6 Stormwater Management

6.1 Existing Conditions

6.1.1 Site Characteristics

The project site is 15.6 acres in size consisting primarily of wooded areas. As per Technical Release 55 (TR-55) from Urban Hydrology for Small Watersheds (dated June 1986), prepared by the Soil Conservation Service, the hydraulic condition of the existing on-site vegetation is woods (fair condition).

Table 1 Existing Conditions Land Use Breakdown

Land Use	Acreage
Woods	15.6

Per the Soil Survey Report for Middlesex County, Massachusetts Interim, Fourth Edition (dated July 1995), Atlas Number 41, the majority of the project site is soil number 555 (Hydrologic Soil Group 'B') and the remaining portion of the site is soil number 46 (Hydrologic Soil Group 'D').

Runoff Curve Number (CN)

The project site consists primarily of wooded areas. The hydraulic condition of the existing on-site vegetation is woods (fair condition) based on field investigations and review of aerial maps of the site. Technical Release 55 (TR-55) from *Urban Hydrology for Small Watersheds* (dated June 1986), prepared by the Soil Conservation Service, defines woods (fair condition) as "grazed, but not burned, and some forest litter covers the soil." The on-site woods have some forest litter covering the ground and barren areas between the trees. Comments were raised regarding the land use selection of woods (fair condition). It was suggested that the land use selection should be woods (good condition). TR-55 defines woods (good condition) as "protected from grazing, and litter and brush adequately cover the soil." The proponent did not select woods (good condition) as the existing on-site land use, since the *Massachusetts Supplement for the TR-55 Hydrology Procedure* (dated April 1990), further states that land use of woods with dense underbrush should be avoided in calculating time of concentrations used to generate runoff hydrographs for the watershed because the Manning's roughness coefficient for this cover type is extrapolated from research data and does not represent typical conditions in the northeast region of the United States.

Time of Concentration

The drainage flow paths used to calculate the time of concentrations under existing and proposed conditions have been added to Figure 1, Existing Conditions Watershed Plan and Figure 3, Proposed Conditions Watershed Plan.

6.1.2 Site Surface Drainage

The hydrologic study area for this project consists of approximately 11.23 acres and includes a portion of Acorn Park Drive. The hydrologic study area is smaller in size than the total site property, since no site improvements are proposed for the portion of the property located east of Acorn Park Drive.

The site is located within the Mystic River Basin Watershed. Little River, located south of the site, flows to the northeast into Alewife Brook. Alewife Brook, located to the south of Route 2, flows to the east and then the north, where it joins with Mystic River.

More specifically, the overall Little River watershed is approximately 8.16 square miles or 5,222 acres in size. The project study area of 11.23 acres is approximately 0.2 percent (%) of the overall Little River watershed area of 5,222 acres.

The potential for flooding of downstream receiving water bodies and adjacent properties due to the proposed project is of concern by residents in the community. The intent of the proposed stormwater management systems is to mitigate for any impacts of the proposed site improvements on the overall watershed and to maintain and improve (to the extent practical) the existing conditions.

Table 2 summarizes the existing conditions drainage basin characteristics. Under Existing Conditions, the project site is divided into four (4) drainage basins (refer to Figure 1, Existing Conditions Watershed Plan).

Table 2 Existing Conditions Drainage Basin Characteristics

Drainage Basin Identification	Receiving Water bodies	Total Area (acres)	Slope of Land (%)	Hydrologic Soil Group	Land Use
Basin 1S	Swale/Little Pond	2.26	2-7%	B/D	Woods Pavement
Basin 2S	Swale/Little Pond	1.89	1-4%	B/D	Woods Pavement
Basin 3S	Wetland/Little River	2.26	0.5-3%	B/D	Woods
Basin 4S	Little River	4.82	1-9%	B/D	Woods
Total Study Area		**11.23**			

Notes: Hydrologic Soil Group 'B' refers to soils having a moderate infiltration rate.
Hydrologic Soil Group 'D' refers to soils having a slow infiltration rate (high runoff potential).

Runoff in Drainage Basin 1S sheet flows north to an existing drainage swale located along Frontage Road, which outfalls to Little Pond. Little Pond is hydraulically connected to Little River.

Runoff in Drainage Basin 2S sheet flows east to an existing drainage swale adjacent to Acorn Park Drive. During storms greater than the 2-year, 24-hour storm event, stormwater within the existing drainage swale stages to and above elevation 9.5. Once stormwater reaches elevation 9.5, it discharges over a 5-foot earthen weir to the downstream swale located along Frontage Road, which outfalls to Little Pond and ultimately to Little River.

Runoff in Drainage Basin 3S sheet flows southeasterly to an existing wetland located adjacent to Acorn Park Drive, hydraulically connected to Litter River.

Runoff in Drainage Basin 4S sheet flows southwesterly to Little River.

6.1.3 Floodplain

The project site is located partially within the 100-year floodplain of Little River. The site and Little River are located within the Mystic River Basin Watershed.

According to the FIRM Flood Insurance Rate Map (Panel No. 250182 0001 B), the 100-year Flood Boundary (Zone A5) is at elevation 8.20+/- feet, NGVD for the project site.

In the case of this project, however, the proponent is anticipating a change to the mapped base flood elevation to increase to 9.8 NGVD. A FEMA analysis of this watershed is currently underway and preliminary results support the higher 100-year floodplain elevation of 9.8 NGVD.

6.2 Proposed Conditions

6.2.1 Site Surface Drainage

As previously noted, the proposed site improvements include the construction of five residential buildings, each with below grade parking, and additional surface parking. The following table summarizes the proposed condition land use breakdown for the site.

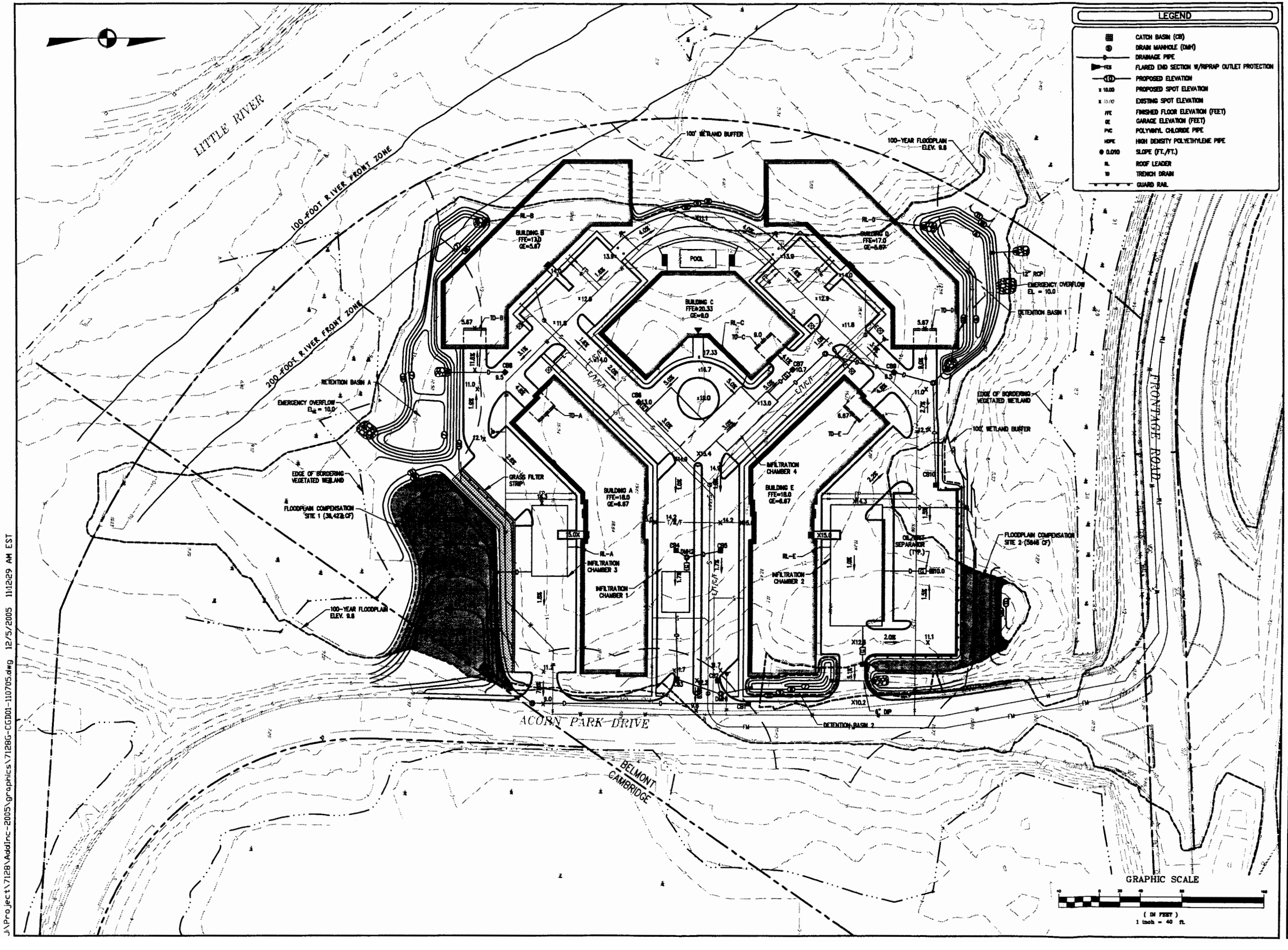
Table 3 Proposed Conditions Land Use Breakdown

Land Use	Acreage
Woods	4.45
Building	1.80
Impervious	2.81
Open Space	2.17
Total Study Area	**11.23**

The proposed stormwater management facilities will include two (2) existing water quality grassed or vegetated swales, two (2) surface detention basins, one (1) surface retention basin, one (1) 15' wide grass filter strip and four (4) sub-surface detention/infiltration (infiltration chambers) systems, as shown on Figure 2, Proposed Grading and Drainage Plan. One of the water quality swales is an existing swale adjacent to Acorn Park Drive which discharges to an existing swale along Frontage Road and ultimately to Little Pond. The other water quality swale outfalls to Little River.

Under proposed conditions, the study area will be divided into ten drainage basins as shown on Figure 3, Proposed Conditions Watershed Plan.

Table 5.3-4 summarizes the basin characteristics for the proposed condition drainage basins.



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No.	Date	Description

Revisions

Drawn By	Designed By	Checked By	Approved By
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Project Title

O'Neill Properties Residential Development Belmont, MA

Sheet Title

Grading and Drainage Plan

Scale: 1"=40'
Job No.: 7128
File Name: 7128P-CGD01
Date: 12/05/05

Sheet No.

Fig 2

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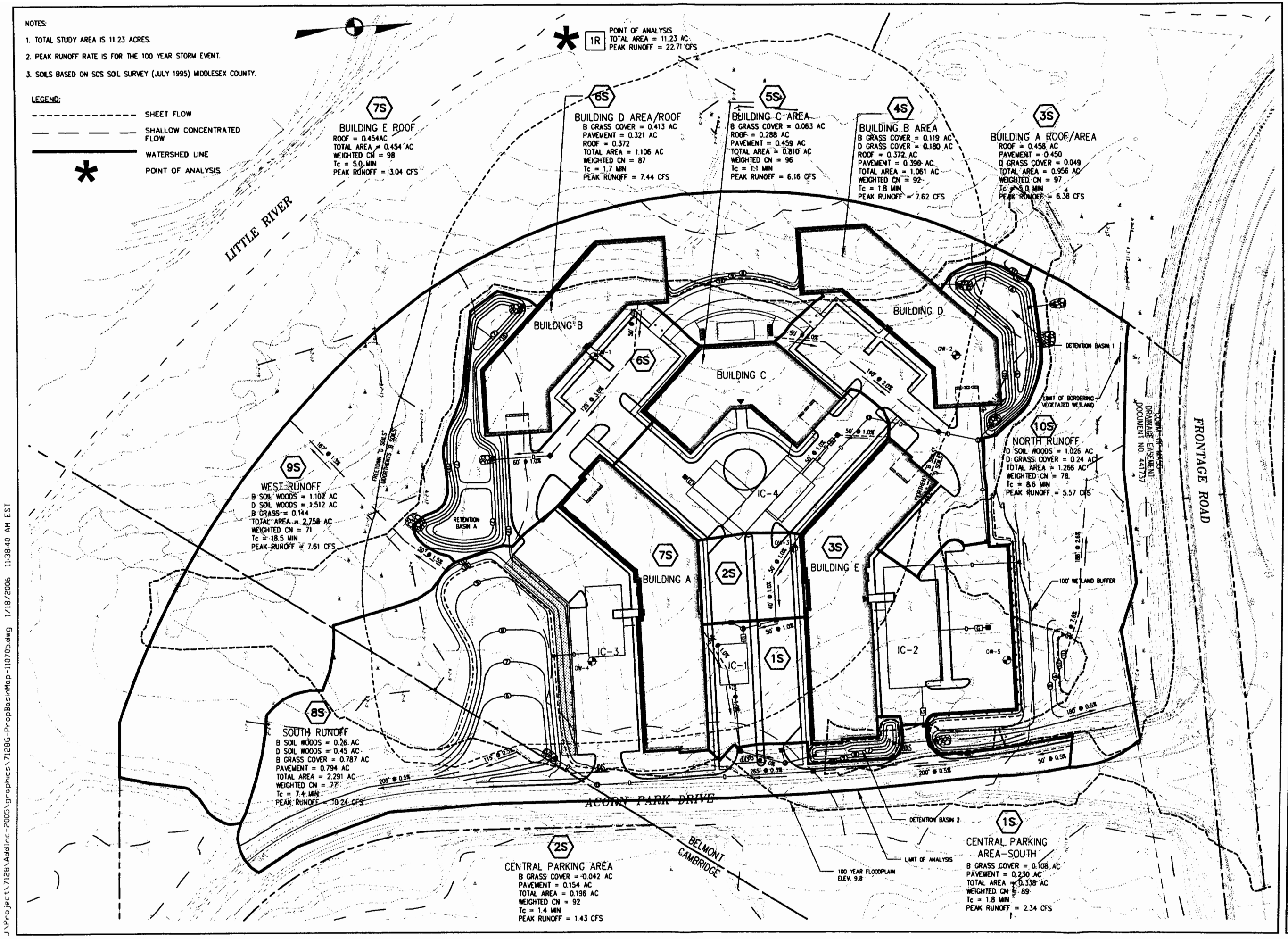
NOTES:

1. TOTAL STUDY AREA IS 11.23 ACRES.
2. PEAK RUNOFF RATE IS FOR THE 100 YEAR STORM EVENT.
3. SOILS BASED ON SCS SOIL SURVEY (JULY 1995) MIDDLESEX COUNTY.

LEGEND:

- SHEET FLOW
- SHALLOW CONCENTRATED FLOW
- WATERSHED LINE
- * POINT OF ANALYSIS



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Residences at Acorn Park Belmont, MA

Sheet Title
Proposed Conditions Watershed Plan

Scale: 1"=40'
Job No.: 7128
File Name: PropBasinMap
Date: 7/21/05
Sheet No.
Fig 3

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Table 4 Proposed Conditions Drainage Basin Characteristics

Drainage Basin Identification	Stormwater Management System/Receiving Waterbody	Total Area (acres)	Slope of Land (%)	Hydrologic Soil Group	Land Use
Basin 1S	Detention Basin 2 Swale/Little Pond	0.34	1%	B	Grass Pavement
Basin 2S	Detention Infiltration System 1	0.20	1%	B	Pavement
Basin 3S	Detention Infiltration System 2	0.96	1%	D	Roof Grass Pavement
Basin 4S	Detention Basin 1/ Wetland/Little River	1.06	2%	B/D	Roof Grass Pavement
Basin 5S	Detention Infiltration System 4	0.81	1%	B	Roof Grass Pavement
Basin 6S	Retention Basin A	1.11	1-3%	B	Roof Grass Pavement
Basin 7S	Detention Infiltration System 3	0.45	-	B	Roof
Basin 8S	Swale/ Wetland/Little River	2.29	1-3%	B/D	Woods Grass Pavement
Basin 9S	Wetland/Little River	2.76	1-2%	B/D	Woods Grass
Basin 10S	Swale/Wetland/Little River	1.27	1-7%	D	Woods Grass
Total Study Area		**11.23**			

Notes: Hydrologic Soil Group 'B' refers to soils having a moderate infiltration rate (medium runoff potential). Hydrologic Soil Group 'D' refers to soils having a slow infiltration rate (high runoff potential).

Runoff in Drainage Basin 1S sheet flows north across the parking lot and is collected in a drainage system which outfalls into Detention Basin 2 then is culverted into an existing drainage swale located along Frontage Road, which outfalls to Little Pond. Little Pond is hydraulically connected to Little River.

Stormwater runoff from the proposed parking area within Basin 2S will be collected and conveyed through a drainage system to a detention/infiltration system (IC-1) designed to provide peak attenuation and allow for recharge of groundwater. An 8" overflow pipe will be connected from IC-1 to a proposed catch basin located at the entrance drive.

Stormwater runoff from Building E's roof leaders and proposed parking areas in Drainage Basin 3S will be collected and conveyed through a drainage system to a detention/infiltration system (IC-2) designed to provide peak rate attenuation and allow for recharge of groundwater. An 8" overflow pipe will be connected from IC-2 to a proposed catch basin at the northern side of the parking lot.

Runoff from Building D's roof leaders and proposed parking area in Drainage Basin 4S will be collected and conveyed through a drainage system to Detention Basin 1 which provides water quality and quantity control prior to discharge to the existing wetland adjacent to Frontage Road.

Stormwater runoff from Building C's roof leaders and parking areas within Drainage Basin 5S will be collected and conveyed through a drainage system to a detention/infiltration system (IC-4), designed to provide peak rate attenuation and allow for recharge of groundwater. An 8" overflow pipe will be connected from IC-4 to a proposed catch basin located between Building E and Building D.

Stormwater runoff from the proposed parking area and Building B's roof leaders within Drainage Basin 6S will be collected and conveyed through a drainage system to Retention Basin A designed to provide peak rate attenuation and allows recharge of groundwater.

Stormwater runoff from Building A's roof leaders, within Drainage Basin 7S, will be collected into a detention/infiltration system (IC-3) designed to provide peak attenuation and allow for recharge of groundwater. An 8" overflow pipe will be connected to IC-3 and will outlet into the proposed swale at the southern side of the site.

Runoff within Drainage basin 8S sheet flows from a proposed parking lot across a grass filter strip which provides water quality control, then conveyed through a grassed swale adjacent to Acorn Park Drive which provides water quality and quantity control prior to discharging to an existing wetland.

Stormwater runoff from Drainage Basin 9S sheet flows southwesterly towards Little River.

Runoff from Drainage Basin 10S sheet flows north to an existing drainage swale located adjacent to Frontage Road, which outfalls to Little Pond which is hydraulically connected to Little River.

6.2.2 Proposed Methods of Stormwater Management

A comprehensive stormwater management plan has been prepared for the project to provide both quality and quantity controls for stormwater runoff. The stormwater management plan is in full compliance with the performance standards described in the DEP Stormwater Management Policy (1997). A copy of the DEP Stormwater Management Form for the project is included in Appendix A.

The proposed stormwater management system includes two (2) surface detention basins, one (1) surface retention basin, one (1) 15' wide grass bio-filter strip, five (5) oil/grit separators and four (4) sub-surface detention/infiltration systems. Stormwater runoff from the site will be collected and conveyed through a drainage system to the stormwater management systems. Surface runoff from paved areas to catch basins will be conveyed through oil/grit separators prior to discharging to the sub-surface detention systems.

The grass bio-filter strip provides pollutant removal through sedimentation, filtration, nutrient uptake and infiltration, and control and conveys it at low velocities to protect against erosion. The detention basins design provides for water quality treatment by allowing the settling of particulates and associated pollutants. A sediment forebay located at the inlets to the detention basins will reduce stormwater velocity and promote efficient settling of suspended solids.

Table 5 summarizes the proposed Stormwater Management System.

Table 5 Summary of Proposed Stormwater Management Systems

Stormwater Management Method	Stormwater Management Identification	Approximate Dimensions (feet by feet)	Peak Storage Volume (cubic feet)	100-year Peak Water Surface Elevation (feet) NGVD	Top of Berm Elevation (feet) NGVD
Retention Basin A	5P	50' x 220'	21,569	9.2	10.5
Detention Basin 1	6P	150' x 35'	14,199	8.3	10.2
Detention Basin 2	7P	20' x 90'	7,459	8.9	10.5
Infiltration System 1	IC-1	30' x 40'	2,868	10.1	11.5 *
Infiltration System 2	IC-2	50' x 120'	14,799	11.7	12.0 *
Infiltration System 3	IC-3	35' x 70'	5,525	11.6	12.0 *
Infiltration System 4	IC-4	85' x 70'	11,282	11.5	12.0 *

*Top of infiltration pipe

As shown in Table 5, the detention systems will contain the 100-year peak elevation, meaning that no adverse flooding impacts will occur on Acorn Park Drive, Frontage Road or abutting properties.

6.3 DEP Stormwater Management Guidelines

6.3.1 Stormwater Quality

The site is located in the Mystic River Basin Watershed to Little River, which abuts the site to the south. The project has been designed to treat 1.0 inches of runoff from all new impervious surfaces. He backup calculations are located in Appendix A. Stormwater runoff from the proposed project will be treated in water quality swales, oil/grit separators, detention basins, or a combination of these three prior to discharge. The proposed project design will inhibit transport of erosion, sediment, oil and grease, nutrients, pathogens, road salt, or debris. Therefore, no impairment of water quality will occur to impact resident and anadromous fish species that use Little Pond, Little River, or Alewife Brook.

6.3.2 Stormwater Quantity

To determine the peak rate of discharge for existing and proposed conditions, runoff hydrographs were generated for the 2-, 10-, 25- and 100-year, 24-hour storm events using the SCS TR-20 Method and Type III rainfall distribution. Under proposed conditions, the post-development runoff hydrographs were flood routed through the proposed stormwater management facilities (detention/infiltration system, detention basins and water quality swales). The pre- versus post-development peak discharge rates were compared to demonstrate that the post-development peak discharge rates will not exceed pre-development discharge rates.

Table 6 summarizes the total rainfall amounts input into the HydroCAD© analyses for the 2-, 10-, 25- and 100-year storm events.

Table 6 Total Rainfall versus Storm Frequency

Storm Event	Duration (hours)	Total Rainfall Amounts (inches)
2-year	24	3.3
10-year	24	4.6
25-year	24	5.4
100-year	24	6.6

The rainfall amounts summarized in Table 6 are based on review of the precipitation values for Massachusetts contained in the Massachusetts Supplement for the TR-55 Hydrology Procedure (210-EFM, Amend. MA1 April 1990), Technical Publication, TP-40.

Table 7 summarizes the pre- and post-development discharge rates determined in the hydrologic/hydraulic analyses performed for the study area. The backup data for the analyses is contained in Appendix A.

Table 7 Pre- versus Post -Development Peak Discharge Rates

Storm Event	Pre-Development Rate (CFS)	Post-Development Rate (CFS)
2-Year, 24-Hour	6.2	6.1
10-Year, 24-Hour	13.1	11.7
25-Year, 24-Hour	17.9	15.8
100-Year, 24-Hour	25.5	22.7

The pre- versus post-development peak discharge rates were compared to demonstrate that the post-development peak discharge rates will not exceed pre-development discharge rates.

As shown in Table 7, the post-development discharge rate for each storm event is less than the peak discharge rate under pre-development conditions. Therefore, the proposed project meets DEP Stormwater Management Standard No. 2 – Peak Discharge Rates, meaning that there will be no adverse impacts to downstream waterbodies, Acorn Park Drive, Frontage Road or abutting properties.

6.3.3 Groundwater Recharge

Under proposed conditions, impervious surfaces (i.e., roof tops, pavement) will be added to the site. The additional stormwater runoff and loss of groundwater recharge due to the increase in impervious surfaces will be mitigated in accordance with DEP Stormwater Management Standard No. 3 – Groundwater Recharge by infiltrating the roof runoff from the buildings and a portion of the parking area.

According to the Middlesex Soils Survey, the project site is located within Hydrological Soil Groups 'B' and 'D'. Based on the DEP Stormwater Management Guidelines, the required groundwater recharge volumes for Hydrological Soil Groups 'B' and 'D' are as follows:

Hydrological Soil Group 'B': 0.25 inches of runoff multiplied by the total impervious area overlying Type 'B' soils.

Hydrological Soil Group 'D': Waived (Because the soils are not conducive to infiltration).

On the basis of these recharge volumes, the required groundwater recharge volume (based on the most conservative Type 'B' soil classification) is 0.08 acre-feet. (3.866 ac. x 0.25")

The proposed detention/infiltration system will infiltrate 0.10 acre-feet of stormwater runoff, thereby exceeding the required DEP recharge standard. Backup calculations are included in Appendix A.

Groundwater elevations within the vicinity of the proposed swales, detention basin and infiltration system were based on borings performed on-site. The boring logs are included in a report entitled, Hydrogeological Report, Frontage Road Office Center (March 6, 2001) prepared by McPhail Associates, Inc. and Epsilon Associates, Inc. In addition, the observed high water table elevation below the proposed detention/infiltration systems was based on site specific groundwater monitoring described in the Groundwater Monitoring Report (dated August 28, 2001) prepared by McPhail Associates, Inc. The observed high groundwater elevations and the elevations at the bottom of the systems are listed below in Table 8. As shown, there is no groundwater interception through the bottom of the stormwater management systems.

Table 8 Observed High Groundwater Elevations

Stormwater Management System	Bottom Elevation	Groundwater Elevation
Retention Basin A	7.0	4.7
Detention Basin 1	6.0	4.2
Detention Basin 2	7.0	5.5
Infiltration System 1	8.5	6.0
Infiltration System 2	8.0	6.0
Infiltration System 3	8.5	7.5
Infiltration System 4	8.0	4.5

During final design of the project, additional groundwater data will be collected to ensure that acceptable separation distances will be maintained.

Percolation tests will be performed near the proposed detention/infiltration system and detention basin as part of the final design. The current design uses a constant infiltration rate of 0.52 inches per hour based on hydrologic soil properties classified by United States Department of Agriculture soil texture for Hydrologic Soil Type 'B'. Given the current understanding of the soils on-site, this rate is considered a conservative estimate of the actual infiltration rate.

6.3.4 TSS Removal Rates

To achieve the required 80 percent total suspended solids (TSS) removal (Standard No. 4), the stormwater management system has been designed to incorporate Best Management Practices (BMP) as outlined in the DEP Stormwater Management Handbook. These include street sweeping (10% removal), deep sump and hooded

catchbasins (25% removal), dry detention basin (70% removal), grassed water quality swales (70% removal) and oil/grit separators (25% removal). The proposed BMPs are described below.

Street Sweeping. The proposed design incorporates street sweeping as a BMP to control the amount of sediment that enters the drainage system. Street sweeping will occur at least two times a year, once coinciding with the end of the winter sanding season and once during the late fall. Efforts will also be made to provide street sweeping immediately following winter snowmelt when road sand and other sediments have accumulated.

Deep Sump Catchbasins. The on-site drainage collection system will incorporate deep sump catchbasins, which will serve to trap sediment and floatables. Sumps will be four-feet deep, and hoods will be provided with vacuum-breaks to avoid siphoning of floatables out of the catchbasin.

Grassed Bio-Filter Strip. A grassed 15 foot wide grassed bio-filter strip will be utilized at the southern side of the site. The strip is planted with vegetation and materials to help capture pollutants, develop nitrogen uptake and to decrease runoff velocity prior to discharging into adjacent wetlands. According to the DEP Stormwater Guidelines, swales capture approximately 70 percent of TSS.

Detention Basins. The detention basins will include a sediment forebay to assist in settling of suspended solids. According to the DEP Stormwater Guidelines, detention basins capture approximately 70 percent of TSS.

Oil/Grit Separators. The proposed design of the on-site drainage system will incorporate oil/grit separators prior to discharging to the underground detention system. According to DEP Stormwater Guidelines, oil/grit separators are similar to deep sump catch basins and capture 25% of TSS.

Underground Infiltation System. Each system consists of a series of perforated pipes surrounded with drain rock and filter fabric. The pavement runoff is directed through the catchbasins and an oil/grit separator prior to discharging into the infiltration system. The infiltration systems used for this project capture approximately 70% of TSS.

As shown in Table 9, the incorporation of these BMP measures will remove approximately 80 % of the TSS in the water column from the proposed impervious surfaces. The composite TSS removal rate of at least 80% was obtained by calculating the TSS removal rate percentage per proposed BMPs "treatment train" for each basin and multiplying by the prorated contributing impervious area.

Table 9 Total Suspended Solids Removal Rate

BMP Methods (TSS Removal Rate%)	Composite TSS Removal Rate Percentage (%)[1]
Street Sweeping (10%)/ Deep Sump Catchbasins (25%)/ Grassed Bio-Filter Strip (70%)	80.0
Street Sweeping (10%)/ Deep Sump Catchbasins (25%)/ Detention Basin (70%)	80.0
Street Sweeping (10%)/ Deep Sump Catchbasins (25%)/ Oil/Grit Separators (25%)/ Infiltration System (70%)	85.0
CUMULATIVE TOTAL	**82.0**

Notes: [1]Refer to TSS Removal Calculation Worksheets for each basin within Appendix A.

6.3.5 Erosion and Sedimentation Controls

The following erosion and sedimentation control devices will be implemented to prevent erosion both during and after construction.

- Initially an erosion control barrier, consisting of a silt fence staked by hay bales, will be installed at the limit of work.
- The temporary sedimentation basins will be constructed in the location of the permanent water quality swales and the detention basin. However, the detention/infiltration system will not be used as a temporary sediment trap for construction utilities. A temporary sedimentation basin will be located upgradient of the detention/infiltration system. The temporary sedimentation basins will be cleaned prior to final grading and stabilization of the water quality swales and the detention basin. The temporary sedimentation basin located upgradient of the detention/infiltration system will be removed.
- Construction entrance apron pads will be constructed at the main site access drive to prevent the tracking of sediment on vehicle tires from transport onto adjacent streets.
- Silt bags will be installed at all existing catchbasin structures to prevent silt from entering the existing drainage lines.

- During construction, cut and fill slopes will be stabilized immediately upon completion with loam, hydro-seeding and erosion control blankets.

- All drainage outfalls will include rip-rap aprons in order to mitigate discharge velocities and minimize erosion potential.

- Temporary haybales will be placed around all new catchbasins, and maintained throughout the duration of construction to prevent silt material from entering the drainage system.

6.3.6 Operation and Maintenance Plan

An Operation and Maintenance Plan for the project site has been prepared in accordance with DEP Stormwater Management Standard No. 9.

The Stormwater Management System will be the overall responsibility of the Owner. The General Contractor (under Contract with the Owner) will appoint a Project Manager who will be responsible during construction. A Facility Manager, hired by the owner, will be responsible after construction completion.

Short-term impacts may occur during construction activities. To minimize these impacts, a comprehensive soil and erosion control plan will be implemented prior to any project construction activities. The primary items of the soil and erosion control plan are outlined below.

- Erosion and sedimentation control devices will be installed along the perimeter of the proposed work area. In addition to providing for sediment deposition and reducing runoff during storm events, the barrier will limit work areas for equipment operators.

- Erosion and sedimentation control devices will be inspected daily during periods of active construction and bi-weekly during the remainder of the construction period. During the construction activities, erosion control devices will be placed at catchbasins to prevent sediment from reaching discharge points.

- Heavy equipment will not be allowed to operate on the surface location where the detention/infiltration system is planned because soil compaction could adversely affect the long-term performance of the system. Diversion berms or staked and lined haybales will be used around the perimeter of the system during its construction. Manual removal or light earth-moving equipment will be used for excavation and construction of the detention/infiltration system. Excavated material from this area will be located downgradient to prevent redeposition of this material into the system during runoff events.

- Stockpiles of cut trees and excavated and/or fill materials will be consolidated outside of wetland resources areas. If a temporary stockpile area is necessary within

the 100-foot Buffer Zone, it will be protected with appropriate erosion controls, such as hay mulch, grass seed, haybale barriers, or a combination of the above to minimize erosion. At the conclusion of the project, stockpiles will be removed from the 100-foot Buffer Zone, original elevations will be restored, and the areas stabilized.

- If necessary, temporary drainage swales will be used to divert stormwater to temporary sedimentation basins. The swales will be constructed with hay bale check dams to prevent erosion. The check dams will be spaced at intervals no greater than 100 feet. The temporary basin will be constructed where the permanent basin has been designed. The basins will be cleaned out prior to final grading and stabilization.

- During construction, disturbed areas will be kept to a minimum, and vegetative stabilization of these areas will occur as soon as possible. Areas that cannot be restored or stabilized immediately will be mulched to prevent any potential erosion or sedimentation.

- Temporary seeding, mulching, or other suitable stabilization measures will be used to protect exposed critical areas, should unprotected soils remain exposed for prolonged periods. Following construction, and once disturbed areas have been stabilized, erosion controls will be removed.

The schedule for inspection and maintenance during and after construction is described below.

Schedule for Inspection and Maintenance during construction:

- *Erosion Control Barrier:* The erosion control barrier will be installed prior to commencement of construction and inspected weekly, prior to storm events and immediately after storm events to ensure its integrity. The erosion control barrier will be repaired as necessary to prevent erosion.

- *Construction Entrance Aprons:* The construction entrance aprons will be installed prior to commencement of construction and inspected weekly. The construction entrance aprons will be replaced when debris becomes noticeable on the existing pavement surfaces opposite the construction side.

- *Slope Stabilization:* Slope stabilization controls will be installed immediately upon obtaining final grades as shown on the project plans. Areas in failure will be re-graded to final grade and stabilized as necessary.

- *Baled Hay Silt Barrier around Catchbasins:* The catchbasin barriers will be installed immediately after installation of catchbasin grates and will be inspected weekly, prior to storm events and immediately after storm events. Catchbasin barriers will be replaced in areas of failure.

- *Riprap Slope Protection:* Slopes requiring riprap protection will be installed to obtain final grade.

- *Infiltration System:* These systems will not be constructed until after the site has been stabilized and will not be used as a temporary sediment trap during construction. Diversion berms or staked and lined haybales will be utilized around the perimeter of the system during its construction. Manual removal or light earth-moving equipment will be used for excavation and construction of the detention/infiltration system. All excavated material from this area will be located downgradient to prevent redeposition of this material in the system during runoff events.

- *Swales:* Temporary erosion and sediment controls will be utilized during construction. Mulch anchoring will be done immediately after seeding.

- *Detention Basins:* The detention basins will be inspected immediately after storm events and cleaned to remove sediment buildup. The control structure will be inspected immediately after storm events and cleaned whenever sediment clogs the structure.

- *Construction Completion:* The entire stormwater management system will be inspected upon completion of construction. Sediment will be removed from the system at this time.

Schedule for Inspection and Maintenance after Construction:

- *Street sweeping:* Street sweeping will occur at least twice a year, once coinciding with the end of the winter sanding season and once during the late fall.

- *Catchbasins, Area Drains and Drop Inlets:* The removal of sediments and trash will occur when catchbasins, area drains and drop inlets are cleaned out. At a minimum, catchbasins, area drains and drop inlets will be inspected quarterly and cleaned on a semi-annual basis. Disposal of accumulated sediment will be performed in accordance with applicable local, state and federal guidelines and regulations.

- *Infiltration System:* After construction, the detention/infiltration system will be inspected after every major storm for the first year to ensure proper function. Thereafter, the system will be inspected twice per year, with cleaning occurring as needed.

- *Swales:* Swales will be inspected at least semi-annually, and maintenance and repairs made as necessary. Additional inspections will be scheduled during the first few months to make sure the vegetation is adequately established. Repairs and reseeding will be done as required. Swales will be mowed at least once per year. The grass will not be cut too often or shorter than four inches, to maintain the

effectiveness of the swale for pollutant removal and nutrient intake. Sediment and debris will be removed manually, at least once per year, before the vegetation is adversely impacted.

- *Sediment Forebay:* The sediment forebay located within the detention basins will be inspected and cleaned at least once per year. A 4"x4" wooden marker post will be placed in each basin forebay. If the forebay fills up by 50%, it shall be cleaned. Sediments will be handled and disposed in accordance with local, state and federal guidelines and regulations.

- *Detention Basin*: Once constructed, the detention basins will be inspected after several storm events to confirm drainage system functions, bank stability, and vegetation growth. Problems will be addressed immediately. During the first six months of operation, the basin will be inspected immediately after significant storm events and cleaned to remove sediment buildup. The control structure will be inspected and cleaned when sediment appears to have clogged the structure. Thereafter, the basin will be inspected annually and sediment will be removed as necessary or at a minimum once every 10 years. At least twice during the growing season, the side slopes will be mowed, and accumulated trash and debris will be removed. Accumulated sediment in forebay will also be removed at this time.

- The entire stormwater management system, including piping, catchbasins, and manholes will be cleaned prior to final site acceptance. Sediment and debris will be removed and disposed of in accordance with local, state and federal guidelines and regulations.

Snow removal and storage: Snow plowing on the property will be done as winter conditions warrant. Snow will be removed from the paved roadways and parking areas using plows and other equipment, as necessary. Signs designating snow pile areas will be kept in place. Snow storage areas will be located in pervious areas on-site that will promote slow infiltration to prevent ponding and prevent draining directly towards the adjacent wetlands. The snow storage areas will be inspected frequently. Removal of sediment from the snow storage areas will occur every spring.

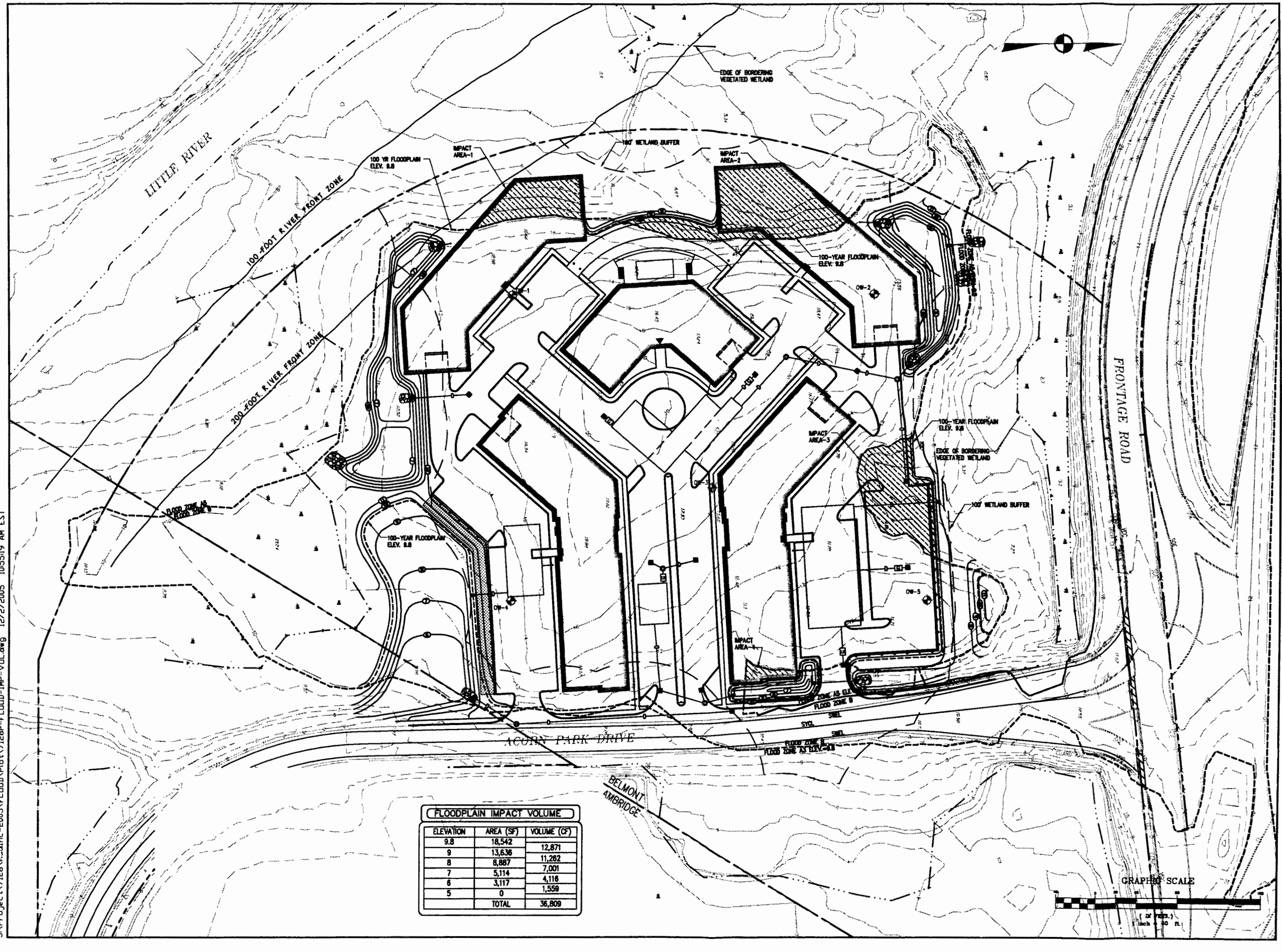
Ice Melt: Calcium chloride, or a similar ice melt product that does not contain sodium, will be used on paved roadways, parking areas, drives, and walkways on the property.

6.3.7 Floodplain

The project will result in an increase in the 100-year floodplain volume available on site. The construction of a small section of parking area/driveway and portions of three buildings will impact the 100-year floodplain of Little Pond (which outfalls to Little River). In order to bring the grade up in these areas to (construct the driveway and buildings),

approximately 36,809 cubic feet (cf) of the 100-year floodplain will be filled between elevations 5.0 and 9.8 (refer to Figure 4 and Table 10).

In accordance with the Town of Belmont Zoning By-laws, floodplain compensation was provided on a foot-by-foot basis. Compensatory calculations were performed for the project site. Existing and proposed floodplain storage volumes were compared to demonstrate that the proposed site improvements would create a net increase in the 100-year floodplain storage volume available to Little River.



FLOODPLAIN IMPACT VOLUME		
ELEVATION	AREA (SF)	VOLUME (CF)
9.8	18,542	
		12,871
9	13,636	
		11,262
8	8,887	
		7,001
7	5,114	
		4,116
6	3,117	
		1,559
5	0	
	TOTAL	36,809

NOT FOR CONSTRUCTION

THESE PLANS WERE PREPARED FOR THE PURPOSE OF OBTAINING STATE AND LOCAL APPROVALS AND ARE NOT INTENDED TO BE USED AS CONSTRUCTION DOCUMENTS.

No.	Date	Description

Revisions

Drawn By	Designed By	Checked By	Approved By
PRS	PRS	____	____

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Project Title

O'Neill Properties Residential Development Belmont, MA

Sheet Title

Proposed Floodplain Impact Plan

Scale: 40

Sheet No.

Job No.: 7128

File Name: 7128P-flood-imp-vol

Date: 12/02/05

Fig 4

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To compensate for the loss in floodplain storage, compensatory storage volume will be created on-site between elevations 5.0 and 9.8, in two areas adjacent to the impacted floodplain (see Figure 5). The compensatory storage areas will be hydraulically connected to the existing floodplain along the northern and southerly portions of the site. This will ensure that during the 100-year storm, water within Little Pond will backflow into the compensatory storage areas. The purpose of the compensatory storage areas is to replicate the existing floodplain and to ensure that the floodplain of Little Pond will continue to function as it does under existing conditions. The compensatory volume will provide a net increase in storage at the same elevations from which existing floodplain storage is being removed.

It should be noted that credit for storage volume within the compensatory storage area was taken only for new floodplain storage volume created at each incremental contour elevation. No credit for compensatory storage was taken for existing floodplain storage volumes.

Tables 10 through 12 summarize the 100-year floodplain (elevation 9.8) impacts and compensatory storage.

Table 10 Impacts to the 100-Year Floodplain

Increment	Area (square feet)	Average Area (square feet)	Cumulative Storage Volume
5.0	0	0	0
6.0	3,117	1,559	1,559
7.0	5,114	4,116	5,675
8.0	8,887	7,001	12,676
9.0	13,636	11,262	23,938
9.8	18,542	12,871	36,809
		TOTAL	36,809

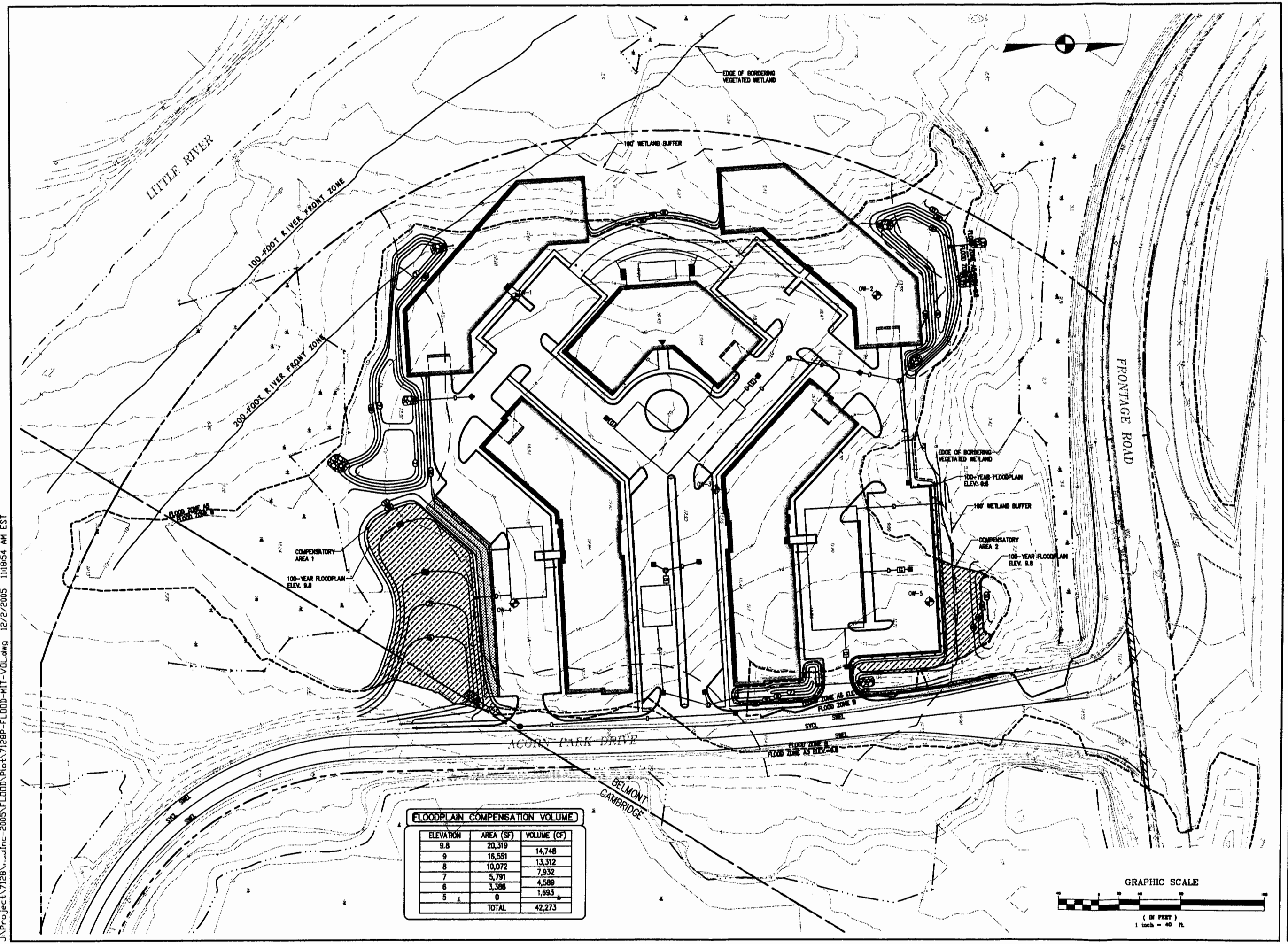
Table 11 100-Year Floodplain Compensatory Storage

Increment	Area (square feet)	Average Area (square feet)	Cumulative Storage Volume (cubic feet)
5.0	0	0	0
6.0	3,386	1,693	1,693
7.0	5,791	4,589	6,282
8.0	10,072	7,932	14,214
9.0	16,551	13,312	27,526
9.8	20,319	14,748	42,274
		TOTAL	42,274

Table 12 100-Year Floodplain Compensatory Storage Analysis

Increment	Impacts to the Existing 100 year Flood Plain (cubic feet)	Proposed Compensatory Storage (cubic feet)
5.0	0	0
6.0	1,559	1,693
7.0	5,675	6,282
8.0	12,676	14,214
9.0	23,938	27,526
9.8	36,809	42,274
TOTAL	36,809	42,274

To compensate for the loss of floodplain storage of approximately 36,809 cf, approximately 42,274 cf of compensatory storage volume (approximately a 10% increase in available volume) will be created on-site between elevation 5.0 and 9.8. This represents a net increase of approximately 5,465 cf of storage volume.



FLOODPLAIN COMPENSATION VOLUME

ELEVATION	AREA (SF)	VOLUME (CF)
9.8	20,319	
		14,748
9	16,551	
		13,312
8	10,072	
		7,932
7	5,791	
		4,589
6	3,386	
		1,693
5	0	
	TOTAL	42,273

NOT FOR CONSTRUCTION

THESE PLANS WERE PREPARED FOR THE PURPOSE OF OBTAINING STATE AND LOCAL APPROVALS AND ARE NOT INTENDED TO BE USED AS CONSTRUCTION DOCUMENTS.

No.	Date	Description

Revisions

Drawn By	Designed By	Checked By	Approved By
PRS	PRS		

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Project Title
O'Neill Properties Residential Development Belmont, MA

Sheet Title
Proposed Floodplain Compensation Plan

Scale: 40
Job No.: 7128 Sheet No.
File Name: 7128P-Flood-mit-vol
Date: 12/02/05

Fig 5

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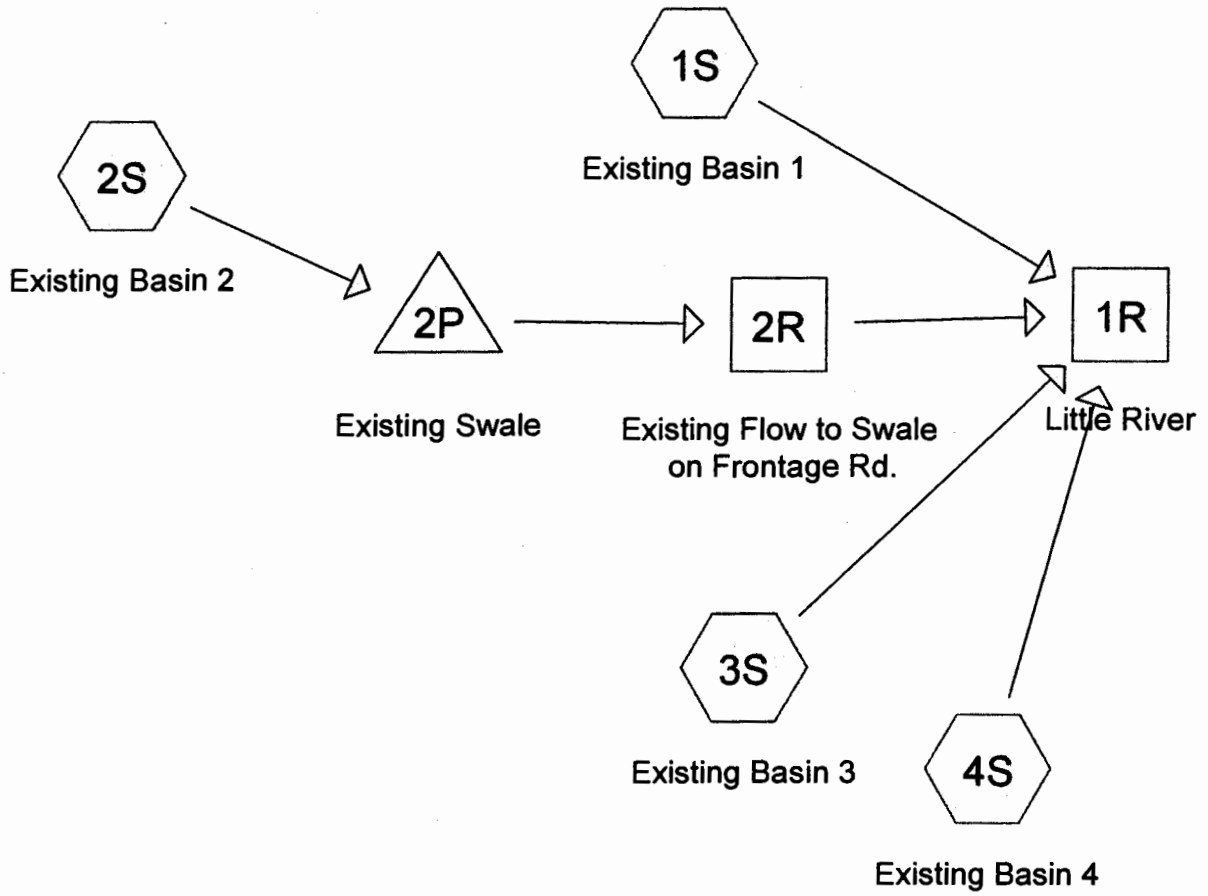
6.3.8 Town of Belmont Zoning By-Laws

The project conforms to the Standards outlined in Section 6B.7-Stormwater Management Facilities of the Town of Belmont Zoning By-Law Amendment (dated May 28, 2002) as described below.

- The post-development discharge rates for the 2-, 10-, 25- and 100-year storm events do not exceed the pre-development discharge rates.
- Building roof drainage will be piped directly to an underground infiltration system sized to meet the DEP groundwater recharge requirements for the site.
- Stormwater runoff from on-site paved areas will be collected and conveyed through deep sump catchbasins and storm drain pipes to adjacent stormwater management systems. The pipe capacity of the storm drain system will be designed to convey the 10-year storm frequency.
- Proposed detention basin(s) and swale(s) will detain the difference in pre- versus post-development stormwater discharge rates from the site.
- Proposed detention basin(s) will have adequate storage volume to contain the peak elevation during the 100-year storm event within its top of bank.
- Compensatory storage volume provided due to loss of floodplain storage of Little River will result in a net increase of 5,465 cf of volume within the 100-year floodplain.
- Creation of an acceptable Stormwater Facilities Maintenance Plan. Refer to Section 6.3.6.

HydroCAD Calculations



Subcat Reach Pond Link

Drainage Diagram for Existing Conditions
Prepared by Rizzo Associates 1/16/2006
HydroCAD® 7.00 s/n 002281 © 1986-2003 Applied Microcomputer Systems

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Basin 1 Runoff Area=2.260 ac Runoff Depth=1.28"
Flow Length=420' Tc=15.2 min CN=77 Runoff=2.47 cfs 0.241 af

Subcatchment 2S: Existing Basin 2 Runoff Area=1.890 ac Runoff Depth=0.78"
Flow Length=410' Tc=22.6 min CN=68 Runoff=0.97 cfs 0.123 af

Subcatchment 3S: Existing Basin 3 Runoff Area=2.260 ac Runoff Depth=0.83"
Flow Length=610' Tc=20.6 min CN=69 Runoff=1.30 cfs 0.157 af

Subcatchment 4S: Existing Basin 4 Runoff Area=4.820 ac Runoff Depth=0.69"
Flow Length=380' Tc=12.7 min CN=66 Runoff=2.55 cfs 0.278 af

Reach 1R: Little River Inflow=6.15 cfs 0.693 af
Outflow=6.15 cfs 0.693 af

Reach 2R: Existing Flow to Swale on Frontag Peak Depth=0.04' Max Vel=0.2 fps Inflow=0.05 cfs 0.018 af
n=0.150 L=125.0' S=0.0320 '/' Capacity=19.84 cfs Outflow=0.05 cfs 0.017 af

Pond 2P: Existing Swale Peak Elev=9.52' Storage=4,595 cf Inflow=0.97 cfs 0.123 af
Outflow=0.05 cfs 0.018 af

Total Runoff Area = 11.230 ac Runoff Volume = 0.799 af Average Runoff Depth = 0.85"

Subcatchment 1S: Existing Basin 1

Runoff = 2.47 cfs @ 12.20 hrs, Volume= 0.241 af, Depth= 1.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
0.250	60	WOODS (FAIR CONDITION) TYPE B
1.940	79	WOODS (FAIR CONDITION) TYPE D
0.070	98	EXISTING ACORN PARK ROADWAY
2.260	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0540	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
1.6	130	0.0770	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.4	240	0.0220	0.7		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.2	420	Total			

Subcatchment 2S: Existing Basin 2

Runoff = 0.97 cfs @ 12.34 hrs, Volume= 0.123 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
1.230	60	WOODS (FAIR CONDITION) TYPE B
0.550	79	WOODS (FAIR CONDITION) TYPE D
0.110	98	EXISTING ACORN PARK ROAD
1.890	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	50	0.0100	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
4.9	280	0.0360	0.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	80	0.0130	0.8		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.6	410	Total			

Subcatchment 3S: Existing Basin 3

Runoff = 1.30 cfs @ 12.30 hrs, Volume= 0.157 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
1.400	60	WOODS (FAIR CONDITION) TYPE B
0.660	79	WOODS (FAIR CONDITION) TYPE D
0.200	98	Pavement
2.260	69	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0	50	0.0140	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
6.1	340	0.0350	0.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	220	0.0050	6.8	287.70	**Channel Flow,** Area= 42.0 sf Perim= 36.0' r= 1.17' n= 0.017
20.6	610	Total			

Subcatchment 4S: Existing Basin 4

Runoff = 2.55 cfs @ 12.19 hrs, Volume= 0.278 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
1.510	79	Woods, Fair, HSG D
3.310	60	Woods, Fair, HSG B
4.820	66	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.0950	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
5.0	290	0.0380	1.0		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.2	40	0.0130	0.6		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.7	380	Total			

Reach 1R: Little River

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 11.230 ac, Inflow Depth = 0.74" for 2-Year Storm event
Inflow = 6.15 cfs @ 12.21 hrs, Volume= 0.693 af
Outflow = 6.15 cfs @ 12.21 hrs, Volume= 0.693 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2R: Existing Flow to Swale on Frontage Rd.

Inflow Area = 1.890 ac, Inflow Depth = 0.12" for 2-Year Storm event
Inflow = 0.05 cfs @ 19.77 hrs, Volume= 0.018 af
Outflow = 0.05 cfs @ 20.05 hrs, Volume= 0.017 af, Atten= 0%, Lag= 17.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.2 fps, Min. Travel Time= 9.7 min
Avg. Velocity = 0.2 fps, Avg. Travel Time= 10.6 min

Peak Depth= 0.04' @ 19.89 hrs
Capacity at bank full= 19.84 cfs
Inlet Invert= 8.00', Outlet Invert= 4.00'
5.00' x 1.50' deep channel, n= 0.150 Length= 125.0' Slope= 0.0320 '/'
Side Slope Z-value= 1.5 '/'

Pond 2P: Existing Swale

Inflow Area = 1.890 ac, Inflow Depth = 0.78" for 2-Year Storm event
Inflow = 0.97 cfs @ 12.34 hrs, Volume= 0.123 af
Outflow = 0.05 cfs @ 19.77 hrs, Volume= 0.018 af, Atten= 95%, Lag= 445.5 min
Primary = 0.05 cfs @ 19.77 hrs, Volume= 0.018 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 9.52' @ 19.77 hrs Surf.Area= 4,537 sf Storage= 4,595 cf
Plug-Flow detention time= 538.8 min calculated for 0.018 af (15% of inflow)
Center-of-Mass det. time= 378.7 min (1,269.8 - 891.1)

#	Invert	Avail.Storage	Storage Description
1	8.00'	5,777 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
8.00	1,428	0	0
9.00	3,322	2,375	2,375
9.80	5,184	3,402	5,777

#	Routing	Invert	Outlet Devices
1	Primary	9.50'	**5.0' 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=0.04 cfs @ 19.77 hrs HW=9.52' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.04 cfs @ 0.4 fps)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Basin 1 Runoff Area=2.260 ac Runoff Depth=2.29"
Flow Length=420' Tc=15.2 min CN=77 Runoff=4.53 cfs 0.431 af

Subcatchment 2S: Existing Basin 2 Runoff Area=1.890 ac Runoff Depth=1.59"
Flow Length=410' Tc=22.6 min CN=68 Runoff=2.16 cfs 0.251 af

Subcatchment 3S: Existing Basin 3 Runoff Area=2.260 ac Runoff Depth=1.66"
Flow Length=610' Tc=20.6 min CN=69 Runoff=2.83 cfs 0.313 af

Subcatchment 4S: Existing Basin 4 Runoff Area=4.820 ac Runoff Depth=1.46"
Flow Length=380' Tc=12.7 min CN=66 Runoff=6.20 cfs 0.585 af

Reach 1R: Little River Inflow=13.11 cfs 1.473 af
Outflow=13.11 cfs 1.473 af

Reach 2R: Existing Flow to Swale on Frontag Peak Depth=0.19' Max Vel=0.6 fps Inflow=0.55 cfs 0.145 af
n=0.150 L=125.0' S=0.0320 '/' Capacity=19.84 cfs Outflow=0.55 cfs 0.144 af

Pond 2P: Existing Swale Peak Elev=9.62' Storage=5,007 cf Inflow=2.16 cfs 0.251 af
Outflow=0.55 cfs 0.145 af

Total Runoff Area = 11.230 ac Runoff Volume = 1.580 af Average Runoff Depth = 1.69"

Subcatchment 1S: Existing Basin 1

Runoff = 4.53 cfs @ 12.19 hrs, Volume= 0.431 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
0.250	60	WOODS (FAIR CONDITION) TYPE B
1.940	79	WOODS (FAIR CONDITION) TYPE D
0.070	98	EXISTING ACORN PARK ROADWAY
2.260	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0540	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
1.6	130	0.0770	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.4	240	0.0220	0.7		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.2	420	Total			

Subcatchment 2S: Existing Basin 2

Runoff = 2.16 cfs @ 12.31 hrs, Volume= 0.251 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
1.230	60	WOODS (FAIR CONDITION) TYPE B
0.550	79	WOODS (FAIR CONDITION) TYPE D
0.110	98	EXISTING ACORN PARK ROAD
1.890	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	50	0.0100	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
4.9	280	0.0360	0.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	80	0.0130	0.8		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.6	410	Total			

Subcatchment 3S: Existing Basin 3

Runoff = 2.83 cfs @ 12.28 hrs, Volume= 0.313 af, Depth= 1.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
1.400	60	WOODS (FAIR CONDITION) TYPE B
0.660	79	WOODS (FAIR CONDITION) TYPE D
0.200	98	Pavement
2.260	69	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0	50	0.0140	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
6.1	340	0.0350	0.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	220	0.0050	6.8	287.70	**Channel Flow,** Area= 42.0 sf Perim= 36.0' r= 1.17' n= 0.017
20.6	610	Total			

Subcatchment 4S: Existing Basin 4

Runoff = 6.20 cfs @ 12.17 hrs, Volume= 0.585 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
1.510	79	Woods, Fair, HSG D
3.310	60	Woods, Fair, HSG B
4.820	66	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.0950	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
5.0	290	0.0380	1.0		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.2	40	0.0130	0.6		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.7	380	Total			

Reach 1R: Little River

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 11.230 ac, Inflow Depth = 1.57" for 10-Year Storm event
Inflow = 13.11 cfs @ 12.19 hrs, Volume= 1.473 af
Outflow = 13.11 cfs @ 12.19 hrs, Volume= 1.473 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2R: Existing Flow to Swale on Frontage Rd.

Inflow Area = 1.890 ac, Inflow Depth = 0.92" for 10-Year Storm event
Inflow = 0.55 cfs @ 13.03 hrs, Volume= 0.145 af
Outflow = 0.55 cfs @ 13.14 hrs, Volume= 0.144 af, Atten= 1%, Lag= 7.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.6 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 0.3 fps, Avg. Travel Time= 6.4 min

Peak Depth= 0.19' @ 13.07 hrs
Capacity at bank full= 19.84 cfs
Inlet Invert= 8.00', Outlet Invert= 4.00'
5.00' x 1.50' deep channel, n= 0.150 Length= 125.0' Slope= 0.0320 '/'
Side Slope Z-value= 1.5 '/'

Pond 2P: Existing Swale

Inflow Area = 1.890 ac, Inflow Depth = 1.59" for 10-Year Storm event
Inflow = 2.16 cfs @ 12.31 hrs, Volume= 0.251 af
Outflow = 0.55 cfs @ 13.03 hrs, Volume= 0.145 af, Atten= 75%, Lag= 42.8 min
Primary = 0.55 cfs @ 13.03 hrs, Volume= 0.145 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 9.62' @ 13.03 hrs Surf.Area= 4,762 sf Storage= 5,007 cf
Plug-Flow detention time= 224.6 min calculated for 0.145 af (58% of inflow)
Center-of-Mass det. time= 106.6 min (975.2 - 868.6)

#	Invert	Avail.Storage	Storage Description
1	8.00'	5,777 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
8.00	1,428	0	0
9.00	3,322	2,375	2,375
9.80	5,184	3,402	5,777

#	Routing	Invert	Outlet Devices
1	Primary	9.50'	**5.0' 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=0.55 cfs @ 13.03 hrs HW=9.62' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.55 cfs @ 0.9 fps)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Basin 1 Runoff Area=2.260 ac Runoff Depth=2.95"
Flow Length=420' Tc=15.2 min CN=77 Runoff=5.87 cfs 0.556 af

Subcatchment 2S: Existing Basin 2 Runoff Area=1.890 ac Runoff Depth=2.16"
Flow Length=410' Tc=22.6 min CN=68 Runoff=3.00 cfs 0.340 af

Subcatchment 3S: Existing Basin 3 Runoff Area=2.260 ac Runoff Depth=2.24"
Flow Length=610' Tc=20.6 min CN=69 Runoff=3.89 cfs 0.423 af

Subcatchment 4S: Existing Basin 4 Runoff Area=4.820 ac Runoff Depth=2.00"
Flow Length=380' Tc=12.7 min CN=66 Runoff=8.76 cfs 0.804 af

Reach 1R: Little River Inflow=17.90 cfs 2.015 af
Outflow=17.90 cfs 2.015 af

Reach 2R: Existing Flow to Swale on Frontag Peak Depth=0.35' Max Vel=0.8 fps Inflow=1.59 cfs 0.234 af
n=0.150 L=125.0' S=0.0320 '/' Capacity=19.84 cfs Outflow=1.57 cfs 0.233 af

Pond 2P: Existing Swale Peak Elev=9.74' Storage=5,524 cf Inflow=3.00 cfs 0.340 af
Outflow=1.59 cfs 0.234 af

Total Runoff Area = 11.230 ac Runoff Volume = 2.122 af Average Runoff Depth = 2.27"

Subcatchment 1S: Existing Basin 1

Runoff = 5.87 cfs @ 12.19 hrs, Volume= 0.556 af, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
0.250	60	WOODS (FAIR CONDITION) TYPE B
1.940	79	WOODS (FAIR CONDITION) TYPE D
0.070	98	EXISTING ACORN PARK ROADWAY
2.260	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0540	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
1.6	130	0.0770	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.4	240	0.0220	0.7		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.2	420	Total			

Subcatchment 2S: Existing Basin 2

Runoff = 3.00 cfs @ 12.31 hrs, Volume= 0.340 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
1.230	60	WOODS (FAIR CONDITION) TYPE B
0.550	79	WOODS (FAIR CONDITION) TYPE D
0.110	98	EXISTING ACORN PARK ROAD
1.890	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	50	0.0100	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
4.9	280	0.0360	0.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	80	0.0130	0.8		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.6	410	Total			

Subcatchment 3S: Existing Basin 3

Runoff = 3.89 cfs @ 12.27 hrs, Volume= 0.423 af, Depth= 2.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
1.400	60	WOODS (FAIR CONDITION) TYPE B
0.660	79	WOODS (FAIR CONDITION) TYPE D
0.200	98	Pavement
2.260	69	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0	50	0.0140	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
6.1	340	0.0350	0.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	220	0.0050	6.8	287.70	**Channel Flow,** Area= 42.0 sf Perim= 36.0' r= 1.17' n= 0.017
20.6	610	Total			

Subcatchment 4S: Existing Basin 4

Runoff = 8.76 cfs @ 12.16 hrs, Volume= 0.804 af, Depth= 2.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
1.510	79	Woods, Fair, HSG D
3.310	60	Woods, Fair, HSG B
4.820	66	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.0950	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
5.0	290	0.0380	1.0		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.2	40	0.0130	0.6		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.7	380	Total			

Reach 1R: Little River

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 11.230 ac, Inflow Depth = 2.15" for 25-Year Storm event
Inflow = 17.90 cfs @ 12.19 hrs, Volume= 2.015 af
Outflow = 17.90 cfs @ 12.19 hrs, Volume= 2.015 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2R: Existing Flow to Swale on Frontage Rd.

Inflow Area = 1.890 ac, Inflow Depth = 1.48" for 25-Year Storm event
Inflow = 1.59 cfs @ 12.67 hrs, Volume= 0.234 af
Outflow = 1.57 cfs @ 12.75 hrs, Volume= 0.233 af, Atten= 1%, Lag= 4.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.8 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 0.4 fps, Avg. Travel Time= 5.6 min

Peak Depth= 0.35' @ 12.70 hrs
Capacity at bank full= 19.84 cfs
Inlet Invert= 8.00', Outlet Invert= 4.00'
5.00' x 1.50' deep channel, n= 0.150 Length= 125.0' Slope= 0.0320 '/'
Side Slope Z-value= 1.5 '/'

Pond 2P: Existing Swale

Inflow Area = 1.890 ac, Inflow Depth = 2.16" for 25-Year Storm event
Inflow = 3.00 cfs @ 12.31 hrs, Volume= 0.340 af
Outflow = 1.59 cfs @ 12.67 hrs, Volume= 0.234 af, Atten= 47%, Lag= 21.7 min
Primary = 1.59 cfs @ 12.67 hrs, Volume= 0.234 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 9.74' @ 12.67 hrs Surf.Area= 5,045 sf Storage= 5,524 cf
Plug-Flow detention time= 170.6 min calculated for 0.233 af (69% of inflow)
Center-of-Mass det. time= 70.4 min (930.0 - 859.6)

#	Invert	Avail.Storage	Storage Description
1	8.00'	5,777 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
8.00	1,428	0	0
9.00	3,322	2,375	2,375
9.80	5,184	3,402	5,777

#	Routing	Invert	Outlet Devices
1	Primary	9.50'	**5.0' 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=1.58 cfs @ 12.67 hrs HW=9.74' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 1.58 cfs @ 1.3 fps)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Basin 1 Runoff Area=2.260 ac Runoff Depth=4.00"
Flow Length=420' Tc=15.2 min CN=77 Runoff=7.93 cfs 0.753 af

Subcatchment 2S: Existing Basin 2 Runoff Area=1.890 ac Runoff Depth=3.08"
Flow Length=410' Tc=22.6 min CN=68 Runoff=4.34 cfs 0.484 af

Subcatchment 3S: Existing Basin 3 Runoff Area=2.260 ac Runoff Depth=3.18"
Flow Length=610' Tc=20.6 min CN=69 Runoff=5.58 cfs 0.598 af

Subcatchment 4S: Existing Basin 4 Runoff Area=4.820 ac Runoff Depth=2.89"
Flow Length=380' Tc=12.7 min CN=66 Runoff=12.92 cfs 1.160 af

Reach 1R: Little River Inflow=25.54 cfs 2.861 af
Outflow=25.54 cfs 2.861 af

Reach 2R: Existing Flow to Swale on Frontag Peak Depth=0.43' Max Vel=0.9 fps Inflow=2.31 cfs 0.351 af
n=0.150 L=125.0' S=0.0320 '/' Capacity=19.84 cfs Outflow=2.23 cfs 0.350 af

Pond 2P: Existing Swale Peak Elev=9.81' Storage=5,777 cf Inflow=4.34 cfs 0.484 af
Outflow=2.31 cfs 0.351 af

Total Runoff Area = 11.230 ac Runoff Volume = 2.995 af Average Runoff Depth = 3.20"

Subcatchment 1S: Existing Basin 1

Runoff = 7.93 cfs @ 12.19 hrs, Volume= 0.753 af, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
0.250	60	WOODS (FAIR CONDITION) TYPE B
1.940	79	WOODS (FAIR CONDITION) TYPE D
0.070	98	EXISTING ACORN PARK ROADWAY
2.260	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0540	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
1.6	130	0.0770	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.4	240	0.0220	0.7		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.2	420	Total			

Subcatchment 2S: Existing Basin 2

Runoff = 4.34 cfs @ 12.30 hrs, Volume= 0.484 af, Depth= 3.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
1.230	60	WOODS (FAIR CONDITION) TYPE B
0.550	79	WOODS (FAIR CONDITION) TYPE D
0.110	98	EXISTING ACORN PARK ROAD
1.890	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	50	0.0100	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
4.9	280	0.0360	0.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	80	0.0130	0.8		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.6	410	Total			

Subcatchment 3S: Existing Basin 3

Runoff = 5.58 cfs @ 12.27 hrs, Volume= 0.598 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
1.400	60	WOODS (FAIR CONDITION) TYPE B
0.660	79	WOODS (FAIR CONDITION) TYPE D
0.200	98	Pavement
2.260	69	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0	50	0.0140	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
6.1	340	0.0350	0.9		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.5	220	0.0050	6.8	287.70	**Channel Flow,** Area= 42.0 sf Perim= 36.0' r= 1.17' n= 0.017
20.6	610	Total			

Subcatchment 4S: Existing Basin 4

Runoff = 12.92 cfs @ 12.16 hrs, Volume= 1.160 af, Depth= 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
1.510	79	Woods, Fair, HSG D
3.310	60	Woods, Fair, HSG B
4.820	66	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.0950	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
5.0	290	0.0380	1.0		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.2	40	0.0130	0.6		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.7	380	Total			

Reach 1R: Little River

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 11.230 ac, Inflow Depth = 3.06" for 100-Year Storm event
Inflow = 25.54 cfs @ 12.18 hrs, Volume= 2.861 af
Outflow = 25.54 cfs @ 12.18 hrs, Volume= 2.861 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2R: Existing Flow to Swale on Frontage Rd.

Inflow Area = 1.890 ac, Inflow Depth = 2.23" for 100-Year Storm event
Inflow = 2.31 cfs @ 12.35 hrs, Volume= 0.351 af
Outflow = 2.23 cfs @ 12.45 hrs, Volume= 0.350 af, Atten= 3%, Lag= 6.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.9 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 0.4 fps, Avg. Travel Time= 4.9 min

Peak Depth= 0.43' @ 12.40 hrs
Capacity at bank full= 19.84 cfs
Inlet Invert= 8.00', Outlet Invert= 4.00'
5.00' x 1.50' deep channel, n= 0.150 Length= 125.0' Slope= 0.0320 '/'
Side Slope Z-value= 1.5 '/'

Pond 2P: Existing Swale

[93] Warning: Storage range exceeded by 0.01'

Inflow Area = 1.890 ac, Inflow Depth = 3.08" for 100-Year Storm event
Inflow = 4.34 cfs @ 12.30 hrs, Volume= 0.484 af
Outflow = 2.31 cfs @ 12.35 hrs, Volume= 0.351 af, Atten= 47%, Lag= 3.1 min
Primary = 2.31 cfs @ 12.35 hrs, Volume= 0.351 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 9.81' @ 12.35 hrs Surf.Area= 5,184 sf Storage= 5,777 cf
Plug-Flow detention time= 150.4 min calculated for 0.351 af (72% of inflow)
Center-of-Mass det. time= 58.7 min (908.1 - 849.4)

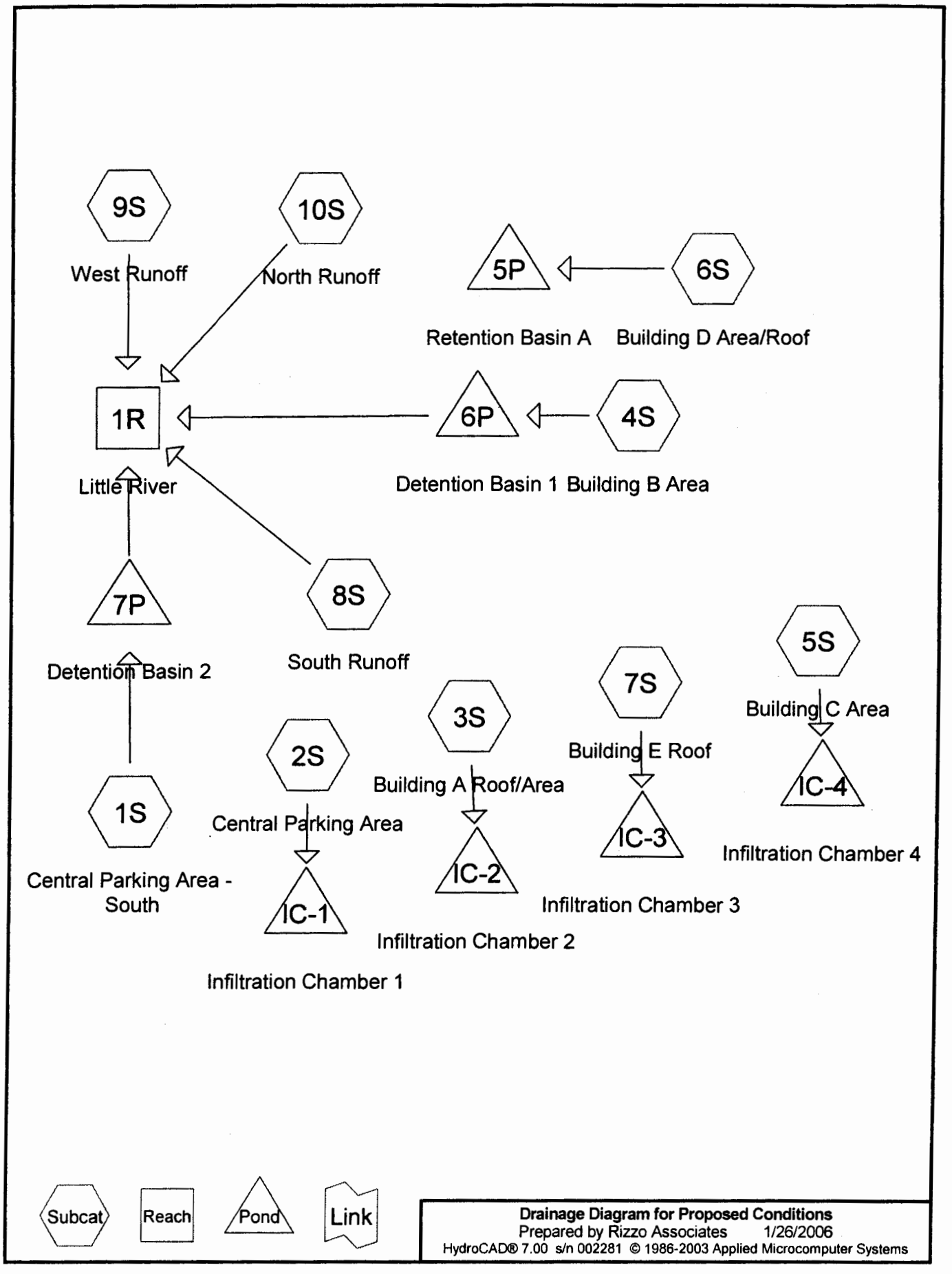
#	Invert	Avail.Storage	Storage Description
1	8.00'	5,777 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
8.00	1,428	0	0
9.00	3,322	2,375	2,375
9.80	5,184	3,402	5,777

#	Routing	Invert	Outlet Devices
1	Primary	9.50'	**5.0' 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=2.31 cfs @ 12.35 hrs HW=9.81' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 2.31 cfs @ 1.5 fps)


9S
West Runoff
10S
North Runoff
5P
Retention Basin A
6S
Building D Area/Roof
1R
Little River
6P
Detention Basin 1
4S
Building B Area
7P
Detention Basin 2
8S
South Runoff
5S
Building C Area
7S
Building E Roof
3S
Building A Roof/Area
2S
Central Parking Area
1S
Central Parking Area - South
IC-4
Infiltration Chamber 4
IC-3
IC-2
Infiltration Chamber 3
IC-1
Infiltration Chamber 2
Infiltration Chamber 1
Subcat
Reach
Pond
Link
Drainage Diagram for Proposed Conditions
Prepared by Rizzo Associates 1/26/2006
HydroCAD® 7.00 s/n 002281 © 1986-2003 Applied Microcomputer Systems

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Central Parking Area - South Runoff Area=0.338 ac Runoff Depth=2.17"
Flow Length=210' Tc=1.8 min CN=89 Runoff=0.99 cfs 0.061 af

Subcatchment 2S: Central Parking Area Runoff Area=0.196 ac Runoff Depth=2.45"
Flow Length=140' Tc=1.4 min CN=92 Runoff=0.65 cfs 0.040 af

Subcatchment 3S: Building A Roof/Area Runoff Area=0.956 ac Runoff Depth=2.95"
Tc=5.0 min CN=97 Runoff=3.13 cfs 0.235 af

Subcatchment 4S: Building B Area Runoff Area=1.061 ac Runoff Depth=2.45"
Flow Length=270' Tc=1.8 min CN=92 Runoff=3.45 cfs 0.216 af

Subcatchment 5S: Building C Area Runoff Area=0.810 ac Runoff Depth=2.85"
Flow Length=102' Tc=1.1 min CN=96 Runoff=2.98 cfs 0.192 af

Subcatchment 6S: Building D Area/Roof Runoff Area=1.106 ac Runoff Depth=2.00"
Flow Length=238' Tc=1.7 min CN=87 Runoff=3.03 cfs 0.185 af

Subcatchment 7S: Building E Roof Runoff Area=0.454 ac Runoff Depth=3.07"
Tc=5.0 min CN=98 Runoff=1.51 cfs 0.116 af

Subcatchment 8S: South Runoff Runoff Area=2.291 ac Runoff Depth=1.28"
Flow Length=835' Tc=7.4 min CN=77 Runoff=3.20 cfs 0.245 af

Subcatchment 9S: West Runoff Runoff Area=2.758 ac Runoff Depth=0.93"
Flow Length=217' Tc=18.5 min CN=71 Runoff=1.92 cfs 0.215 af

Subcatchment 10S: North Runoff Runoff Area=1.266 ac Runoff Depth=1.34"
Flow Length=238' Tc=8.6 min CN=78 Runoff=1.79 cfs 0.142 af

Reach 1R: Little River Inflow=6.14 cfs 0.601 af
Outflow=6.14 cfs 0.601 af

Pond 5P: Retention Basin A Peak Elev=7.78' Storage=4,215 cf Inflow=3.03 cfs 0.185 af
Outflow=0.12 cfs 0.138 af

Pond 6P: Detention Basin 1 Peak Elev=8.00' Storage=5,007 cf Inflow=3.45 cfs 0.216 af
Discarded=0.12 cfs 0.150 af Primary=0.00 cfs 0.000 af Outflow=0.12 cfs 0.150 af

Pond 7P: Detention Basin 2 Peak Elev=7.34' Storage=839 cf Inflow=0.99 cfs 0.061 af
Discarded=0.12 cfs 0.061 af Primary=0.00 cfs 0.000 af Outflow=0.12 cfs 0.061 af

Pond IC-1: Infiltration Chamber 1 Peak Elev=9.43' Storage=409 cf Inflow=0.65 cfs 0.040 af
Outflow=0.12 cfs 0.040 af

Pond IC-2: Infiltration Chamber 2 Peak Elev=9.70' Storage=5,268 cf Inflow=3.13 cfs 0.235 af
Outflow=0.12 cfs 0.165 af

Pond IC-3: Infiltration Chamber 3 Peak Elev=9.96' Storage=1,840 cf Inflow=1.51 cfs 0.116 af
Outflow=0.12 cfs 0.116 af

Pond IC-4: Infiltration Chamber 4 Peak Elev=9.68' Storage=4,006 cf Inflow=2.98 cfs 0.192 af
Outflow=0.12 cfs 0.158 af

Total Runoff Area = 11.236 ac Runoff Volume = 1.647 af Average Runoff Depth = 1.76"

Subcatchment 1S: Central Parking Area - South

Runoff = 0.99 cfs @ 12.03 hrs, Volume= 0.061 af, Depth= 2.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
0.230	98	Paved roads w/curbs & sewers
0.108	69	50-75% Grass cover, Fair, HSG B
0.338	89	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.6	75	0.0100	2.0		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	85	0.0100	4.5	3.56	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
1.8	210	Total			

Subcatchment 2S: Central Parking Area

Runoff = 0.65 cfs @ 12.02 hrs, Volume= 0.040 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
0.154	98	Paved parking & roofs
0.042	69	50-75% Grass cover, Fair, HSG B
0.196	92	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.3	40	0.0100	2.0		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	50	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.4	140	Total			

Subcatchment 3S: Building A Roof/Area

Runoff = 3.13 cfs @ 12.07 hrs, Volume= 0.235 af, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
0.458	98	Roof
0.450	98	Driveway
0.048	84	50-75% Grass cover, Fair, HSG D
0.956	97	Weighted Average

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

Subcatchment 4S: Building B Area

Runoff = 3.45 cfs @ 12.03 hrs, Volume= 0.216 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
0.390	98	Pavement
0.119	69	50-75% Grass cover, Fair, HSG B
0.180	84	50-75% Grass cover, Fair, HSG D
0.372	98	Roof
1.061	92	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.2		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.8	130	0.0200	2.9		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	90	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.8	270	Total			

Subcatchment 5S: Building C Area

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.98 cfs @ 12.02 hrs, Volume= 0.192 af, Depth= 2.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
0.288	98	Roof
0.459	98	Paved parking
0.063	69	50-75% Grass cover, Fair, HSG B
0.810	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.2	52	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.1	102	Total			

Subcatchment 6S: Building D Area/Roof

Runoff = 3.03 cfs @ 12.03 hrs, Volume= 0.185 af, Depth= 2.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
0.321	98	Pavement
0.413	69	50-75% Grass cover, Fair, HSG B
0.372	98	Paved parking & roofs
1.106	87	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.6	128	0.0300	3.5		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	60	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.7	238	Total			

Subcatchment 7S: Building E Roof

Runoff = 1.51 cfs @ 12.07 hrs, Volume= 0.116 af, Depth= 3.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
0.454	98	Roof

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

Subcatchment 8S: South Runoff

Runoff = 3.20 cfs @ 12.11 hrs, Volume= 0.245 af, Depth= 1.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
0.794	98	Pavement
0.450	79	Woods, Fair, HSG D
0.787	61	>75% Grass cover, Good, HSG B
0.260	60	Woods, Fair, HSG B
2.291	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	50	0.0050	0.7		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
2.3	200	0.0050	1.4		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.6	265	0.0030	2.7	2.11	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.8	115	0.0050	1.1		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	205	0.0050	6.8	287.70	**Channel Flow,** Area= 42.0 sf Perim= 36.0' r= 1.17' n= 0.017
7.4	835	Total			

Subcatchment 9S: West Runoff

Runoff = 1.92 cfs @ 12.28 hrs, Volume= 0.215 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
1.102	60	Woods, Fair, HSG B
1.512	79	Woods, Fair, HSG D
0.144	69	50-75% Grass cover, Fair, HSG B
2.758	71	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.6	50	0.0150	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
4.9	167	0.0130	0.6		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.5	217	Total			

Subcatchment 10S: North Runoff

Runoff = 1.79 cfs @ 12.13 hrs, Volume= 0.142 af, Depth= 1.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (ac)	CN	Description
1.026	77	Woods, Good, HSG D
0.240	80	>75% Grass cover, Good, HSG D
1.266	78	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0760	0.2		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.30"
3.9	188	0.0260	0.8		**Shallow Concentrated Flow, Shallow** Woodland Kv= 5.0 fps
8.6	238	Total			

Reach 1R: Little River

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 7.714 ac, Inflow Depth = 0.94" for 2-Year Storm event
Inflow = 6.14 cfs @ 12.13 hrs, Volume= 0.601 af
Outflow = 6.14 cfs @ 12.13 hrs, Volume= 0.601 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond 5P: Retention Basin A

Inflow Area = 1.106 ac, Inflow Depth = 2.00" for 2-Year Storm event
Inflow = 3.03 cfs @ 12.03 hrs, Volume= 0.185 af
Outflow = 0.12 cfs @ 11.26 hrs, Volume= 0.138 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.12 cfs @ 11.26 hrs, Volume= 0.138 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 7.78' @ 14.99 hrs Surf.Area= 5,933 sf Storage= 4,215 cf
Plug-Flow detention time= 294.1 min calculated for 0.138 af (75% of inflow)
Center-of-Mass det. time= 206.9 min (1,020.4 - 813.4)

#	Invert	Avail.Storage	Storage Description
1	7.00'	21,569 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.00	4,388	0	0
8.00	6,358	5,373	5,373
9.00	8,093	7,226	12,599
10.00	9,848	8,971	21,569

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 11.26 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond 6P: Detention Basin 1

Inflow Area = 1.061 ac, Inflow Depth = 2.45" for 2-Year Storm event
Inflow = 3.45 cfs @ 12.03 hrs, Volume= 0.216 af
Outflow = 0.12 cfs @ 15.13 hrs, Volume= 0.150 af, Atten= 97%, Lag= 186.4 min
Discarded = 0.12 cfs @ 10.53 hrs, Volume= 0.150 af
Primary = 0.00 cfs @ 15.13 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 8.00' @ 15.13 hrs Surf.Area= 3,454 sf Storage= 5,007 cf
Plug-Flow detention time= 282.9 min calculated for 0.150 af (69% of inflow)
Center-of-Mass det. time= 189.8 min (982.4 - 792.6)

#	Invert	Avail.Storage	Storage Description
1	6.00'	14,199 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	1,603	0	0
7.00	2,468	2,036	2,036
8.00	3,451	2,960	4,995
9.00	4,553	4,002	8,997
10.00	5,850	5,202	14,199

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**
2	Primary	8.00'	**12.0" x 40.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500
			Outlet Invert= 7.80' S= 0.0050 '/' n= 0.012 Cc= 0.900

20'

Discarded OutFlow Max=0.12 cfs @ 10.53 hrs HW=6.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 15.13 hrs HW=8.00' (Free Discharge)
↑**2=Culvert** (Barrel Controls 0.00 cfs @ 0.1 fps)

Pond 7P: Detention Basin 2

Inflow Area =	0.338 ac,	Inflow Depth =	2.17"	for 2-Year Storm event
Inflow =	0.99 cfs @	12.03 hrs,	Volume=	0.061 af
Outflow =	0.12 cfs @	11.63 hrs,	Volume=	0.061 af, Atten= 88%, Lag= 0.0 min
Discarded =	0.12 cfs @	11.63 hrs,	Volume=	0.061 af
Primary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 7.34' @ 12.53 hrs Surf.Area= 1,129 sf Storage= 839 cf
Plug-Flow detention time= 47.8 min calculated for 0.061 af (100% of inflow)
Center-of-Mass det. time= 47.5 min (853.3 - 805.8)

#	Invert	Avail.Storage	Storage Description
1	6.00'	7,459 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	0	0	0
7.00	800	400	400
8.00	1,757	1,279	1,679
9.00	2,850	2,304	3,982
10.00	4,103	3,477	7,459

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**
2	Primary	8.00'	**6.0" x 63.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500
			Outlet Invert= 7.70' S= 0.0048 '/' n= 0.012 Cc= 0.900

35'

Discarded OutFlow Max=0.12 cfs @ 11.63 hrs HW=6.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=6.00' (Free Discharge)
↑**2=Culvert** (Controls 0.00 cfs)

Pond IC-1: Infiltration Chamber 1

Inflow Area =	0.196 ac,	Inflow Depth =	2.45"	for 2-Year Storm event
Inflow =	0.65 cfs @	12.02 hrs,	Volume=	0.040 af
Outflow =	0.12 cfs @	11.69 hrs,	Volume=	0.040 af, Atten= 81%, Lag= 0.0 min
Discarded =	0.12 cfs @	11.69 hrs,	Volume=	0.040 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 9.43' @ 12.43 hrs Surf.Area= 1,120 sf Storage= 409 cf
Plug-Flow detention time= 18.5 min calculated for 0.040 af (100% of inflow)
Center-of-Mass det. time= 18.3 min (810.6 - 792.3)

#	Invert	Avail.Storage	Storage Description
1	8.50'	655 cf	**28.00'W x 40.00'L x 3.00'H Prismatoid**
			3,360 cf Overall - 1,178 cf Embedded = 2,182 cf x 30.0% Voids
2	9.00'	1,178 cf	**30.0"D x 40.00'L Horizontal Cylinder** x 6 Inside #1
		1,833 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 11.69 hrs HW=8.53' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-2: Infiltration Chamber 2

Inflow Area = 0.956 ac, Inflow Depth = 2.95" for 2-Year Storm event
Inflow = 3.13 cfs @ 12.07 hrs, Volume= 0.235 af
Outflow = 0.12 cfs @ 9.83 hrs, Volume= 0.165 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.12 cfs @ 9.83 hrs, Volume= 0.165 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 9.70' @ 15.02 hrs Surf.Area= 6,000 sf Storage= 5,268 cf
Plug-Flow detention time= 261.2 min calculated for 0.165 af (70% of inflow)
Center-of-Mass det. time= 169.0 min (932.9 - 763.9)

#	Invert	Avail.Storage	Storage Description
1	8.00'	4,083 cf	**50.00'W x 120.00'L x 4.00'H Prismatoid**
			24,000 cf Overall - 10,391 cf Embedded = 13,609 cf x 30.0% Voids
2	8.50'	10,391 cf	**42.0"D x 120.00'L Horizontal Cylinder** x 9 Inside #1
		14,474 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 9.83 hrs HW=8.04' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-3: Infiltration Chamber 3

Inflow Area = 0.454 ac, Inflow Depth = 3.07" for 2-Year Storm event
Inflow = 1.51 cfs @ 12.07 hrs, Volume= 0.116 af
Outflow = 0.12 cfs @ 11.24 hrs, Volume= 0.116 af, Atten= 92%, Lag= 0.0 min
Discarded = 0.12 cfs @ 11.24 hrs, Volume= 0.116 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 9.96' @ 13.00 hrs Surf.Area= 2,450 sf Storage= 1,840 cf
Plug-Flow detention time= 110.8 min calculated for 0.116 af (100% of inflow)
Center-of-Mass det. time= 110.4 min (864.7 - 754.4)

#	Invert	Avail.Storage	Storage Description
1	8.50'	1,385 cf	**35.00'W x 70.00'L x 3.50'H Prismatoid**
			8,575 cf Overall - 3,958 cf Embedded = 4,617 cf x 30.0% Voids
2	9.00'	3,958 cf	**36.0"D x 70.00'L Horizontal Cylinder** x 8 Inside #1
		5,343 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 11.24 hrs HW=8.54' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-4: Infiltration Chamber 4

Inflow Area = 0.810 ac, Inflow Depth = 2.85" for 2-Year Storm event
Inflow = 2.98 cfs @ 12.02 hrs, Volume= 0.192 af
Outflow = 0.12 cfs @ 10.35 hrs, Volume= 0.158 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.12 cfs @ 10.35 hrs, Volume= 0.158 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 9.68' @ 14.33 hrs Surf.Area= 4,515 sf Storage= 4,006 cf
Plug-Flow detention time= 257.1 min calculated for 0.158 af (82% of inflow)
Center-of-Mass det. time= 186.4 min (955.0 - 768.6)

#	Invert	Avail.Storage	Storage Description
1	8.00'	1,107 cf	**48.00'W x 35.00'L x 4.00'H Prismatoid**
			6,720 cf Overall - 3,031 cf Embedded = 3,689 cf x 30.0% Voids
2	8.50'	3,031 cf	**42.0"D x 35.00'L Horizontal Cylinder** x 9 Inside #1
3	8.00'	1,161 cf	**21.00'W x 85.00'L x 4.00'H Prismatoid**
			7,140 cf Overall - 3,271 cf Embedded = 3,869 cf x 30.0% Voids
4	8.50'	3,271 cf	**42.0"D x 85.00'L Horizontal Cylinder** x 4 Inside #3
5	8.00'	654 cf	**15.00'W x 70.00'L x 4.00'H Prismatoid**
			4,200 cf Overall - 2,020 cf Embedded = 2,180 cf x 30.0% Voids
6	8.50'	2,020 cf	**42.0"D x 70.00'L Horizontal Cylinder** x 3 Inside #5
		11,244 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 10.35 hrs HW=8.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Central Parking Area - South Runoff Area=0.338 ac Runoff Depth=3.39"
Flow Length=210' Tc=1.8 min CN=89 Runoff=1.52 cfs 0.095 af

Subcatchment 2S: Central Parking Area Runoff Area=0.196 ac Runoff Depth=3.70"
Flow Length=140' Tc=1.4 min CN=92 Runoff=0.96 cfs 0.060 af

Subcatchment 3S: Building A Roof/Area Runoff Area=0.956 ac Runoff Depth=4.25"
Tc=5.0 min CN=97 Runoff=4.42 cfs 0.338 af

Subcatchment 4S: Building B Area Runoff Area=1.061 ac Runoff Depth=3.70"
Flow Length=270' Tc=1.8 min CN=92 Runoff=5.10 cfs 0.327 af

Subcatchment 5S: Building C Area Runoff Area=0.810 ac Runoff Depth=4.13"
Flow Length=102' Tc=1.1 min CN=96 Runoff=4.24 cfs 0.279 af

Subcatchment 6S: Building D Area/Roof Runoff Area=1.106 ac Runoff Depth=3.19"
Flow Length=238' Tc=1.7 min CN=87 Runoff=4.76 cfs 0.294 af

Subcatchment 7S: Building E Roof Runoff Area=0.454 ac Runoff Depth=4.36"
Tc=5.0 min CN=98 Runoff=2.11 cfs 0.165 af

Subcatchment 8S: South Runoff Runoff Area=2.291 ac Runoff Depth=2.29"
Flow Length=835' Tc=7.4 min CN=77 Runoff=5.85 cfs 0.437 af

Subcatchment 9S: West Runoff Runoff Area=2.758 ac Runoff Depth=1.81"
Flow Length=217' Tc=18.5 min CN=71 Runoff=3.99 cfs 0.416 af

Subcatchment 10S: North Runoff Runoff Area=1.266 ac Runoff Depth=2.37"
Flow Length=238' Tc=8.6 min CN=78 Runoff=3.22 cfs 0.250 af

Reach 1R: Little River Inflow=11.66 cfs 1.180 af
Outflow=11.66 cfs 1.180 af

Pond 5P: Retention Basin A Peak Elev=8.33' Storage=7,786 cf Inflow=4.76 cfs 0.294 af
Outflow=0.12 cfs 0.150 af

Pond 6P: Detention Basin 1 Peak Elev=8.40' Storage=6,604 cf Inflow=5.10 cfs 0.327 af
Discarded=0.12 cfs 0.163 af Primary=0.49 cfs 0.076 af Outflow=0.61 cfs 0.239 af

Pond 7P: Detention Basin 2 Peak Elev=7.90' Storage=1,553 cf Inflow=1.52 cfs 0.095 af
Discarded=0.12 cfs 0.095 af Primary=0.00 cfs 0.000 af Outflow=0.12 cfs 0.095 af

Pond IC-1: Infiltration Chamber 1 Peak Elev=9.96' Storage=779 cf Inflow=0.96 cfs 0.060 af
Outflow=0.12 cfs 0.060 af

Pond IC-2: Infiltration Chamber 2 Peak Elev=10.46' Storage=8,604 cf Inflow=4.42 cfs 0.338 af
Outflow=0.12 cfs 0.178 af

Pond IC-3: Infiltration Chamber 3 Peak Elev=10.57' Storage=2,990 cf Inflow=2.11 cfs 0.165 af
Outflow=0.12 cfs 0.162 af

Pond IC-4: Infiltration Chamber 4 Peak Elev=10.45' Storage=6,671 cf Inflow=4.24 cfs 0.279 af
Outflow=0.12 cfs 0.171 af

Total Runoff Area = 11.236 ac Runoff Volume = 2.663 af Average Runoff Depth = 2.84"

Subcatchment 1S: Central Parking Area - South

Runoff = 1.52 cfs @ 12.03 hrs, Volume= 0.095 af, Depth= 3.39"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
0.230	98	Paved roads w/curbs & sewers
0.108	69	50-75% Grass cover, Fair, HSG B
0.338	89	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.6	75	0.0100	2.0		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	85	0.0100	4.5	3.56	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
1.8	210	Total			

Subcatchment 2S: Central Parking Area

Runoff = 0.96 cfs @ 12.02 hrs, Volume= 0.060 af, Depth= 3.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
0.154	98	Paved parking & roofs
0.042	69	50-75% Grass cover, Fair, HSG B
0.196	92	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.3	40	0.0100	2.0		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	50	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.4	140	Total			

Subcatchment 3S: Building A Roof/Area

Runoff = 4.42 cfs @ 12.07 hrs, Volume= 0.338 af, Depth= 4.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
0.458	98	Roof
0.450	98	Driveway
0.048	84	50-75% Grass cover, Fair, HSG D
0.956	97	Weighted Average

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

Subcatchment 4S: Building B Area

Runoff = 5.10 cfs @ 12.03 hrs, Volume= 0.327 af, Depth= 3.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
0.390	98	Pavement
0.119	69	50-75% Grass cover, Fair, HSG B
0.180	84	50-75% Grass cover, Fair, HSG D
0.372	98	Roof
1.061	92	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.2		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.8	130	0.0200	2.9		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	90	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.8	270	Total			

Subcatchment 5S: Building C Area

[49] Hint: Tc<2dt may require smaller dt

Runoff = 4.24 cfs @ 12.02 hrs, Volume= 0.279 af, Depth= 4.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
0.288	98	Roof
0.459	98	Paved parking
0.063	69	50-75% Grass cover, Fair, HSG B
0.810	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.2	52	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.1	102	Total			

Subcatchment 6S: Building D Area/Roof

Runoff = 4.76 cfs @ 12.03 hrs, Volume= 0.294 af, Depth= 3.19"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
0.321	98	Pavement
0.413	69	50-75% Grass cover, Fair, HSG B
0.372	98	Paved parking & roofs
1.106	87	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.6	128	0.0300	3.5		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	60	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.7	238	Total			

Subcatchment 7S: Building E Roof

Runoff = 2.11 cfs @ 12.07 hrs, Volume= 0.165 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
0.454	98	Roof

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

Subcatchment 8S: South Runoff

Runoff = 5.85 cfs @ 12.11 hrs, Volume= 0.437 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
0.794	98	Pavement
0.450	79	Woods, Fair, HSG D
0.787	61	>75% Grass cover, Good, HSG B
0.260	60	Woods, Fair, HSG B
2.291	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	50	0.0050	0.7		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
2.3	200	0.0050	1.4		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.6	265	0.0030	2.7	2.11	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.8	115	0.0050	1.1		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	205	0.0050	6.8	287.70	**Channel Flow,** Area= 42.0 sf Perim= 36.0' r= 1.17' n= 0.017
7.4	835	Total			

Subcatchment 9S: West Runoff

Runoff = 3.99 cfs @ 12.27 hrs, Volume= 0.416 af, Depth= 1.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
1.102	60	Woods, Fair, HSG B
1.512	79	Woods, Fair, HSG D
0.144	69	50-75% Grass cover, Fair, HSG B
2.758	71	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.6	50	0.0150	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
4.9	167	0.0130	0.6		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.5	217	Total			

Subcatchment 10S: North Runoff

Runoff = 3.22 cfs @ 12.12 hrs, Volume= 0.250 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Storm Rainfall=4.60"

Area (ac)	CN	Description
1.026	77	Woods, Good, HSG D
0.240	80	>75% Grass cover, Good, HSG D
1.266	78	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0760	0.2		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.30"
3.9	188	0.0260	0.8		**Shallow Concentrated Flow, Shallow** Woodland Kv= 5.0 fps
8.6	238	Total			

Reach 1R: Little River

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 7.714 ac, Inflow Depth = 1.84" for 10-Year Storm event
Inflow = 11.66 cfs @ 12.13 hrs, Volume= 1.180 af
Outflow = 11.66 cfs @ 12.13 hrs, Volume= 1.180 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond 5P: Retention Basin A

Inflow Area = 1.106 ac, Inflow Depth = 3.19" for 10-Year Storm event
Inflow = 4.76 cfs @ 12.03 hrs, Volume= 0.294 af
Outflow = 0.12 cfs @ 10.34 hrs, Volume= 0.150 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.12 cfs @ 10.34 hrs, Volume= 0.150 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 8.33' @ 16.14 hrs Surf.Area= 6,937 sf Storage= 7,786 cf
Plug-Flow detention time= 296.0 min calculated for 0.150 af (51% of inflow)
Center-of-Mass det. time= 184.4 min (984.6 - 800.2)

#	Invert	Avail.Storage	Storage Description
1	7.00'	21,569 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.00	4,388	0	0
8.00	6,358	5,373	5,373
9.00	8,093	7,226	12,599
10.00	9,848	8,971	21,569

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 10.34 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond 6P: Detention Basin 1

Inflow Area = 1.061 ac, Inflow Depth = 3.70" for 10-Year Storm event
Inflow = 5.10 cfs @ 12.03 hrs, Volume= 0.327 af
Outflow = 0.61 cfs @ 12.52 hrs, Volume= 0.239 af, Atten= 88%, Lag= 29.4 min
Discarded = 0.12 cfs @ 9.41 hrs, Volume= 0.163 af
Primary = 0.49 cfs @ 12.52 hrs, Volume= 0.076 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 8.40' @ 12.52 hrs Surf.Area= 3,894 sf Storage= 6,604 cf
Plug-Flow detention time= 212.3 min calculated for 0.239 af (73% of inflow)
Center-of-Mass det. time= 124.9 min (906.3 - 781.3)

#	Invert	Avail.Storage	Storage Description
1	6.00'	14,199 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	1,603	0	0
7.00	2,468	2,036	2,036
8.00	3,451	2,960	4,995
9.00	4,553	4,002	8,997
10.00	5,850	5,202	14,199

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**
2	Primary	8.00'	**12.0" x 40.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 7.80' S= 0.0050 '/' n= 0.012 Cc= 0.900

Discarded OutFlow Max=0.12 cfs @ 9.41 hrs HW=6.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.49 cfs @ 12.52 hrs HW=8.40' (Free Discharge)
↑**2=Culvert** (Barrel Controls 0.49 cfs @ 2.4 fps)

Pond 7P: Detention Basin 2

Inflow Area = 0.338 ac, Inflow Depth = 3.39" for 10-Year Storm event
Inflow = 1.52 cfs @ 12.03 hrs, Volume= 0.095 af
Outflow = 0.12 cfs @ 11.45 hrs, Volume= 0.095 af, Atten= 92%, Lag= 0.0 min
Discarded = 0.12 cfs @ 11.45 hrs, Volume= 0.095 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 7.90' @ 12.92 hrs Surf.Area= 1,663 sf Storage= 1,553 cf
Plug-Flow detention time= 100.7 min calculated for 0.095 af (100% of inflow)
Center-of-Mass det. time= 100.4 min (893.6 - 793.3)

#	Invert	Avail.Storage	Storage Description
1	6.00'	7,459 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	0	0	0
7.00	800	400	400
8.00	1,757	1,279	1,679
9.00	2,850	2,304	3,982
10.00	4,103	3,477	7,459

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**
2	Primary	8.00'	**6.0" x 63.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 7.70' S= 0.0048 '/' n= 0.012 Cc= 0.900

Discarded OutFlow Max=0.12 cfs @ 11.45 hrs HW=6.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=6.00' (Free Discharge)
↑**2=Culvert** (Controls 0.00 cfs)

Pond IC-1: Infiltration Chamber 1

Inflow Area = 0.196 ac, Inflow Depth = 3.70" for 10-Year Storm event
Inflow = 0.96 cfs @ 12.02 hrs, Volume= 0.060 af
Outflow = 0.12 cfs @ 11.59 hrs, Volume= 0.060 af, Atten= 87%, Lag= 0.0 min
Discarded = 0.12 cfs @ 11.59 hrs, Volume= 0.060 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 9.96' @ 12.50 hrs Surf.Area= 1,120 sf Storage= 779 cf
Plug-Flow detention time= 40.1 min calculated for 0.060 af (100% of inflow)
Center-of-Mass det. time= 39.9 min (820.9 - 781.0)

#	Invert	Avail.Storage	Storage Description
1	8.50'	655 cf	**28.00'W x 40.00'L x 3.00'H Prismatoid**
			3,360 cf Overall - 1,178 cf Embedded = 2,182 cf x 30.0% Voids
2	9.00'	1,178 cf	**30.0"D x 40.00'L Horizontal Cylinder** x 6 Inside #1
		1,833 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 11.59 hrs HW=8.53' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-2: Infiltration Chamber 2

Inflow Area = 0.956 ac, Inflow Depth = 4.25" for 10-Year Storm event
Inflow = 4.42 cfs @ 12.07 hrs, Volume= 0.338 af
Outflow = 0.12 cfs @ 8.71 hrs, Volume= 0.178 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.12 cfs @ 8.71 hrs, Volume= 0.178 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 10.46' @ 15.97 hrs Surf.Area= 6,000 sf Storage= 8,604 cf
Plug-Flow detention time= 257.2 min calculated for 0.178 af (53% of inflow)
Center-of-Mass det. time= 138.0 min (894.1 - 756.1)

#	Invert	Avail.Storage	Storage Description
1	8.00'	4,083 cf	**50.00'W x 120.00'L x 4.00'H Prismatoid**
			24,000 cf Overall - 10,391 cf Embedded = 13,609 cf x 30.0% Voids
2	8.50'	10,391 cf	**42.0"D x 120.00'L Horizontal Cylinder** x 9 Inside #1
		14,474 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 8.71 hrs HW=8.04' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-3: Infiltration Chamber 3

Inflow Area = 0.454 ac, Inflow Depth = 4.36" for 10-Year Storm event
Inflow = 2.11 cfs @ 12.07 hrs, Volume= 0.165 af
Outflow = 0.12 cfs @ 10.55 hrs, Volume= 0.162 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.12 cfs @ 10.55 hrs, Volume= 0.162 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 10.57' @ 13.74 hrs Surf.Area= 2,450 sf Storage= 2,990 cf
Plug-Flow detention time= 198.4 min calculated for 0.162 af (98% of inflow)
Center-of-Mass det. time= 187.8 min (935.9 - 748.1)

#	Invert	Avail.Storage	Storage Description
1	8.50'	1,385 cf	**35.00'W x 70.00'L x 3.50'H Prismatoid**
			8,575 cf Overall - 3,958 cf Embedded = 4,617 cf x 30.0% Voids
2	9.00'	3,958 cf	**36.0"D x 70.00'L Horizontal Cylinder** x 8 Inside #1
		5,343 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 10.55 hrs HW=8.54' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-4: Infiltration Chamber 4

Inflow Area = 0.810 ac, Inflow Depth = 4.13" for 10-Year Storm event
Inflow = 4.24 cfs @ 12.02 hrs, Volume= 0.279 af
Outflow = 0.12 cfs @ 9.22 hrs, Volume= 0.171 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.12 cfs @ 9.22 hrs, Volume= 0.171 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 10.45' @ 15.47 hrs Surf.Area= 4,515 sf Storage= 6,671 cf
Plug-Flow detention time= 261.4 min calculated for 0.171 af (61% of inflow)
Center-of-Mass det. time= 157.1 min (916.9 - 759.8)

#	Invert	Avail.Storage	Storage Description
1	8.00'	1,107 cf	**48.00'W x 35.00'L x 4.00'H Prismatoid**
			6,720 cf Overall - 3,031 cf Embedded = 3,689 cf x 30.0% Voids
2	8.50'	3,031 cf	**42.0"D x 35.00'L Horizontal Cylinder** x 9 Inside #1
3	8.00'	1,161 cf	**21.00'W x 85.00'L x 4.00'H Prismatoid**
			7,140 cf Overall - 3,271 cf Embedded = 3,869 cf x 30.0% Voids
4	8.50'	3,271 cf	**42.0"D x 85.00'L Horizontal Cylinder** x 4 Inside #3
5	8.00'	654 cf	**15.00'W x 70.00'L x 4.00'H Prismatoid**
			4,200 cf Overall - 2,020 cf Embedded = 2,180 cf x 30.0% Voids
6	8.50'	2,020 cf	**42.0"D x 70.00'L Horizontal Cylinder** x 3 Inside #5
		11,244 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 9.22 hrs HW=8.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Central Parking Area - South Runoff Area=0.338 ac Runoff Depth=4.15"
Flow Length=210' Tc=1.8 min CN=89 Runoff=1.85 cfs 0.117 af

Subcatchment 2S: Central Parking Area Runoff Area=0.196 ac Runoff Depth=4.48"
Flow Length=140' Tc=1.4 min CN=92 Runoff=1.15 cfs 0.073 af

Subcatchment 3S: Building A Roof/Area Runoff Area=0.956 ac Runoff Depth=5.04"
Tc=5.0 min CN=97 Runoff=5.20 cfs 0.402 af

Subcatchment 4S: Building B Area Runoff Area=1.061 ac Runoff Depth=4.48"
Flow Length=270' Tc=1.8 min CN=92 Runoff=6.11 cfs 0.396 af

Subcatchment 5S: Building C Area Runoff Area=0.810 ac Runoff Depth=4.93"
Flow Length=102' Tc=1.1 min CN=96 Runoff=5.01 cfs 0.333 af

Subcatchment 6S: Building D Area/Roof Runoff Area=1.106 ac Runoff Depth=3.94"
Flow Length=238' Tc=1.7 min CN=87 Runoff=5.83 cfs 0.364 af

Subcatchment 7S: Building E Roof Runoff Area=0.454 ac Runoff Depth=5.16"
Tc=5.0 min CN=98 Runoff=2.49 cfs 0.195 af

Subcatchment 8S: South Runoff Runoff Area=2.291 ac Runoff Depth=2.96"
Flow Length=835' Tc=7.4 min CN=77 Runoff=7.58 cfs 0.564 af

Subcatchment 9S: West Runoff Runoff Area=2.758 ac Runoff Depth=2.41"
Flow Length=217' Tc=18.5 min CN=71 Runoff=5.39 cfs 0.555 af

Subcatchment 10S: North Runoff Runoff Area=1.266 ac Runoff Depth=3.05"
Flow Length=238' Tc=8.6 min CN=78 Runoff=4.15 cfs 0.322 af

Reach 1R: Little River Inflow=15.77 cfs 1.577 af
Outflow=15.77 cfs 1.577 af

Pond 5P: Retention Basin A Peak Elev=8.67' Storage=10,211 cf Inflow=5.83 cfs 0.364 af
Outflow=0.12 cfs 0.156 af

Pond 6P: Detention Basin 1 Peak Elev=8.63' Storage=7,516 cf Inflow=6.11 cfs 0.396 af
Discarded=0.12 cfs 0.169 af Primary=1.08 cfs 0.132 af Outflow=1.20 cfs 0.301 af

Pond 7P: Detention Basin 2 Peak Elev=8.13' Storage=1,978 cf Inflow=1.85 cfs 0.117 af
Discarded=0.12 cfs 0.113 af Primary=0.04 cfs 0.004 af Outflow=0.16 cfs 0.117 af

Pond IC-1: Infiltration Chamber 1 Peak Elev=10.27' Storage=1,016 cf Inflow=1.15 cfs 0.073 af
Outflow=0.12 cfs 0.073 af

Pond IC-2: Infiltration Chamber 2 Peak Elev=10.96' Storage=10,778 cf Inflow=5.20 cfs 0.402 af
Outflow=0.12 cfs 0.185 af

Pond IC-3: Infiltration Chamber 3 Peak Elev=10.99' Storage=3,790 cf Inflow=2.49 cfs 0.195 af
Outflow=0.12 cfs 0.168 af

Pond IC-4: Infiltration Chamber 4 Peak Elev=10.98' Storage=8,445 cf Inflow=5.01 cfs 0.333 af
Outflow=0.12 cfs 0.177 af

Total Runoff Area = 11.236 ac Runoff Volume = 3.320 af Average Runoff Depth = 3.55"

Subcatchment 1S: Central Parking Area - South

Runoff = 1.85 cfs @ 12.03 hrs, Volume= 0.117 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
0.230	98	Paved roads w/curbs & sewers
0.108	69	50-75% Grass cover, Fair, HSG B
0.338	89	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.6	75	0.0100	2.0		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	85	0.0100	4.5	3.56	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
1.8	210	Total			

Subcatchment 2S: Central Parking Area

Runoff = 1.15 cfs @ 12.02 hrs, Volume= 0.073 af, Depth= 4.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
0.154	98	Paved parking & roofs
0.042	69	50-75% Grass cover, Fair, HSG B
0.196	92	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.3	40	0.0100	2.0		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	50	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.4	140	Total			

Subcatchment 3S: Building A Roof/Area

Runoff = 5.20 cfs @ 12.07 hrs, Volume= 0.402 af, Depth= 5.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
0.458	98	Roof
0.450	98	Driveway
0.048	84	50-75% Grass cover, Fair, HSG D
0.956	97	Weighted Average

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

Subcatchment 4S: Building B Area

Runoff = 6.11 cfs @ 12.03 hrs, Volume= 0.396 af, Depth= 4.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
0.390	98	Pavement
0.119	69	50-75% Grass cover, Fair, HSG B
0.180	84	50-75% Grass cover, Fair, HSG D
0.372	98	Roof
1.061	92	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.2		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.8	130	0.0200	2.9		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	90	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.8	270	Total			

Subcatchment 5S: Building C Area

[49] Hint: Tc<2dt may require smaller dt

Runoff = 5.01 cfs @ 12.02 hrs, Volume= 0.333 af, Depth= 4.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
0.288	98	Roof
0.459	98	Paved parking
0.063	69	50-75% Grass cover, Fair, HSG B
0.810	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.2	52	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.1	102	Total			

Subcatchment 6S: Building D Area/Roof

Runoff = 5.83 cfs @ 12.03 hrs, Volume= 0.364 af, Depth= 3.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
0.321	98	Pavement
0.413	69	50-75% Grass cover, Fair, HSG B
0.372	98	Paved parking & roofs
1.106	87	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.6	128	0.0300	3.5		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	60	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.7	238	Total			

Subcatchment 7S: Building E Roof

Runoff = 2.49 cfs @ 12.07 hrs, Volume= 0.195 af, Depth= 5.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
0.454	98	Roof

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

Subcatchment 8S: South Runoff

Runoff = 7.58 cfs @ 12.11 hrs, Volume= 0.564 af, Depth= 2.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
0.794	98	Pavement
0.450	79	Woods, Fair, HSG D
0.787	61	>75% Grass cover, Good, HSG B
0.260	60	Woods, Fair, HSG B
2.291	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	50	0.0050	0.7		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
2.3	200	0.0050	1.4		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.6	265	0.0030	2.7	2.11	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.8	115	0.0050	1.1		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	205	0.0050	6.8	287.70	**Channel Flow,** Area= 42.0 sf Perim= 36.0' r= 1.17' n= 0.017
7.4	835	Total			

Subcatchment 9S: West Runoff

Runoff = 5.39 cfs @ 12.27 hrs, Volume= 0.555 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
1.102	60	Woods, Fair, HSG B
1.512	79	Woods, Fair, HSG D
0.144	69	50-75% Grass cover, Fair, HSG B
2.758	71	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.6	50	0.0150	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
4.9	167	0.0130	0.6		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.5	217	Total			

Subcatchment 10S: North Runoff

Runoff = 4.15 cfs @ 12.12 hrs, Volume= 0.322 af, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Storm Rainfall=5.40"

Area (ac)	CN	Description
1.026	77	Woods, Good, HSG D
0.240	80	>75% Grass cover, Good, HSG D
1.266	78	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0760	0.2		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.30"
3.9	188	0.0260	0.8		**Shallow Concentrated Flow, Shallow** Woodland Kv= 5.0 fps
8.6	238	Total			

Reach 1R: Little River

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 7.714 ac, Inflow Depth = 2.45" for 25-Year Storm event
Inflow = 15.77 cfs @ 12.13 hrs, Volume= 1.577 af
Outflow = 15.77 cfs @ 12.13 hrs, Volume= 1.577 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond 5P: Retention Basin A

Inflow Area = 1.106 ac, Inflow Depth = 3.94" for 25-Year Storm event
Inflow = 5.83 cfs @ 12.03 hrs, Volume= 0.364 af
Outflow = 0.12 cfs @ 9.77 hrs, Volume= 0.156 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.12 cfs @ 9.77 hrs, Volume= 0.156 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 8.67' @ 16.99 hrs Surf.Area= 7,520 sf Storage= 10,211 cf
Plug-Flow detention time= 291.6 min calculated for 0.156 af (43% of inflow)
Center-of-Mass det. time= 171.8 min (966.1 - 794.3)

#	Invert	Avail.Storage	Storage Description
1	7.00'	21,569 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.00	4,388	0	0
8.00	6,358	5,373	5,373
9.00	8,093	7,226	12,599
10.00	9,848	8,971	21,569

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 9.77 hrs HW=7.03' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond 6P: Detention Basin 1

Inflow Area = 1.061 ac, Inflow Depth = 4.48" for 25-Year Storm event
Inflow = 6.11 cfs @ 12.03 hrs, Volume= 0.396 af
Outflow = 1.20 cfs @ 12.42 hrs, Volume= 0.301 af, Atten= 80%, Lag= 23.4 min
Discarded = 0.12 cfs @ 8.86 hrs, Volume= 0.169 af
Primary = 1.08 cfs @ 12.42 hrs, Volume= 0.132 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 8.63' @ 12.42 hrs Surf.Area= 4,145 sf Storage= 7,516 cf
Plug-Flow detention time= 181.8 min calculated for 0.301 af (76% of inflow)
Center-of-Mass det. time= 99.3 min (875.5 - 776.3)

#	Invert	Avail.Storage	Storage Description
1	6.00'	14,199 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	1,603	0	0
7.00	2,468	2,036	2,036
8.00	3,451	2,960	4,995
9.00	4,553	4,002	8,997
10.00	5,850	5,202	14,199

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**
2	Primary	8.00'	**12.0" x 40.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 7.80' S= 0.0050 '/' n= 0.012 Cc= 0.900

Discarded OutFlow Max=0.12 cfs @ 8.86 hrs HW=6.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=1.08 cfs @ 12.42 hrs HW=8.63' (Free Discharge)
↑**2=Culvert** (Barrel Controls 1.08 cfs @ 3.0 fps)

Pond 7P: Detention Basin 2

Inflow Area = 0.338 ac, Inflow Depth = 4.15" for 25-Year Storm event
Inflow = 1.85 cfs @ 12.03 hrs, Volume= 0.117 af
Outflow = 0.16 cfs @ 12.85 hrs, Volume= 0.117 af, Atten= 92%, Lag= 49.1 min
Discarded = 0.12 cfs @ 11.24 hrs, Volume= 0.113 af
Primary = 0.04 cfs @ 12.85 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 8.13' @ 12.85 hrs Surf.Area= 1,899 sf Storage= 1,978 cf
Plug-Flow detention time= 124.4 min calculated for 0.117 af (100% of inflow)
Center-of-Mass det. time= 124.1 min (911.8 - 787.7)

#	Invert	Avail.Storage	Storage Description
1	6.00'	7,459 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	0	0	0
7.00	800	400	400
8.00	1,757	1,279	1,679
9.00	2,850	2,304	3,982
10.00	4,103	3,477	7,459

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**
2	Primary	8.00'	**6.0" x 63.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 7.70' S= 0.0048 '/' n= 0.012 Cc= 0.900

Discarded OutFlow Max=0.12 cfs @ 11.24 hrs HW=6.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.03 cfs @ 12.85 hrs HW=8.13' (Free Discharge)
↑**2=Culvert** (Barrel Controls 0.03 cfs @ 1.3 fps)

Pond IC-1: Infiltration Chamber 1

Inflow Area = 0.196 ac, Inflow Depth = 4.48" for 25-Year Storm event
Inflow = 1.15 cfs @ 12.02 hrs, Volume= 0.073 af
Outflow = 0.12 cfs @ 11.56 hrs, Volume= 0.073 af, Atten= 90%, Lag= 0.0 min
Discarded = 0.12 cfs @ 11.56 hrs, Volume= 0.073 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 10.27' @ 12.55 hrs Surf.Area= 1,120 sf Storage= 1,016 cf
Plug-Flow detention time= 55.7 min calculated for 0.073 af (100% of inflow)
Center-of-Mass det. time= 55.5 min (831.5 - 775.9)

#	Invert	Avail.Storage	Storage Description
1	8.50'	655 cf	**28.00'W x 40.00'L x 3.00'H Prismatoid**
			3,360 cf Overall - 1,178 cf Embedded = 2,182 cf x 30.0% Voids
2	9.00'	1,178 cf	**30.0"D x 40.00'L Horizontal Cylinder** x 6 Inside #1
		1,833 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 11.56 hrs HW=8.53' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-2: Infiltration Chamber 2

Inflow Area = 0.956 ac, Inflow Depth = 5.04" for 25-Year Storm event
Inflow = 5.20 cfs @ 12.07 hrs, Volume= 0.402 af
Outflow = 0.12 cfs @ 8.25 hrs, Volume= 0.185 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.12 cfs @ 8.25 hrs, Volume= 0.185 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 10.96' @ 16.65 hrs Surf.Area= 6,000 sf Storage= 10,778 cf
Plug-Flow detention time= 256.0 min calculated for 0.185 af (46% of inflow)
Center-of-Mass det. time= 121.7 min (874.5 - 752.8)

#	Invert	Avail.Storage	Storage Description
1	8.00'	4,083 cf	**50.00'W x 120.00'L x 4.00'H Prismatoid**
			24,000 cf Overall - 10,391 cf Embedded = 13,609 cf x 30.0% Voids
2	8.50'	10,391 cf	**42.0"D x 120.00'L Horizontal Cylinder** x 9 Inside #1
		14,474 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 8.25 hrs HW=8.04' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-3: Infiltration Chamber 3

Inflow Area = 0.454 ac, Inflow Depth = 5.16" for 25-Year Storm event
Inflow = 2.49 cfs @ 12.07 hrs, Volume= 0.195 af
Outflow = 0.12 cfs @ 10.18 hrs, Volume= 0.168 af, Atten= 95%, Lag= 0.0 min
Discarded = 0.12 cfs @ 10.18 hrs, Volume= 0.168 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 10.99' @ 14.11 hrs Surf.Area= 2,450 sf Storage= 3,790 cf
Plug-Flow detention time= 234.5 min calculated for 0.168 af (86% of inflow)
Center-of-Mass det. time= 172.9 min (918.3 - 745.4)

#	Invert	Avail.Storage	Storage Description
1	8.50'	1,385 cf	**35.00'W x 70.00'L x 3.50'H Prismatoid**
			8,575 cf Overall - 3,958 cf Embedded = 4,617 cf x 30.0% Voids
2	9.00'	3,958 cf	**36.0"D x 70.00'L Horizontal Cylinder** x 8 Inside #1
		5,343 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 10.18 hrs HW=8.54' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-4: Infiltration Chamber 4

Inflow Area = 0.810 ac, Inflow Depth = 4.93" for 25-Year Storm event
Inflow = 5.01 cfs @ 12.02 hrs, Volume= 0.333 af
Outflow = 0.12 cfs @ 8.71 hrs, Volume= 0.177 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.12 cfs @ 8.71 hrs, Volume= 0.177 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 10.98' @ 15.90 hrs Surf.Area= 4,515 sf Storage= 8,445 cf
Plug-Flow detention time= 259.1 min calculated for 0.177 af (53% of inflow)
Center-of-Mass det. time= 142.0 min (898.0 - 756.0)

#	Invert	Avail.Storage	Storage Description
1	8.00'	1,107 cf	**48.00'W x 35.00'L x 4.00'H Prismatoid**
			6,720 cf Overall - 3,031 cf Embedded = 3,689 cf x 30.0% Voids
2	8.50'	3,031 cf	**42.0"D x 35.00'L Horizontal Cylinder** x 9 Inside #1
3	8.00'	1,161 cf	**21.00'W x 85.00'L x 4.00'H Prismatoid**
			7,140 cf Overall - 3,271 cf Embedded = 3,869 cf x 30.0% Voids
4	8.50'	3,271 cf	**42.0"D x 85.00'L Horizontal Cylinder** x 4 Inside #3
5	8.00'	654 cf	**15.00'W x 70.00'L x 4.00'H Prismatoid**
			4,200 cf Overall - 2,020 cf Embedded = 2,180 cf x 30.0% Voids
6	8.50'	2,020 cf	**42.0"D x 70.00'L Horizontal Cylinder** x 3 Inside #5
		11,244 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 8.71 hrs HW=8.04' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Central Parking Area - South Runoff Area=0.338 ac Runoff Depth=5.32"
Flow Length=210' Tc=1.8 min CN=89 Runoff=2.34 cfs 0.150 af

Subcatchment 2S: Central Parking Area Runoff Area=0.196 ac Runoff Depth=5.66"
Flow Length=140' Tc=1.4 min CN=92 Runoff=1.43 cfs 0.092 af

Subcatchment 3S: Building A Roof/Area Runoff Area=0.956 ac Runoff Depth=6.24"
Tc=5.0 min CN=97 Runoff=6.38 cfs 0.497 af

Subcatchment 4S: Building B Area Runoff Area=1.061 ac Runoff Depth=5.66"
Flow Length=270' Tc=1.8 min CN=92 Runoff=7.62 cfs 0.500 af

Subcatchment 5S: Building C Area Runoff Area=0.810 ac Runoff Depth=6.12"
Flow Length=102' Tc=1.1 min CN=96 Runoff=6.16 cfs 0.413 af

Subcatchment 6S: Building D Area/Roof Runoff Area=1.106 ac Runoff Depth=5.09"
Flow Length=238' Tc=1.7 min CN=87 Runoff=7.44 cfs 0.469 af

Subcatchment 7S: Building E Roof Runoff Area=0.454 ac Runoff Depth=6.36"
Tc=5.0 min CN=98 Runoff=3.04 cfs 0.241 af

Subcatchment 8S: South Runoff Runoff Area=2.291 ac Runoff Depth=4.00"
Flow Length=835' Tc=7.4 min CN=77 Runoff=10.24 cfs 0.764 af

Subcatchment 9S: West Runoff Runoff Area=2.758 ac Runoff Depth=3.38"
Flow Length=217' Tc=18.5 min CN=71 Runoff=7.61 cfs 0.776 af

Subcatchment 10S: North Runoff Runoff Area=1.266 ac Runoff Depth=4.11"
Flow Length=238' Tc=8.6 min CN=78 Runoff=5.57 cfs 0.433 af

Reach 1R: Little River Inflow=22.71 cfs 2.214 af
Outflow=22.71 cfs 2.214 af

Pond 5P: Retention Basin A Peak Elev=9.16' Storage=14,071 cf Inflow=7.44 cfs 0.469 af
Outflow=0.12 cfs 0.164 af

Pond 6P: Detention Basin 1 Peak Elev=8.94' Storage=8,757 cf Inflow=7.62 cfs 0.500 af
Discarded=0.12 cfs 0.177 af Primary=2.04 cfs 0.220 af Outflow=2.16 cfs 0.397 af

Pond 7P: Detention Basin 2 Peak Elev=8.33' Storage=2,449 cf Inflow=2.34 cfs 0.150 af
Discarded=0.12 cfs 0.128 af Primary=0.20 cfs 0.021 af Outflow=0.32 cfs 0.150 af

Pond IC-1: Infiltration Chamber 1 Peak Elev=10.78' Storage=1,394 cf Inflow=1.43 cfs 0.092 af
Outflow=0.12 cfs 0.092 af

Pond IC-2: Infiltration Chamber 2 Peak Elev=11.88' Storage=14,180 cf Inflow=6.38 cfs 0.497 af
Outflow=0.12 cfs 0.193 af

Pond IC-3: Infiltration Chamber 3 Peak Elev=11.79' Storage=5,099 cf Inflow=3.04 cfs 0.241 af
Outflow=0.12 cfs 0.176 af

Pond IC-4: Infiltration Chamber 4 Peak Elev=11.98' Storage=11,218 cf Inflow=6.16 cfs 0.413 af
Outflow=0.12 cfs 0.185 af

Total Runoff Area = 11.236 ac Runoff Volume = 4.336 af Average Runoff Depth = 4.63"

Subcatchment 1S: Central Parking Area - South

Runoff = 2.34 cfs @ 12.03 hrs, Volume= 0.150 af, Depth= 5.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
0.230	98	Paved roads w/curbs & sewers
0.108	69	50-75% Grass cover, Fair, HSG B
0.338	89	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.6	75	0.0100	2.0		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	85	0.0100	4.5	3.56	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
1.8	210	Total			

Subcatchment 2S: Central Parking Area

Runoff = 1.43 cfs @ 12.02 hrs, Volume= 0.092 af, Depth= 5.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
0.154	98	Paved parking & roofs
0.042	69	50-75% Grass cover, Fair, HSG B
0.196	92	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.3	40	0.0100	2.0		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	50	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.4	140	Total			

Subcatchment 3S: Building A Roof/Area

Runoff = 6.38 cfs @ 12.07 hrs, Volume= 0.497 af, Depth= 6.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
0.458	98	Roof
0.450	98	Driveway
0.048	84	50-75% Grass cover, Fair, HSG D
0.956	97	Weighted Average

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

Subcatchment 4S: Building B Area

Runoff = 7.62 cfs @ 12.03 hrs, Volume= 0.500 af, Depth= 5.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
0.390	98	Pavement
0.119	69	50-75% Grass cover, Fair, HSG B
0.180	84	50-75% Grass cover, Fair, HSG D
0.372	98	Roof
1.061	92	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.2		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.8	130	0.0200	2.9		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	90	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.8	270	Total			

Subcatchment 5S: Building C Area

[49] Hint: Tc<2dt may require smaller dt

Runoff = 6.16 cfs @ 12.02 hrs, Volume= 0.413 af, Depth= 6.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
0.288	98	Roof
0.459	98	Paved parking
0.063	69	50-75% Grass cover, Fair, HSG B
0.810	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.2	52	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.1	102	Total			

Subcatchment 6S: Building D Area/Roof

Runoff = 7.44 cfs @ 12.03 hrs, Volume= 0.469 af, Depth= 5.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
0.321	98	Pavement
0.413	69	50-75% Grass cover, Fair, HSG B
0.372	98	Paved parking & roofs
1.106	87	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
0.6	128	0.0300	3.5		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	60	0.0100	4.9	3.86	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.7	238	Total			

Subcatchment 7S: Building E Roof

Runoff = 3.04 cfs @ 12.07 hrs, Volume= 0.241 af, Depth= 6.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
0.454	98	Roof

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

Subcatchment 8S: South Runoff

Runoff = 10.24 cfs @ 12.11 hrs, Volume= 0.764 af, Depth= 4.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
0.794	98	Pavement
0.450	79	Woods, Fair, HSG D
0.787	61	>75% Grass cover, Good, HSG B
0.260	60	Woods, Fair, HSG B
2.291	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	50	0.0050	0.7		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.30"
2.3	200	0.0050	1.4		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.6	265	0.0030	2.7	2.11	**Circular Channel (pipe),** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.8	115	0.0050	1.1		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.5	205	0.0050	6.8	287.70	**Channel Flow,** Area= 42.0 sf Perim= 36.0' r= 1.17' n= 0.017
7.4	835	Total			

Subcatchment 9S: West Runoff

Runoff = 7.61 cfs @ 12.26 hrs, Volume= 0.776 af, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
1.102	60	Woods, Fair, HSG B
1.512	79	Woods, Fair, HSG D
0.144	69	50-75% Grass cover, Fair, HSG B
2.758	71	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.6	50	0.0150	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
4.9	167	0.0130	0.6		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.5	217	Total			

Subcatchment 10S: North Runoff

Runoff = 5.57 cfs @ 12.12 hrs, Volume= 0.433 af, Depth= 4.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Storm Rainfall=6.60"

Area (ac)	CN	Description
1.026	77	Woods, Good, HSG D
0.240	80	>75% Grass cover, Good, HSG D
1.266	78	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0760	0.2		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.30"
3.9	188	0.0260	0.8		**Shallow Concentrated Flow, Shallow** Woodland Kv= 5.0 fps
8.6	238	Total			

Reach 1R: Little River

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 7.714 ac, Inflow Depth = 3.44" for 100-Year Storm event
Inflow = 22.71 cfs @ 12.13 hrs, Volume= 2.214 af
Outflow = 22.71 cfs @ 12.13 hrs, Volume= 2.214 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond 5P: Retention Basin A

Inflow Area = 1.106 ac, Inflow Depth = 5.09" for 100-Year Storm event
Inflow = 7.44 cfs @ 12.03 hrs, Volume= 0.469 af
Outflow = 0.12 cfs @ 9.05 hrs, Volume= 0.164 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.12 cfs @ 9.05 hrs, Volume= 0.164 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 9.16' @ 17.82 hrs Surf.Area= 8,381 sf Storage= 14,071 cf
Plug-Flow detention time= 289.5 min calculated for 0.164 af (35% of inflow)
Center-of-Mass det. time= 155.2 min (942.4 - 787.2)

#	Invert	Avail.Storage	Storage Description
1	7.00'	21,569 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.00	4,388	0	0
8.00	6,358	5,373	5,373
9.00	8,093	7,226	12,599
10.00	9,848	8,971	21,569

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 9.05 hrs HW=7.03' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond 6P: Detention Basin 1

Inflow Area = 1.061 ac, Inflow Depth = 5.66" for 100-Year Storm event
Inflow = 7.62 cfs @ 12.03 hrs, Volume= 0.500 af
Outflow = 2.16 cfs @ 12.30 hrs, Volume= 0.397 af, Atten= 72%, Lag= 16.7 min
Discarded = 0.12 cfs @ 8.23 hrs, Volume= 0.177 af
Primary = 2.04 cfs @ 12.30 hrs, Volume= 0.220 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 8.94' @ 12.30 hrs Surf.Area= 4,487 sf Storage= 8,757 cf
Plug-Flow detention time= 153.2 min calculated for 0.397 af (79% of inflow)
Center-of-Mass det. time= 76.7 min (847.0 - 770.3)

#	Invert	Avail.Storage	Storage Description
1	6.00'	14,199 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	1,603	0	0
7.00	2,468	2,036	2,036
8.00	3,451	2,960	4,995
9.00	4,553	4,002	8,997
10.00	5,850	5,202	14,199

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**
2	Primary	8.00'	**12.0" x 40.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 7.80' S= 0.0050 '/' n= 0.012 Cc= 0.900

Discarded OutFlow Max=0.12 cfs @ 8.23 hrs HW=6.04' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=2.04 cfs @ 12.30 hrs HW=8.94' (Free Discharge)
↑—**2=Culvert** (Barrel Controls 2.04 cfs @ 3.5 fps)

Pond 7P: Detention Basin 2

Inflow Area = 0.338 ac, Inflow Depth = 5.32" for 100-Year Storm event
Inflow = 2.34 cfs @ 12.03 hrs, Volume= 0.150 af
Outflow = 0.32 cfs @ 12.49 hrs, Volume= 0.150 af, Atten= 86%, Lag= 27.8 min
Discarded = 0.12 cfs @ 10.92 hrs, Volume= 0.128 af
Primary = 0.20 cfs @ 12.49 hrs, Volume= 0.021 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 8.33' @ 12.49 hrs Surf.Area= 2,122 sf Storage= 2,449 cf
Plug-Flow detention time= 120.7 min calculated for 0.150 af (100% of inflow)
Center-of-Mass det. time= 120.4 min (901.4 - 781.0)

#	Invert	Avail.Storage	Storage Description
1	6.00'	7,459 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.00	0	0	0
7.00	800	400	400
8.00	1,757	1,279	1,679
9.00	2,850	2,304	3,982
10.00	4,103	3,477	7,459

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**
2	Primary	8.00'	**6.0" x 63.0' long Culvert** RCP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 7.70' S= 0.0048 '/' n= 0.012 Cc= 0.900

Discarded OutFlow Max=0.12 cfs @ 10.92 hrs HW=6.04' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.20 cfs @ 12.49 hrs HW=8.33' (Free Discharge)
↑—**2=Culvert** (Barrel Controls 0.20 cfs @ 2.1 fps)

Pond IC-1: Infiltration Chamber 1

Inflow Area = 0.196 ac, Inflow Depth = 5.66" for 100-Year Storm event
Inflow = 1.43 cfs @ 12.02 hrs, Volume= 0.092 af
Outflow = 0.12 cfs @ 11.39 hrs, Volume= 0.092 af, Atten= 92%, Lag= 0.0 min
Discarded = 0.12 cfs @ 11.39 hrs, Volume= 0.092 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 10.78' @ 12.79 hrs Surf.Area= 1,120 sf Storage= 1,394 cf
Plug-Flow detention time= 81.7 min calculated for 0.092 af (100% of inflow)
Center-of-Mass det. time= 81.5 min (851.5 - 770.0)

#	Invert	Avail.Storage	Storage Description
1	8.50'	655 cf	**28.00'W x 40.00'L x 3.00'H Prismatoid**
			3,360 cf Overall - 1,178 cf Embedded = 2,182 cf x 30.0% Voids
2	9.00'	1,178 cf	**30.0"D x 40.00'L Horizontal Cylinder** x 6 Inside #1
		1,833 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 11.39 hrs HW=8.53' (Free Discharge)
↳**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-2: Infiltration Chamber 2

Inflow Area = 0.956 ac, Inflow Depth = 6.24" for 100-Year Storm event
Inflow = 6.38 cfs @ 12.07 hrs, Volume= 0.497 af
Outflow = 0.12 cfs @ 7.38 hrs, Volume= 0.193 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.12 cfs @ 7.38 hrs, Volume= 0.193 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 11.88' @ 17.50 hrs Surf.Area= 6,000 sf Storage= 14,180 cf
Plug-Flow detention time= 257.2 min calculated for 0.193 af (39% of inflow)
Center-of-Mass det. time= 100.6 min (849.6 - 749.0)

#	Invert	Avail.Storage	Storage Description
1	8.00'	4,083 cf	**50.00'W x 120.00'L x 4.00'H Prismatoid**
			24,000 cf Overall - 10,391 cf Embedded = 13,609 cf x 30.0% Voids
2	8.50'	10,391 cf	**42.0"D x 120.00'L Horizontal Cylinder** x 9 Inside #1
		14,474 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 7.38 hrs HW=8.04' (Free Discharge)
↳**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-3: Infiltration Chamber 3

Inflow Area = 0.454 ac, Inflow Depth = 6.36" for 100-Year Storm event
Inflow = 3.04 cfs @ 12.07 hrs, Volume= 0.241 af
Outflow = 0.12 cfs @ 9.44 hrs, Volume= 0.176 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.12 cfs @ 9.44 hrs, Volume= 0.176 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 11.79' @ 14.88 hrs Surf.Area= 2,450 sf Storage= 5,099 cf
Plug-Flow detention time= 243.9 min calculated for 0.176 af (73% of inflow)
Center-of-Mass det. time= 153.3 min (895.7 - 742.4)

#	Invert	Avail.Storage	Storage Description
1	8.50'	1,385 cf	**35.00'W x 70.00'L x 3.50'H Prismatoid**
			8,575 cf Overall - 3,958 cf Embedded = 4,617 cf x 30.0% Voids
2	9.00'	3,958 cf	**36.0"D x 70.00'L Horizontal Cylinder** x 8 Inside #1
		5,343 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 9.44 hrs HW=8.54' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Pond IC-4: Infiltration Chamber 4

Inflow Area = 0.810 ac, Inflow Depth = 6.12" for 100-Year Storm event
Inflow = 6.16 cfs @ 12.02 hrs, Volume= 0.413 af
Outflow = 0.12 cfs @ 8.13 hrs, Volume= 0.185 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.12 cfs @ 8.13 hrs, Volume= 0.185 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 11.98' @ 16.75 hrs Surf.Area= 4,515 sf Storage= 11,218 cf
Plug-Flow detention time= 257.8 min calculated for 0.185 af (45% of inflow)
Center-of-Mass det. time= 121.9 min (873.5 - 751.6)

#	Invert	Avail.Storage	Storage Description
1	8.00'	1,107 cf	**48.00'W x 35.00'L x 4.00'H Prismatoid**
			6,720 cf Overall - 3,031 cf Embedded = 3,689 cf x 30.0% Voids
2	8.50'	3,031 cf	**42.0"D x 35.00'L Horizontal Cylinder** x 9 Inside #1
3	8.00'	1,161 cf	**21.00'W x 85.00'L x 4.00'H Prismatoid**
			7,140 cf Overall - 3,271 cf Embedded = 3,869 cf x 30.0% Voids
4	8.50'	3,271 cf	**42.0"D x 85.00'L Horizontal Cylinder** x 4 Inside #3
5	8.00'	654 cf	**15.00'W x 70.00'L x 4.00'H Prismatoid**
			4,200 cf Overall - 2,020 cf Embedded = 2,180 cf x 30.0% Voids
6	8.50'	2,020 cf	**42.0"D x 70.00'L Horizontal Cylinder** x 3 Inside #5
		11,244 cf	Total Available Storage

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**0.12 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.12 cfs @ 8.13 hrs HW=8.04' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

TSS Removal Calculations

RIZZO ASSOCIATES, INC.

Project: Residences at Acorn Park
Location: Belmont, Massachusetts

By: CDH
Chkd:

Date: 12/06/2005

Watershed Area: **Basin 1S**

TSS Removal Calculation Worksheet

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Street Sweeping	0.10	1.00	0.100	0.90
Deep Sump Catch Basin	0.25	0.90	0.225	0.68
Detention Basin	0.70	0.68	0.473	0.20

* Equals remaining load from previous BMP

Total TSS Removal = **80%**

Source: Volume Two: Stormwater Technical Handbook, Dated March 1997, prepared by Ma DEP, Section VI Case studies.

file no.: 7128 tss01

Project: **Residences at Acorn Park** By: **CDH** **Date: 12/06/2005**

Location: **Belmont, Massachusetts** Chkd:

Watershed Area: **Basin 2S, 3S and 5S**

TSS Removal Calculation Worksheet

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Street Sweeping	0.10	1.00	0.100	0.90
Deep Sump Catch Basin	0.25	0.90	0.225	0.68
Oil/Grit Separator	0.25	0.68	0.169	0.51
Infiltration / Detention System	0.70	0.51	0.354	0.15

* Equals remaining load from previous BMP

Total TSS Removal = **85%**

Source: Volume Two: Stormwater Technical Handbook, Dated March 1997, prepared by Ma DEP, Section VI Case studies.

file no.: **7128 tss01**

Project: **Residences at Acorn Park** By: **CDH** **Date: 12/06/2005**

Location: **Belmont, Massachusetts** Chkd:

Watershed Area: **Basin 4S and 6S**

TSS Removal Calculation Worksheet

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Street Sweeping	0.10	1.00	0.100	0.90
Deep Sump Catch Basin	0.25	0.90	0.225	0.68
Detention Basin	0.70	0.68	0.473	0.20

* Equals remaining load from previous BMP

Total TSS Removal = **80.0%**

Source: Volume Two: Stormwater Technical Handbook, Dated March 1997, prepared by Ma DEP, Section VI Case studies.

file no.: **7128 tss01**

Project: **Residences at Acorn Park**
Location: **Belmont, Massachusetts**
By: **CDH**
Chkd:
Date: 12/06/2005

Watershed Area: **Basin 8S**

TSS Removal Calculation Worksheet

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Street Sweeping	0.10	1.00	0.100	0.90
Grass Filter Strip	0.70	0.90	0.630	0.27
Grassed Bio-Filter Strip	0.70	0.27	0.189	0.08

* Equals remaining load from previous BMP

Total TSS Removal = **91.9%**

Source: Volume Two: Stormwater Technical Handbook, Dated March 1997, prepared by Ma DEP, Section VI Case studies.

file no.: **7128 tss01**

Stormwater Management Form

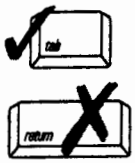
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Appendix C – Stormwater Management Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

A. Property Information

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



1. The proposed project is: Proposed Residential Development
   Belmont, MA

New development ☒ Yes ☐ No

Redevelopment ☐ Yes ☒ No

Combination ☐ Yes ☒ No (If yes, distinguish redevelopment components from new development components on plans).

Note: This February 2000 version of the Stormwater Management Form supersedes earlier versions including those contained in DEP's Stormwater Handbooks.

2. Stormwater runoff to be treated for water quality are based on which of the following calculations:

☐ 1 inch of runoff x total impervious area of post-development site for discharge to **critical areas** (Outstanding Resource Waters, recharge areas of public water supplies, shellfish growing areas, swimming beaches, cold water fisheries).

☒ 0.5 inches of runoff x total impervious area of post-development site for other resource areas.

3. List all plans and documents (e.g. calculations and additional narratives) submitted with this form:

None. This is not being submitted to the town.

B. Stormwater Management Standards

DEP's Stormwater Management Policy (March 1997) includes nine standards that are listed on the following pages. Check the appropriate boxes for each standard and provide documentation and additional information when applicable.

Standard #1: Untreated stormwater

☒ The project is designed so that new stormwater point discharges do not discharge untreated stormwater into, or cause erosion to, wetlands and waters.

B. Stormwater Management Standards (cont.)

Standard #2: Post-development peak discharges rates

☐ Not applicable – project site contains waters subject to tidal action.

Post-development peak discharge does not exceed pre-development rates on the site at the point of discharge or downgradient property boundary for the 2-yr and 100-yr, 24-hr storms.

☐ without stormwater controls

☒ with stormwater controls designed for the 24-hr, 2-yr, and 10-yr storms.

☒ The project's stormwater design will not increase off-site flooding impacts from the 100-yr, 24-hr storm.

Standard #3: Recharge to groundwater

Amount of impervious area (sq. ft.) to be infiltrated: 217,800 sf

Volume to be recharged is based on:

☒ The following Natural Resources Conservation Service hydrologic soils groups (e.g. A, B, C, D, or UA) or any combination of groups:

100%	B		
(% of impervious area)	(Hydrologic soil group)	(% of impervious area)	(Hydrologic soil group)
(% of impervious area)	(Hydrologic soil group)	(% of impervious area)	(Hydrologic soil group)

☒ Site specific pre-development conditions: 0.52 in/hr (Recharge rate) .062 AC-FT (Volume)

Describe how there calculations were determined:

Refer to Stormwater Management Summary

List each BMP or nonstructural measure used to meet Standard #3. (e.g. dry well, infiltration trench).

4 Underground detention / Infiltration System (1) Retention Basin

(2) Detention Basins (2) Grassed Swales

The annual groundwater recharge for the post-development site approximates the annual recharge from existing site conditions.

☒ Yes

☐ No

B. Stormwater Management Standards (cont.)

Standard #4: 80% TSS Removal

☒ The proposed stormwater management system will remove 80% of the post-development site's average annual Total Suspended Solids (TSS) load.

Identify the BMP's proposed for the project and describe how the 80% TSS removal will be achieved.

Street Sweeping, deep sump and hooded catchbasins, detention basin, and water quality swales.

If the project is redevelopment, explain how much TSS will be removed and briefly explain why 80% removal cannot be achieved.

N/A

Standard #5: Higher potential pollutant loads

Does the project site contain land uses with higher potential pollutant loads (See Stormwater Policy Handbook – Vol. I, page I-23, for land uses of high pollutant loading).

☐ Yes If yes, describe land uses: _____

☒ No

Identify the BMPs selected to treat stormwater runoff. If infiltration measures are proposed, describe the pretreatment. (Note: If the area of higher potential pollutant loading is upgradient of a critical area, infiltration is not allowed.

Standard #6: Protection of critical areas

Will the project discharge to or affect a critical area? (See Stormwater Policy Handbook – Vol. I, page I - 25, for critical areas).

☐ Yes If yes, describe areas: _____

☒ No

Identify the BMPs selected for stormwater discharges in these areas and describe how BMPs meet restrictions listed on pages I-27 and I-28 of the Stormwater Policy Handbook – Vol. I:

B. Stormwater Management Standards (cont.)

Note: components of redevelopment projects which plan to develop previously undeveloped areas do not fall under the scope

Standard #7: Redevelopment projects

Is the proposed activity a redevelopment project?

☐ Yes If yes, the following stormwater management standards have been met:

☒ No

The following stormwater standards have not been met for the following reasons:

☒ The proposed project will reduce the annual pollutant load on the site with new or improved stormwater control.

Standard #8: Erosion/sediment control

☒ Erosion and sediment controls are incorporated into the project design to prevent erosion, control sediments, and stabilize exposed soils during construction or land disturbance.

Standard #9: Operation/maintenance plan

☒ An operation and maintenance plan for the post-development stormwater controls have been developed. The plan includes ownership of the stormwater BMPs, parties responsible for operation and maintenance, schedule for inspection and maintenance, routine and long-term maintenance responsibilities, and provision for appropriate access and maintenance easements extending from a public right-of-way to the stormwater controls.

Refer to Stormwater Management Summary	12/05
Plan/Title	Date
Plan/Title	Date

C. Submittal Requirements

DEP recommends that applicants submit this form, as well as, supporting documentation and plans, with the Notice of Intent to provide stormwater management information for Commission review consistent with the wetland regulations (310 CMR 10.05 (6)(b)) and DEP's Stormwater Management Policy (March 1997). If a particular stormwater management standard cannot be met, information should be provided to demonstrate how equivalent water quality and water quantity protection will be provided. DEP encourages engineers to use this form to certify that the project meets the stormwater management standards as well as acceptable engineering standards. For more information, consult the Stormwater Management Policy.

D. Signatures

Applicant	Date
Signature	
Brian Sullivan, P.E.	12/06/05
Representative	Date
Signature	

Groundwater Recharge Calculations

RIZZO ASSOCIATES
TETRA TECH COMPANY
One Grant Street
Framingham, MA 01701-9005
(508) 903-2000
(508) 903-2001 fax
www.rizzo.com

JOB 7128 - RESIDENTIAL DEVELOPMENT
SHEET NO. _____ OF _____
CALCULATED BY CDH DATE 12/1/05
CHECKED BY _____ DATE _____
SCALE GROUNDWATER RECHARGE

VOLUME OF GROUNDWATER REQUIRED FOR RECHARGE

TOTAL IMPERVIOUS AREA OVER "D" SOILS - DISREGARD

TOTAL IMPERVIOUS AREA OVER "B" SOILS - 2.79 AC.

RECHARGE REQUIRED = $2.79 \text{ AC.} \times 0.25 \text{ INCH} \times \frac{1 \text{ FT}}{12 \text{ IN}}$

= 0.06 AC./FT.

INFILTRATION RATE FOR "B" SOILS - 0.52 IN/HR
(SEE CHART ATTACHED)

INFILTRATION AREA PROVIDED		VOLUME PROVIDED
IC-1	= 30' x 40' x 5'	1833 CF
IC-2	= 50' x 120' x 6'	14,474 CF
IC-3	= 35' x 10' x 5'	5343 CF
IC-4	= 30' x 90' x 6'	11,244 CF
RETENTION BASIN A	= 50' x 220' x 3'	21,569 CF
DETENTION BASIN 1	150' - 34' x 3'	14,199 CF
DETENTION BASIN 2	20' x 20' x 3'	7,459 CF
		76,121 CF

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SHEET NO. _____ OF _____
CALCULATED BY CDH DATE 12/1/05
CHECKED BY _____ DATE _____
SCALE GROUNDWATER RECHARGE

INFILTRATION PROVIDED

IC-1 SURFACE AREA = (30' × 40') + (40 × 5' × 2) + (30 × 5 × 2)
= 1900 SF

INFILTRATION RATE = 1900 SF × .52 IN/HR × 1FT/12 IN × 1 HR/3600 S = 0.02 cfs

IC-2 SURFACE AREA = (50' × 120') + (50' × 6' × 2) + (120 × 6 × 2)
= 8040 SF

INFILTRATION RATE = 5040 SF × .52 IN/HR × 1FT/12 IN × 1 HR/3600 S = 0.10 cfs

IC-3 SURFACE AREA = (35' × 70') + (35 × 5' × 2) + (70' × 5' × 2)
= 3500 SF

INFILTRATION RATE 3500 SF × .52 IN/HR × 1FT/12 IN × 1 HR/3600 S = 0.04 cfs

IC-4 SURFACE AREA (90' × 90') + (90 × 6' × 2) + (90' × 6' × 2)
= 9240 SF

INFILTRATION RATE = 9240 SF × .52 IN/HR × 1FT/12 IN × 1 HR/3600 S = 0.11 cfs

RETENTION BASIN A (50' × 200') + (50' × 3' × 2) + (200 × 3' × 2)
SURFACE AREA = 10,600 SF

INFILTRATION RATE = 10,600 SF × .52 IN/HR × 1FT/12 IN × 1 HR/3600 S = 0.13 cfs

RETENTION BASIN 1 = (40' × 35') + (40' × 3' × 2) + (35' × 3' × 2)
SURFACE AREA = 1,700 SF

INFILTRATION RATE = 1,700 SF × .52 IN/HR × 1FT/12 IN × 1 HR/3600 S = 0.02 cfs

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JOB 7125 - RESIDENTIAL DEVELOPMENT
SHEET NO. ____ OF ____
CALCULATED BY CDH DATE 12/5/05
CHECKED BY ____ DATE ____
SCALE GROUNDWATER RECHARGE

INFILTRATION PROVIDED (CONT.)

DETENTION BASIN 2 = (20' x 90') + (25' x 3' x 2) + (90' x 3' x 2)

SURFACE AREA = 2460 SF

INFILTRATION RATE = 2460 SF x .52 IN/HR x $\frac{1 FT}{12 IN}$ x $\frac{1 HR}{3600 S}$ = 0.03 cfs

TOTAL SURFACE AREA PROVIDED = 37,520 SF

TOTAL VOLUME PROVIDED = 76,121 CF

TABLE of HYDROLOGIC SOIL PROPERTIES CLASSIFIED BY USDA SOIL TEXTURE*

Texture Class	Design Infiltration Rate (f)	Hydrologic Soil Grouping
	(Inches per hour)	
Sand	8.27	A
Loamy Sand	2.41	A
Sandy Loam	1.02	B
Loam	.52	B
Silt Loam	.27	C
Sandy Clay Loam	.17	C
Clay Loam	.09	D**
Silty Clay Loam	.06	D**
Sandy Clay	.05	D**
Silty Clay	.04	D**
Clay	.02	D**

* Source: Rawls, Brakensiek and Saxton, 1982

** Not suitable for recharge systems

Groundwater Recharge Calculations
Residences at Acorn Park
Belmont, MA

Design Criteria:
B-soil=0.25"/AC x total impervious area
Infiltration Rate = 0.52 in/hr

Total Impervious Area (Ac)= 2.79

Required Recharge Volume (AF) = 2.79 x .25"/12= **0.058**

Recharge Provided from 4 Infiltration Basins (AF) = **0.48** (see HydroCAD)
Recharge Provided from 1 Retention Basin (AF) = **0.14** (see HydroCAD)
Recharge Provided from 2 Detention Basins (AF) = **0.21** (see HydroCAD)

Number based on HydroCad analysis for 2-year storm, will increase with higher storm events.

Drawdown Analysis:

Infiltration Volume =76,121 CF
Infiltration Area = 37,520 SF
Drawdown Rate: 0.52 in/hr X 1/12 x 37,520=1626 CF/HR

V/R=76121/1626=47 Hours

Water Quantity Calculations

Water Quality Calculations
Acorn Park
Belmont, MA

Watershed ID	BMP	Tributary Drainage Basin ID	Pavement Area (SF)	Treatment Rate (inch/acre)	Required WQ Volume (CF)	Provided WQ Volume (CF)	Comments
6S	Basin A	6S	13983	1.00	**1165**	**2687**	Elev 7.0 to 7.5
				Total =	**1165**	**2687**	
4S	Basin 1	4S	16988	1.00	**1416**	**1758**	Elev 7.0 to 7.5
				Total =	**1416**	**1758**	
1S	Basin 2	1S	10019	1.00	**835**	**1279**	Elev 7.0 to 8.0
				Total =	**835**	**1279**	
2S	IC-1	2S	6708	1.00	**559**	**589**	Elev 9.0 to 10.25
				Total =	**559**	**589**	
3S	IC-2	3S	19602	1.00	**1634**	**5196**	Elev 8.5 to 9.75
				Total =	**1634**	**5196**	
5S	IC-4	5S	19994	1.00	**1666**	**4146**	Elev 8.5 to 10.25
				Total =	**1666**	**4146**	

Pond design: 1.0"/AC of pavement area to be treated

6.1 Wastewater Management

6.1.1 Sewer Connection

The sewer connection route for the project consists of installing a small sewer pump station on-site and a 5-inch force main along Acorn Park Drive, Frontage Road, Lake Street and Garrison Road. The force main will connect to the existing Town of Belmont gravity sewer located at the intersection of Garrison Road and Gilmore Road. The Town has plans to replace the downstream 8-inch sewers in Gilmore Road and Oliver Road as part of its infiltration/inflow (I/I) reduction program described below. The proponent will work with the Town to upgrade these sewers to provide additional capacity to accept flow from the proposed project. The proponent will further work with the Town to coordinate the construction of the new sewers required for the project connection with the planned sewer upgrade work to minimize disruption to town streets.