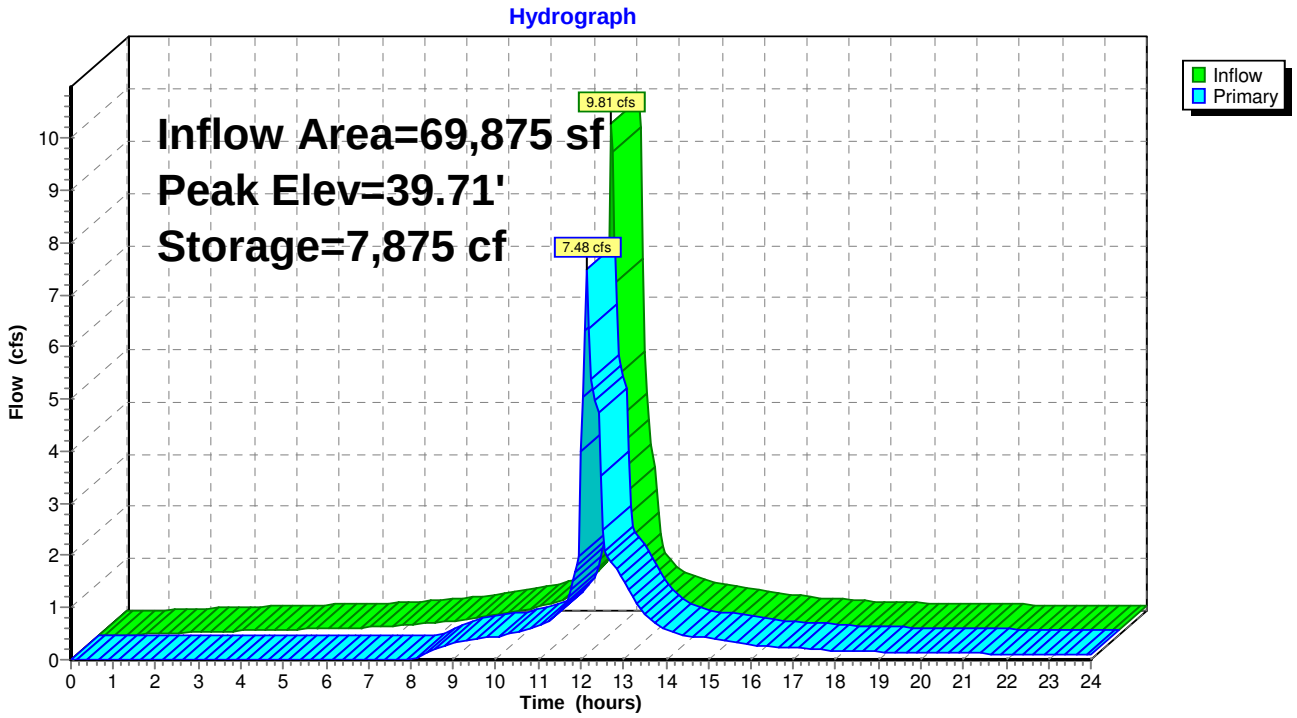
Volume	Invert	Avail.Storage	Storage Description
#1	34.00'	8,560 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
34.00	612	0	0	612
35.00	837	722	722	856
36.00	1,094	963	1,684	1,136
37.00	1,384	1,236	2,920	1,451
38.00	1,703	1,541	4,461	1,799
39.00	2,046	1,872	6,333	2,175
40.00	2,414	2,227	8,560	2,579

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round RCP_Round 12"** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	37.00'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	38.83'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	39.50'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=7.46 cfs @ 12.15 hrs HW=39.71' (Free Discharge)
- **1=RCP_Round 12"** (Barrel Controls 5.56 cfs @ 7.08 fps)
  - **2=Orifice/Grate** (Passes < 2.59 cfs potential flow)
  - **3=Orifice/Grate** (Passes < 18.05 cfs potential flow)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 1.90 cfs @ 1.14 fps)

Pond 20Pa: BMP 2



Summary for Pond 20Pb: BMP 3

Inflow Area = 19,243 sf,100.00% Impervious, Inflow Depth > 5.96" for 50 yr event
Inflow = 2.70 cfs @ 12.07 hrs, Volume= 9,556 cf
Outflow = 1.66 cfs @ 12.17 hrs, Volume= 8,868 cf, Atten= 39%, Lag= 6.1 min
Primary = 1.66 cfs @ 12.17 hrs, Volume= 8,868 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 40.30' @ 12.17 hrs Surf.Area= 1,074 sf Storage= 1,711 cf

Plug-Flow detention time= 80.4 min calculated for 8,850 cf (93% of inflow)
Center-of-Mass det. time= 42.0 min (785.4 - 743.4)

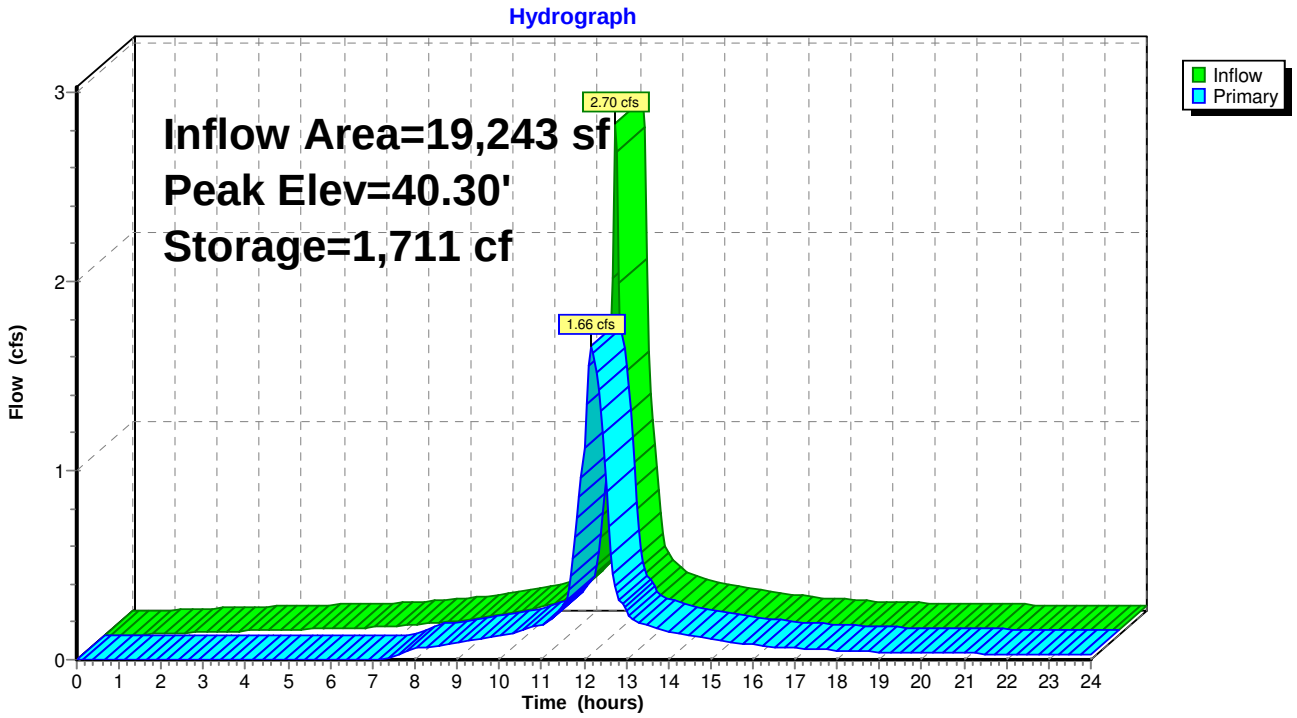
Volume	Invert	Avail.Storage	Storage Description
#1	37.00'	2,560 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
37.00	111	0	0	111
38.00	303	199	199	309
39.00	590	439	638	606
40.00	954	765	1,402	983
41.00	1,373	1,157	2,560	1,419

Device	Routing	Invert	Outlet Devices
#1	Primary	39.00'	**12.0" Round RCP_Round 12"** L= 81.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.00' / 38.00' S= 0.0122 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	39.00'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	40.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.64 cfs @ 12.17 hrs HW=40.29' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 1.64 cfs of 3.36 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.64 cfs @ 4.71 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 20Pb: BMP 3



Summary for Pond 31P: BMP 4

Inflow Area = 18,275 sf,100.00% Impervious, Inflow Depth > 5.96" for 50 yr event
Inflow = 2.57 cfs @ 12.07 hrs, Volume= 9,075 cf
Outflow = 0.72 cfs @ 12.41 hrs, Volume= 3,606 cf, Atten= 72%, Lag= 20.4 min
Primary = 0.72 cfs @ 12.41 hrs, Volume= 3,606 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 57.59' @ 12.41 hrs Surf.Area= 2,601 sf Storage= 5,690 cf

Plug-Flow detention time= 333.1 min calculated for 3,606 cf (40% of inflow)
Center-of-Mass det. time= 173.9 min (917.3 - 743.4)

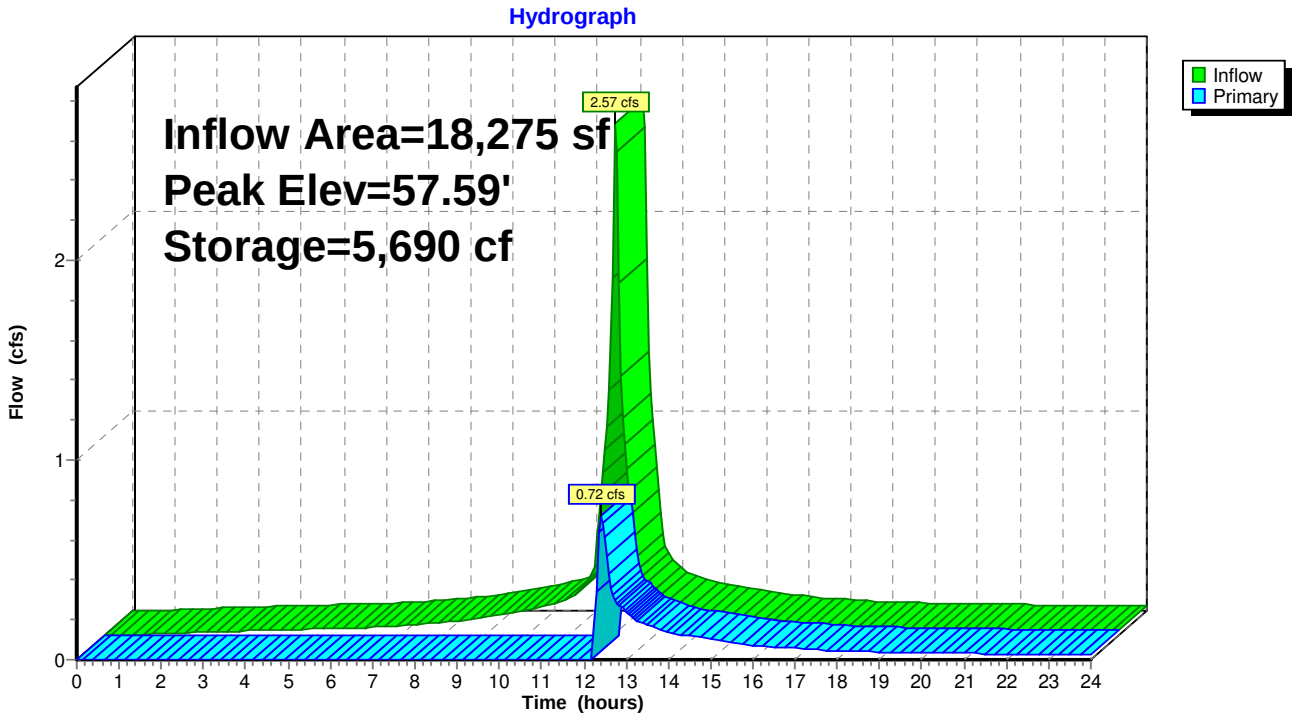
Volume	Invert	Avail.Storage	Storage Description
#1	54.00'	10,022 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
54.00	729	0	0	729
55.00	1,147	930	930	1,161
56.00	1,658	1,395	2,325	1,689
57.00	2,236	1,940	4,265	2,287
58.00	2,871	2,547	6,812	2,947
59.00	3,563	3,211	10,022	3,667

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**10.0" Round Culvert** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 55.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.55 sf
#2	Device 1	57.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	58.50'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.69 cfs @ 12.41 hrs HW=57.59' (Free Discharge)
└─**1=Culvert** (Passes 0.69 cfs of 2.74 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 0.69 cfs @ 0.98 fps)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 31P: BMP 4



Summary for Pond 32P: BMP 5A

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 5.96" for 50 yr event
Inflow = 2.93 cfs @ 12.07 hrs, Volume= 10,362 cf
Outflow = 2.40 cfs @ 12.13 hrs, Volume= 6,452 cf, Atten= 18%, Lag= 3.6 min
Primary = 2.40 cfs @ 12.13 hrs, Volume= 6,452 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 101.67' @ 12.13 hrs Surf.Area= 4,342 sf Storage= 4,592 cf

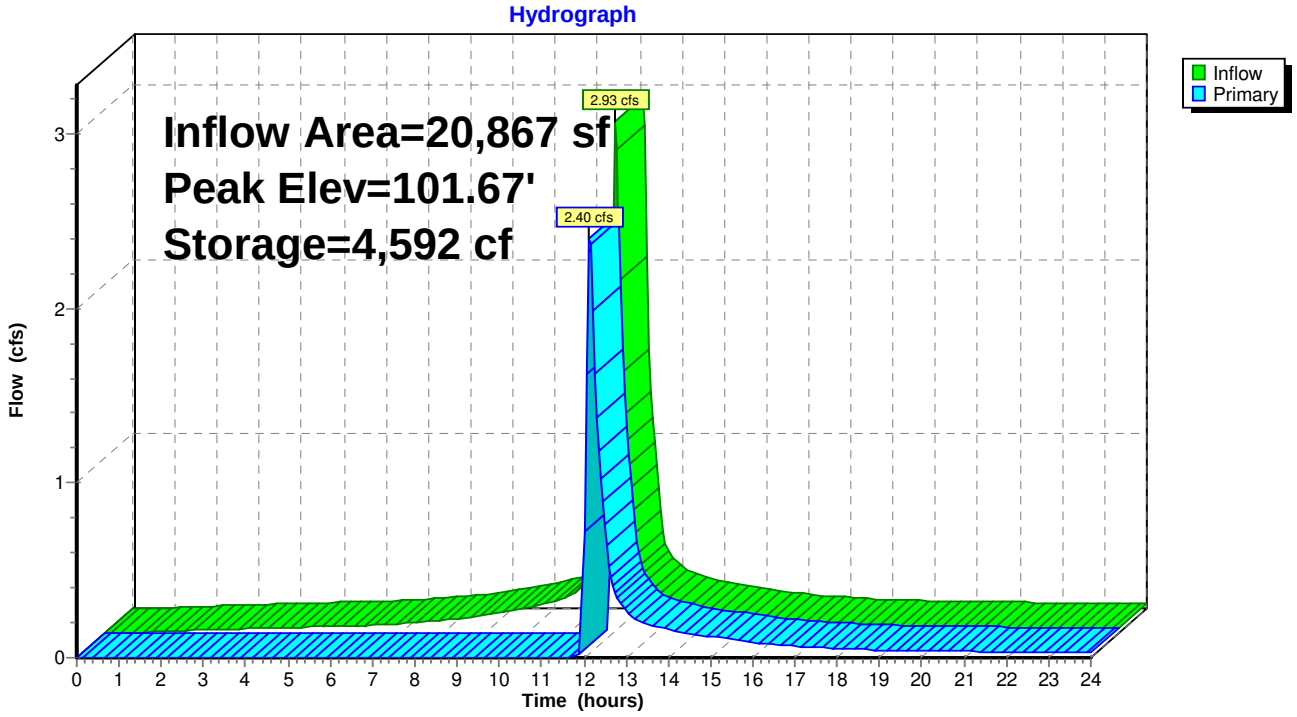
Plug-Flow detention time= 213.9 min calculated for 6,439 cf (62% of inflow)
Center-of-Mass det. time= 107.6 min (851.0 - 743.4)

Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	12,132 cf	**4.00'W x 300.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	101.50'	**13.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=2.35 cfs @ 12.13 hrs HW=101.67' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 2.35 cfs @ 1.09 fps)

Pond 32P: BMP 5A



Summary for Pond 33P: BMP 5B

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 3.71" for 50 yr event
Inflow = 2.40 cfs @ 12.13 hrs, Volume= 6,452 cf
Outflow = 0.17 cfs @ 13.95 hrs, Volume= 2,542 cf, Atten= 93%, Lag= 109.0 min
Primary = 0.17 cfs @ 13.95 hrs, Volume= 2,542 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 99.53' @ 13.95 hrs Surf.Area= 4,071 sf Storage= 4,005 cf

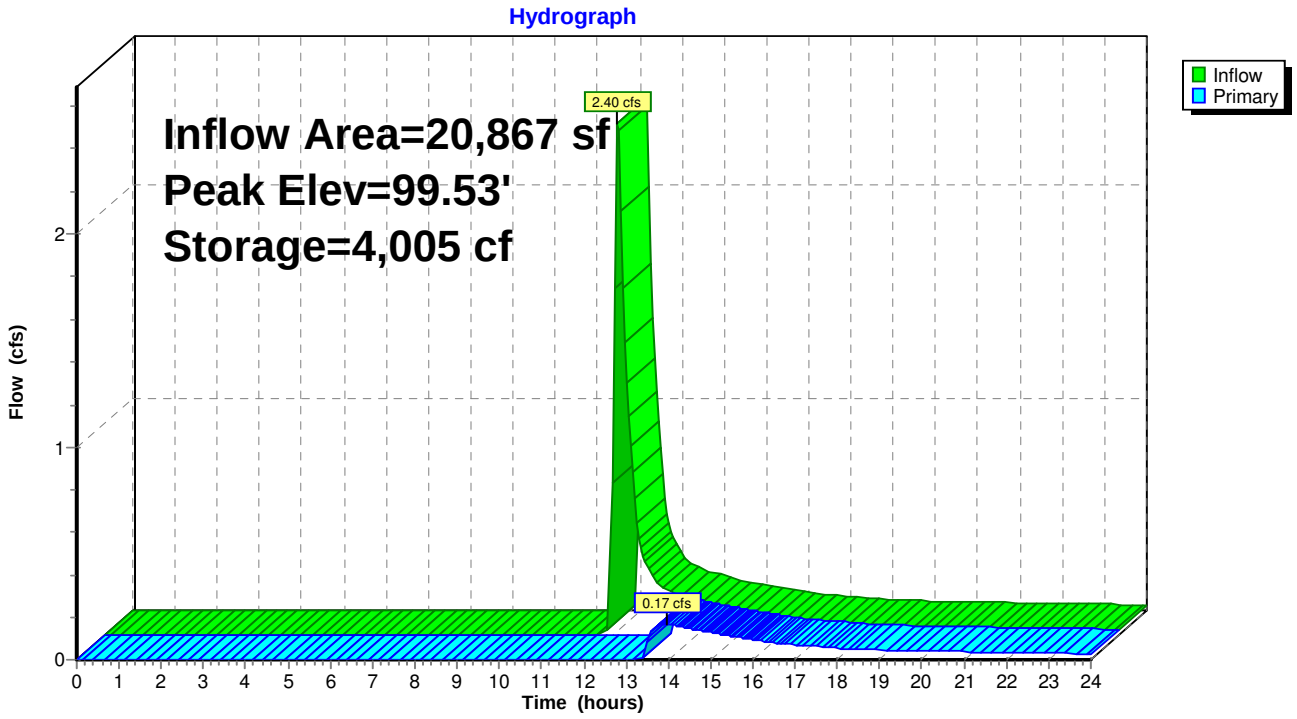
Plug-Flow detention time= 290.8 min calculated for 2,536 cf (39% of inflow)
Center-of-Mass det. time= 171.8 min (1,022.8 - 851.0)

Volume	Invert	Avail.Storage	Storage Description
#1	98.00'	12,132 cf	**4.00'W x 300.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	99.50'	**13.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.16 cfs @ 13.95 hrs HW=99.53' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.16 cfs @ 0.45 fps)

Pond 33P: BMP 5B

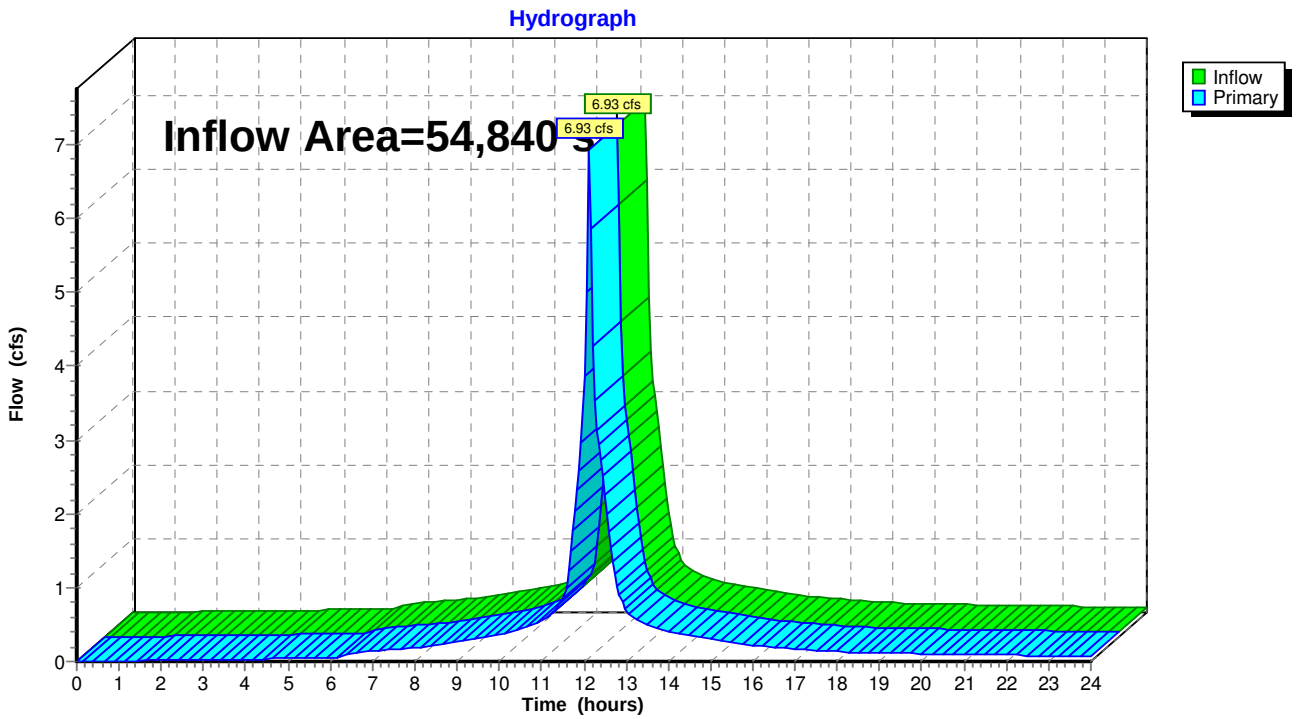


Summary for Link 10L: POI 1

Inflow Area = 54,840 sf,100.00% Impervious, Inflow Depth > 5.79" for 50 yr event
Inflow = 6.93 cfs @ 12.11 hrs, Volume= 26,460 cf
Primary = 6.93 cfs @ 12.11 hrs, Volume= 26,460 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 10L: POI 1

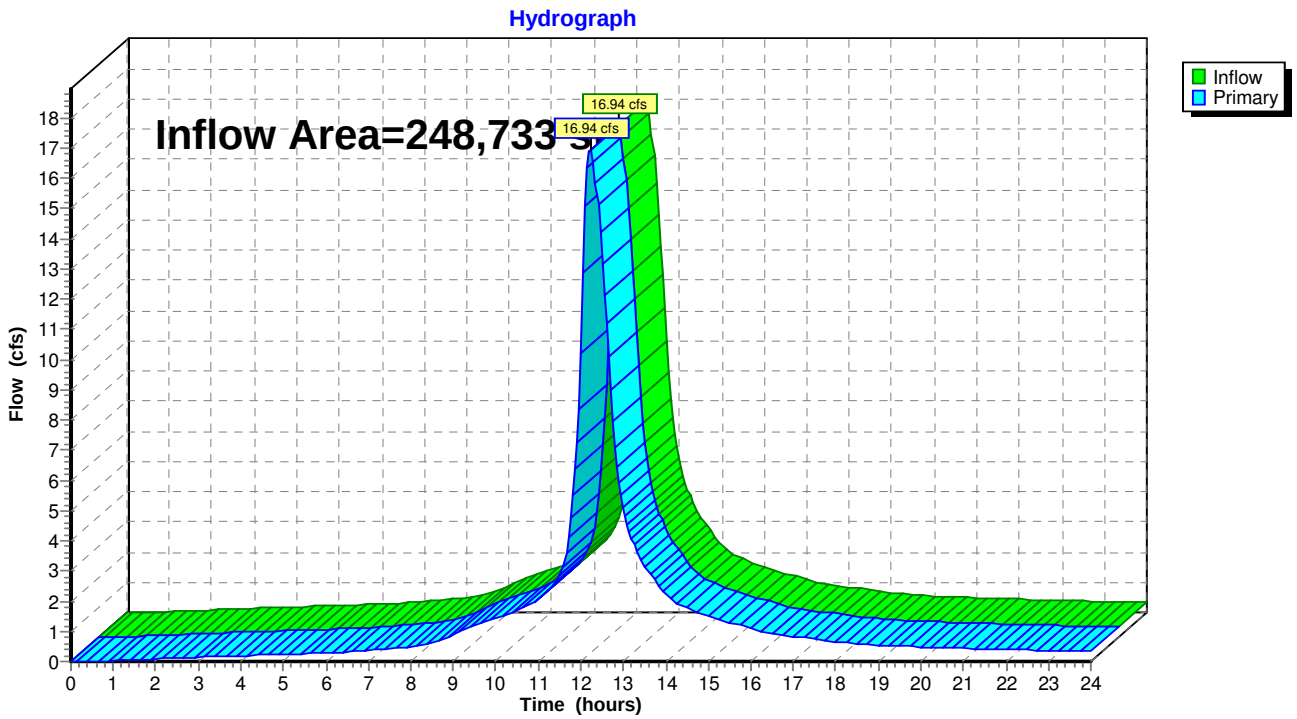


Summary for Link 20L: POI 2

Inflow Area = 248,733 sf, 99.21% Impervious, Inflow Depth > 5.49" for 50 yr event
Inflow = 16.94 cfs @ 12.22 hrs, Volume= 113,712 cf
Primary = 16.94 cfs @ 12.22 hrs, Volume= 113,712 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 20L: POI 2

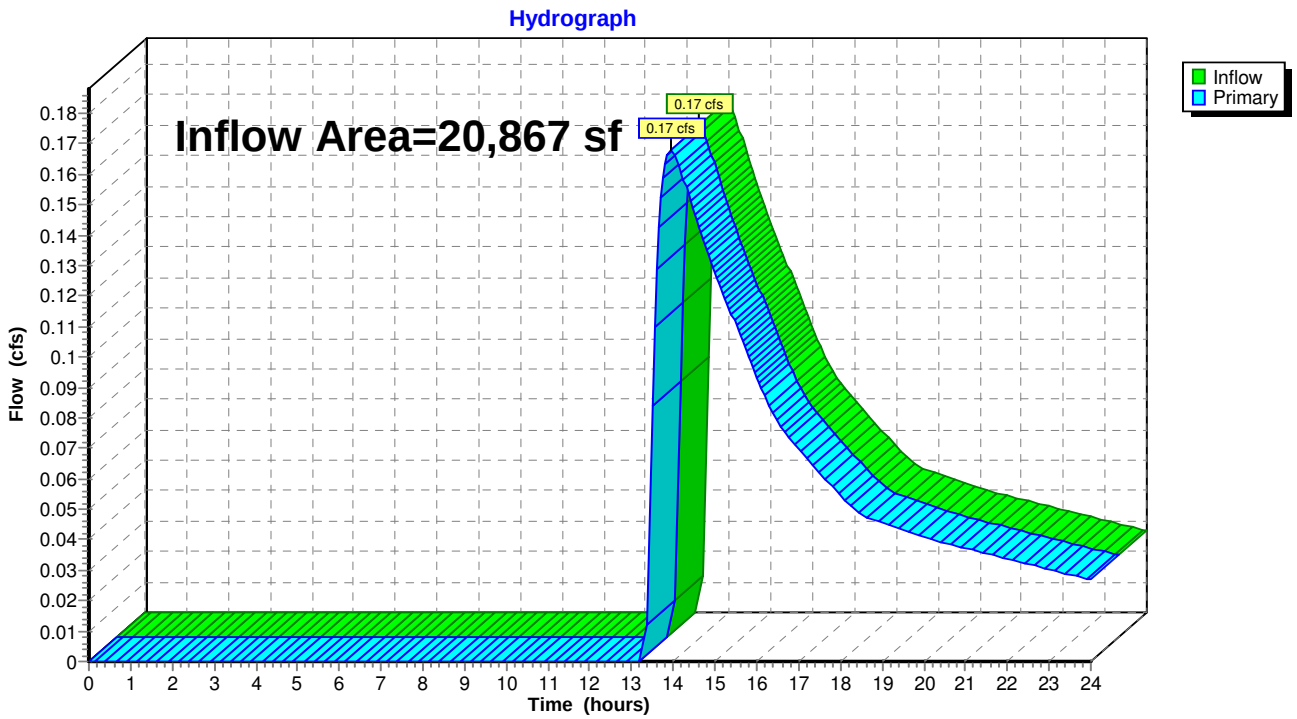


Summary for Link 30L: POI 3

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 1.46" for 50 yr event
Inflow = 0.17 cfs @ 13.95 hrs, Volume= 2,542 cf
Primary = 0.17 cfs @ 13.95 hrs, Volume= 2,542 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 30L: POI 3



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10Sa: POI 1 - OVERLAND Runoff Area=22,715 sf 100.00% Impervious Runoff Depth>6.66"
Tc=5.0 min CN=98 Runoff=3.55 cfs 12,603 cf

Subcatchment 10Sb: POI 1 - OVERLAND Runoff Area=32,125 sf 100.00% Impervious Runoff Depth>6.66"
Tc=5.0 min CN=98 Runoff=5.02 cfs 17,824 cf

Subcatchment 20Sa: POI 2 - OVERLAND Runoff Area=69,875 sf 100.00% Impervious Runoff Depth>6.66"
Tc=5.0 min CN=98 Runoff=10.93 cfs 38,768 cf

Subcatchment 20Sb: POI 3 - SLIP RAMP Runoff Area=27,151 sf 100.00% Impervious Runoff Depth>6.66"
Tc=5.0 min CN=98 Runoff=4.25 cfs 15,064 cf

Subcatchment 20Sc: POI 2 - OVERLAND Runoff Area=114,189 sf 98.28% Impervious Runoff Depth>6.65"
Flow Length=957' Slope=0.0094 '/' Tc=14.9 min CN=98 Runoff=13.52 cfs 63,268 cf

Subcatchment 20Sd: POI 2 - OVERLAND Runoff Area=19,243 sf 100.00% Impervious Runoff Depth>6.66"
Tc=5.0 min CN=98 Runoff=3.01 cfs 10,677 cf

Subcatchment 20Se: POI 2 - ROUTE 24 Runoff Area=18,275 sf 100.00% Impervious Runoff Depth>6.66"
Tc=5.0 min CN=98 Runoff=2.86 cfs 10,139 cf

Subcatchment 30S: POI 3 - OVERLAND Runoff Area=20,867 sf 100.00% Impervious Runoff Depth>6.66"
Tc=5.0 min CN=98 Runoff=3.26 cfs 11,578 cf

Reach 20Ra1: Grassed Channel Avg. Flow Depth=0.37' Max Vel=3.44 fps Inflow=8.99 cfs 35,608 cf
n=0.022 L=436.0' S=0.0161 '/' Capacity=16.40 cfs Outflow=8.46 cfs 35,539 cf

Reach 20Ra2: Natural Stream Avg. Flow Depth=0.38' Max Vel=1.42 fps Inflow=8.46 cfs 35,539 cf
n=0.040 L=600.0' S=0.0100 '/' Capacity=12.48 cfs Outflow=6.86 cfs 35,344 cf

Reach 20Rb: Natural Stream Avg. Flow Depth=0.17' Max Vel=1.04 fps Inflow=1.77 cfs 9,987 cf
n=0.040 L=1,006.0' S=0.0129 '/' Capacity=14.18 cfs Outflow=1.49 cfs 9,856 cf

Reach 32R: Natural Stream Avg. Flow Depth=0.14' Max Vel=0.82 fps Inflow=1.22 cfs 4,670 cf
n=0.040 L=400.0' S=0.0100 '/' Capacity=12.48 cfs Outflow=0.91 cfs 4,616 cf

Pond 10P: BMP 1 Peak Elev=39.29' Storage=2,447 cf Inflow=5.02 cfs 17,824 cf
Outflow=4.63 cfs 17,048 cf

Pond 20Pa: BMP 2 Peak Elev=39.80' Storage=8,087 cf Inflow=10.93 cfs 38,768 cf
Outflow=8.99 cfs 35,608 cf

Pond 20Pb: BMP 3 Peak Elev=40.44' Storage=1,866 cf Inflow=3.01 cfs 10,677 cf
Outflow=1.77 cfs 9,987 cf

Pond 31P: BMP 4 Peak Elev=57.63' Storage=5,790 cf Inflow=2.86 cfs 10,139 cf
Outflow=1.22 cfs 4,670 cf

Pond 32P: BMP 5A Peak Elev=101.69' Storage=4,678 cf Inflow=3.26 cfs 11,578 cf
Outflow=2.83 cfs 7,666 cf

Pond 33P: BMP 5B Peak Elev=99.55' Storage=4,076 cf Inflow=2.83 cfs 7,666 cf
Outflow=0.35 cfs 3,753 cf

Link 10L: POI 1 Inflow=7.81 cfs 29,651 cf
Primary=7.81 cfs 29,651 cf

Link 20L: POI 2 Inflow=19.22 cfs 128,147 cf
Primary=19.22 cfs 128,147 cf

Link 30L: POI 3 Inflow=0.35 cfs 3,753 cf
Primary=0.35 cfs 3,753 cf

Total Runoff Area = 324,440 sf Runoff Volume = 179,921 cf Average Runoff Depth = 6.65"
0.61% Pervious = 1,968 sf 99.39% Impervious = 322,472 sf

Summary for Subcatchment 10Sa: POI 1 - OVERLAND DIRECT DISCHARGE

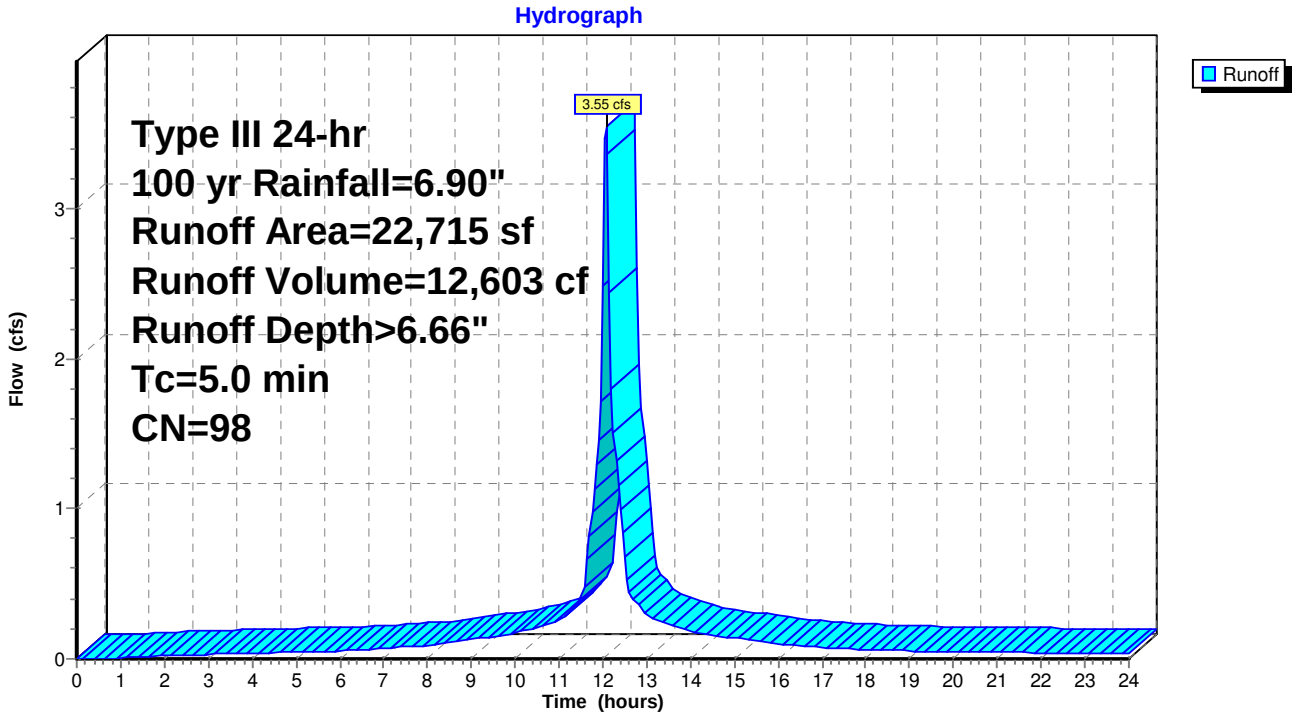
Runoff = 3.55 cfs @ 12.07 hrs, Volume= 12,603 cf, Depth> 6.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
22,715	98	Paved roads w/curbs & sewers, HSG C
22,715		100.00% Impervious Area

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

Subcatchment 10Sa: POI 1 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 10Sb: POI 1 - OVERLAND TO BMP 1

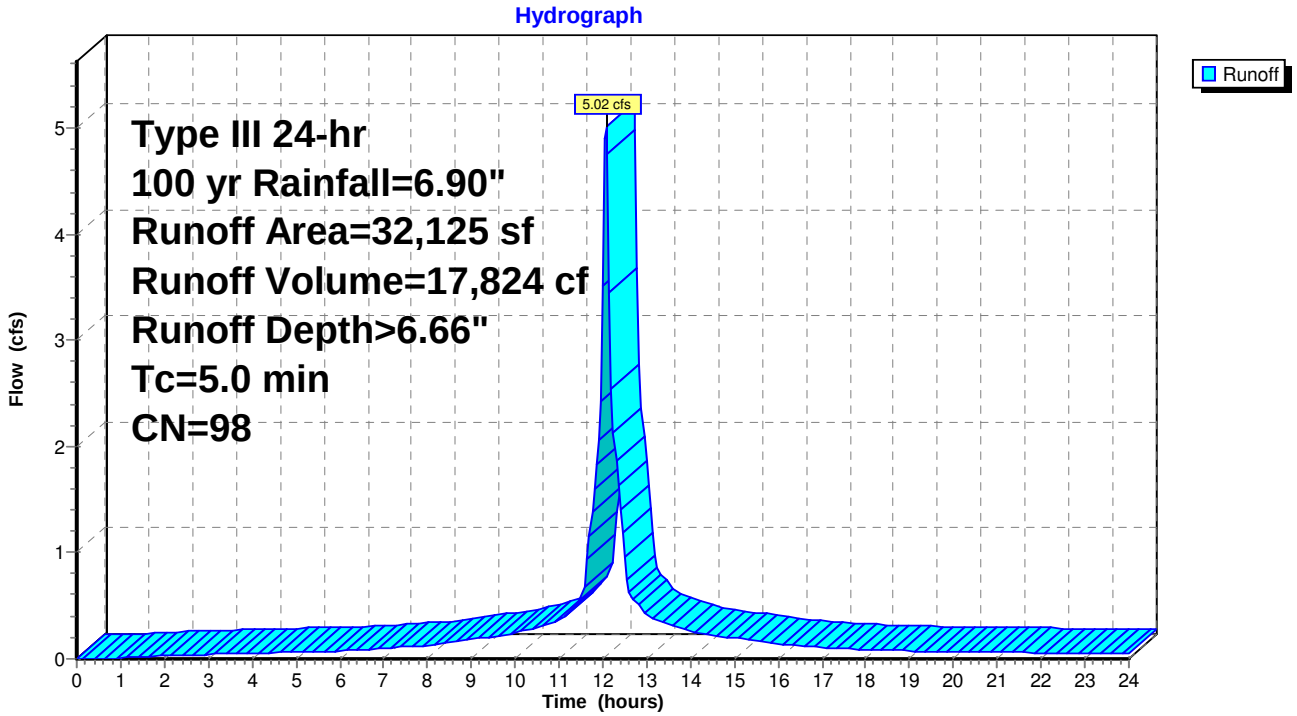
Runoff = 5.02 cfs @ 12.07 hrs, Volume= 17,824 cf, Depth> 6.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
32,125	98	Paved roads w/curbs & sewers, HSG C
32,125		100.00% Impervious Area

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

Subcatchment 10Sb: POI 1 - OVERLAND TO BMP 1



Summary for Subcatchment 20Sa: POI 2 - OVERLAND TO BMP 2

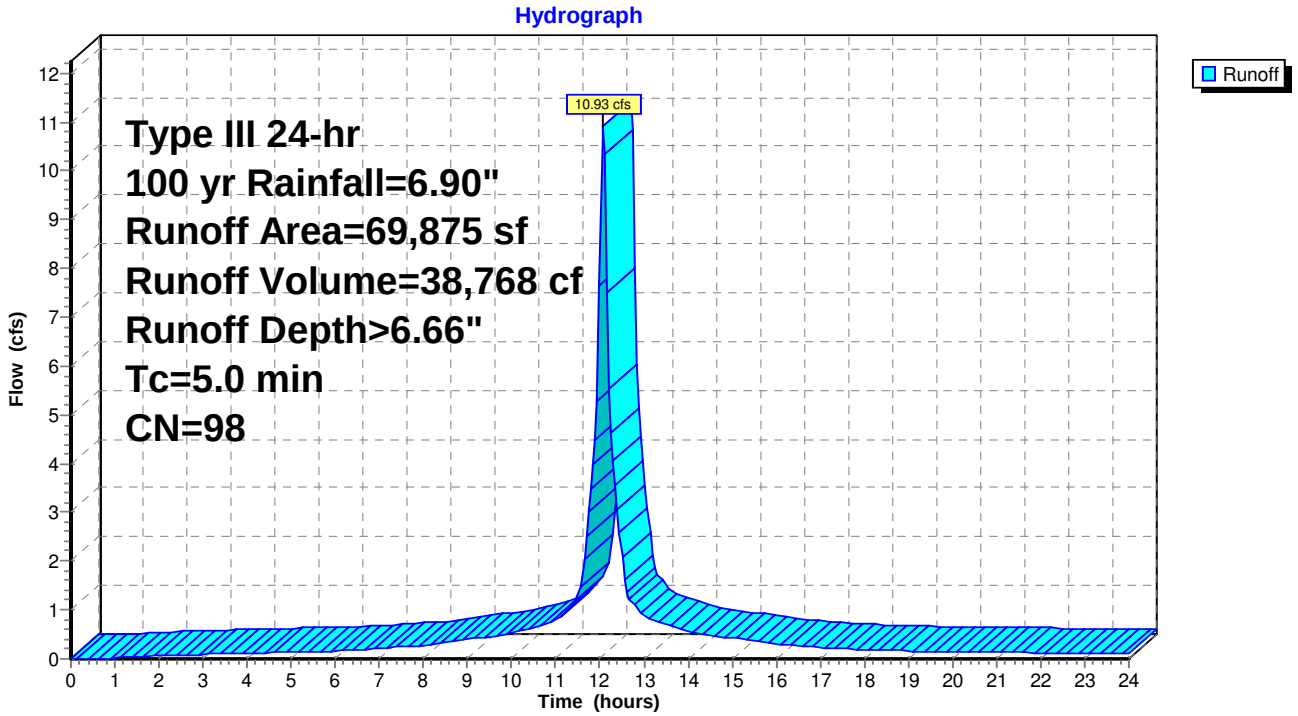
Runoff = 10.93 cfs @ 12.07 hrs, Volume= 38,768 cf, Depth> 6.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
69,875	98	Paved roads w/curbs & sewers, HSG C
69,875		100.00% Impervious Area

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

Subcatchment 20Sa: POI 2 - OVERLAND TO BMP 2



Summary for Subcatchment 20Sb: POI 3 - SLIP RAMP POST DEVELOPMENT

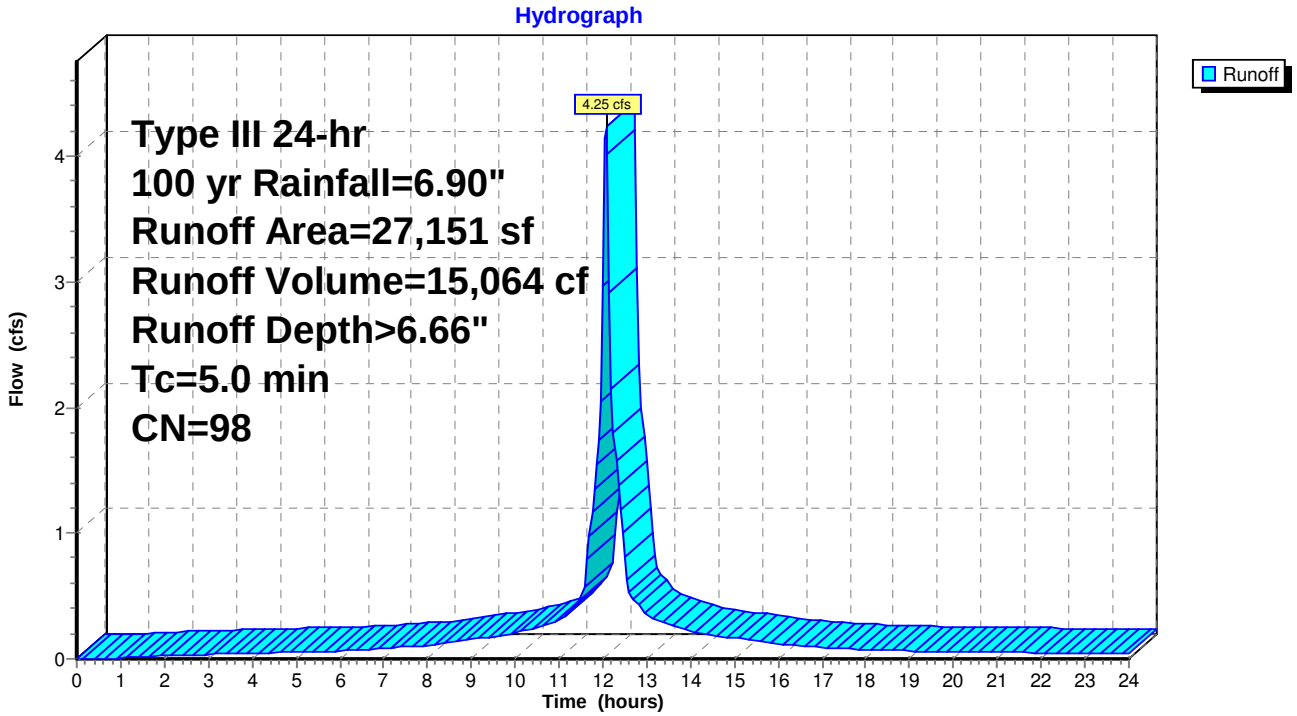
Runoff = 4.25 cfs @ 12.07 hrs, Volume= 15,064 cf, Depth> 6.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
27,151	98	Paved roads w/curbs & sewers, HSG D
27,151		100.00% Impervious Area

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

Subcatchment 20Sb: POI 3 - SLIP RAMP POST DEVELOPMENT



Summary for Subcatchment 20Sc: POI 2 - OVERLAND DIRECT DISCHARGE

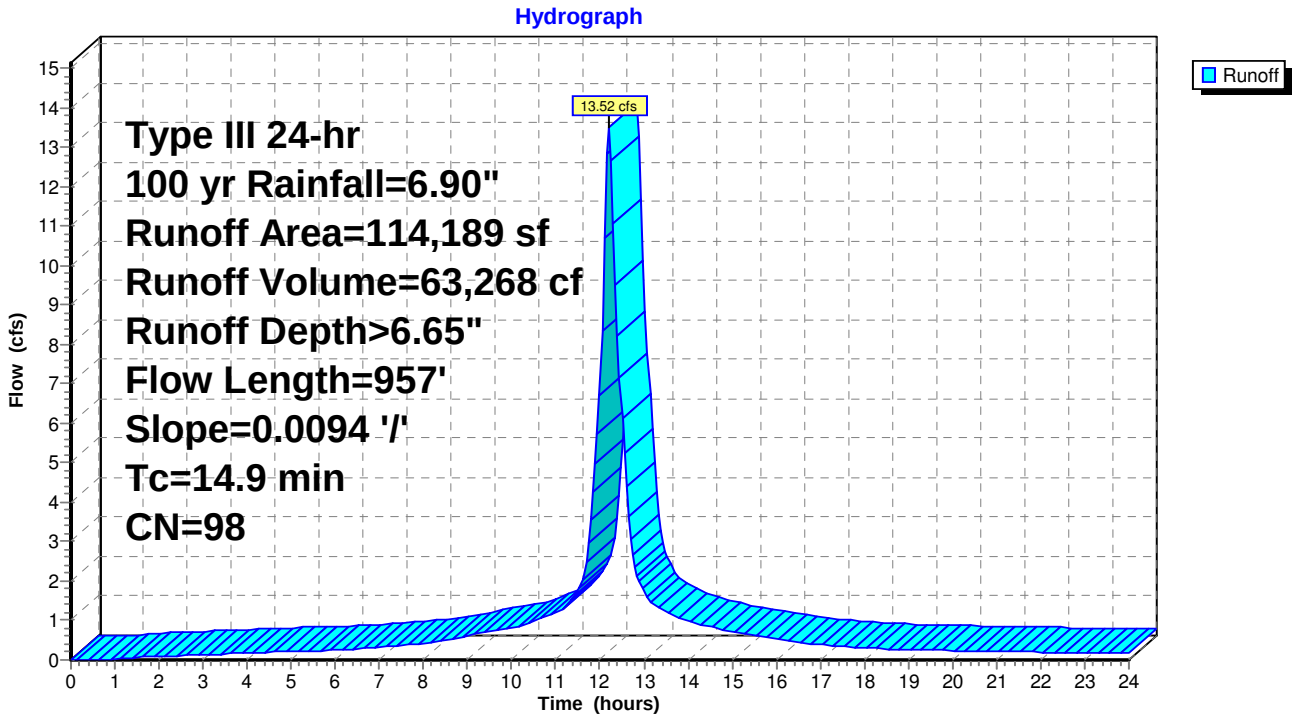
Runoff = 13.52 cfs @ 12.20 hrs, Volume= 63,268 cf, Depth> 6.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
103,199	98	Paved roads w/curbs & sewers, HSG C
1,968	79	50-75% Grass cover, Fair, HSG C
7,934	98	Paved roads w/curbs & sewers, HSG D
1,088	98	Paved roads w/curbs & sewers, HSG B
114,189	98	Weighted Average
1,968		1.72% Pervious Area
112,221		98.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**
9.9	957	0.0094	1.61	12.11	**Channel Flow, Natural Stream** Area= 7.5 sf Perim= 25.0' r= 0.30' n= 0.040 Winding stream
14.9	957	Total			

Subcatchment 20Sc: POI 2 - OVERLAND DIRECT DISCHARGE



Summary for Subcatchment 20Sd: POI 2 - OVERLAND TO BMP 3

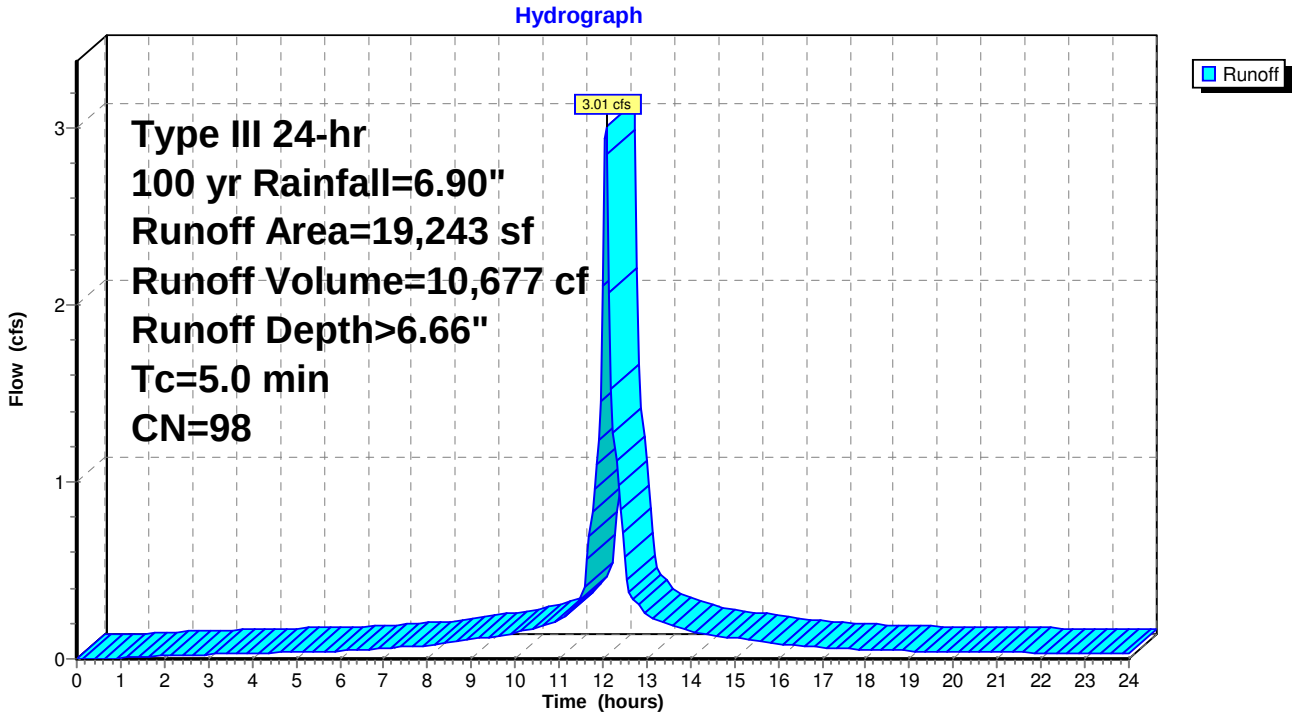
Runoff = 3.01 cfs @ 12.07 hrs, Volume= 10,677 cf, Depth> 6.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
19,243	98	Paved roads w/curbs & sewers, HSG C
19,243		100.00% Impervious Area

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

Subcatchment 20Sd: POI 2 - OVERLAND TO BMP 3



Summary for Subcatchment 20Se: POI 2 - ROUTE 24

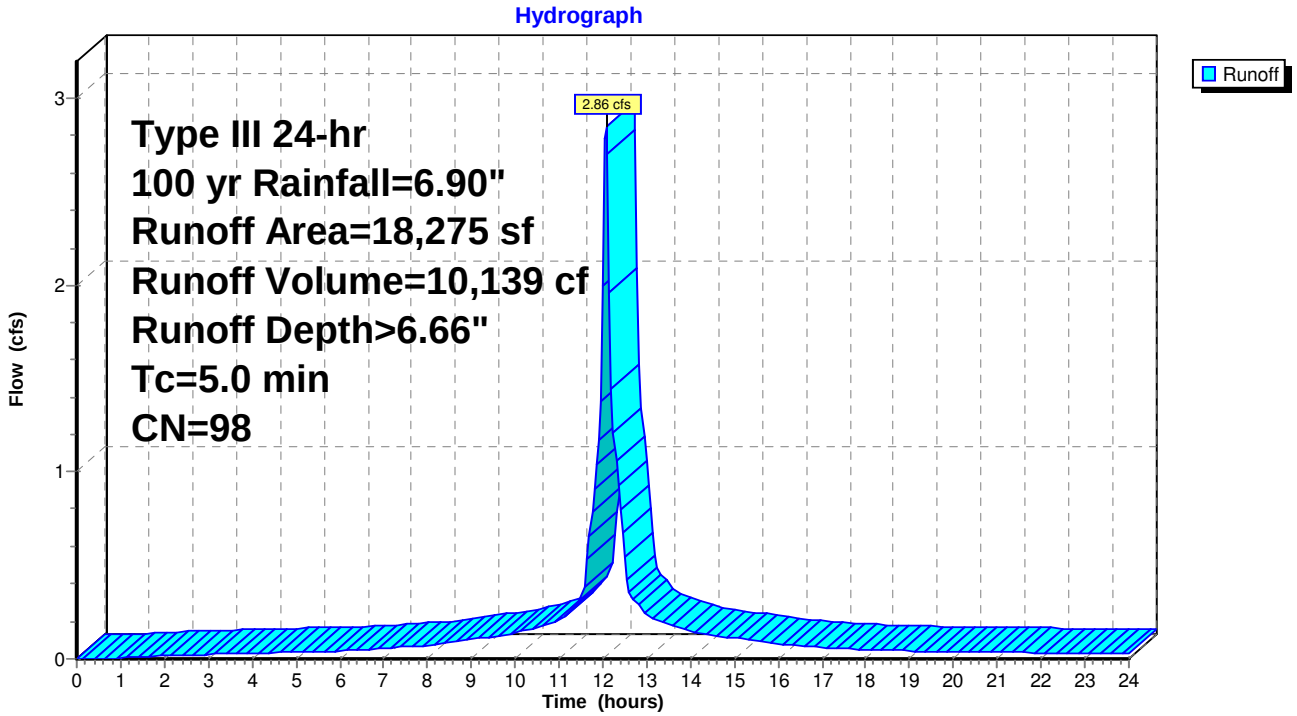
Runoff = 2.86 cfs @ 12.07 hrs, Volume= 10,139 cf, Depth> 6.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
18,275	98	Paved roads w/curbs & sewers, HSG C
18,275		100.00% Impervious Area

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

Subcatchment 20Se: POI 2 - ROUTE 24



Summary for Subcatchment 30S: POI 3 - OVERLAND DIRECT DISCHARGE

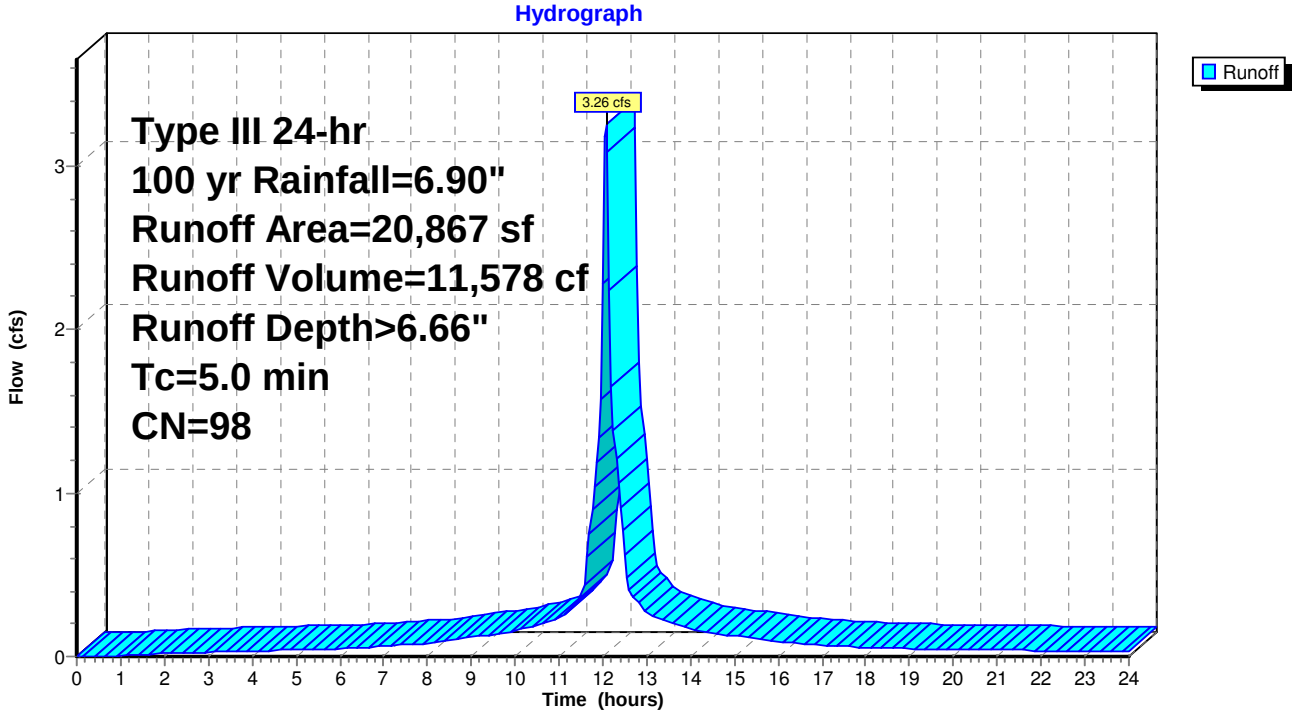
Runoff = 3.26 cfs @ 12.07 hrs, Volume= 11,578 cf, Depth> 6.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.90"

Area (sf)	CN	Description
8,256	98	Paved roads w/curbs & sewers, HSG D
12,611	98	Paved roads w/curbs & sewers, HSG B
20,867	98	Weighted Average
20,867		100.00% Impervious Area

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

Subcatchment 30S: POI 3 - OVERLAND DIRECT DISCHARGE



Summary for Reach 20Ra1: Grassed Channel

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 6.12" for 100 yr event
Inflow = 8.99 cfs @ 12.13 hrs, Volume= 35,608 cf
Outflow = 8.46 cfs @ 12.20 hrs, Volume= 35,539 cf, Atten= 6%, Lag= 4.2 min

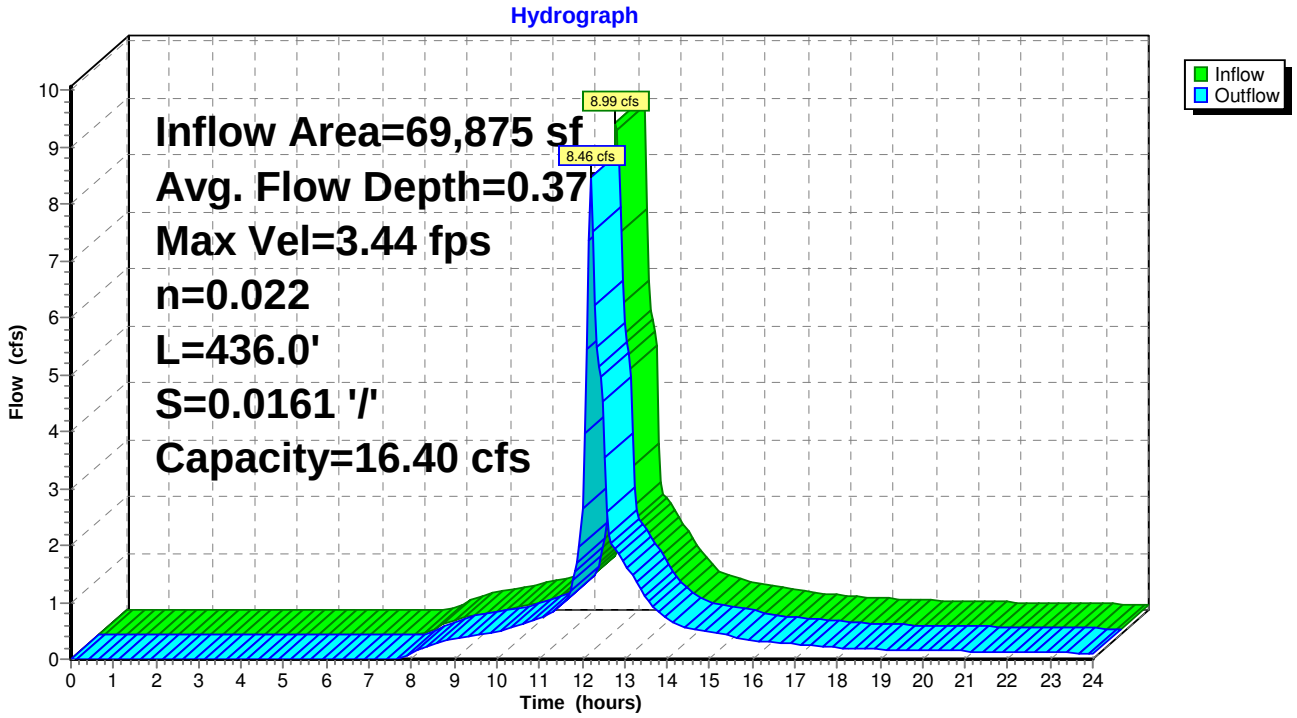
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.44 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.27 fps, Avg. Travel Time= 5.7 min

Peak Storage= 1,104 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 0.50' Flow Area= 4.0 sf, Capacity= 16.40 cfs

4.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 8.0 '/' Top Width= 12.00'
Length= 436.0' Slope= 0.0161 '/'
Inlet Invert= 36.00', Outlet Invert= 29.00'

‡

Reach 20Ra1: Grassed Channel



Summary for Reach 20Ra2: Natural Stream

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 6.10" for 100 yr event
Inflow = 8.46 cfs @ 12.20 hrs, Volume= 35,539 cf
Outflow = 6.86 cfs @ 12.40 hrs, Volume= 35,344 cf, Atten= 19%, Lag= 11.9 min

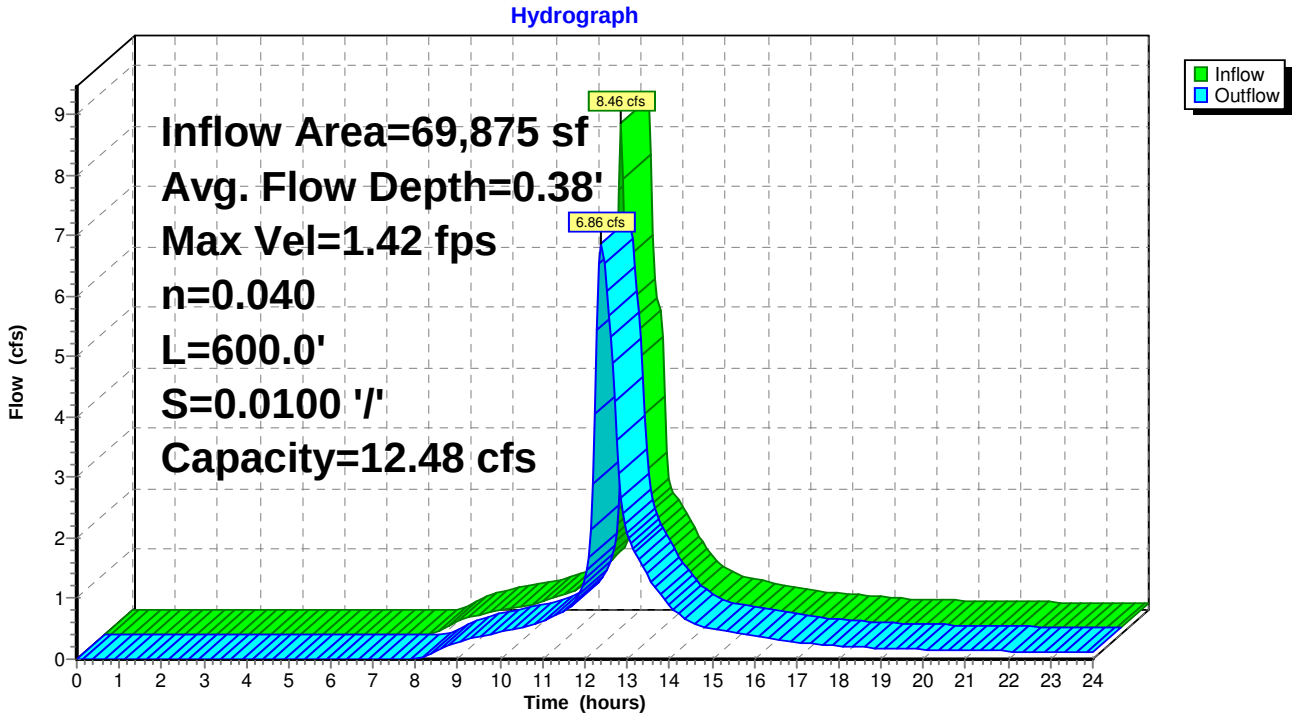
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.42 fps, Min. Travel Time= 7.0 min
Avg. Velocity = 0.62 fps, Avg. Travel Time= 16.2 min

Peak Storage= 2,905 cf @ 12.28 hrs
Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 12.48 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 600.0' Slope= 0.0100 '/'
Inlet Invert= 29.00', Outlet Invert= 23.00'

‡

Reach 20Ra2: Natural Stream



Summary for Reach 20Rb: Natural Stream

Inflow Area = 19,243 sf,100.00% Impervious, Inflow Depth > 6.23" for 100 yr event
Inflow = 1.77 cfs @ 12.18 hrs, Volume= 9,987 cf
Outflow = 1.49 cfs @ 12.66 hrs, Volume= 9,856 cf, Atten= 16%, Lag= 28.8 min

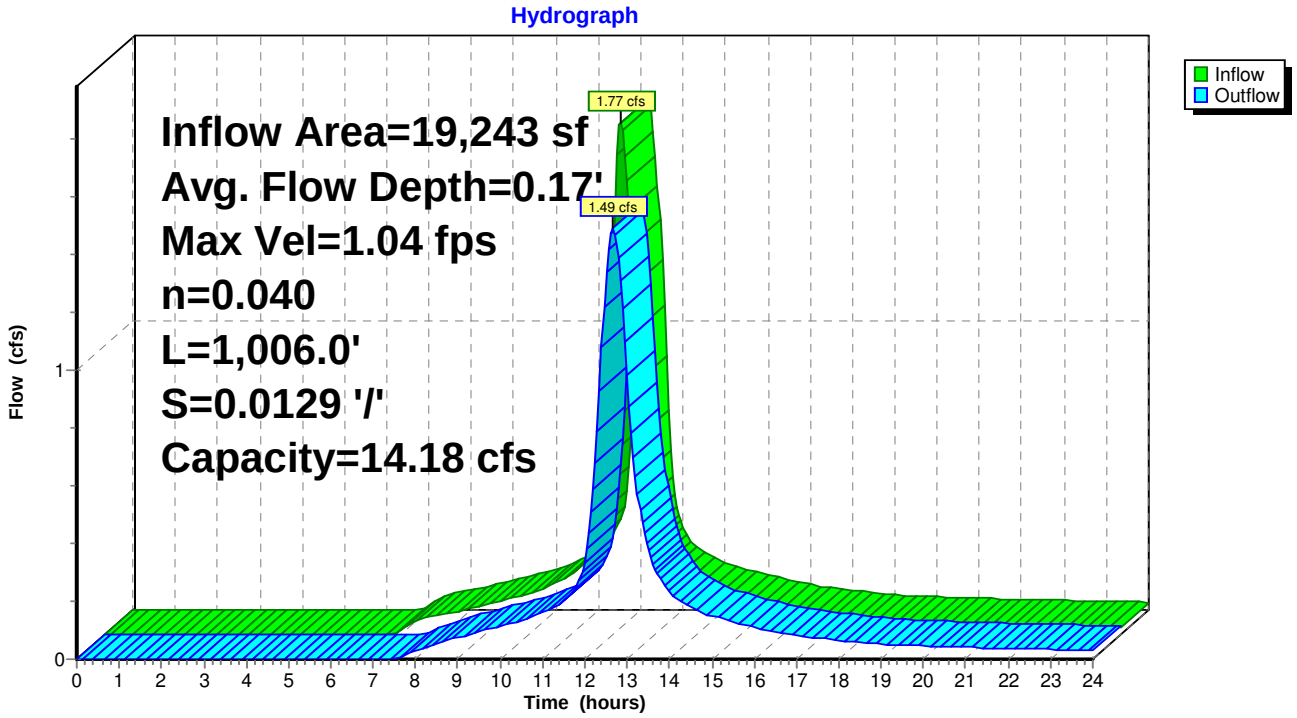
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.04 fps, Min. Travel Time= 16.2 min
Avg. Velocity = 0.44 fps, Avg. Travel Time= 38.1 min

Peak Storage= 1,451 cf @ 12.39 hrs
Average Depth at Peak Storage= 0.17'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 14.18 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 1,006.0' Slope= 0.0129 '/'
Inlet Invert= 36.00', Outlet Invert= 23.00'

‡

Reach 20Rb: Natural Stream



Summary for Reach 32R: Natural Stream

Inflow Area = 18,275 sf,100.00% Impervious, Inflow Depth > 3.07" for 100 yr event
Inflow = 1.22 cfs @ 12.27 hrs, Volume= 4,670 cf
Outflow = 0.91 cfs @ 12.55 hrs, Volume= 4,616 cf, Atten= 25%, Lag= 17.0 min

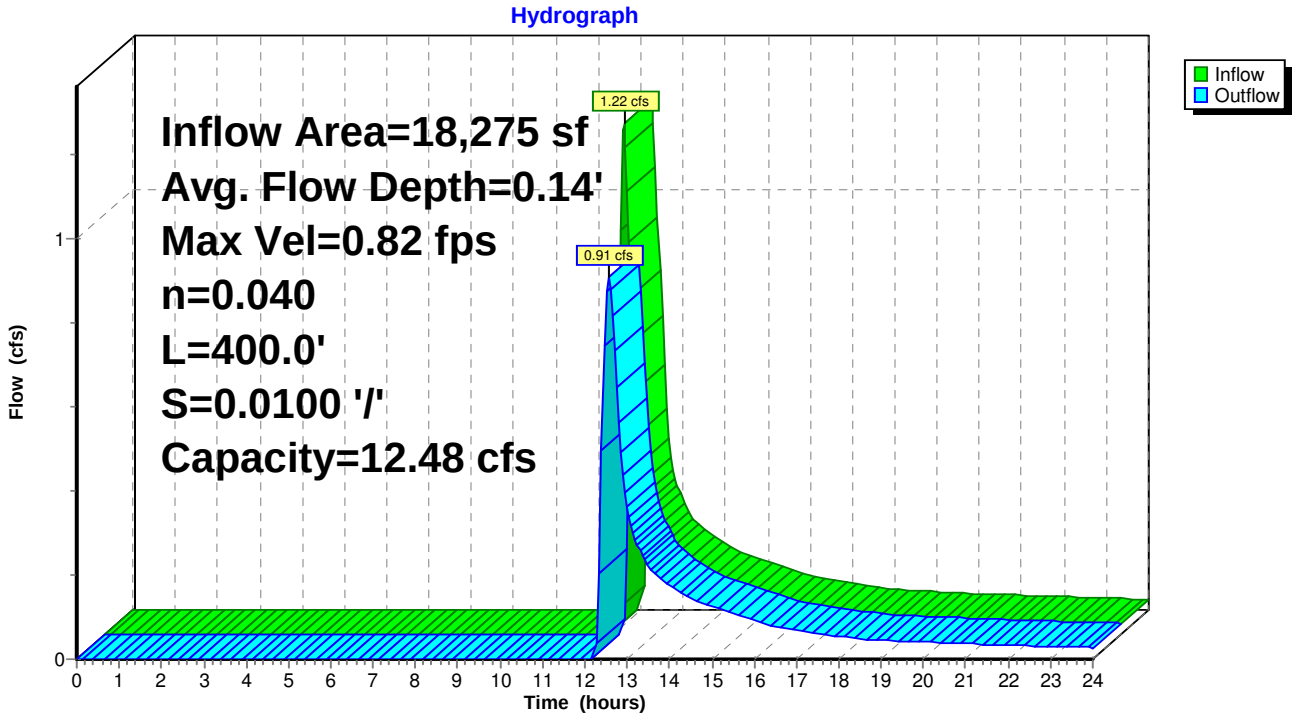
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.82 fps, Min. Travel Time= 8.1 min
Avg. Velocity = 0.37 fps, Avg. Travel Time= 17.9 min

Peak Storage= 446 cf @ 12.41 hrs
Average Depth at Peak Storage= 0.14'
Bank-Full Depth= 0.50' Flow Area= 7.5 sf, Capacity= 12.48 cfs

5.00' x 0.50' deep channel, n= 0.040 Winding stream
Side Slope Z-value= 20.0 '/' Top Width= 25.00'
Length= 400.0' Slope= 0.0100 '/'
Inlet Invert= 27.00', Outlet Invert= 23.00'

‡

Reach 32R: Natural Stream



Summary for Pond 10P: BMP 1

Inflow Area = 32,125 sf,100.00% Impervious, Inflow Depth > 6.66" for 100 yr event
Inflow = 5.02 cfs @ 12.07 hrs, Volume= 17,824 cf
Outflow = 4.63 cfs @ 12.12 hrs, Volume= 17,048 cf, Atten= 8%, Lag= 3.2 min
Primary = 4.63 cfs @ 12.12 hrs, Volume= 17,048 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 39.29' @ 12.12 hrs Surf.Area= 1,261 sf Storage= 2,447 cf

Plug-Flow detention time= 55.6 min calculated for 17,012 cf (95% of inflow)
Center-of-Mass det. time= 30.1 min (772.0 - 741.9)

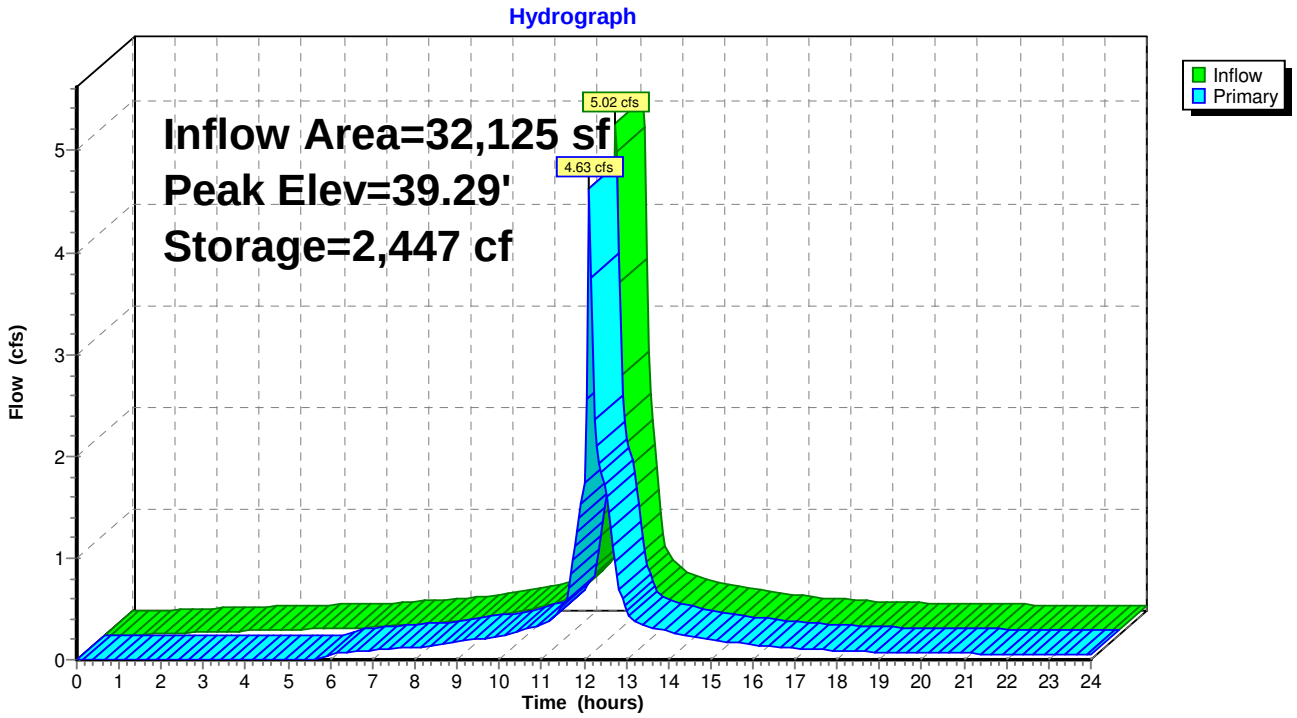
Volume	Invert	Avail.Storage	Storage Description
#1	35.00'	3,463 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
35.00	110	0	0	110
36.00	257	178	178	264
37.00	476	361	539	493
38.00	768	616	1,156	798
39.00	1,139	947	2,103	1,185
40.00	1,593	1,360	3,463	1,657

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round RCP_Round 12"** L= 172.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 35.28' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	37.33'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	39.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.40 cfs @ 12.12 hrs HW=39.25' (Free Discharge)
└─**1=RCP_Round 12"** (Barrel Controls 4.40 cfs @ 5.60 fps)
  ├─**2=Orifice/Grate** (Passes < 2.12 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 3.34 cfs potential flow)

Pond 10P: BMP 1



Summary for Pond 20Pa: BMP 2

Inflow Area = 69,875 sf,100.00% Impervious, Inflow Depth > 6.66" for 100 yr event
Inflow = 10.93 cfs @ 12.07 hrs, Volume= 38,768 cf
Outflow = 8.99 cfs @ 12.13 hrs, Volume= 35,608 cf, Atten= 18%, Lag= 3.7 min
Primary = 8.99 cfs @ 12.13 hrs, Volume= 35,608 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 39.80' @ 12.13 hrs Surf.Area= 2,338 sf Storage= 8,087 cf

Plug-Flow detention time= 93.0 min calculated for 35,608 cf (92% of inflow)
Center-of-Mass det. time= 50.2 min (792.1 - 741.9)

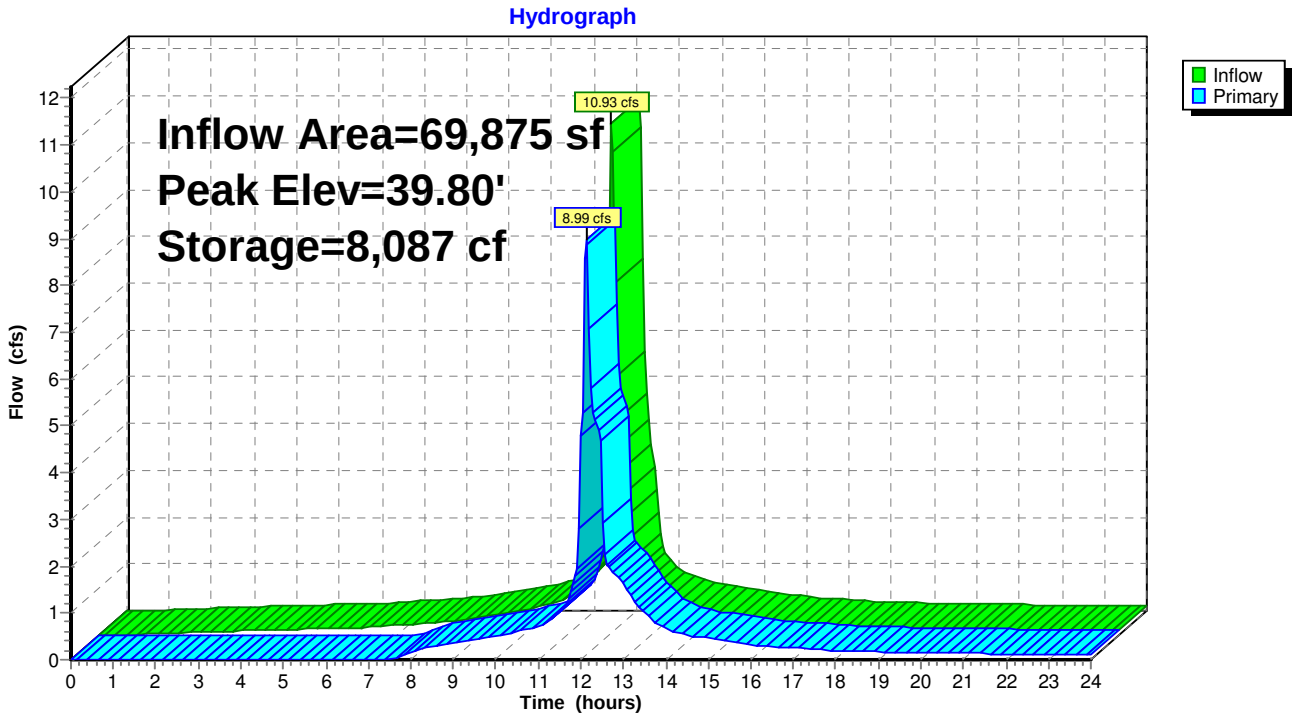
Volume	Invert	Avail.Storage	Storage Description
#1	34.00'	8,560 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
34.00	612	0	0	612
35.00	837	722	722	856
36.00	1,094	963	1,684	1,136
37.00	1,384	1,236	2,920	1,451
38.00	1,703	1,541	4,461	1,799
39.00	2,046	1,872	6,333	2,175
40.00	2,414	2,227	8,560	2,579

Device	Routing	Invert	Outlet Devices
#1	Primary	37.00'	**12.0" Round RCP_Round 12"** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 37.00' / 36.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	37.00'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	38.83'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	39.50'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=8.74 cfs @ 12.13 hrs HW=39.79' (Free Discharge)
- **1=RCP_Round 12"** (Barrel Controls 5.66 cfs @ 7.20 fps)
  - **2=Orifice/Grate** (Passes < 2.63 cfs potential flow)
  - **3=Orifice/Grate** (Passes < 18.83 cfs potential flow)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 3.08 cfs @ 1.35 fps)

Pond 20Pa: BMP 2



Summary for Pond 20Pb: BMP 3

Inflow Area = 19,243 sf,100.00% Impervious, Inflow Depth > 6.66" for 100 yr event
Inflow = 3.01 cfs @ 12.07 hrs, Volume= 10,677 cf
Outflow = 1.77 cfs @ 12.18 hrs, Volume= 9,987 cf, Atten= 41%, Lag= 6.5 min
Primary = 1.77 cfs @ 12.18 hrs, Volume= 9,987 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 40.44' @ 12.18 hrs Surf.Area= 1,131 sf Storage= 1,866 cf

Plug-Flow detention time= 75.2 min calculated for 9,966 cf (93% of inflow)
Center-of-Mass det. time= 39.9 min (781.7 - 741.9)

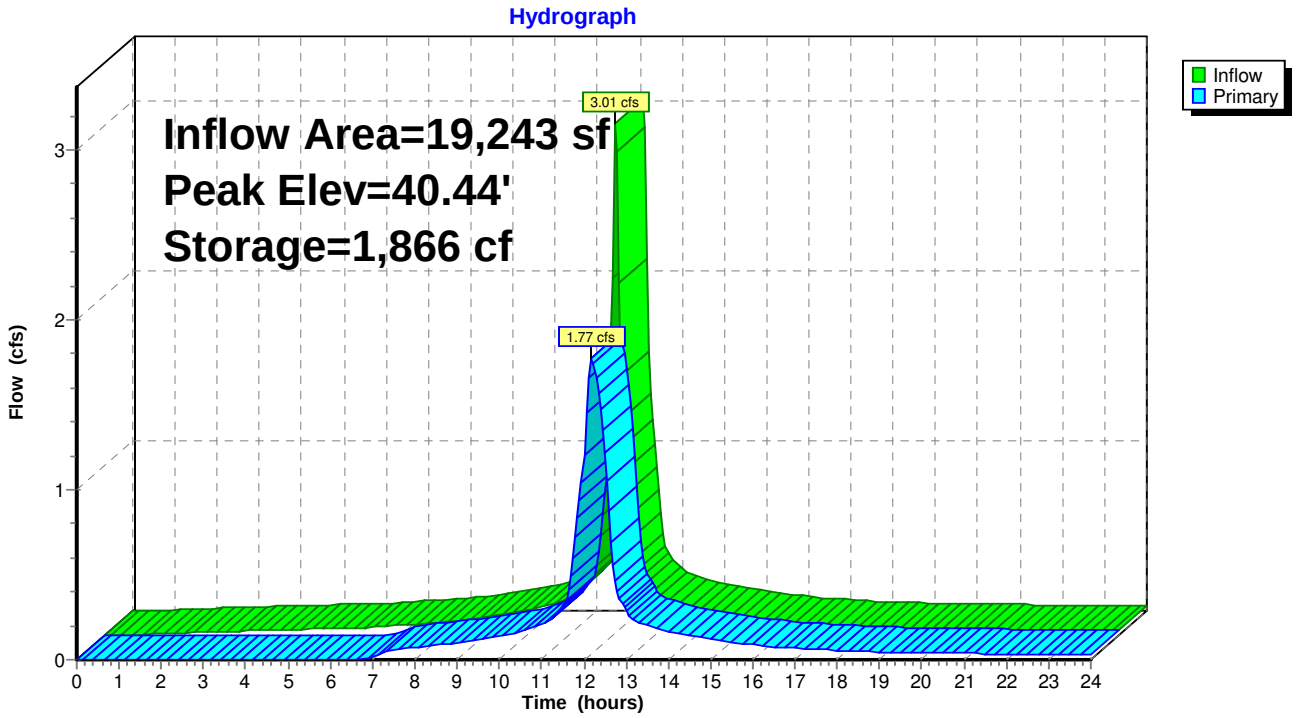
Volume	Invert	Avail.Storage	Storage Description
#1	37.00'	2,560 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
37.00	111	0	0	111
38.00	303	199	199	309
39.00	590	439	638	606
40.00	954	765	1,402	983
41.00	1,373	1,157	2,560	1,419

Device	Routing	Invert	Outlet Devices
#1	Primary	39.00'	**12.0" Round RCP_Round 12"** L= 81.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 39.00' / 38.00' S= 0.0122 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Device 1	39.00'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	40.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.77 cfs @ 12.18 hrs HW=40.44' (Free Discharge)
└─**1=RCP_Round 12"** (Passes 1.77 cfs of 3.66 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.77 cfs @ 5.06 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 20Pb: BMP 3



Summary for Pond 31P: BMP 4

Inflow Area = 18,275 sf,100.00% Impervious, Inflow Depth > 6.66" for 100 yr event
Inflow = 2.86 cfs @ 12.07 hrs, Volume= 10,139 cf
Outflow = 1.22 cfs @ 12.27 hrs, Volume= 4,670 cf, Atten= 57%, Lag= 11.9 min
Primary = 1.22 cfs @ 12.27 hrs, Volume= 4,670 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 57.63' @ 12.27 hrs Surf.Area= 2,626 sf Storage= 5,790 cf

Plug-Flow detention time= 291.3 min calculated for 4,670 cf (46% of inflow)
Center-of-Mass det. time= 149.9 min (891.7 - 741.9)

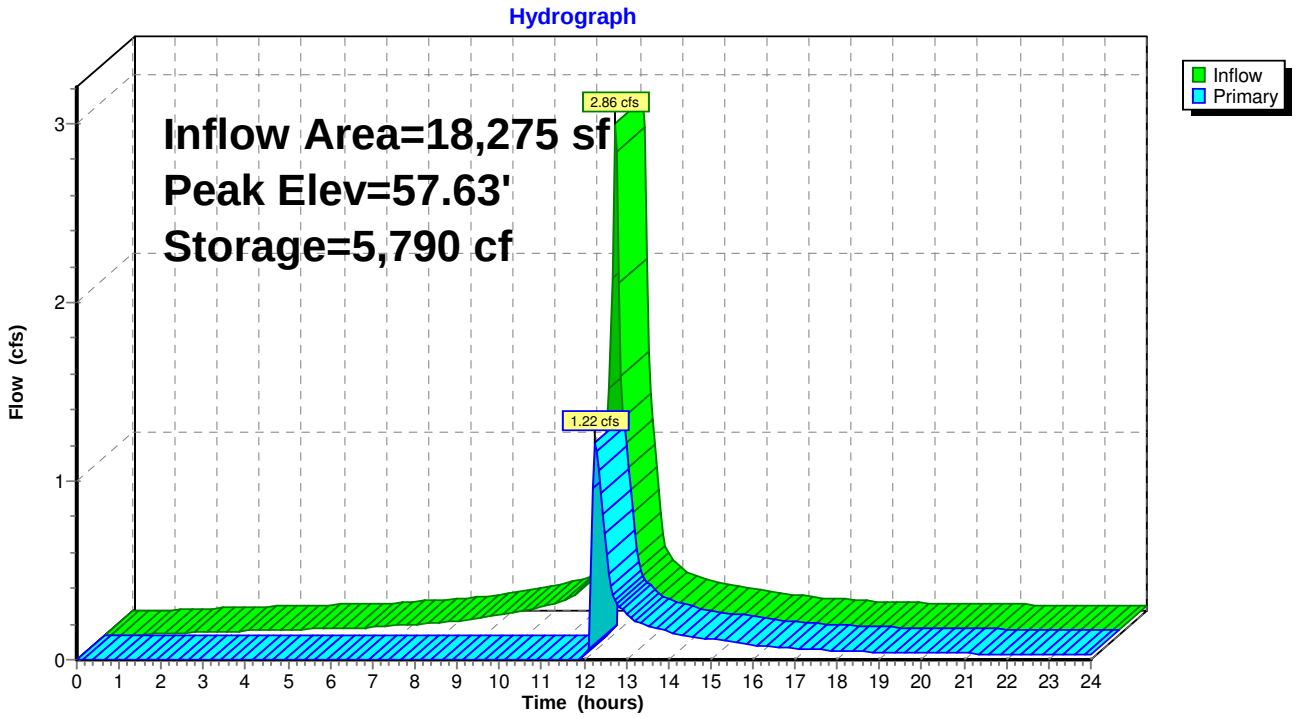
Volume	Invert	Avail.Storage	Storage Description
#1	54.00'	10,022 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
54.00	729	0	0	729
55.00	1,147	930	930	1,161
56.00	1,658	1,395	2,325	1,689
57.00	2,236	1,940	4,265	2,287
58.00	2,871	2,547	6,812	2,947
59.00	3,563	3,211	10,022	3,667

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**10.0" Round Culvert** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 55.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.55 sf
#2	Device 1	57.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	58.50'	**8.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=1.17 cfs @ 12.27 hrs HW=57.63' (Free Discharge)
└─**1=Culvert** (Passes 1.17 cfs of 2.78 cfs potential flow)
└─**2=Orifice/Grate** (Weir Controls 1.17 cfs @ 1.16 fps)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 31P: BMP 4



Summary for Pond 32P: BMP 5A

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 6.66" for 100 yr event
Inflow = 3.26 cfs @ 12.07 hrs, Volume= 11,578 cf
Outflow = 2.83 cfs @ 12.12 hrs, Volume= 7,666 cf, Atten= 13%, Lag= 2.9 min
Primary = 2.83 cfs @ 12.12 hrs, Volume= 7,666 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 101.69' @ 12.12 hrs Surf.Area= 4,380 sf Storage= 4,678 cf

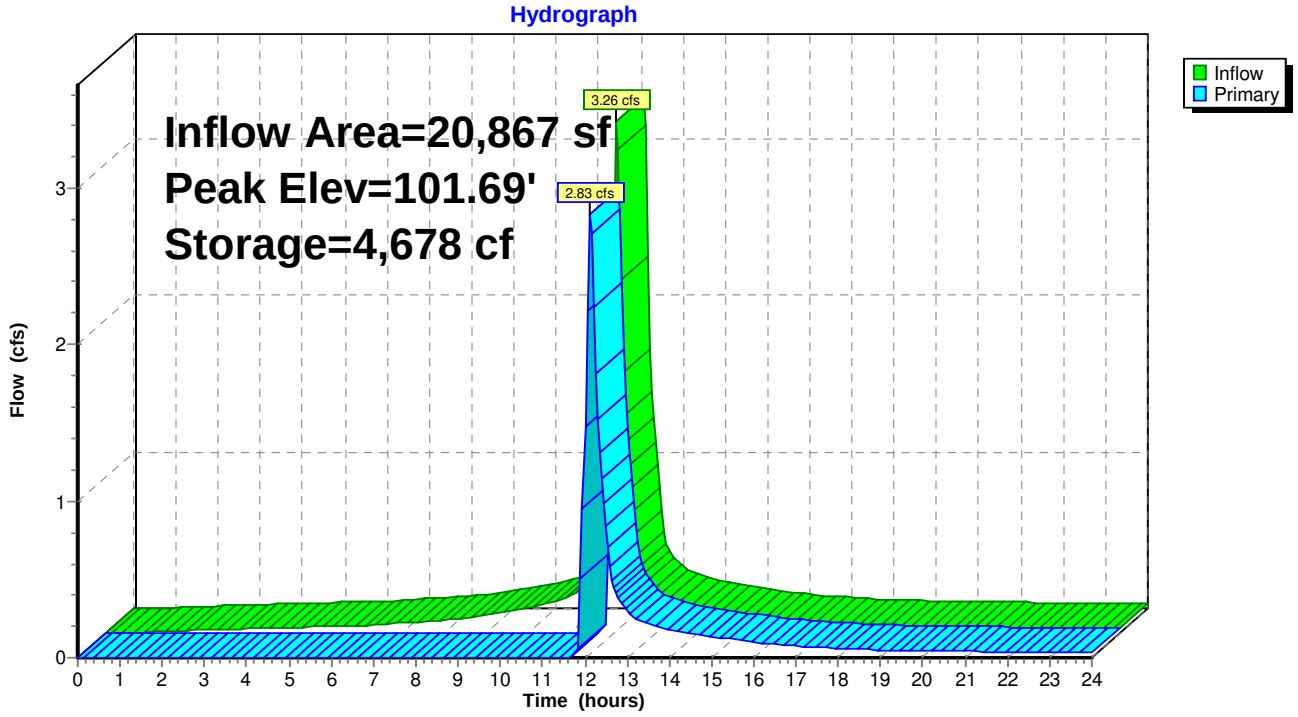
Plug-Flow detention time= 201.9 min calculated for 7,666 cf (66% of inflow)
Center-of-Mass det. time= 100.6 min (842.5 - 741.9)

Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	12,132 cf	**4.00'W x 300.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	101.50'	**13.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=2.75 cfs @ 12.12 hrs HW=101.68' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 2.75 cfs @ 1.15 fps)

Pond 32P: BMP 5A



Summary for Pond 33P: BMP 5B

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 4.41" for 100 yr event
Inflow = 2.83 cfs @ 12.12 hrs, Volume= 7,666 cf
Outflow = 0.35 cfs @ 12.87 hrs, Volume= 3,753 cf, Atten= 88%, Lag= 45.2 min
Primary = 0.35 cfs @ 12.87 hrs, Volume= 3,753 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 99.55' @ 12.87 hrs Surf.Area= 4,104 sf Storage= 4,076 cf

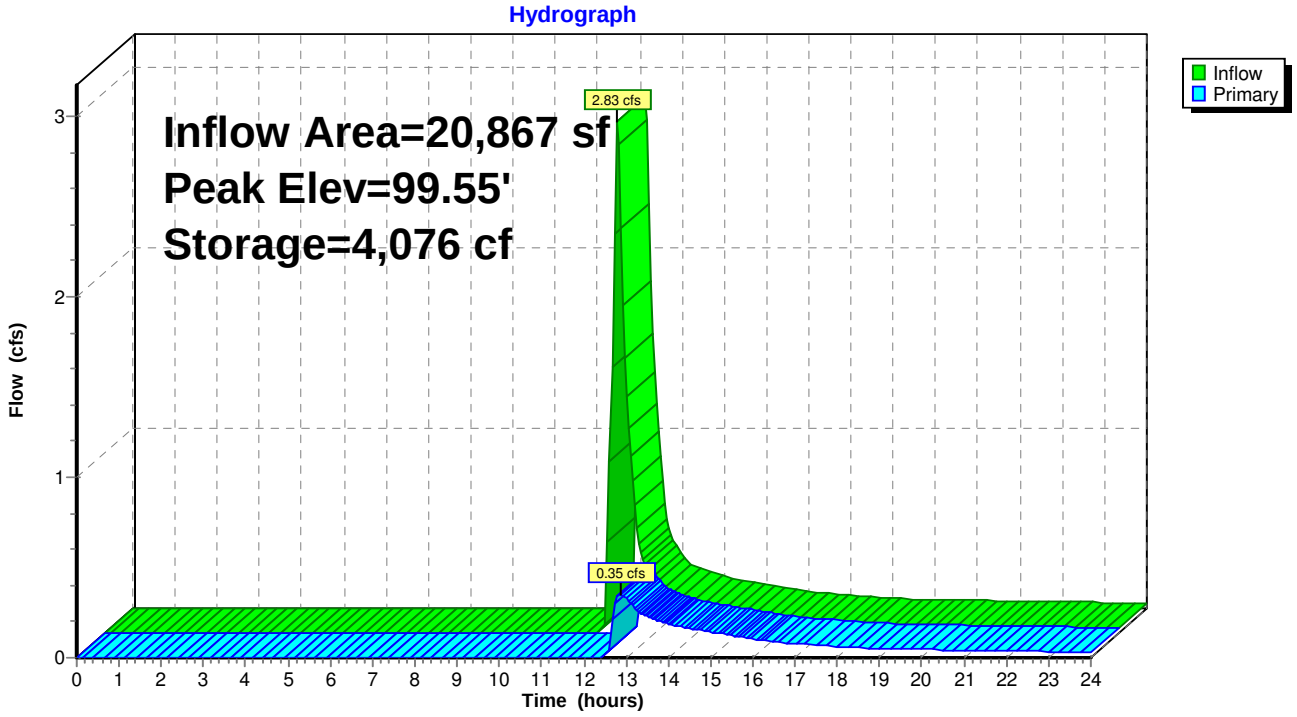
Plug-Flow detention time= 232.9 min calculated for 3,753 cf (49% of inflow)
Center-of-Mass det. time= 121.8 min (964.3 - 842.5)

Volume	Invert	Avail.Storage	Storage Description
#1	98.00'	12,132 cf	**4.00'W x 300.00'L x 3.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	99.50'	**13.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.33 cfs @ 12.87 hrs HW=99.55' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.33 cfs @ 0.57 fps)

Pond 33P: BMP 5B

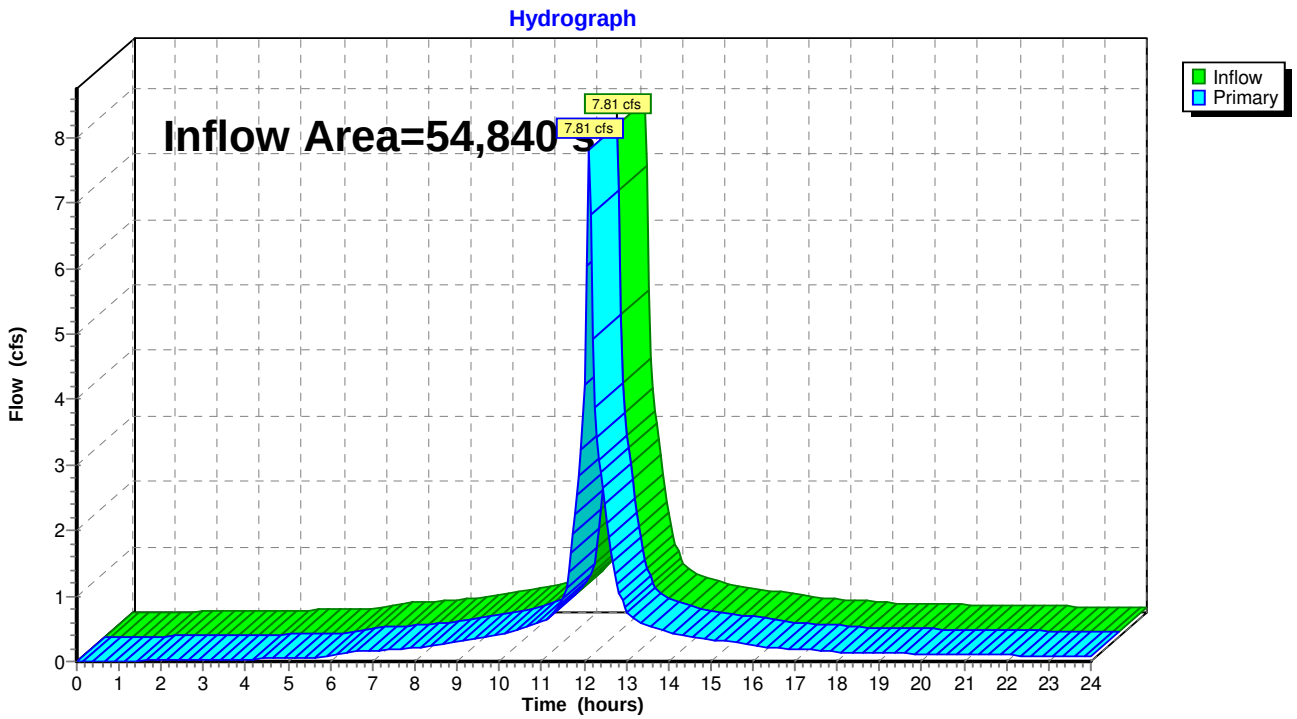


Summary for Link 10L: POI 1

Inflow Area = 54,840 sf,100.00% Impervious, Inflow Depth > 6.49" for 100 yr event
Inflow = 7.81 cfs @ 12.11 hrs, Volume= 29,651 cf
Primary = 7.81 cfs @ 12.11 hrs, Volume= 29,651 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 10L: POI 1

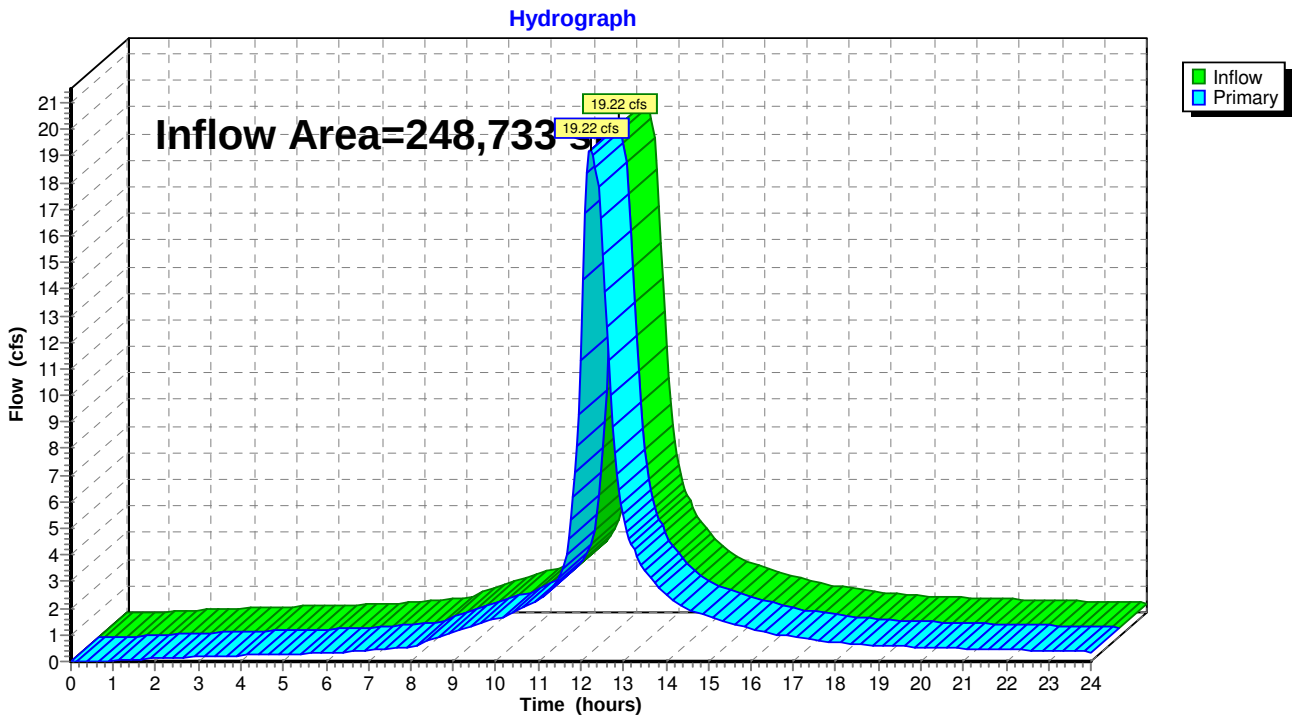


Summary for Link 20L: POI 2

Inflow Area = 248,733 sf, 99.21% Impervious, Inflow Depth > 6.18" for 100 yr event
Inflow = 19.22 cfs @ 12.23 hrs, Volume= 128,147 cf
Primary = 19.22 cfs @ 12.23 hrs, Volume= 128,147 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 20L: POI 2

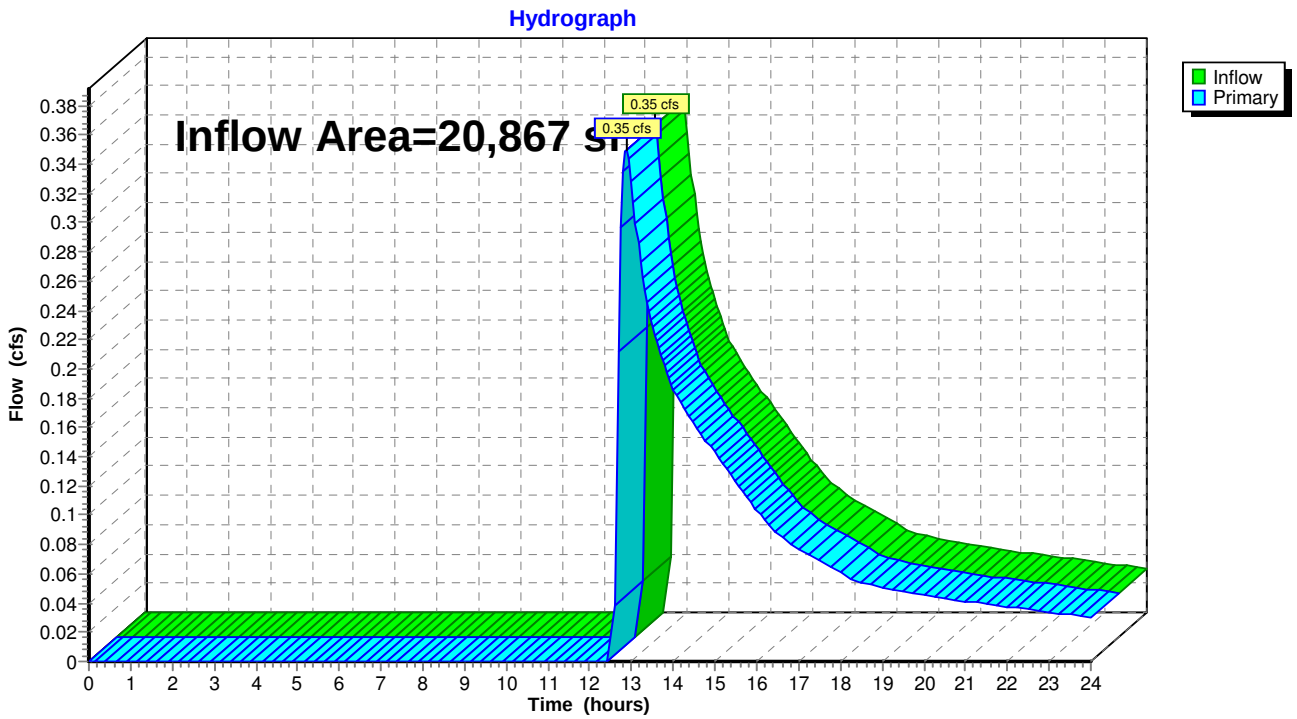


Summary for Link 30L: POI 3

Inflow Area = 20,867 sf,100.00% Impervious, Inflow Depth > 2.16" for 100 yr event
Inflow = 0.35 cfs @ 12.87 hrs, Volume= 3,753 cf
Primary = 0.35 cfs @ 12.87 hrs, Volume= 3,753 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 30L: POI 3



APPENDIX F

ROUTES 140/24 IMPROVEMENTS
PHASE 1

DRAINAGE AREA MAPS

SOURCE: Fay, Spofford & Thorndike

Final EIR - Phase 1
Pre-Developement Drainge Map

SOURCE: Fay, Spofford & Thorndike

Final EIR - Phase 1
Post-Developement Drainge Map