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ELDERLY HOUSING DEVELOPMENT 470 BOSTON STREET

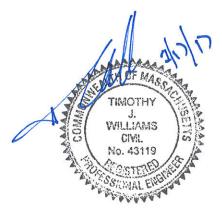
TOPSFIELD, MASSACHUSETTS DRAINAGE REPORT

DATE PREPARED: OCTOBER 13, 2016

REVISED: JANUARY 17, 2017

APPLICANT: SARKIS DEVELOPMENT COMPANY 2 ELM SQUARE ANDOVER, MA 01810

PREPARED BY: ALLEN & MAJOR ASSOCIATES, INC. P.O. BOX 2118 100 COMMERCE WAY WOBURN, MASSACHUSETTS 01888-0118



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INTRODUCTION

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The purpose of this drainage report is to provide an overview of the proposed stormwater management system (SMS) for the proposed site development at #470 Boston Street in Topsfield, MA. The report will show by means of narrative, calculations, and exhibits that the proposed stormwater management system will meet or exceed the 10 Massachusetts Department of Environment Protection (DEP) stormwater standards, as well as the Town of Topsfield's Stormwater Management Regulations.

The proposed site improvements include construction of 15 condominium-style duplexes consisting of 30 elderly housing units, as well as two common area structures, pedestrian sidewalks, paved drives, landscaped islands, grading, underground utilities, and associated site work. Proposed site improvements also include Best Management Practices (BMP) to effectively handle stormwater runoff from the site.

The proposed Stormwater Management System (SMS) incorporates structural and nonstructural BMPs to provide stormwater peak flow mitigation, quality treatment, stormwater infiltration and conveyance. The SMS includes roof drains, drain manholes, underground piping, deep-sump catch basins, proprietary hydro-dynamic separators, infiltration chambers to treat roof runoff, a surface detention/infiltration basin, and a long term Operation and Maintenance Plan.

SITE CATEGORIZATION FOR STORMWATER REGULATIONS

The proposed site improvements at #470 Boston Street are considered a new development under the MA DEP Stormwater Management Standards.

All improvements are considered a "new" development and shall comply with all ten (10) of the MA DEP Stormwater Management Standards. Furthermore, the Town of Topsfield Conservation Commission has eleven (11) Stormwater Standards of their own, which the project will comply with as well.

SITE LOCATION AND ACCESS

The project site is located at #470 Boston Street and is identified on the Town of Topsfield's Assessor's Map #7, Lot #3. The site is a single lot with frontage on Boston Street (Route 1). The site is comprised of $16.32\pm$ acres located within both the towns of Topsfield ($13.24\pm$ acres) and Ipswich ($3.08\pm$ acres), is located approximately 5.0 miles north of the Exit 50 off-ramp from Route 95 Northbound, and is owned by Sarkis Development Company. The site contains approximately 9.45 \pm acres of "upland" area, which are considered buildable areas located outside of flagged bordering vegetated wetland resource areas.

The site has one existing paved access driveway from Boston Street, a public right-of-way 66

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feet in width, also known as Route 1. This access drive will continue to serve as the primary access point for the development of the parcel. A gated emergency egress drive is proposed to be constructed just south of the existing drive, with access to Boston Street.

WATERSHED

The project site is located within the Ipswich River Watershed. The site primarily drains into surrounding wetlands to the north of the site, with a relatively small amount draining to a wetland along Boston Street.

EXISTING SITE CONDITIONS

The Site consists of approximately 16.32± acres, all of which is located within the Elderly Housing District (EHD) Overlay, known as "Rolling Green Elderly Housing District," per Article 33 of Annual and Special Town Meeting Warrant for fiscal year 2017, from the May 3, 2016 Town Meeting. The lot is currently occupied by a garage with a paved drive and gravel area nearby, as well as grassed meadow areas, a small garden area, vegetated wetlands and treed woodlands.

Southeast of the garage, is an abandoned residential dwelling, which is proposed to be razed. A concrete surface detention structure and associated catch basins and a drain manhole are also located on-site. The parcel is identified as Map #7 Lot #3 on the Town of Topsfield's Assessor's Maps. The surrounding land uses are primarily Business Park District (BP) and Outlying Residential and Agricultural District (ORA).

Areas of Bordering Vegetated Wetlands (BVW) to the southeast of the site were flagged by Seekamp Environmental Consulting on or between June 27 and June 30, 2016. With the exception of the emergency drive and a 15" outlet pipe mandated by the Town Planning Board and Conservation Commission, respectively, it should be noted that all construction for the project is proposed outside of the 100' wetland buffer. No work is proposed to disturb the existing BVW.

The majority of the site is comprised of undeveloped meadow and woodland. There is also a large wetland area to the north and a small wetland area abutting Boston Street. An impervious drive and a gravel area outside of the existing garage area slope towards existing catch basins and a drain manhole, which outlet to an existing concrete detention structure located on-site. The site generally slopes from south to north from approximate El. 84+/- at the southwestern property corner to El. 57+/- at the Bordering Vegetated Wetlands (BVW) to the north. See the attached Existing Watershed Plan (EWP) and Aerial Photo (EX-1).

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Drainage peak flows and volumes were analyzed at three (3) Study Points:

- <u>Study point 1</u>: This point represents flows to the existing wetlands near Boston Street. Runoff from subcatchments areas E-1 and E-2 eventually collect at Study Point 1. Stormwater runoff from E-1 flows over the paved drive, to the existing catch basins within the existing drive, to a drain manhole, where it is eventually routed to an existing concrete surface detention basin. Overflow from the basin flows overland to the existing downgradient wetlands along Boston Street, designated as Study Point 1, where it is recharged to groundwater. Runoff from E-2 flows overland to the wetland area, defined as study point 1.
- <u>Study Point 2</u> is a large wetland resource area on the northern portion of the site. Runoff from subcatchments areas E-3 flows overland and eventually reaches the wetland area, where it is recharged to groundwater.
- <u>Study Point 3</u> is a natural on-site depression. Stormwater runoff from sub-catchment area E-4 flows overland, before it is collected at Study Point 3, and recharged to groundwater.

EXISTING SOIL CONDITIONS

The on-site soils were identified using the USDA Natural Resources Conservation Services (NRCS) Soil Survey for Essex County. The site's soil types and corresponding Hydrologic Soil Groups (HSG) include:

٠	52A	(HSG - B/D)	- Freetown Muck, 0-3% slopes
٠	420B	(HSG - A)	- Canton Fine Sandy Loam, 3-8% slopes
٠	420C	(HSG - A)	- Canton Fine Sandy Loam, 8-15% slopes
٠	421C	(HSG - C)	- Canton Fine Sandy Loam, 8-15% slopes (Very stony)
٠	421D	(HSG - C)	- Canton Fine Sandy Loam, 15-25% slopes (Very stony)

See the Section 6.1 of the Appendix of this report for a copy of the soil mapping with Hydrological Soil Groups (HSG).

FEMA FLOODPLAIN/ENVIRONMENTAL DUE DILIGENCE

An environmental due diligence was completed by consulting the latest Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) dated July 3, 2012 noted as community panel #25009CO266F (Exhibit 3 - FEMA FIRM). A portion of the project site lies within a 100-year floodplain area (Zone A – Areas subject to inundation by the 1-

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percent-annual-chance flood, with no Base Flood Elevation (BFE)). No portion of the project site lies within the 500-year floodplain.

A review of the latest Massachusetts Natural Heritage Atlas (13th Edition) reveals that there are no Estimated Habitats, Priority Habitats or Certified Vernal Pools onsite or directly adjacent to the site (Exhibit 4 - Priority & Estimated Habitats). Additionally, the site is not located within any Areas of Critical Environmental Concern (ACEC).

On or between June 27 to June 30, 2016, approximately $1,600\pm$ linear feet of Bordering Vegetated Wetland to the north of the site was delineated by Seekamp Environmental Consultants, Inc. (SEC). Approximately $300\pm$ linear feet of Bordering Vegetated Wetland to the east of the site was delineated by SEC. In total, approximately, $1,900\pm$ linear feet of Bordering Vegetated Wetland were delineated on-site. The BVW and its associated buffer zone (100 ft. State Jurisdictional and Local Buffer) are shown on the plans.

DRAINAGE ANALYSIS METHODOLOGY

Peak rates of runoff were determined using techniques and data found in the following reference materials:

- 1. <u>Urban Hydrology for Small Watersheds Technical Release 55</u> by the United States Department of Agriculture Soils Conservation Service (SCS), June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.
- 2. <u>HydroCAD[©] Stormwater Modeling System</u> by HydroCAD Software Solutions LLC, version 10.00, 2013. The HydroCAD[©] program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/stage/storage characteristics for the stormwater BMPs, to perform drainage routing and to combine the results of the runoff hydrographs. HydroCAD[©] uses the TR-20 methodology of the SCS Unit Hydrograph procedure (SCS-UH).
- 3. <u>Soil Survey of Essex County Massachusetts</u> by United States Department of Agriculture, NRCS. Soil types and boundaries were obtained from this reference.

PEAK RATE OF RUNOFF

The storm water runoff analysis of the existing and proposed conditions includes an estimate of the peak rate of runoff from various rainfall events. Peak runoff rates were developed using TR-55 Urban Hydrology for Small Watersheds, developed by the U.S. Department of Commerce, Engineering Division and the HydroCAD computer program. Furthermore, the analysis has been prepared in accordance with the MA DEP and the Town of Topsfield requirements, as well as standard engineering practices. The peak rates of runoff have been

Elderly Housing DevelopmentA&M Project # 2165-01ATopsfield, MAJanuary 17, 2017estimated for each watershed for the theoretical 2-, 10-, and 25-year storm events.

A surface infiltration basin and subsurface infiltration chambers will receive stormwater directly from the proposed roofs and pretreated impervious site areas (parking lots and driveways). Pretreatment for runoff from paved surfaces is provided by deep sump catch basins and proprietary hydro-dynamic separators which prevents sediment from being deposited into the infiltration systems, inhibiting stormwater treatment. The systems have been designed to mitigate the required recharge and water quality volume generated on the developed surfaces. The systems maintain at least two (2) feet of separation from groundwater and drain down within the required 72 hours.

The HydroCAD storm water runoff model shows that *the proposed site development reduces the overall rate of runoff when the identified points of analysis are combined*. Furthermore, the analysis shows that the overall volume discharged from the site will also be reduced. The following tables provide a summary of the estimated peak rate at each Study Point during each of the design storm events. The HydroCAD worksheets are included in Section 4 of this report.

SIDDI POINT #1 (Flow to wetland hear Boston Street)					
Peak Flows	2-Year	10-Year	25-Year		
Existing Runoff (CFS)	0.07	0.58	1.14		
Proposed Runoff (CFS)	0.01	0.18	0.45		
% REDUCTION	85.7%	69.0%	60.5%		

STUDY POINT #1 (Flow to wetland near Boston Street)

STUDY POINT #1 (Flow to wetland near Boston Street)

Peak Volumes	2-Year	10-Year	25-Year	100-Year
Existing Runoff (AF)	0.05	0.15	0.23	0.34
Proposed Runoff (AF)	0.01	0.07	0.12	0.20
% REDUCTION	80.0%	53.3%	47.8%	41.2%

Peak Flows	2-Year	10-Year	25-Year	
Existing Runoff (CFS)	0.02	0.10	0.56	
Proposed Runoff (CFS)	0.00	0.05	0.27	
% REDUCTION	100.0%	50.0%	51.8%	

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STUDY POINT #2 (Flow	to wetland to northea	st of the project site)	

Peak Volumes	2-Year	10-Year	25-Year	100-Year
Existing Runoff (AF)	0.00	0.06	0.13	0.25
Proposed Runoff (AF)	0.00	0.03	0.06	0.23
% REDUCTION	0.0%	50.0%	53.8%	8.0%

STUDY POINT #3 (Flow to wetland to northwest of the project site)

Peak Flows	2-Year	10-Year	25-Year	
Existing Runoff (CFS)	0.01	0.22	0.79	
Proposed Runoff (CFS)	0.00	0.21	0.93	
% REDUCTION	100.0%	4.5%	+17.7%*	

STUDY POINT #3 (Flow to wetland to northwest of the project site)

Peak Volumes	2-Year	10-Year	25-Year	100-Year
Existing Runoff (AF)	0.005	0.08	0.16	0.30
Proposed Runoff (AF)	0.00	0.07	0.23	0.46
% REDUCTION	100%	12.5%	+43.8%*	+53.3%*

*See total wetland flow and volume calculations below.

TOTAL STUDY POINT PEAK FLOWS (Combined peak flows of SP-1, 2 & 3)

Peak Flows	2-Year	10-Year	25-Year	,
Existing Runoff (CFS)	0.08	0.82	2.29	
Proposed Runoff (CFS)	0.01	0.36	1.33	
% REDUCTION	87.5%	56.1%	41.9%	

TOTAL STUDY POINT VOLUMES (Combined peak volumes of SP-1, 2 & 3)

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Peak Volumes	2-Year	10-Year	25-Year	100-Year
Existing Runoff (AF)	0.06	0.29	0.53	0.89
Proposed Runoff (AF)	0.01	0.16	0.41	0.89
% REDUCTION	83.3%	44.8%	22.6%	0.0%

As described in the tables above, the total existing storm water peak flow and volume directed to the northern wetland area decreases overall in the post-construction watershed, as compared to the pre-construction watershed. The three study points can be considered hydraulically connected and therefore, based on the HydroCAD model, the overall proposed watershed area will <u>not</u> increase in flow and/or volume.

MA DEP STORMWATER PERFORMANCE STANDARDS

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The MA DEP Stormwater Management Policy was developed to improve water quality by implementing performance standards for storm water management. The intent is to implement the stormwater management standards through the review of Notice of Intent filings by the issuing authority (Conservation Commission or DEP). The following section outlines how the proposed Stormwater Management System (SMS) meets the standards set forth by the Policy.

Stormwater Best Management Practices (BMPs) implemented in the proposed SMS design include:

Deep Sump Catch Basins with Hoods Surface Infiltration Basin Subsurface Infiltration Chambers Proprietary Hydro-dynamic Separators

Stormwater BMPs have been incorporated into the design of the project to mitigate the anticipated pollutant loading. Temporary erosion and sedimentation controls will be incorporated during the construction phase of the project. These temporary controls include coir logs and/or silt fence barriers, inlet sediment traps, diversion channels, slope stabilization and stabilized construction entrances.

The Massachusetts Department of Environmental Protection has established ten (10) Stormwater Management Standards. A project that meets or exceeds the standards is presumed to satisfy the regulatory requirements regarding stormwater management. The Standards are as follows:

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

The proposed development will not introduce any new outfalls with direct discharge to a wetland areas or waters of the Commonwealth of Massachusetts. All discharges will be treated for water quality.

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

The proposed development has been designed such that the post-development peak discharge rates do not exceed the pre-development peak discharge rates. A summary of the existing and proposed discharge rates is included within this document.

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

The existing annual recharge for the site has been approximated in the developed condition. Subsurface infiltration chambers and a surface infiltration basin have been designed to meet this requirement. Soil test data can be found in the appendix of this report. The proposed Recharge Volume is based on the Static Method per the MA DEP Stormwater Management Standards, Volume 3, Chapter 1.

The primary on-site soils are classified as follows by the USDA NRSC:

- 52A (HSG B/D) Freetown Muck, 0-3% slopes
- 420B (HSG A) Canton Fine Sandy Loam, 3-8% slopes
- 420C (HSG A) Canton Fine Sandy Loam, 8-15% slopes
- 421C (HSG C) Canton Fine Sandy Loam, 8-15% slopes (Very stony)
- 421D (HSG C) Canton Fine Sandy Loam, 15-25% slopes (Very stony)

See attached Standard DEP Calculations in the appendix of this report for Recharge Volume and 72-hour drawdown time calculations.

- 4. Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:
 - a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
 - b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
 - *c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

The proposed stormwater management system has been designed such that the 80% TSS removal standard will be met for each drainage area. Standard #4 is met when

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structural stormwater best management practices are sized to capture and treat the required water quality volume and pretreatment is provided in accordance with the Massachusetts Stormwater Handbook. Standard #4 also requires that suitable source control measures are identified in the Long Term Pollution Prevention Plan.

Water quality volume for the developed site will be captured and treated using deep sump catch basins and proprietary hydro-dynamic separators. All systems will be sized to meet the water quality flow rate for the $\frac{1}{2}$ " storm event.

The TSS removal efficiencies for the deep sump catch basins and infiltration basin are based on the values assigned under the MA DEP Stormwater handbook. All proprietary separators have been sized using *water quality discharge flow rate* and for a minimum TSS removal based on values assigned by the PC version of EPA's Stormwater Management Model (PCSWMM).

The PCSWMM program was used to size the proprietary separators. Water Quality Units #2 and #3 shall be Stormceptor STC-900 units, which will remove a minimum of 80% of total suspended solids (TSS). Water Quality Unit #1 is sized to be a Stormceptor 450i treatment unit, and in combination with catch basins with deep sumps and hoods as well as Underground Infiltration System #1 with an isolator row wrapped in filter fabric will achieve a minimum of 80% TSS removal. See the MADEP TSS removal worksheets in the Appendix for more data.

Standard #4 also requires that suitable source control measures are identified in the Long Term Pollution Prevention Plan including street sweeping and proper cleaning of the water quality swale, drainage structures (catch basins), and proprietary separators.

See attached Standard DEP Calculations in the appendix of this report for TSS removal and water quality discharge flow rate calculations.

5. For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant

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loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

The proposed development is not considered a land use with higher potential pollutant loads (LUHPPL).

6. Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

The project site does not discharge stormwater within a Zone II and Interim Wellhead Protection Area or near a critical area.

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

The proposed project is not considered a re-development project under the Stormwater Management Handbook guidelines because while there is an existing, abandoned structure, driveway, and garage, the total impervious area for the site will increase.

8. A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities

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(construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

A plan to control construction-related impacts, including erosion, sedimentation and other pollutant sources during construction and land disturbance activities has been developed. A detailed Erosion and Sedimentation Control Plan is included in the Permit Drawings. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

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

A Long-Term Operation and Maintenance (O&M) Plan has been developed for the proposed stormwater management system and can be found within this Drainage Report.

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

There are no expected illicit discharges to the stormwater management system. An Illicit Discharge Compliance Statement is attached in the Appendix of this report.

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Topsfield, MA **TOWN OF TOPSFIELD STORMWATER PERFORMANCE STANDARDS** The Town of Topsfield has also developed their own Stormwater Standards to ensure that the waters within the town are protected.

 Stormwater run-off directed or channeled into any resource area has the potential of degrading or altering that area as a result of pollution conveyed and/or the disposition of silt and sediments into that area. It is presumed that a fully viable resource area is significantly to the interests of the Act and the Bylaw. Therefore, any discharge of any stormwater directed or channeled into a resource area by any new or repaired stormwater management system shall conform to all listed standards contained in the Massachusetts Stormwater Management Regulations adopted by the Mass Department of Environmental Protection as they may amended from time to time, hereafter called the Stormwater Regulations, and the provisions of 310 CMR-10.05, paragraphs: (k), (m), (n), (p), and (q), as they may be amended over time. Detailed performance requirements of stormwater management systems constructed in compliance with the above standards are found in the Massachusetts Stormwater Handbook volumes 1-4.

The proposed Stormwater Management System has been designed to meet or exceed all ten (10) of the Massachusetts Stormwater Standards (see section entitled "MA DEP Stormwater Performance Standards", above.

2) Any lot proposed for development, redevelopment, or additional development that borders on or contains any resource area protected by the Act and the Bylaw located in the red zone of the Soils Map or on a drumlin shall demonstrate by engineered design that stormwater runoff from the proposed construction would be retained onsite in either bio-retention ponds, rain gardens, drywells, or similarly functioning low impact features. Where that is proved not to be feasible, the drainage system shall be designed to intercept suspended solids and hydrocarbon pollutants using best management practices (BMP's) in conformance with standard four of the Stormwater Regulations prior to being discharged into the resource area.

The proposed Stormwater Management System has been designed to meet Standard #4 in the Massachusetts Stormwater Handbook. Subsurface infiltration chambers and an infiltration basin are used to ensure waters are kept on site and charged to groundwater.

3) All designs and BMPs managing stormwater runoff shall be sized to accommodate a 100-year storm frequency event without causing erosion or siltation of the retention area.

The analysis shows the overall volume has been reduced for the 100-year storm and no erosion or scouring will be caused to the retention areas.

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4) During the construction of the proposed development and until such time that the disturbed soil has been stabilized appropriately, erosion and sedimentation control measures shall be installed around the perimeter of the construction site in accordance with standard eight of the Stormwater Regulations. Erosion and sedimentation controls for the proposed construction site shall be approved by the Topsfield Conservation Commission or its designated agent prior to the start of any work onsite. All soils stored at the construction site for greater than 24 hours shall be covered by a waterproof tarpaulin or equivalent rainwater protection.

A detailed Erosion and Sedimentation Control Plan is included in the Permit Drawings. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

5) No snow hauled from parking lots or public ways shall be deposited in any resource area under the jurisdiction of the Topsfield Conservation Commission unless authorized under (permit) conditions deemed necessary by the Topsfield Conservation Commission to protect interests of the Act and the Bylaw.

Snow storage regulations have been included as part of the O&M Plan. See also the Snow Storage Plan.

6) All stormwater management systems permitted hereunder shall have operations and maintenance plans approved by the Commission in conformance with standard nine of the Stormwater Regulations.

An Operation and Maintenance (O&M) Plan is included within this drainage report. As part of the O&M Plan, there is an attachment entitled "Snow Disposal Guidance" issued by the MassDEP which outlines appropriate snow disposal methods.

7) Impervious areas such as driveways, patios, and parking lots shall be graded to facilitate stormwater runoff into adjacent grassy swales or catchment areas. No driveway shall be constructed or modified with a pitch such that runoff is directed onto a public road or street. Wherever possible, vegetated drainage swales and rain gardens shall be located to retain stormwater runoff onsite. The Commission encourages the use of pervious pavement materials such as pavers and porous asphalt. For information on porous asphalt contact: National Asphalt Pavement Assoc.

The proposed Stormwater Management System has been designed such that all stormwater remains on site. Subsurface infiltration chambers and a surface infiltration system infiltration the majority of the sites runoff back to groundwater. However, during intense storm events, the emergency overflow outlets both the subsurface infiltration chambers and the surface infiltration basin outlet to the abutting wetlands to prevent onsite flooding.

Elderly Housing Development Topsfield, MA

8) As part of new construction and modifications to existing structures, stormwater runoff from all roof drains shall be conveyed into infiltration trenches, drywells, rain gardens, or similar BMPs to facilitate groundwater recharge and protect water quality.

All proposed roof drains are conveyed to infiltration chambers.

9) Developments or construction in Riverfront Areas or Buffer Zones shall be designed to be in conformance with LID practices.

The proposed site development is not located within a Riverfront Area and primarily avoids work within the wetland buffer zone, with the exception of the gravel emergency access driveway requested by the Town Planning Board. The access road will primarily be gravel to promote infiltration and an LID practice.

10) As-built plans of stormwater management systems permitted hereunder shall be submitted to the Conservation Commission upon completion of the construction together with a certificate signed by an engineer or professional land surveyor that the system meets the relevant requirements of the Stormwater Regulations. This submission is required at least 14 days prior to the issuance of a Certificate of Compliance by the Commission.

An as-built plan shall be submitted to the Topsfield Conservation Commission before the issuance of the Certificate of Compliance.

MA DEP CHECKLIST FOR STORMWATER REPORTS

See following pages.

Elderly Housing Development

A&M Project # 2165-01A January 17, 2017

Topsfield, MA **TOWN OF TOPSFIELD STORMWATER PERFORMANCE STANDARDS** The Town of Topsfield has also developed their own Stormwater Standards to ensure that the waters within the town are protected.

 Stormwater run-off directed or channeled into any resource area has the potential of degrading or altering that area as a result of pollution conveyed and/or the disposition of silt and sediments into that area. It is presumed that a fully viable resource area is significantly to the interests of the Act and the Bylaw. Therefore, any discharge of any stormwater directed or channeled into a resource area by any new or repaired stormwater management system shall conform to all listed standards contained in the Massachusetts Stormwater Management Regulations adopted by the Mass Department of Environmental Protection as they may amended from time to time, hereafter called the Stormwater Regulations, and the provisions of 310 CMR-10.05, paragraphs: (k), (m), (n), (p), and (q), as they may be amended over time. Detailed performance requirements of stormwater management systems constructed in compliance with the above standards are found in the Massachusetts Stormwater Handbook volumes 1-4.

The proposed Stormwater Management System has been designed to meet or exceed all ten (10) of the Massachusetts Stormwater Standards (see section entitled "MA DEP Stormwater Performance Standards", above.

2) Any lot proposed for development, redevelopment, or additional development that borders on or contains any resource area protected by the Act and the Bylaw located in the red zone of the Soils Map or on a drumlin shall demonstrate by engineered design that stormwater runoff from the proposed construction would be retained onsite in either bio-retention ponds, rain gardens, drywells, or similarly functioning low impact features. Where that is proved not to be feasible, the drainage system shall be designed to intercept suspended solids and hydrocarbon pollutants using best management practices (BMP's) in conformance with standard four of the Stormwater Regulations prior to being discharged into the resource area.

The proposed Stormwater Management System has been designed to meet Standard #4 in the Massachusetts Stormwater Handbook. Subsurface infiltration chambers and an infiltration basin are used to ensure waters are kept on site and charged to groundwater.

3) All designs and BMPs managing stormwater runoff shall be sized to accommodate a 100-year storm frequency event without causing erosion or siltation of the retention area.

The analysis shows the overall volume has been reduced for the 100-year storm and no erosion or scouring will be caused to the retention areas.

Elderly Housing Development Topsfield, MA A&M Project # 2165-01A January 17, 2017

4) During the construction of the proposed development and until such time that the disturbed soil has been stabilized appropriately, erosion and sedimentation control measures shall be installed around the perimeter of the construction site in accordance with standard eight of the Stormwater Regulations. Erosion and sedimentation controls for the proposed construction site shall be approved by the Topsfield Conservation Commission or its designated agent prior to the start of any work onsite. All soils stored at the construction site for greater than 24 hours shall be covered by a waterproof tarpaulin or equivalent rainwater protection.

A detailed Erosion and Sedimentation Control Plan is included in the Permit Drawings. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

5) No snow hauled from parking lots or public ways shall be deposited in any resource area under the jurisdiction of the Topsfield Conservation Commission unless authorized under (permit) conditions deemed necessary by the Topsfield Conservation Commission to protect interests of the Act and the Bylaw.

Snow storage regulations have been included as part of the O&M Plan. See also the Snow Storage Plan.

6) All stormwater management systems permitted hereunder shall have operations and maintenance plans approved by the Commission in conformance with standard nine of the Stormwater Regulations.

An Operation and Maintenance (O&M) Plan is included within this drainage report. As part of the O&M Plan, there is an attachment entitled "Snow Disposal Guidance" issued by the MassDEP which outlines appropriate snow disposal methods.

7) Impervious areas such as driveways, patios, and parking lots shall be graded to facilitate stormwater runoff into adjacent grassy swales or catchment areas. No driveway shall be constructed or modified with a pitch such that runoff is directed onto a public road or street. Wherever possible, vegetated drainage swales and rain gardens shall be located to retain stormwater runoff onsite. The Commission encourages the use of pervious pavement materials such as pavers and porous asphalt. For information on porous asphalt contact: National Asphalt Pavement Assoc.

The proposed Stormwater Management System has been designed such that all stormwater remains on site. Subsurface infiltration chambers and a surface infiltration system infiltration the majority of the sites runoff back to groundwater. However, during intense storm events, the emergency overflow outlets both the subsurface infiltration chambers and the surface infiltration basin outlet to the abutting wetlands to prevent onsite flooding.

Elderly Housing Development Topsfield, MA

8) As part of new construction and modifications to existing structures, stormwater runoff from all roof drains shall be conveyed into infiltration trenches, drywells, rain gardens, or similar BMPs to facilitate groundwater recharge and protect water quality.

All proposed roof drains are conveyed to infiltration chambers.

9) Developments or construction in Riverfront Areas or Buffer Zones shall be designed to be in conformance with LID practices.

The proposed site development is not located within a Riverfront Area and primarily avoids work within the wetland buffer zone, with the exception of the gravel emergency access driveway requested by the Town Planning Board. The access road will primarily be gravel to promote infiltration and an LID practice.

10) As-built plans of stormwater management systems permitted hereunder shall be submitted to the Conservation Commission upon completion of the construction together with a certificate signed by an engineer or professional land surveyor that the system meets the relevant requirements of the Stormwater Regulations. This submission is required at least 14 days prior to the issuance of a Certificate of Compliance by the Commission.

An as-built plan shall be submitted to the Topsfield Conservation Commission before the issuance of the Certificate of Compliance.

MA DEP CHECKLIST FOR STORMWATER REPORTS

See following pages.



Massachusetts Department of Environmental Protection Bureau of Resource Protection - Wetlands Program Checklist for Stormwater Report

A. Introduction

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



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.¹ This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8²
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

¹ The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

² For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.



B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Longterm Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

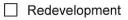


Registered Professional Engineer Block and Signature

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

New development



Mix of New Development and Redevelopment



LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- No disturbance to any Wetland Resource Areas
- Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- Reduced Impervious Area (Redevelopment Only)
- Minimizing disturbance to existing trees and shrubs
- LID Site Design Credit Requested:
 - Credit 1
 - Credit 2
 - Credit 3
- Use of "country drainage" versus curb and gutter conveyance and pipe
- Bioretention Cells (includes Rain Gardens)
- Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- Treebox Filter
- □ Water Quality Swale
- Grass Channel
- Green Roof
- Other (describe): Subsurface infiltration systems, reduced pavement width to 22' wide for onsite roadway, gravel emergency access road versus paved.

Standard 1: No New Untreated Discharges

- No new untreated discharges
- Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.



Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

Calculations provided to show that post-development peak discharge rates do not exceed predevelopment rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24hour storm.

Standard 3: Recharge

\boxtimes	Soil	Anal	ysis	provided.
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- Required Recharge Volume calculation provided.
- Required Recharge volume reduced through use of the LID site Design Credits.
- Sizing the infiltration, BMPs is based on the following method: Check the method used.

🛛 Static	Simple Dynamic
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Dynamic Field¹

- Runoff from all impervious areas at the site discharging to the infiltration BMP.
- Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - Site is comprised solely of C and D soils and/or bedrock at the land surface
 - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - Solid Waste Landfill pursuant to 310 CMR 19.000
 - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

¹ 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



Standard 3: Recharge (continued)

The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
- Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - is within the Zone II or Interim Wellhead Protection Area
 - is near or to other critical areas
 - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - involves runoff from land uses with higher potential pollutant loads.
- The Required Water Quality Volume is reduced through use of the LID site Design Credits.
- Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Massachusetts Department of Environmental Protection Bureau of Resource Protection - Wetlands Program Checklist for Stormwater Report

Checklist ((continued)
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Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
 - The 1/2" or 1" Water Quality Volume or
 - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does *not* cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has *not* been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- ☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

Limited	Project
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Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.

Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area

- Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- Bike Path and/or Foot Path
- Redevelopment Project
- Redevelopment portion of mix of new and redevelopment.
- Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.
- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

- ☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has *not* been included in the Stormwater Report but will be submitted *before* land disturbance begins.
- The project is *not* covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - Name of the stormwater management system owners;
 - Party responsible for operation and maintenance;
 - Schedule for implementation of routine and non-routine maintenance tasks;
 - Plan showing the location of all stormwater BMPs maintenance access areas;
 - Description and delineation of public safety features;
 - Estimated operation and maintenance budget; and
 - Operation and Maintenance Log Form.
- The responsible party is *not* the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- An Illicit Discharge Compliance Statement is attached;
- NO Illicit Discharge Compliance Statement is attached but will be submitted *prior to* the discharge of any stormwater to post-construction BMPs.

Section 2.0 – Operation & Maintenance Plan

Elderly Housing Development Topsfield, MA A&M Project # 2165-01A October 13, 2016 January 17, 2017

OPERATION AND MAINTENANCE PLAN

In accordance with the standards set forth by the Stormwater Management Policy issued by the Department of Environmental Protection (DEP), Allen & Major Associates, Inc. (A&M) has prepared the following Operation and Maintenance plan for the proposed elderly housing development and drainage improvements at #470 Boston Street (Route 1).

This plan is broken into three major sections. The first section describes construction-related erosion and sedimentation controls (Construction Period). The second section describes the long term pollution prevention measures (Long Term Pollution Prevention Plan). The third section is devoted to a post-development operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long Term Maintenance Plan). An operation and maintenance schedule has been included with this report.

Stormwater Management System Owner:	Sarkis Development Company
	2 Elm Square
	Andover, MA 01810

Emergency Contact Information:

• Sa	rkis Development Company	(Owner)	Phone (978) 475-4055
• Al	len & Major Associates, Inc.	(Site Civil Engineer)	Phone (781) 935-6889
• To	psfield Public Works - Water		Phone (978) 887-1517
• To	psfield Public Works – Highway		Phone (978) 887-1542
• To	psfield Conservation Commission	L	Phone (978) 887-1510
• To	psfield Fire Department (non-eme	rgency line)	Phone (978) 887-5148
• DE	EP Emergency Response (Mass DI	EP)	Phone (888) 304-1133

INTRODUCTION

The stormwater management system (SMS) for this project is owned by Sarkis Development Company, and shall be legally responsible for long-term operation and maintenance for this SMS as outlined in this Operation and Maintenance (O&M) Plan. Should ownership of the SMS change the succeeding owner will be presented with this O&M Plan and supporting attachments at or before legal conveyance of ownership and will assume the obligations of the O&M Plan.

In the event that the SMS will be operated and maintained by an entity other than that listed in this document, the applicant shall provide a plan and easement deed that provides a right of access for the legal entity to be able to perform said operation and maintenance functions. In the event the SMS will serve multiple lots/owners, the applicant shall also provide a copy

Elderly Housing Development Topsfield, MA

of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the entire SMS.

DEMOLITION & CONSRUCTION MAINTENANCE PLAN

- 1. Contact the Topsfield Conservation Commission Agent at least three (3) days prior to start of demolition and/or construction activities.
- 2. Install Erosion Control measures as shown on the Plans prepared by A&M. The Topsfield Conservation agent shall approve the installation of coir logs and silt fencing prior to the start of any site demolition work. Install construction fencing, if determined to be necessary, at the commencement of construction.
- 3. Install construction entrances, coir logs and silt fence at the locations shown on the Demolition and Erosion Control Plan prepared by A&M.
- 4. Site access shall be achieved only from the designated construction entrances.
- 5. Stockpiles of materials subject to erosion shall be stabilized with erosion control matting or temporary seeding whenever practicable, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.
- 6. Install silt sacks and straw bales around each drain inlet prior to any demolition and or construction activities.
- All erosion control measures shall be inspected weekly and after every rainfall event. Records of these inspections shall be kept on site for review.
- 8. All erosion control measures shall be maintained, repaired or replaced as required or at the direction of the owner's engineer or the Town Conservation Agent.
- 9. Sediment accumulation up-gradient of the straw bales, silt fence, and stone check dams greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.
- 10. Silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack replaced if torn or damaged.

Elderly Housing Development Topsfield, MA

- 11. Install stone check dams on site during construction as needed; refer to the erosion control details. Temporary sediment basins combined with stone check dams shall be installed on site during construction to control and collect runoff from upland areas of this site during demolition and construction activities.
- 12. The contractor shall comply with the Sedimentation and Erosion Control Notes as shown on the Site Development Plans and Specifications.
- 13. The stabilized construction entrances shall be inspected weekly and records of inspections kept. The entrances shall be maintained by adding additional clean, angular, durable stone to remove the soil from the construction vehicle's tires when exiting the site. If soil is still leaving the site via the construction vehicle tires, adjacent roadways shall be kept clean by street sweeping.
- 14. Dust pollution shall be controlled using on-site water trucks and or an approved soil stabilization product.
- 15. During demolition and construction activities, Status Reports on compliance with this O&M Document shall be submitted weekly to the Conservation agent. The report shall document any deficiencies and corrective actions taken by the applicant.

LONG TERM POLLUTION PREVENTION PLAN

Standard #4 from the MA DEP Stormwater Management Handbook requires that a Long Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation and Maintenance of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures for the LTPPP.

• HOUSEKEEPING

The proposed site development has been designed to maintain a high level of water quality treatment for all stormwater discharge to the wetland area. An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The owner (or its designee) is responsible for adherence to the O&M plan in a strict and complete manner.

Elderly Housing Development Topsfield, MA A&M Project # 2165-01A October 13, 2016 January 17, 2017

• STORING OF MATERIALS AND WASTE PRODUCTS

There are no proposed exterior (un-covered) storage areas.. The stormwater drainage system has water quality inlets designed to capture trash and debris.

• VEHICLE WASHING

The proposed project does not include any designated vehicle washing areas.

• SPILL PREVENTION AND RESPONSE

Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents and liquid cleaning products. The majority of the spill hazards would likely occur within the building and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

- 1. Spill Hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
- 2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
- 3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.
- 4. All spills shall be cleaned up immediately after discovery
- 5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at 888-304-1133.
- 6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

Elderly Housing Development Topsfield, MA

A&M Project # 2165-01A October 13, 2016 January 17, 2017

LANDSCAPE MAINTENANCE PLAN

o MAINTENANCE OF LAWNS, GARDENS AND OTHER LANDSCAPED AREAS

It should be recognized that this is a general guideline towards achieving high quality and well-groomed landscaped areas. The grounds staff / landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis.

Fertilizer

Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

Both slow-release organic fertilizers and synthetic fertilizers can be used onsite. Fertilization of the planting, lawns and mulch areas will be performed within manufacturers labeling instructions. Examples of some fertilizers options include but is not limited to:

> LESCO[®] 28-0-12 (Lawn Fertilizer) MERIT[®] 0.2 Plus Turf Fertilizer MOMENTUMTM Force Weed & Feed

Landscape Maintenance Program Practices:

♦ Lawn

1. Mow a minimum of once a week in spring, to a height of 2" to 2 1/2" high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cut, the less the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate.

Elderly Housing Development Topsfield, MA

- 2. Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth.
- 3. Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture.
- 4. Do not remove grass clippings after mowing.
- 5. Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.
- Shrubs
 - 1. Mulch not more than 3" depth with shredded pine or fir bark.
 - 2. Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals to occur within 6" of the ground to open up shrub and maintain two-year wood (the blooming wood).
 - 3. Hand prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.
- ♦ Trees
 - 1. Provide aftercare for new tree plantings for the first three years.
 - 2. Do not fertilize trees, it artificially stimulates them (unless tree health warrants).
 - 3. Water once a week for the first year; twice a month the second, once a month the third year.
 - 4. Prune trees on a four-year cycle.
- ♦ Invasive Species
 - 1. Inform the Conservation Commission Agent prior to the removal of invasive species proposed either through hand work or through chemical removal.

• STORAGE AND USE OF HERBICIDES AND PESTICIDES

Integrated Pest Management is the combination of all methods (of pest control) which may prevent, reduce, suppress, eliminate, or repel an insect population. The main requirements necessary to support any pest population are food, shelter and water, and any upset of the balance of these will assist in controlling a pest population. Scientific pest management is the knowledgeable use of all pest control methods (sanitation, mechanical, chemical) to benefit mankind's health, welfare, comfort, property and food. A Pest Management Professional (PMP) will be retained who is licensed with the Commonwealth of Massachusetts Executive

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Office of Energy and Environmental Affairs, Department of Agricultural Resources.

The site manager will be provided with approved bulletin before entering into or renewing an agreement to apply pesticides for the control of indoor or structural pests. 333 CMR 13.08.

Before beginning each application, the applicator must inform the conservation commission and post a state and local approved notice on all of the entrances to the treated room or area. The applicator must leave such notices posted after the application. The notice will be posted at conspicuous point(s) of access to the area treated. The location and number of signs will be determined by the configuration of the area to be treated based on the applicator's best judgment. It is intended to give sufficient notice that no one comes into an area being treated unaware that the applicator is working and pesticides are being applied. However, if the contracting entity does not want the signs posted, he/she may sign a Department approved waiver indicating this.

The applicator or employer will provide to any person upon their request the following information on previously conducted applications:

- 1. Name and phone number of pest control company
- 2. Date and time of the application;
- 3. Name and license number of the applicator
- 4. Target pests
- 5. Name and EPA Registration Number of pesticide products applied

The notification must be made in writing. The intent is so that individuals, who wish to avoid exposure or want to avoid encountering the applicator, can make necessary arrangements. Applicators are required by law to follow all directions on the pesticide label and must take all steps necessary to avoid applications with people present in a room or area to be treated. Individuals occupying a room or area to be treated at the time of application shall be informed of the procedure. Whenever possible, the applicator should not apply pesticides with anyone present. That may mean treating other areas and returning when occupants have left, asking people to leave the area while the work is being done, or treating before or after people occupy the room. If people do not leave, the applicator must make it clear that he is there to apply pesticides. The applicator will be prepared

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to provide whatever information possible about the pesticides and techniques used.

• MANAGEMENT OF DEICING CHEMICALS AND SNOW

It will be the responsibility of the snow removal contractor to properly dispose of transported snow according to Massachusetts DEP, Bureau of Resource Protection – Snow Disposal Guideline #BRPG01-01, governing the proper disposal of snow. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations.

The owner's maintenance staff (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface. The de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the building. De-icing agents will not be stored outside. The owner's maintenance staff will limit the application of sand and salt to the amounts needed for public safety.

POST CONSRUCTION MAINTENANCE PLAN

The SMS shall be inspected immediately after construction. A maintenance log will be kept (i.e. report) summarizing inspections, maintenance, and any corrective actions taken. The log will include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. The log will be made accessible to department staff and a copy provided to the department upon request.

Inspection and Maintenance Frequency and Corrective Measures:

In accordance with MA DEP Stormwater Handbook: Volume 2, Chapter 2; the following areas, facilities, and measures will be inspected and the identified deficiencies will be corrected. Clean-out must include the removal and legal disposal of any accumulated sediments, trash, and debris. In any and all cases, operations, inspections, and maintenance activities shall utilize best practical measures to avoid and minimize impacts to wetland resource areas outside the foot print of the SMS.

<u>Structural Pretreatment BMPs:</u> Regular maintenance of these BMPs is especially critical because they typically receive the highest concentration of suspended solids during the first flush of a storm event.

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Deep Sump Catch Basins:

Inspect or clean catch basins at least 4 times per year and at the end of the foliage and snow removal seasons. Sediments must also be removed four (4) times a year or whenever the depth of the deposits is greater than or equal to open half of the bottom of the invert of the lowest pipe in the basin. Structures will be skimmed of floatable debris at each inspection and if the basin outlet is designed with a hood to trap floatable materials (i.e. Snout), check to ensure watertight seal is working. Clamshell buckets or vacuum trucks are typically used, however, vacuum trucks are preferred.

Proprietary Separators:

Proprietary Separators will be inspected and cleaned out in accordance with the manufacturer's requirements, or at least twice per year. Sediments and debris removed should be disposed of in accordance with all applicable local, state and federal laws and regulations including M.G.L.c. 21C and 310 CMR 30.00.

Cultec Isolator Row:

At a minimum, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observations. However, the isolator row should be inspected at least once a year. A stadia rod should be used during inspection to measure the depth of sediment in the isolator row. Once there is three inches (3") of sediment throughout the bottom of the isolator row, a clean-out should be performed. The isolator row should be cleaned using a JetVac process.

Infiltration BMPs:

Stormwater Infiltration Basin:

The basin must be inspected and preventive maintenance must be performed at least twice a year and after every time drainage discharges through the high outlet orifice. Maintenance of upstream pre-treatment measures is critically important to the function of infiltration BMPs. Pre-treatment BMPs should be inspected for sediment and floatables accumulation and maintained at least twice per year (every other month recommended) and after every major storm event.

Other BMPs and Accessories:

Culverts:

Inspect culverts 2 times per year (preferably in spring and fall) to ensure that the culverts are working in their intended fashion and that they are free of debris. Remove any obstructions to flow; remove accumulated sediments and debris at the inlet, at the outlet, and within the conduit and to repair any erosion damage at the culvert's inlet and outlet.

Surface Infiltration Basin:

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The operation and maintenance plan required must include inspections and preventative maintenance at least twice a year, and after every time drainage discharges through the high outlet orifice. The basin should be inspected after every major storm event for the first few months to ensure it is stabilized and functioning properly. Note how long water remain in the basin after a major storm event; standing water within 48 to 72 hours of an event may indicate the infiltration capacity may have been overestimated.

Thereafter, inspect the infiltration basin at least twice a year. Important items to check include:

- Signs of differential settlement
- Cracking
- Erosion
- Leakage of embankments
- Tree growth on embankments
- Condition of rip-rap
- Sediment accumulation
- The health of the turf

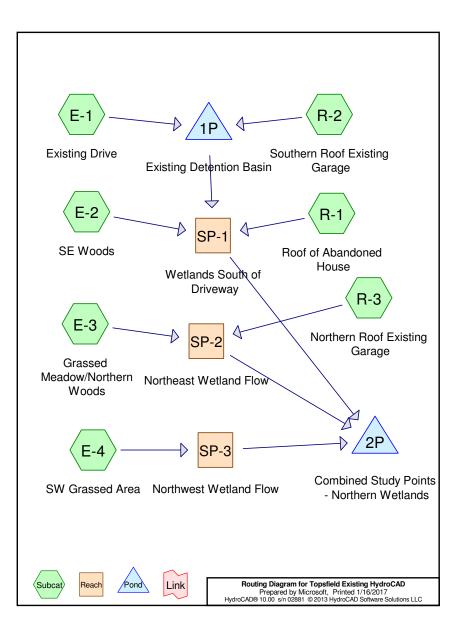
At least twice a year the side slopes, buffer area, and basin bottom need to be mowed. Glass clippings should be removed to prevent an organic, impervious mat from forming.

Roadways and Parking Surfaces:

Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring. Accumulations on pavement may be removed by pavement sweeping. Accumulations of sand along road shoulders may be removed by grading excess sand to the pavement edge and removing it manually or by a front-end loader.

Level Spreaders, Check Dams, and Rip-rap:

These accessories will be inspected twice a year for erosion, debris accumulation, and unwanted vegetation. Erosion will be stabilized and sediment, debris, and wood vegetation shall be removed. Section 4.0 – HydroCAD Reports



Topsfield Existing HydroCAD	
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Area Listing (all nodes)	

Area Listing (all nodes)

_		
Area	CN	Description
(acres)		(subcatchment-numbers)
0.186	49	50-75% Grass cover, Fair, HSG A (E-1, E-2)
0.059	79	50-75% Grass cover, Fair, HSG C (E-1, E-2)
3.887	39	>75% Grass cover, Good, HSG A (E-3, E-4)
0.872	74	>75% Grass cover, Good, HSG C (E-3, E-4)
0.094	96	Gravel surface, HSG A (E-1)
0.320	98	Paved parking, HSG A (E-1)
0.026	98	Roofs, HSG A (R-1, R-3)
0.081	98	Unconnected pavement, HSG A (E-2)
0.008	98	Unconnected roofs, HSG A (R-2)
3.217	30	Woods, Good, HSG A (E-1, E-2, E-3, E-4)
0.315	55	Woods, Good, HSG B (E-3)
0.803	70	Woods, Good, HSG C (E-1, E-2, E-3, E-4)
0.140	77	Woods, Good, HSG D (E-2)
10.008	46	TOTAL AREA

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Soil Listing (all nodes)

Area	Soil	Subcatchment
(acres)	Group	Numbers
7.819	HSG A	E-1, E-2, E-3, E-4, R-1, R-2, R-3
0.315	HSG B	E-3
1.734	HSG C	E-1, E-2, E-3, E-4
0.140	HSG D	E-2
0.000	Other	
10.008		TOTAL AREA

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HSG-A	HSG-B	HSG-C	HSG-D	Other	Total	Ground	Subcatchmen
(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	Cover	Numbers
0.186	0.000	0.059	0.000	0.000	0.244	50-75% Grass cover, Fair	E-1, E-2
3.887	0.000	0.872	0.000	0.000	4.759	>75% Grass cover, Good	E-3, E-4
0.094	0.000	0.000	0.000	0.000	0.094	Gravel surface	E-1
0.320	0.000	0.000	0.000	0.000	0.320	Paved parking	E-1
0.026	0.000	0.000	0.000	0.000	0.026	Roofs	R-1, R-3
0.081	0.000	0.000	0.000	0.000	0.081	Unconnected pavement	E-2
0.008	0.000	0.000	0.000	0.000	0.008	Unconnected roofs	R-2
3.217	0.315	0.803	0.140	0.000	4.474	Woods, Good	E-1, E-2, E-3, E-4
7.819	0.315	1.734	0.140	0.000	10.008	TOTAL AREA	

Prepare	d by Micro		CAD	D Software	Solutions	S LLC		Prir	nted 1/16/2017 Page 5	Topsfield Existing HydroCAD Prepared by Microsoft HydroCAD® 10.00 s/n 02881 © 2013 HydroCAE	Type III 24-hr 2-Year Rainfall=3.10 Printed 1/16/2017 D Software Solutions LLC Page 6
Line#	Node	In-Invert		pe Listin Length	g (all no Slope		Diam/Width	Height	Inside-Fill	Runoff by SCS TF	-24.00 hrs, dt=0.01 hrs, 2401 points -20 method, UH=SCS, Weighted-CN rans method - Pond routing by Stor-Ind method
1	Number E-1	(feet) 0.00	(feet) 0.00	(feet) 25.0	(ft/ft) 0.0100	0.015	(inches) 12.0	(inches) 0.0	(inches) 0.0	Subcatchment E-1: Existing Drive	Runoff Area=22,922 sf 60.86% Impervious Runoff Depth>2.16 Flow Length=444' Tc=10.2 min CN=91 Runoff=1.15 cfs 0.095 a
										Subcatchment E-2: SE Woods Flow Leng	Runoff Area=49,278 sf 7.20% Impervious Runoff Depth>0.17 th=420' Tc=12.0 min UI Adjusted CN=53 Runoff=0.05 cfs 0.016 al
										Subcatchment E-3: Grassed Meadow/North	ern Runoff Area=180,525 sf 0.00% Impervious Runoff Depth>0.00' Flow Length=465' Tc=12.3 min CN=41 Runoff=0.00 cfs 0.001 at
										Subcatchment E-4: SW Grassed Area	Runoff Area=181,751 sf 0.00% Impervious Runoff Depth>0.01' Flow Length=622' Tc=15.7 min CN=43 Runoff=0.01 cfs 0.005 at
										Subcatchment R-1: Roof of Abandoned Hou	use Runoff Area=787 sf 100.00% Impervious Runoff Depth>2.87 Tc=6.0 min CN=98 Runoff=0.05 cfs 0.004 a
										Subcatchment R-2: Southern Roof Existing	Runoff Area=346 sf 100.00% Impervious Runoff Depth>2.87 Tc=6.0 min CN=98 Runoff=0.02 cfs 0.002 a
										Subcatchment R-3: Northern Roof Existing	Runoff Area=346 sf 100.00% Impervious Runoff Depth>2.87 Tc=6.0 min CN=98 Runoff=0.02 cfs 0.002 at
										Reach SP-1: Wetlands South of Driveway	Inflow=0.07 cfs 0.049 at Outflow=0.07 cfs 0.049 at
										Reach SP-2: Northeast Wetland Flow	Inflow=0.02 cfs 0.003 at Outflow=0.02 cfs 0.003 at
										Reach SP-3: Northwest Wetland Flow	Inflow=0.01 cfs 0.005 at Outflow=0.01 cfs 0.005 at
										Pond 1P: Existing Detention Basin	Peak Elev=58.23' Storage=3,183 cf Inflow=1.16 cfs 0.097 al Outflow=0.05 cfs 0.028 al
										Pond 2P: Combined Study Points - Norther	n Wetlands Inflow=0.08 cfs 0.057 at Primary=0.08 cfs 0.057 at
										Total Runoff Area = 10.008	8 ac Runoff Volume = 0.125 af Average Runoff Depth = 0.15" 95.65% Pervious = 9.572 ac 4.35% Impervious = 0.436 ac

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Type III 24-hr 2-Year Rainfall=3.10" Printed 1/16/2017 Page 7

Summary for Subcatchment E-1: Existing Drive

Runoff = 1.15 cfs @ 12.14 hrs, Volume= 0.095 af, Depth> 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

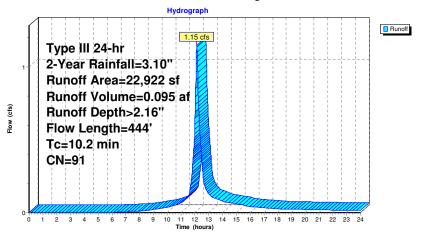
	A	rea (sf)	CN E	Description								
		13,950	98 F									
		4,096	96 C	Gravel surfa	ace, HSG A	4						
		411	30 V	30 Woods, Good, HSG A								
		3,284	70 V	Voods, Go	od, HSG C							
		509	49 5	0-75% Gra	ass cover, F	Fair, HSG A						
		672	79 5	0-75% Gra	ass cover, F	Fair, HSG C						
		22,922	91 V	Veighted A	verage							
		8,972			vious Area							
		13,950	6	0.86% Imr	pervious Ar	ea						
		-,										
	Тс	Length	Slope	Velocity	Capacity	Description						
_ (n	nin)	(feet)	(ft/ft)	(ft/sec)	(cfs)							
	8.1	50	0.0600	0.10		Sheet Flow, A-B						
						Woods: Light underbrush n= 0.400 P2= 3.10"						
	0.3	33	0.1060	1.63		Shallow Concentrated Flow, B-C						
						Woodland Kv= 5.0 fps						
	0.1	19	0.2200	3.28		Shallow Concentrated Flow, C-D						
						Short Grass Pasture Kv= 7.0 fps						
	0.5	112	0.0450	3.42		Shallow Concentrated Flow, D-E						
						Unpaved Kv= 16.1 fps						
	1.1	205	0.0240	3.14		Shallow Concentrated Flow, E-F						
						Paved Kv= 20.3 fps						
	0.1	25	0.0100	3.93	3.09							
						12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'						
						n= 0.015 Corrugated PE, smooth interior						

10.2 444 Total

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Type III 24-hr 2-Year Rainfall=3.10" Printed 1/16/2017 Page 8

Subcatchment E-1: Existing Drive



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Summary for Subcatchment E-2: SE Woods

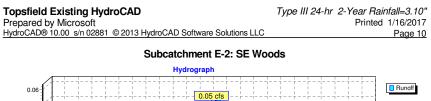
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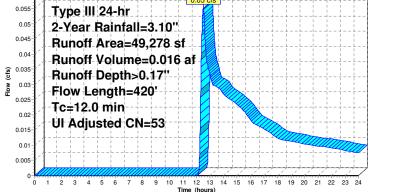
Runoff = 0.05 cfs @ 12.49 hrs, Volume= 0.016 af, Depth> 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

_	A	rea (sf)	CN /	Adj Desc	cription							
		3,550	98	Unco	onnected pa	avement, HSG A						
		7,582	49	50-7	5% Grass c	cover, Fair, HSG A						
		1,887	79	50-7	75% Grass cover, Fair, HSG C							
		18,787	30	Woo	oods, Good, HSG A							
		11,389	70	Woo	oods, Good, HSG C							
		6,083	77	Woo	oods, Good, HSG D							
		49,278	55	53 Weig	phted Avera	age, UI Adjusted						
		45,728		92.8	0% Perviou	is Area						
		3,550			% Impervio							
		3,550		100.0	00% Uncon	nected						
	τ.	L a constitu	01	Mala alter	0	Description						
	Tc	Length	Slope		Capacity	Description						
-	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)							
	6.3	50	0.1100	0.13		Sheet Flow, A-B						
	0.0	75	0 0000	1 50		Woods: Light underbrush n= 0.400 P2= 3.10"						
	0.8	75	0.0930	1.52		Shallow Concentrated Flow, B-C						
	0.4	35	0.0430	1.45		Woodland Kv= 5.0 fps Shallow Concentrated Flow, C-D						
	0.4	35	0.0430	1.45		Short Grass Pasture Kv= 7.0 fps						
	4.5	260	0.0370	0.96		Shallow Concentrated Flow, D-E						
	4.5	200	0.0070	0.50		Woodland Kv= 5.0 fps						
-	12.0	420	Total									

420 Total 12.0





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Type III 24-hr 2-Year Rainfall=3.10" Printed 1/16/2017 Page 11

Summary for Subcatchment E-3: Grassed Meadow/Northern Woods

[73] Warning: Peak may fall outside time span

Runoff = 0.00 cfs @ 23.82 hrs, Volume= 0.001 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

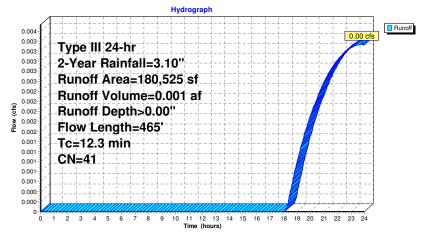
A	rea (sf)	CN D	Description								
	76,402	30 V	Voods, Go	od, HSG A							
	13,713	55 V	Voods, Go	od, HSG B							
	15,503		70 Woods, Good, HSG C								
	67,450										
	7,457	74 >	75% Gras	s cover, Go	od, HSG C						
	80,525		Veighted A								
180,525 100.00% Pervious Area					a						
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description						
7.2	50	0.0800	0.12		Sheet Flow, A-B						
3.6	293	0.0375	1.36		Woods: Light underbrush n= 0.400 P2= 3.10" Shallow Concentrated Flow, B-C						
1.5	122	0.0740	1.36		Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Woodland Kv= 5.0 fps						

12.3 465 Total

Type III 24-hr 2-Year Rainfall=3.10" Topsfield Existing HydroCAD Prepared by Microsoft HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC Printed 1/16/2017

Subcatchment E-3: Grassed Meadow/Northern Woods

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Summary for Subcatchment E-4: SW Grassed Area

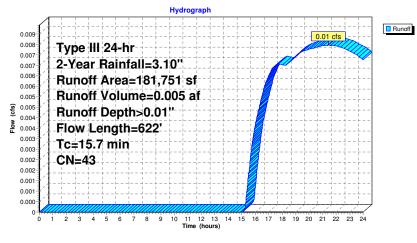
Runoff = 0.01 cfs @ 21.44 hrs, Volume= 0.005 af, Depth> 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

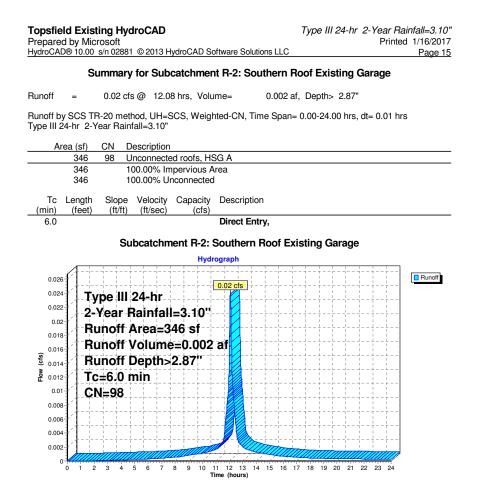
	A	rea (sf)	CN E	Description					
		44,530	30 V	/oods, Good, HSG A					
		4,806	70 V	Voods, Go	od, HSG C				
	1	01,870	39 >	75% Gras	s cover, Go	ood, HSG A			
_		30,545	74 >	75% Gras	s cover, Go	ood, HSG C			
	1	81,751	43 V	Veighted A	verage				
	1	81,751	1	00.00% Pe	ervious Area	a			
	Tc	Length	Slope	Velocity	Capacity	Description			
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)				
	8.7	50	0.0500	0.10		Sheet Flow, A-B			
						Woods: Light underbrush n= 0.400 P2= 3.10"			
	5.6	462	0.0390	1.38		Shallow Concentrated Flow, B-C			
						Short Grass Pasture Kv= 7.0 fps			
	1.4	110	0.0682	1.31		Shallow Concentrated Flow, C-D			
						Woodland Kv= 5.0 fps			

15.7 622 Total

Subcatchment E-4: SW Grassed Area



Prepared by				<i>infall=3.10'</i> 1 1/16/2017 Page 14
	Summary for Subcatchment R-1: Roof of Aban	ndoned Hou	se	
Runoff =	0.05 cfs @ 12.08 hrs, Volume= 0.004 af, De	epth> 2.87"		
	S TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00 2-Year Rainfall=3.10")-24.00 hrs, dt	= 0.01 hrs	;
Area (sf) CN Description			
	37 98 Roofs, HSG A			
7	37 100.00% Impervious Area			
Tc Len (min) (fe	gth Slope Velocity Capacity Description eet) (ft/ft) (ft/sec) (cfs)			
6.0	Direct Entry,			
	Subcatchment R-1: Roof of Abandoned	House		
	Hydrograph			
0.06 0.055 0.045 0.045 0.045 0.045 0.045 0.035 0.035 0.035 0.035 0.035 0.035 0.035 0.035 0.035 0.055 0.05 0.0	Type III 24-hr 2-Year Rainfall=3.10" Runoff Area=787 sf Runoff Volume=0.004 af Runoff Depth>2.87" Tc=6.0 min CN=98			Runoff
0	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 Time (hours)	19 20 21 22	23 24	



	by Microsoft 3 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC	Printed 1/16/2017 Page 16
	Summary for Subcatchment R-3: Northern R	oof Existing Garage
unoff	= 0.02 cfs @ 12.08 hrs, Volume= 0.002 at	f, Depth> 2.87"
unoff by	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span=	: 0.00-24.00 hrs, dt= 0.01 hrs
/pe III 24	-hr 2-Year Rainfall=3.10"	
Are	a (sf) CN Description	
	346 98 Roofs, HSG A	
	346 100.00% Impervious Area	
Tc I	ength Slope Velocity Capacity Description	
(min)	(feet) (ft/ft) (ft/sec) (cfs)	
6.0	Direct Entry,	
	Subcatchment R-3: Northern Roof Exi	isting Garage
	Hydrograph	
4		
0.026	0.02 cfs	
0.024		
0.022	-2-Year Rainfall=3.10"	
0.018	Runoff Area=346 sf	
0.016	Runoff Volume=0.002 af	- + - + + +
(cls) 0.014 0.012	Runoff Depth>2.87"	- + - + + +
0.012	Tc=6.0 min	+-+-+-+
0.01	CN=98	
0.008		
0.006		
0.004		
0.002		
0	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 1	7 18 19 20 21 22 23 24
	Time (hours)	

Topsfield Existing HydroCAD Prepared by Microsoft HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC Type III 24-hr 2-Year Rainfall=3.10" Printed 1/16/2017

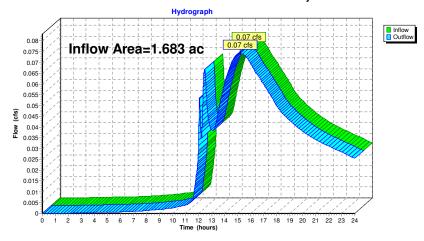
Summary for Reach SP-1: Wetlands South of Driveway

Page 17

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

Inflow Area =	1.683 ac, 25.41% Impervious, Inflow Depth > 0.35" for 2-Year event
Inflow =	0.07 cfs @ 15.19 hrs, Volume= 0.049 af
Outflow =	0.07 cfs @ 15.19 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.0 min

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



Reach SP-1: Wetlands South of Driveway

Topsfield Existing HydroCAD	Type III 24-hr 2-Year Rainfall=3.10"
Prepared by Microsoft	Printed 1/16/2017
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Summary for Reach SP-2: Northeast Wetland Flow

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

Inflow Area =	4.152 ac,	0.19% Impervious, Inflow	Depth > 0.01"	for 2-Year event
Inflow =	0.02 cfs @	12.08 hrs, Volume=	0.003 af	
Outflow =	0.02 cfs @	12.08 hrs, Volume=	0.003 af, Atte	en= 0%, Lag= 0.0 min

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

Hydrograph Inflow Outflow 0.026 Inflow Area=4.152 0.024 0.022 0.02 0.018 0.016 (cfs) 0.014 0.012 0.01 0.008 0.006 0.004 0.002 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)

Reach SP-2: Northeast Wetland Flow

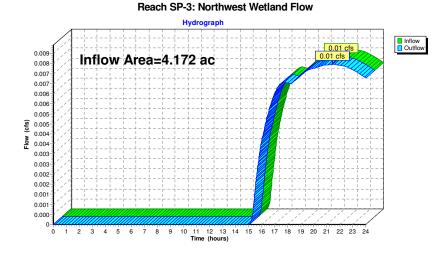
Topsfield Existing HydroCAD Type III 24-hr 2-Year Rainfall=3.10" Prepared by Microsoft HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC Printed 1/16/2017 Page 19

Summary for Reach SP-3: Northwest Wetland Flow

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

Inflow Area =	4.172 ac,	0.00% Impervious, Inflow	Depth > 0.01"	for 2-Year event
Inflow =	0.01 cfs @	21.44 hrs, Volume=	0.005 af	
Outflow =	0.01 cfs @	21.44 hrs, Volume=	0.005 af, Atte	en= 0%, Lag= 0.0 min

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



Topsfield Existing HydroCAD	Type III 24-hr 2-Year Rainfall=3.10"
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Summary for Pond 1P: Existing Detention Basin

Inflow Area =	0.534 ac, 61.44% Impervious, Inflow I	Depth > 2.17" for 2-Year event
Inflow =	1.16 cfs @ 12.14 hrs, Volume=	0.097 af
Outflow =	0.05 cfs @ 15.56 hrs, Volume=	0.028 af, Atten= 96%, Lag= 205.6 min
Primary =	0.05 cfs @ 15.56 hrs, Volume=	0.028 af

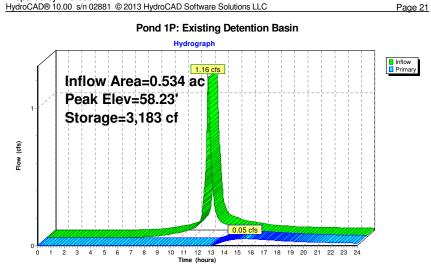
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.23' @ 15.56 hrs Surf.Area= 3,090 sf Storage= 3,183 cf

Plug-Flow detention time= 409.2 min calculated for 0.028 af (29% of inflow) Center-of-Mass det. time= 270.3 min (1,075.8 - 805.5)

Volume	Inve	ert Avail.St	orage	Storage	Description				
#1	57.2	0' 9,0	020 cf	Custom	Stage Data ((Prismatic)	Listed belo	ow (Recalc)	
Elevatio	n :	Surf.Area	Inc.8	Store	Cum.Stor	re			
(feet	t)	(sq-ft)	(cubic-	-feet)	(cubic-fee	et)			
57.2	0	3,090		0		0			
58.0	0	3,090	2	2,472	2,47	72			
59.0	0	3,090	3	3,090	5,56	62			
59.4	0	3,550	1	1,328	6,89	90			
60.0	0	3,550	2	2,130	9,02	20			
Device	Routing	Inver	t Outle	t Devices	5				
#1	Primary	58.08	· 4.0" \	Vert. Orif	ice/Grate	C= 0.600			
#2	Primary	58.80	' 8.0'' \	Vert. Orif	ice/Grate (C= 0.600			

Primary OutFlow Max=0.05 cfs @ 15.56 hrs HW=58.23' (Free Discharge) 1=Orifice/Grate (Orifice Controls 0.05 cfs @ 1.32 fps) 2=Orifice/Grate (Controls 0.00 cfs)





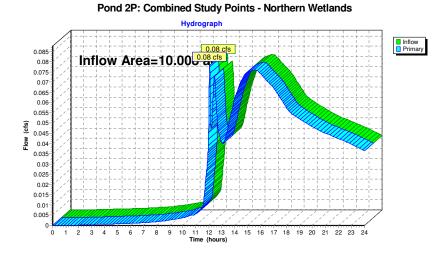
Topsfield Existing HydroCAD	Type III 24-hr 2-Year Rainfall=3.10"
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Summary for Pond 2P: Combined Study Points - Northern Wetlands

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

Inflow Area =	10.008 ac,	4.35% Impervious, Inflow	Depth > 0.07"	for 2-Year event
Inflow =	0.08 cfs @	12.08 hrs, Volume=	0.057 af	
Primary =	0.08 cfs @	12.08 hrs, Volume=	0.057 af, Atte	en= 0%, Lag= 0.0 min

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

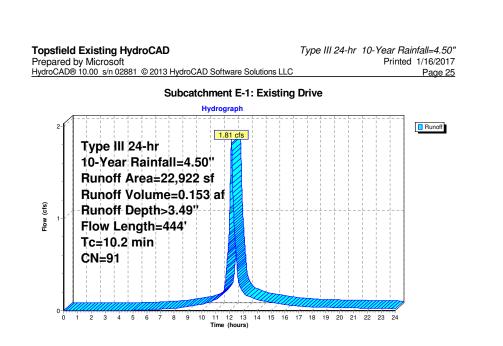


opsfield Existing HydroCAD Prepared by Microsoft	Type III 24-hr 10-Year Rainfall=4.50" Printed 1/16/2017
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Runoff by SCS T	24.00 hrs, dt=0.01 hrs, 2401 points R-20 method, UH=SCS, Weighted-CN rans method - Pond routing by Stor-Ind method
Subcatchment E-1: Existing Drive	Runoff Area=22,922 sf 60.86% Impervious Runoff Depth>3.49" Flow Length=444' Tc=10.2 min CN=91 Runoff=1.81 cfs 0.153 af
Subcatchment E-2: SE Woods Flow Ler	Runoff Area=49,278 sf 7.20% Impervious Runoff Depth>0.64" th=420' Tc=12.0 min UI Adjusted CN=53 Runoff=0.44 cfs 0.060 af
Subcatchment E-3: Grassed Meadow/Nort	ern Runoff Area=180,525 sf 0.00% Impervious Runoff Depth>0.16" Flow Length=465' Tc=12.3 min CN=41 Runoff=0.10 cfs 0.056 af
ubcatchment E-4: SW Grassed Area	Runoff Area=181,751 sf 0.00% Impervious Runoff Depth>0.22" Flow Length=622' Tc=15.7 min CN=43 Runoff=0.22 cfs 0.078 af
ubcatchment R-1: Roof of Abandoned He	use Runoff Area=787 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.08 cfs 0.006 af
bubcatchment R-2: Southern Roof Existin	Runoff Area=346 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.03 cfs 0.003 af
bubcatchment R-3: Northern Roof Existing	Runoff Area=346 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.03 cfs 0.003 af
Reach SP-1: Wetlands South of Driveway	Inflow=0.58 cfs 0.153 af Outflow=0.58 cfs 0.153 af
each SP-2: Northeast Wetland Flow	Inflow=0.10 cfs 0.059 af Outflow=0.10 cfs 0.059 af
each SP-3: Northwest Wetland Flow	Inflow=0.22 cfs 0.078 af Outflow=0.22 cfs 0.078 af
ond 1P: Existing Detention Basin	Peak Elev=58.52' Storage=4,084 cf Inflow=1.84 cfs 0.156 af Outflow=0.22 cfs 0.086 af
ond 2P: Combined Study Points - Northe	n Wetlands Inflow=0.82 cfs 0.290 af Primary=0.82 cfs 0.290 af

 Total Runoff Area = 10.008 ac
 Runoff Volume = 0.360 af
 Average Runoff Depth = 0.43"

 95.65% Pervious = 9.572 ac
 4.35% Impervious = 0.436 ac

Topsfield Existing HydroCAD Type III 24-hr 10-Year R Prepared by Microsoft Printe HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC Printe Summary for Subcatchment E-1: Existing Drive								
Runoff	=	1.81 cf	s@ 12.1	4 hrs, Volu	Ime= 0.153 af, Depth> 3.49"			
			hod, UH=S infall=4.50		nted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs			
A	rea (sf)		Description					
	13,950			ing, HSG A				
	4,096 411			ace, HSG A od, HSG A				
	3.284			od, HSG C				
	509				Fair, HSG A			
	672			,	Fair, HSG C			
	22,922		Veighted A					
	8,972 13,950	-		vious Area				
	13,950		0.00 % IIIi	Jei vious An	ea			
Tc	Length	Slope	Velocity	Capacity	Description			
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)				
8.1	50	0.0600	0.10		Sheet Flow, A-B			
0.3	33	0.1060	1.63		Woods: Light underbrush n= 0.400 P2= 3.10" Shallow Concentrated Flow, B-C			
0.1	19	0.2200	3.28		Woodland Kv= 5.0 fps Shallow Concentrated Flow, C-D			
0.1	10	0.2200	0.20		Short Grass Pasture Kv= 7.0 fps			
0.5	112	0.0450	3.42		Shallow Concentrated Flow, D-E			
					Unpaved Kv= 16.1 fps			
1.1	205	0.0240	3.14		Shallow Concentrated Flow, E-F			
0.1	25	0.0100	3.93	3.09	Paved Kv= 20.3 fps Pipe Channel, F-G			
0.1	20	5.0150	0.00	0.00	12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'			
					n= 0.015 Corrugated PE, smooth interior			
10.2	444	Total						



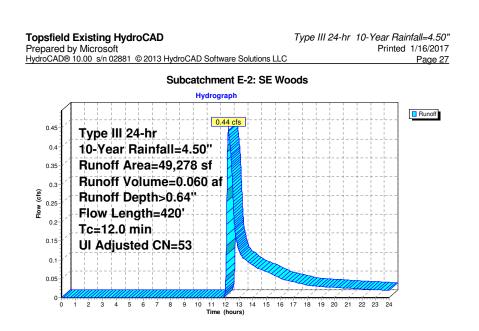
Topsfield Existing HydroCAD	Type III 24-hr	10-Year Rainfall=4.50"
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Summary for Subcatchment E-2: SE Woods

Runoff = 0.44 cfs @ 12.23 hrs, Volume= 0.060 af, Depth> 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"

_	A	rea (sf)	CN /	Adj Desc	ription				
		3,550	98	Unco	Jnconnected pavement, HSG A				
		7,582	49	50-7	50-75% Grass cover, Fair, HSG A				
		1,887	79	50-7	5% Grass o	cover, Fair, HSG C			
		18,787	30	Woo	ds, Good, I	HSG A			
		11,389	70	Woo	ds, Good, I	HSG C			
		6,083	77	Woo	ds, Good, I	HSG D			
		49,278	55			age, UI Adjusted			
		45,728		92.8	0% Perviou	is Area			
		3,550			% Impervio				
		3,550		100.	00% Uncor	nected			
	т.	1	01	Mala alta	0	Description			
	Tc (min)	Length	Slope		Capacity	Description			
-	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	Object Flow A D			
	6.3	50	0.1100	0.13		Sheet Flow, A-B			
		75	0 0000	4 50		Woods: Light underbrush n= 0.400 P2= 3.10"			
	0.8	75	0.0930	1.52		Shallow Concentrated Flow, B-C			
	0.4	35	0.0430	1.45		Woodland Kv= 5.0 fps Shallow Concentrated Flow, C-D			
	0.4	30	0.0430	1.40		Short Grass Pasture Kv= 7.0 fps			
	4.5	260	0.0370	0.96		Shallow Concentrated Flow, D-E			
	4.5	200	0.0070	0.30		Woodland Kv= 5.0 fps			
-	12.0	420	Total						
	12.0	420	rotal						



Topsfield Existing HydroCAD	Type III 24-hr 10-Year Rainfall=4.50"
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Summary for Subcatchment E-3: Grassed Meadow/Northern Woods

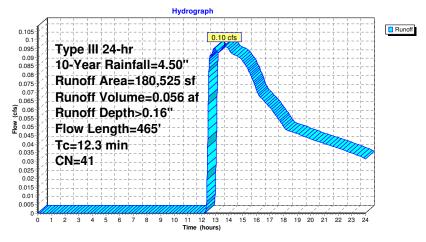
Runoff = 0.10 cfs @ 13.68 hrs, Volume= 0.056 af, Depth> 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"

_	Ai	rea (sf)	CN E	Description		
		76,402	30 V	Voods, Go	od, HSG A	
		13,713	55 V	Voods, Go	od, HSG B	
		15,503	70 V	Voods, Go	od, HSG C	
		67,450	39 >	75% Gras	s cover, Go	bod, HSG A
_		7,457	74 >	75% Gras	s cover, Go	bod, HSG C
	1	80,525	41 V	Veighted A	verage	
	1	80,525	1	00.00% Pe	ervious Are	a
	_		.		. .	
	Tc	Length	Slope	Velocity	Capacity	Description
-	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	7.2	50	0.0800	0.12		Sheet Flow, A-B
						Woods: Light underbrush n= 0.400 P2= 3.10"
	3.6	293	0.0375	1.36		Shallow Concentrated Flow, B-C
						Short Grass Pasture Kv= 7.0 fps
	1.5	122	0.0740	1.36		Shallow Concentrated Flow, C-D
_						Woodland Kv= 5.0 fps

12.3 465 Total

Subcatchment E-3: Grassed Meadow/Northern Woods



Topsfield Existing HydroCAD	Type III 24-hr	10-Year Rain
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infall=4.50" 1/16/2017 Page 29

Summary for Subcatchment E-4: SW Grassed Area

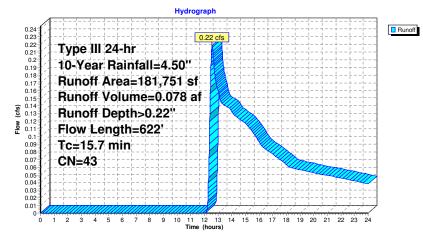
Runoff = 0.22 cfs @ 12.57 hrs, Volume= 0.078 af, Depth> 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"

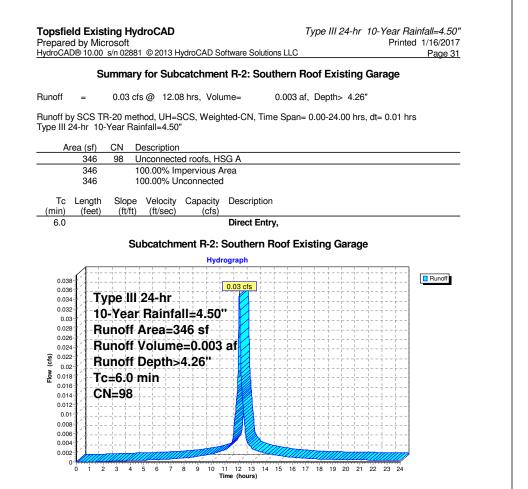
_	A	rea (sf)	CN I	Description					
		44,530	30 \	30 Woods, Good, HSG A					
		4,806	70 N	Noods, Go	od, HSG C				
	1	01,870	39 >	>75% Gras	s cover, Go	bod, HSG A			
		30,545	74 >	>75% Gras	s cover, Go	bod, HSG C			
	1	81,751	43 N	Neighted A	verage				
	1	81,751		100.00% Pe	ervious Area	a			
	Tc	Length	Slope	Velocity	Capacity	Description			
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)				
	8.7	50	0.0500	0.10		Sheet Flow, A-B			
						Woods: Light underbrush n= 0.400 P2= 3.10"			
	5.6	462	0.0390	1.38		Shallow Concentrated Flow, B-C			
						Short Grass Pasture Kv= 7.0 fps			
	1.4	110	0.0682	1.31		Shallow Concentrated Flow, C-D			
						Woodland Kv= 5.0 fps			
			T						

622 Total 15.7

Subcatchment E-4: SW Grassed Area



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Summary for Subcatchment R-	I: Roof of Abandoned	House
unoff = 0.08 cfs @ 12.08 hrs, Volume=	0.006 af, Depth> 4.2	6"
unoff by SCS TR-20 method, UH=SCS, Weighted-CN ype III 24-hr 10-Year Rainfall=4.50"	Time Span= 0.00-24.00 hr	s, dt= 0.01 hrs
Area (sf) CN Description		
787 98 Roofs, HSG A		
787 100.00% Impervious Area		
Tc Length Slope Velocity Capacity Descri (min) (feet) (ft/ft) (ft/sec) (cfs)	otion	
6.0 Direct	Entry,	
Subcatchment R-1: Roof	of Abandoned House	
	of Aballuoneu nouse	
Hydrograph		
0.085		Runoff
0.08 Type III 24-hr] · · · · · · · · · · · · · · · · · · ·	
0.07 10-Year Rainfall=4.50"	- + +	
0.065 Runoff Area=787 sf		
0.055 Runoff Volume=0.006 af		
	-+++++++++++++-	
0.035 CN=98		
0.015	+	
0.01		
0.005		
0 1 2 3 4 5 6 7 8 9 10 11 12 13		1 22 23 24
		1 22 23 24



Topsfield Existing HydroCAD Prepared by Microsoft HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC	Type III 24-hr 10-Year Rainfall=4.50" Printed 1/16/2017 Page 32
Summary for Subcatchment R-3: Northern	Roof Existing Garage
Runoff = 0.03 cfs @ 12.08 hrs, Volume= 0.003	af, Depth> 4.26"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Spar Type III 24-hr 10-Year Rainfall=4.50"	n= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
346 98 Roofs, HSG A	
346 100.00% Impervious Area	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment R-3: Northern Roof E Hydrograph	xisting Garage
0.034 0.032 10-Year Rainfall=4.50''	
0.028 0.026 Runoff Area=346 sf	
0.024 Runoff Volume=0.003 af	
€ 0.022 0.02 Runoff Depth>4.26"	
₫ 0.018 - Tc=6.0 min	
0.016 0.014 CN=98	
0.012	
0.006	
	17 18 19 20 21 22 23 24

 Topsfield Existing HydroCAD
 Type III 24-hr
 10-Year Rainfall=4.50"

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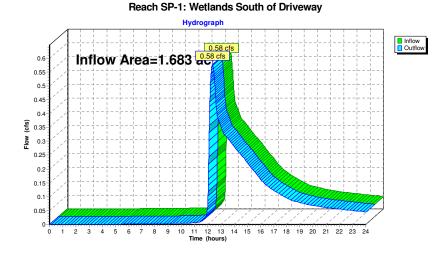
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Summary for Reach SP-1: Wetlands South of Driveway

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

Inflow Area =	1.683 ac, 25.41% Impervious, Inflow Depth > 1.09" for 10-Year event
Inflow =	0.58 cfs @ 12.36 hrs, Volume= 0.153 af
Outflow =	0.58 cfs @ 12.36 hrs, Volume= 0.153 af, Atten= 0%, Lag= 0.0 min

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



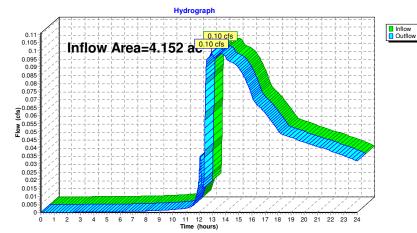
Topsfield Existing HydroCAD	Type III 24-hr 10-Year Rainfall=4.50"
Prepared by Microsoft	Printed 1/16/2017
HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC	Page 34
	1 490 0

Summary for Reach SP-2: Northeast Wetland Flow

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

Inflow Area =	4.152 ac,	0.19% Impervious, Infl	ow Depth > 0.17"	for 10-Year event
Inflow =	0.10 cfs @	12.94 hrs, Volume=	0.059 af	
Outflow =	0.10 cfs @	12.94 hrs, Volume=	0.059 af, Atte	en= 0%, Lag= 0.0 min

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



Reach SP-2: Northeast Wetland Flow

 Topsfield Existing HydroCAD
 Type III 24-hr
 10-Year Rainfall=4.50"

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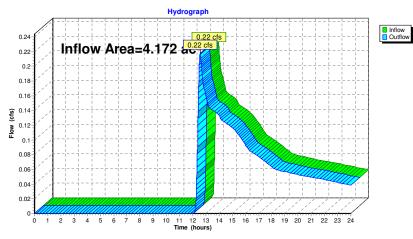
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Summary for Reach SP-3: Northwest Wetland Flow

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

Inflow Area =	4.172 ac, 0.00	0% Impervious, Inflow D	Depth > 0.22" for 10-Year event
Inflow =	0.22 cfs @ 12.	57 hrs, Volume=	0.078 af
Outflow =	0.22 cfs @ 12.	57 hrs, Volume=	0.078 af, Atten= 0%, Lag= 0.0 min

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



Reach SP-3: Northwest Wetland Flow

Topsfield Existing HydroCAD	Type III 24-hr 10-Year Rainfall=4.50"
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Summary for Pond 1P: Existing Detention Basin

Inflow Area =	0.534 ac, 61.44% Impervious, Inflow D	Depth > 3.50" for 10-Year event
Inflow =	1.84 cfs @ 12.14 hrs, Volume=	0.156 af
Outflow =	0.22 cfs @ 12.91 hrs, Volume=	0.086 af, Atten= 88%, Lag= 46.1 min
Primary =	0.22 cfs @ 12.91 hrs, Volume=	0.086 af

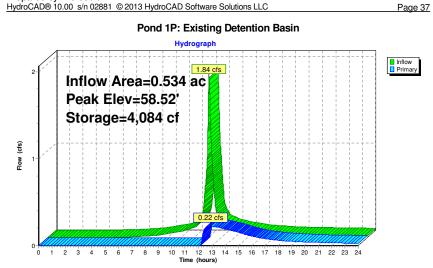
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.52' @ 12.91 hrs Surf.Area= 3,090 sf Storage= 4,084 cf

Plug-Flow detention time= 265.0 min calculated for 0.086 af (55% of inflow) Center-of-Mass det. time= 157.9 min (950.3 - 792.4)

Volume	lr	nvert	Avail.St	orage	Storage	Description	۱					
#1	5	7.20'	9,0	020 cf	Custom	Stage Data	ı (Pris	smatic)	Listed b	elow (Recalc)	
Elevatio (fee		Surf (s	Area sq-ft)		.Store c-feet)	Cum.St (cubic-fe						
57.2	20	3	,090		0		0					
58.0	00	3	,090		2,472	2,4	172					
59.0	00	3	,090		3,090	5,5	562					
59.4	10	3	,550		1,328	6,8	390					
60.0	00	3	,550		2,130	9,0)20					
Device	Routin	g	Inver	t Outle	et Device	S						
#1	Prima	ry	58.08	4.0"	Vert. Ori	fice/Grate	C= 0	0.600				
#2	Prima	ry	58.80	8.0"	Vert. Ori	fice/Grate	C= 0).600				

Primary OutFlow Max=0.22 cfs @ 12.91 hrs HW=58.52' (Free Discharge) 1=Orifice/Grate (Orifice Controls 0.22 cfs @ 2.53 fps) 2=Orifice/Grate (Controls 0.00 cfs)





Topsfield Existing HydroCAD	Type III 24-hr	10-Year Rainfall=4.50"
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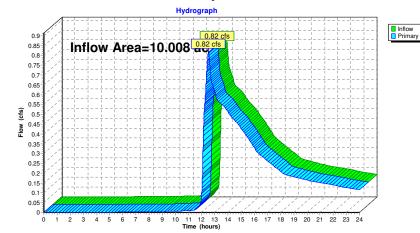
Summary for Pond 2P: Combined Study Points - Northern Wetlands

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

Inflow Area =	10.008 ac,	4.35% Impervious, Inflow	Depth > 0.35"	for 10-Year event
Inflow =	0.82 cfs @	12.51 hrs, Volume=	0.290 af	
Primary =	0.82 cfs @	12.51 hrs, Volume=	0.290 af, Atte	en= 0%, Lag= 0.0 min

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

Pond 2P: Combined Study Points - Northern Wetlands

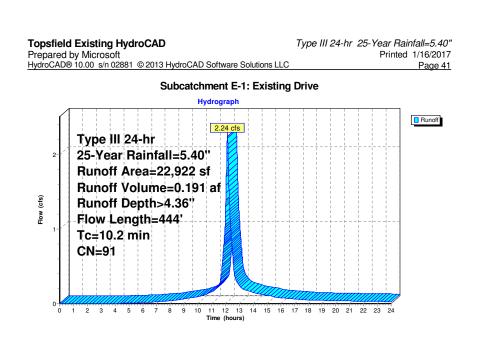


opsfield Existing HydroCAD repared by Microsoft	Type III 24-hr 25-Year Rainfall=5.40' Printed 1/16/2017
ydroCAD® 10.00 s/n 02881 © 2013 HydroCA	
Runoff by SCS T	24.00 hrs, dt=0.01 hrs, 2401 points -20 method, UH=SCS, Weighted-CN ans method - Pond routing by Stor-Ind method
ubcatchment E-1: Existing Drive	Runoff Area=22,922 sf 60.86% Impervious Runoff Depth>4.36" Flow Length=444' Tc=10.2 min CN=91 Runoff=2.24 cfs 0.191 af
ubcatchment E-2: SE Woods Flow Ler	Runoff Area=49,278 sf 7.20% Impervious Runoff Depth>1.05" h=420' Tc=12.0 min UI Adjusted CN=53 Runoff=0.90 cfs 0.099 af
ubcatchment E-3: Grassed Meadow/Nort	rm Runoff Area=180,525 sf 0.00% Impervious Runoff Depth>0.37" Flow Length=465' Tc=12.3 min CN=41 Runoff=0.55 cfs 0.129 af
ubcatchment E-4: SW Grassed Area	Runoff Area=181,751 sf 0.00% Impervious Runoff Depth>0.47" Flow Length=622' Tc=15.7 min CN=43 Runoff=0.79 cfs 0.163 af
ubcatchment R-1: Roof of Abandoned Ho	se Runoff Area=787 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.10 cfs 0.008 af
ubcatchment R-2: Southern Roof Existin	Runoff Area=346 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.04 cfs 0.003 af
ubcatchment R-3: Northern Roof Existing	Runoff Area=346 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.04 cfs 0.003 af
each SP-1: Wetlands South of Driveway	Inflow=1.14 cfs 0.231 af Outflow=1.14 cfs 0.231 af
each SP-2: Northeast Wetland Flow	Inflow=0.56 cfs 0.132 af Outflow=0.56 cfs 0.132 af
each SP-3: Northwest Wetland Flow	Inflow=0.79 cfs 0.163 af Outflow=0.79 cfs 0.163 af
ond 1P: Existing Detention Basin	Peak Elev=58.81' Storage=4,979 cf Inflow=2.27 cfs 0.195 af Outflow=0.32 cfs 0.124 af
ond 2P: Combined Study Points - Northe	Wetlands Inflow=2.29 cfs 0.526 af Primary=2.29 cfs 0.526 af

 Total Runoff Area = 10.008 ac
 Runoff Volume = 0.597 af
 Average Runoff Depth = 0.72"

 95.65% Pervious = 9.572 ac
 4.35% Impervious = 0.436 ac

Prepar	eld Exist ed by Mic AD® 10.00	rosoft s/n 0288	1 © 2013 H	Type III 24-hr 25-Year Rainfall=5.40" Printed 1/16/2017 oftware Solutions LLC Page 40 catchment E-1: Existing Drive				
Runoff	=	2.24 cf	is@ 12.1	4 hrs, Volu	me= 0.191 af, Depth> 4.36"			
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40"								
A	Area (sf)	CN [Description					
	13,950	98 F	Paved park	ing, HSG A				
	4,096			ace, HSG A				
	411			od, HSG A				
	3,284		Noods, Go					
	509				Fair, HSG A			
	672			(Fair, HSG C			
	22,922		Neighted A					
	8,972	-		vious Area				
	13,950	e	0.80% Imp	pervious Ar	ea			
Тс	Length	Slope	Velocity	Canacity	Description			
(min)		(ft/ft)		(cfs)				
8.1	50	0.0600	0.10		Sheet Flow, A-B			
					Woods: Light underbrush n= 0.400 P2= 3.10"			
0.3	33	0.1060	1.63		Shallow Concentrated Flow, B-C			
					Woodland Kv= 5.0 fps			
0.1	19	0.2200	3.28		Shallow Concentrated Flow, C-D			
0.5	110	0.0450	3.42		Short Grass Pasture Kv= 7.0 fps			
0.5	112	0.0450	3.42		Shallow Concentrated Flow, D-E Unpaved Kv= 16.1 fps			
1.1	205	0.0240	3.14		Shallow Concentrated Flow, E-F			
1.1	205	0.0240	0.14		Paved Kv= 20.3 fps			
0.1	25	0.0100	3.93	3.09				
					12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'			
					n= 0.015 Corrugated PE, smooth interior			
10.2	444	Total						
10.2	444	IOIAI						



Topsfield Existing HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
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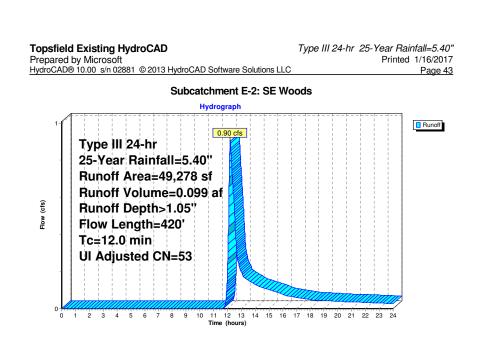
Summary for Subcatchment E-2: SE Woods

Runoff = 0.90 cfs @ 12.20 hrs, Volume= 0.099 af, Depth> 1.05"

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

_	A	rea (sf)	CN /	Adj Desc	ription						
		3,550	98	Unco	onnected pa	avement, HSG A					
		7,582	49	50-7	5% Grass o	cover, Fair, HSG A					
		1,887	79	50-7	0-75% Grass cover, Fair, HSG C						
		18,787	30		Woods, Good, HSG A						
		11,389	70		ds, Good, H						
-		6,083	77	Woo	ds, Good, H	HSG D					
		49,278	55			age, UI Adjusted					
		45,728			0% Perviou						
		3,550			% Impervio						
		3,550		100.0	00% Uncon	inected					
	Tc	Length	Slope	Velocity	Capacity	Description					
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	Description					
-	6.3	50	0.1100	0.13	(0.0)	Sheet Flow, A-B					
	0.0	00	0.1100	0.10		Woods: Light underbrush n= 0.400 P2= 3.10"					
	0.8	75	0.0930	1.52		Shallow Concentrated Flow, B-C					
						Woodland Kv= 5.0 fps					
	0.4	35	0.0430	1.45		Shallow Concentrated Flow, C-D					
						Short Grass Pasture Kv= 7.0 fps					
	4.5	260	0.0370	0.96		Shallow Concentrated Flow, D-E					
_						Woodland Kv= 5.0 fps					
	12.0	420	Total								

12.0 420 Total



Topsfield Existing HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
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Summary for Subcatchment E-3: Grassed Meadow/Northern Woods

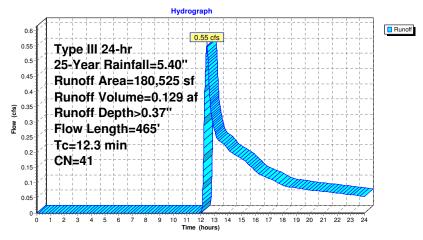
Runoff = 0.55 cfs @ 12.45 hrs, Volume= 0.129 af, Depth> 0.37"

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

_	Ai	rea (sf)	CN [Description										
-		76,402	30 \	Noods, Go	od, HSG A									
		13,713	55 N	Noods, Go	od, HSG B									
		15,503	70 N	Noods, Go	od, HSG C									
		67,450	39 >	-75% Grass cover, Good, HSG A										
		7,457	74 >	>75% Gras	s cover, Go	bod, HSG C								
	1	80,525	41 \	Neighted A	verage									
	1	80,525	1	00.00% Pe	ervious Are	a								
	Tc	Length	Slope		Capacity	Description								
-	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)									
	7.2	50	0.0800	0.12		Sheet Flow, A-B								
						Woods: Light underbrush n= 0.400 P2= 3.10"								
	3.6	293	0.0375	1.36		Shallow Concentrated Flow, B-C								
						Short Grass Pasture Kv= 7.0 fps								
	1.5	122	0.0740	1.36		Shallow Concentrated Flow, C-D								
-						Woodland Kv= 5.0 fps								
	40.0	405	T-+-1											

12.3 465 Total

Subcatchment E-3: Grassed Meadow/Northern Woods



Topsfield Existing HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
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Summary for Subcatchment E-4: SW Grassed Area

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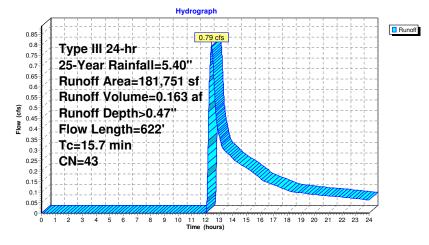
0.79 cfs @ 12.47 hrs, Volume= Runoff = 0.163 af, Depth> 0.47"

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

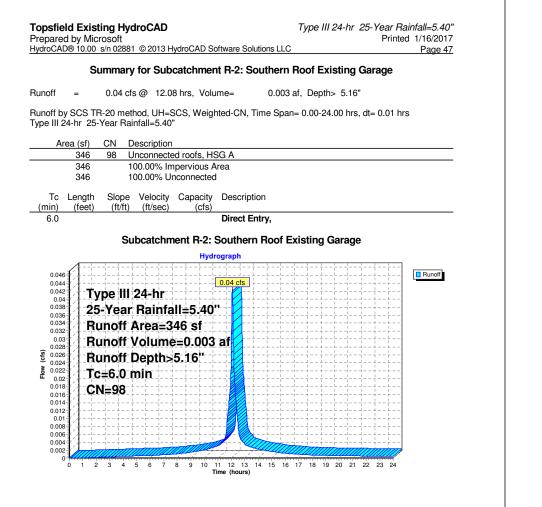
	A	rea (sf)	CN E	Description											
		44,530	30 V	Voods, Go	od, HSG A										
		4,806	70 V	Voods, Go	od, HSG C										
	1	01,870	39 >	75% Gras	75% Grass cover, Good, HSG A										
_		30,545	74 >	75% Gras	s cover, Go	ood, HSG C									
	1	81,751	43 V	Veighted A	verage										
	1	81,751	1	00.00% Pe	ervious Area	a									
	Tc	Length	Slope	Velocity	Capacity	Description									
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)										
	8.7	50	0.0500	0.10		Sheet Flow, A-B									
						Woods: Light underbrush n= 0.400 P2= 3.10"									
	5.6	462	0.0390	1.38		Shallow Concentrated Flow, B-C									
						Short Grass Pasture Kv= 7.0 fps									
	1.4	110	0.0682	1.31		Shallow Concentrated Flow, C-D									
_						Woodland Kv= 5.0 fps									

622 Total 15.7

Subcatchment E-4: SW Grassed Area



		Sum	mary	for s	Subo	catch	mer	nt R-	1: R	oof	of	Ab	and	dor	ed	Ho	use		
Runoff	=	0.10	cfs @	0 12.	.08 hr	rs, Vo	olume	Э=		0.0	08	af, I	Dep	oth>	5.1	6"			
Runoff by	SCS TI	R-20 m	ethor	1 I H-	-SCS	We	iahte	d-CN	Tim	ie S	nar	i= 0	00-	24 (10 h	~~ ~	łt– C	01	hrs
Type III 24						,	gino		,	10 0	pui	0.			50 11	0, 0	c		
Area	a (sf)	CN	Des	criptio	n														
	787	98		fs, HS															
	787		100.	00% l	mper	rvious	s Area	a											
Tc L	ength	Slop	e V	elocity	v C:	apaci	tv Γ)escri	ntior	'n									
(min)	(feet)	(ft/f		ft/sec		(Cfs			p										
6.0							D	Direct	Entr	у,									
			Su	bcat	chm	ent F	-1 :	Roof	of	Aba	nd	one	ed l	Ηοι	ise				
							vdrog		••••			••••							
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044	1 2	3 4	5	6 7	8	9 10	11	12 13	14	15	16	17 17	18	19	20 2	1 2	2 23	3 24	
								(hours)										



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	Summary for	Subcatchment	R-3: Northern	Roof Existing	Garage
Runoff =	0.04 cfs @	12.08 hrs, Volume)= 0.003	3 af, Depth> 5.16	,
	CS TR-20 method, L Ir 25-Year Rainfall=		d-CN, Time Spa	ın= 0.00-24.00 hrs	, dt= 0.01 hrs
Area	<u> </u>				
	346 98 Roofs, 346 100.00	HSG A % Impervious Area			
Tc Le	ngth Slope Velo	city Capacity D	escription		
<u>(min) (</u> 6.0	feet) (ft/ft) (ft/s		irect Entry,		
0.0	.		•		
	Subcat	chment R-3: No		Existing Garage	ŧ
		Hydrog	aph	-!!!!!!	
0.046			04 cfs		Runoff
0.042	Type III 24-I				
0.038	25-Year Rai	nfall ≞5.40 "			
0.034	Runoff Area	1=346 sf			
0.03	Runoff Volu	ıme=0.003 a	f		+
(\$) 0.026	Runoff Dep	th>5.16"			
0.024 0.022	Tc=6.0 min				
0.018	CN=98				JL
0.014	}				
0.012			-+		
0.006					+
0.004 0.002					
0	1 2 3 4 5 6		12 13 14 15 16 (hours)	6 17 18 19 20 21	22 23 24
		Time	(

 Topsfield Existing HydroCAD
 Type III 24-hr
 25-Year Rainfall=5.40"

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 1/16/2017

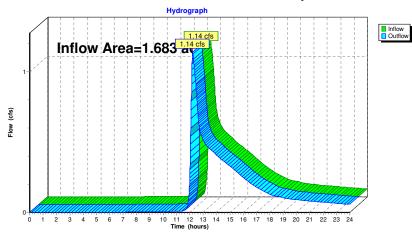
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Summary for Reach SP-1: Wetlands South of Driveway

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

Inflow Area =	1.683 ac, 25.41% Impervious, Inflow Depth > 1.65" for 25-Year event
Inflow =	1.14 cfs @ 12.21 hrs, Volume= 0.231 af
Outflow =	1.14 cfs @ 12.21 hrs, Volume= 0.231 af, Atten= 0%, Lag= 0.0 min

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





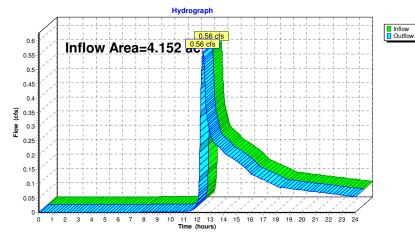
Topsfield Existing HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
Prepared by Microsoft	Printed 1/16/2017
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Summary for Reach SP-2: Northeast Wetland Flow

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

Inflow Area =	4.152 ac,	0.19% Impervious, Inflow	/ Depth > 0.38"	for 25-Year event
Inflow =	0.56 cfs @	12.45 hrs, Volume=	0.132 af	
Outflow =	0.56 cfs @	12.45 hrs, Volume=	0.132 af, Atte	en= 0%, Lag= 0.0 min

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



Reach SP-2: Northeast Wetland Flow

Topsfield Existing HydroCAD Type III 24-hr 25-Year Rainfall=5.40" Prepared by Microsoft HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC Printed 1/16/2017

Summary for Reach SP-3: Northwest Wetland Flow

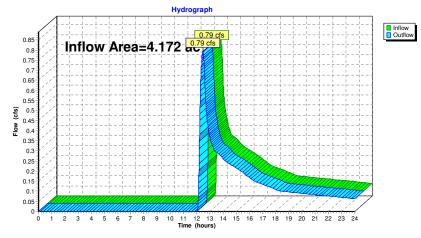
Page 51

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

Inflow Area =	4.172 ac, 0.00% Impervious, Inflow Depth > 0.47" for 25-Year event	t
Inflow =	0.79 cfs @ 12.47 hrs, Volume= 0.163 af	
Outflow =	0.79 cfs @ 12.47 hrs, Volume= 0.163 af, Atten= 0%, Lag= 0.0 n	nin

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

Reach SP-3: Northwest Wetland Flow



Topsfield Existing HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
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Summary for Pond 1P: Existing Detention Basin

Inflow Area =	0.534 ac, 61.44% Impervious, Inflow	Depth > 4.38" for 25-Year event
Inflow =	2.27 cfs @ 12.14 hrs, Volume=	0.195 af
Outflow =	0.32 cfs @ 12.76 hrs, Volume=	0.124 af, Atten= 86%, Lag= 37.5 min
Primary =	0.32 cfs @ 12.76 hrs, Volume=	0.124 af

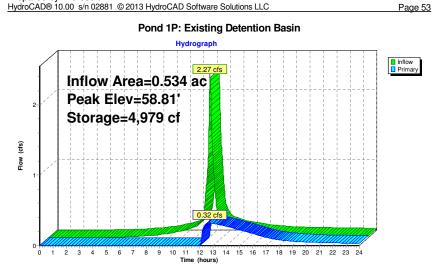
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.81' @ 12.76 hrs Surf.Area= 3,090 sf Storage= 4,979 cf

Plug-Flow detention time= 248.3 min calculated for 0.124 af (64% of inflow) Center-of-Mass det. time= 149.9 min (936.4 - 786.5)

Volume	Inv	ert Avail.Sto	orage Storage	Description	
#1	57.2	20' 9,0	20 cf Custom	Stage Data (Prismatic) Listed below (F	Recalc)
Elevation (feet		Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
57.2 58.0	-	3,090 3.090	0 2.472	0 2.472	
59.0	0	3,090	3,090	5,562	
59.4 60.0	-	3,550 3,550	1,328 2,130	6,890 9,020	
Device	Routing	Invert	Outlet Device	s	
#1	Primary	58.08'	4.0" Vert. Ori	fice/Grate C= 0.600	
#2	Primary	58.80'	8.0" Vert. Ori	fice/Grate C= 0.600	

Primary OutFlow Max=0.32 cfs @ 12.76 hrs HW=58.81' (Free Discharge) 1=Orifice/Grate (Orifice Controls 0.32 cfs @ 3.62 fps) 2=Orifice/Grate (Orifice Controls 0.00 cfs @ 0.36 fps)





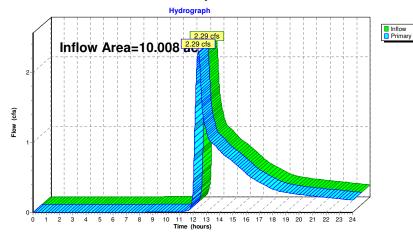
Topsfield Existing HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
Prepared by Microsoft	Printed 1/16/2017
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Summary for Pond 2P: Combined Study Points - Northern Wetlands

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

Inflow Area =	10.008 ac,	4.35% Impervious, Inflow	Depth > 0.63"	for 25-Year event
Inflow =	2.29 cfs @	12.42 hrs, Volume=	0.526 af	
Primary =	2.29 cfs @	12.42 hrs, Volume=	0.526 af, Atte	en= 0%, Lag= 0.0 min

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



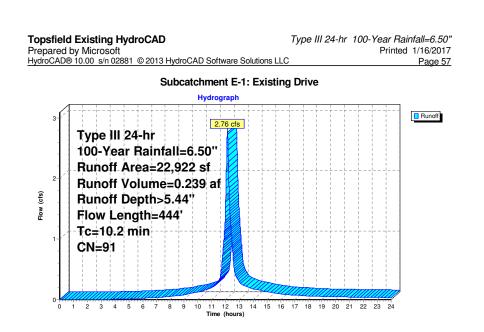
Pond 2P: Combined Study Points - Northern Wetlands

ppsfield Existing HydroCAD repared by Microsoft	<i></i>	0-Year Rainfall=6.50" Printed 1/16/2017
/droCAD® 10.00 s/n 02881 © 2013 HydroCA	D Software Solutions LLC	Page 55
Runoff by SCS T	0-24.00 hrs, dt=0.01 hrs, 2401 points R-20 method, UH=SCS, Weighted-CN Trans method - Pond routing by Stor-Ind r	nethod
ubcatchment E-1: Existing Drive	Runoff Area=22,922 sf 60.86% Impervi Flow Length=444' Tc=10.2 min CN=91 I	
ubcatchment E-2: SE Woods Flow Ler	Runoff Area=49,278 sf 7.20% Impervi ngth=420' Tc=12.0 min UI Adjusted CN=53 I	
ubcatchment E-3: Grassed Meadow/Nort	hern Runoff Area=180,525 sf 0.00% Impervi Flow Length=465' Tc=12.3 min CN=41 I	
ubcatchment E-4: SW Grassed Area	Runoff Area=181,751 sf 0.00% Impervi Flow Length=622' Tc=15.7 min CN=43 I	
ubcatchment R-1: Roof of Abandoned He		ous Runoff Depth>6.26" Runoff=0.12 cfs 0.009 af
ubcatchment R-2: Southern Roof Existin		ous Runoff Depth>6.26" Runoff=0.05 cfs 0.004 af
ubcatchment R-3: Northern Roof Existing		ous Runoff Depth>6.26" Runoff=0.05 cfs 0.004 af
each SP-1: Wetlands South of Driveway	C	Inflow=1.93 cfs 0.335 af outflow=1.93 cfs 0.335 af
each SP-2: Northeast Wetland Flow	C	Inflow=1.52 cfs 0.254 af outflow=1.52 cfs 0.254 af
each SP-3: Northwest Wetland Flow		Inflow=1.94 cfs 0.299 af outflow=1.94 cfs 0.299 af
ond 1P: Existing Detention Basin	Peak Elev=59.10' Storage=5,880 cf C	Inflow=2.80 cfs 0.243 af outflow=0.67 cfs 0.171 af
ond 2P: Combined Study Points - Northe		Inflow=5.19 cfs 0.889 af rimary=5.19 cfs 0.889 af

 Total Runoff Area = 10.008 ac
 Runoff Volume = 0.960 af
 Average Runoff Depth = 1.15"

 95.65% Pervious = 9.572 ac
 4.35% Impervious = 0.436 ac

Topsfield Existing HydroCAD Prepared by Microsoft HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Soft Summary for Subca					Type III 24-hr 100-Year Rainfall=6.50" Printed 1/16/2017 oftware Solutions LLC Page 56 catchment E-1: Existing Drive
Runoff	=	2.76 cf	s@ 12.1	4 hrs, Volu	me= 0.239 af, Depth> 5.44"
			hod, UH=S ainfall=6.50		nted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
A	rea (sf)		Description		
	13,950			ing, HSG A	
	4,096			ace, HSG A	
	411 3,284			od, HSG A od, HSG C	
	509				Fair, HSG A
	672				Fair, HSG C
	22,922		Veighted A		
	8,972	3	9.14% Per	vious Area	
	13,950	6	0.86% Imp	pervious Ar	ea
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0600	0.10		Sheet Flow, A-B
					Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	33	0.1060	1.63		Shallow Concentrated Flow, B-C
0.1	19	0.2200	3.28		Woodland Kv= 5.0 fps
0.1	19	0.2200	3.28		Shallow Concentrated Flow, C-D Short Grass Pasture Kv= 7.0 fps
0.5	112	0.0450	3.42		Shallow Concentrated Flow, D-E
			••••=		Unpaved Kv= 16.1 fps
1.1	205	0.0240	3.14		Shallow Concentrated Flow, E-F
					Paved Kv= 20.3 fps
0.1	25	0.0100	3.93	3.09	Pipe Channel, F-G 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'
					n= 0.015 Corrugated PE, smooth interior
10.2	444	Total			
10.2	444	rotai			



Topsfield Existing HydroCAD	Type III 24-hr	100-Year Rainfall=6.50"
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HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC	;	Page 58

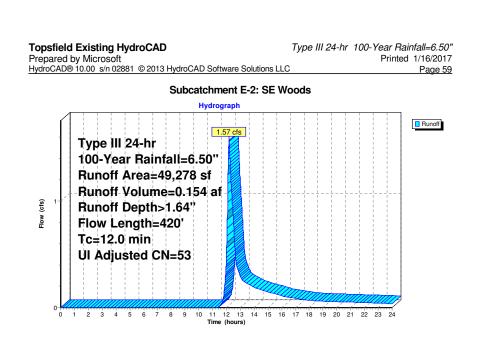
Summary for Subcatchment E-2: SE Woods

Runoff = 1.57 cfs @ 12.18 hrs, Volume= 0.154 af, Depth> 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

_	A	rea (sf)	CN /	Adj Desc	ription	
		3,550	98	Unco	onnected pa	avement, HSG A
		7,582	49	50-7	5% Grass o	cover, Fair, HSG A
		1,887	79	50-7	5% Grass o	cover, Fair, HSG C
		18,787	30		ds, Good, H	
		11,389	70		ds, Good, H	
-		6,083	77	Woo	ds, Good, H	HSG D
		49,278	55			age, UI Adjusted
		45,728			0% Perviou	
		3,550			% Impervio	
		3,550		100.0	00% Uncon	inected
	Tc	Length	Slope	Velocity	Capacity	Description
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	Description
-	6.3	50	0.1100	0.13	(0.0)	Sheet Flow, A-B
	0.0	00	0.1100	0.10		Woods: Light underbrush n= 0.400 P2= 3.10"
	0.8	75	0.0930	1.52		Shallow Concentrated Flow, B-C
						Woodland Kv= 5.0 fps
	0.4	35	0.0430	1.45		Shallow Concentrated Flow, C-D
						Short Grass Pasture Kv= 7.0 fps
	4.5	260	0.0370	0.96		Shallow Concentrated Flow, D-E
_						Woodland Kv= 5.0 fps
	12.0	420	Total			

12.0 420 Total



Topsfield Existing HydroCAD	Type III 24-hr	100-Year Rainfall=6.50"
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Summary for Subcatchment E-3: Grassed Meadow/Northern Woods

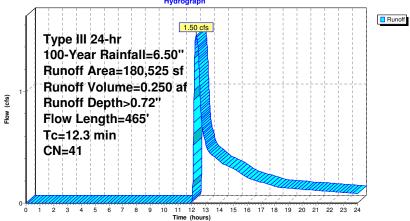
1.50 cfs @ 12.34 hrs, Volume= 0.250 af, Depth> 0.72" Runoff =

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

_	A	rea (sf)	CN [Description		
_		76,402	30 \	Voods, Go	od, HSG A	
		13,713	55 N	Voods, Go	od, HSG B	
		15,503	70 N	Voods, Go	od, HSG C	
		67,450	39 >	75% Gras	s cover, Go	bod, HSG A
_		7,457	74 >	75% Gras	s cover, Go	bod, HSG C
	1	80,525	41 \	Veighted A	verage	
	1	80,525	1	00.00% Pe	ervious Are	a
	_				. .	
	Tc	Length	Slope		Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	7.2	50	0.0800	0.12		Sheet Flow, A-B
						Woods: Light underbrush n= 0.400 P2= 3.10"
	3.6	293	0.0375	1.36		Shallow Concentrated Flow, B-C
						Short Grass Pasture Kv= 7.0 fps
	1.5	122	0.0740	1.36		Shallow Concentrated Flow, C-D
						Woodland Ky= 5.0 fps
_	10.0		T · ·			

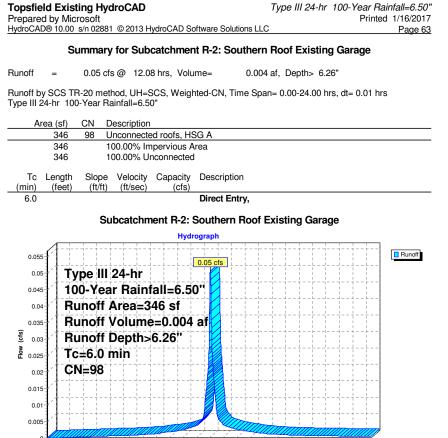
12.3 465 Total

Subcatchment E-3: Grassed Meadow/Northern Woods



Hydrograph

opsfield Existing HydroCAD Type III 24-hr 100-Year Rainfall=6.50" repared by Microsoft Printed 1/16/2017 vdroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC Page 61	Topsfield Existing HydroCAD Type III 24-hr 100-Year Rainfall=6. Prepared by Microsoft Printed 1/16/20 HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC Page
Summary for Subcatchment E-4: SW Grassed Area	Summary for Subcatchment R-1: Roof of Abandoned House
unoff = 1.94 cfs @ 12.33 hrs, Volume= 0.299 af, Depth> 0.86"	Runoff = 0.12 cfs @ 12.08 hrs, Volume= 0.009 af, Depth> 6.26"
unoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs /pe III 24-hr 100-Year Rainfall=6.50"	Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"
Area (sf) CN Description	Area (sf) CN Description
44,530 30 Woods, Good, HSG A	787 98 Roofs, HSG A
4,806 70 Woods, Good, HSG C 101.870 39 >75% Grass cover. Good. HSG A	787 100.00% Impervious Area
30,545 74 >75% Grass cover, Good, HSG C	Tc Length Slope Velocity Capacity Description
181,751 43 Weighted Average	(min) (feet) (ft/ft) (ft/sec) (cfs)
181,751 100.00% Pervious Area	6.0 Direct Entry,
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	Subcatchment R-1: Roof of Abandoned House
8.7 50 0.0500 0.10 Sheet Flow. A-B	Hydrograph
Woods: Light underbrush $n=0.400$ P2= 3.10"	
5.6 462 0.0390 1.38 Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps	0.12 1 0.12 1 0.12 cfs
1.4 110 0.0682 1.31 Shallow Concentrated Flow, C-D	0.11 Type III 24-hr
Woodland Kv= 5.0 fps	0.1 100-Year Rainfall=6.50"
15.7 622 Total	0.09 Runoff Area=787 sf
Subcatchment E-4: SW Grassed Area	0.08 Runoff Volume=0.009 af
Hydrograph	€ 0.07 Runoff Depth>6.26"
	≜ ^{0.06} Tc=6.0 min
	0.05 CN=98
¹ Type III 24-hr	
100-Year Rainfall=6.50"	
Runoff Area=181,751 sf	
Runoff Volume=0.299 af	
	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)
E 1 Flow Length=622'	
Tc=15.7 min	
CN=43	



Time (hours)

10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Type III 24-hr 100-Year Rainfall=6.50" Prepared by Microsoft Printed 1/16/2017 HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC Page 64 Summary for Subcatchment R-3: Northern Roof Existing Garage 0.05 cfs @ 12.08 hrs, Volume= Runoff = 0.004 af, Depth> 6.26" Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50" Area (sf) CN Description 346 98 Roofs, HSG A 346 100.00% Impervious Area Tc Lenath Slope Velocity Capacity Description (ft/ft) (ft/sec) (cfs) (min) (feet) Direct Entry, 6.0 Subcatchment R-3: Northern Roof Existing Garage Hydrograph Runoff 0.055 0.05 cfs Type III 24-hr 0.05 100-Year Rainfall=6.50" 0.045 Runoff Area=346 sf 0.04 Runoff Volume=0.004 af 0.035 (cfs) Runoff Depth>6.26" 0.03-<u>8</u> Tc=6.0 min 0.025 CN=98 0.02 0.015 0.01

0.005

Ó - i -

 Area (sf)	CN	Description	
 346	98	Unconnected roofs, HSG A	
 346		100.00% Impervious Area	
346		100.00% Unconnected	

0 1 2 3 4 5 6 7 8 9

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)

Topsfield Existing HydroCAD

 Topsfield Existing HydroCAD
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 Type III 24-hr 100-Year Rainfall=6.50" Printed 1/16/2017

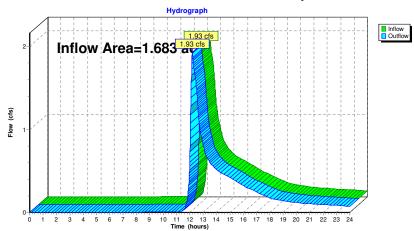
Summary for Reach SP-1: Wetlands South of Driveway

Page 65

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

Inflow Area =	1.683 ac, 25.41% Impervious, Inflow Depth > 2.39" for 100-Year event
Inflow =	1.93 cfs @ 12.19 hrs, Volume= 0.335 af
Outflow =	1.93 cfs @ 12.19 hrs, Volume= 0.335 af, Atten= 0%, Lag= 0.0 min

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



Reach SP-1: Wetlands South of Driveway

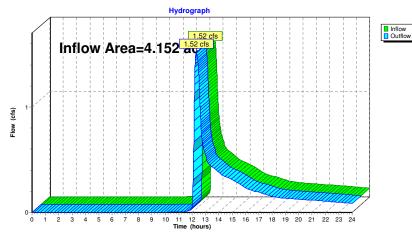
Topsfield Existing HydroCAD	Type III 24-hr	100-Year Rainfall=6.50"
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Summary for Reach SP-2: Northeast Wetland Flow

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

Inflow Area	=	4.152 ac,	0.19% Impervious,	Inflow Depth > 0.	74" for 100-Year event
Inflow =	=	1.52 cfs @	12.32 hrs, Volume=	= 0.254 af	
Outflow =	=	1.52 cfs @	12.32 hrs, Volume=	= 0.254 af,	Atten= 0%, Lag= 0.0 min

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



Reach SP-2: Northeast Wetland Flow

Topsfield Existing HydroCAD Type III 24-hr 100-Year Rainfall=6.50" Prepared by Microsoft HydroCAD® 10.00 s/n 02881 © 2013 HydroCAD Software Solutions LLC Printed 1/16/2017

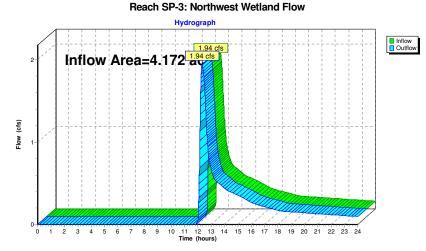
Summary for Reach SP-3: Northwest Wetland Flow

Page 67

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

Inflow Area =	4.172 ac,	0.00% Impervious, Inflow	Depth > 0.86"	for 100-Year event
Inflow =	1.94 cfs @	12.33 hrs, Volume=	0.299 af	
Outflow =	1.94 cfs @	12.33 hrs, Volume=	0.299 af, Atte	en= 0%, Lag= 0.0 min

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



Topsfield Existing HydroCAD	Type III 24-hr 100-Year Rainfall=6.50"	
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Summary for Pond 1P: Existing Detention Basin

Inflow Area =	0.534 ac, 61.44% Impervious, Inflow E	Depth > 5.45" for 100-Year event
Inflow =	2.80 cfs @ 12.14 hrs, Volume=	0.243 af
Outflow =	0.67 cfs @ 12.57 hrs, Volume=	0.171 af, Atten= 76%, Lag= 25.8 min
Primary =	0.67 cfs @ 12.57 hrs, Volume=	0.171 af

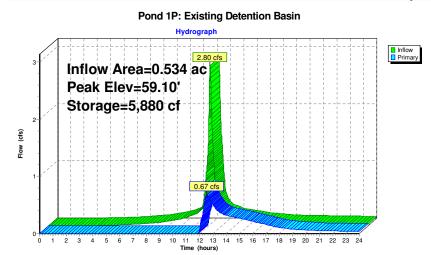
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 59.10' @ 12.57 hrs Surf.Area= 3,206 sf Storage= 5,880 cf

Plug-Flow detention time= 228.3 min calculated for 0.171 af (71% of inflow) Center-of-Mass det. time= 138.2 min (919.0 - 780.8)

Volume	Inve	ert Avail.S	torage	Storage [Description		
#1	57.2	.0' 9,	020 cf	Custom S	Stage Data (Prismatic) Listed below (Re	ecalc)
Elevatio		Surf.Area		Store	Cum.Stor	-	
(fee	t)	(sq-ft)	(cubic	-feet)	(cubic-fee	<u>t)</u>	
57.2	0	3,090		0		0	
58.0	0	3,090	:	2,472	2,47	2	
59.0	0	3,090	;	3,090	5,56	62	
59.4	0	3,550		1,328	6,89	0	
60.0	0	3,550	:	2,130	9,02	20	
Device	Routing	Inver	rt Outle	et Devices	i		
#1	Primary	58.08	3' 4.0'' '	Vert. Orifi	ce/Grate (C= 0.600	
#2	Primary	58.80)' 8.0'' '	Vert. Orifi	ce/Grate (C= 0.600	

Primary OutFlow Max=0.67 cfs @ 12.57 hrs HW=59.10' (Free Discharge) 1=Orifice/Grate (Orifice Controls 0.39 cfs @ 4.45 fps) 2=Orifice/Grate (Orifice Controls 0.29 cfs @ 1.87 fps)





Topsfield Existing HydroCAD	Type III 24-hr	100-Year Rainfall=6.50"
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Summary for Pond 2P: Combined Study Points - Northern Wetlands

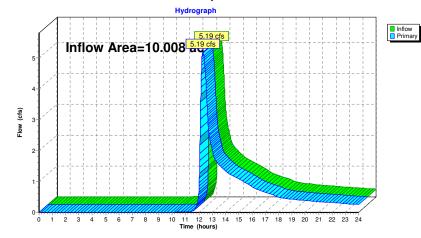
[40] Hint: Not Described (Outflow=Inflow)

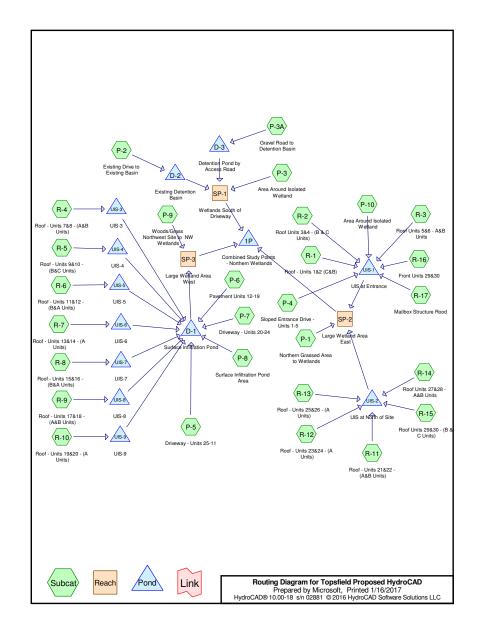
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Inflow Area =	10.008 ac,	4.35% Impervious, Inflow	Depth > 1.07"	for 100-Year event
Inflow =	5.19 cfs @	12.30 hrs, Volume=	0.889 af	
Primary =	5.19 cfs @	12.30 hrs, Volume=	0.889 af, Atte	en= 0%, Lag= 0.0 min

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

Pond 2P: Combined Study Points - Northern Wetlands





Topsfield Proposed HydroCAD

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Area Listing (all nodes)

Ar	ea	CN	Description
(acre	es)		(subcatchment-numbers)
0.3	76	49	50-75% Grass cover, Fair, HSG A (P-6, P-7)
2.4	22	39	>75% Grass cover, Good, HSG A (P-1, P-2, P-3, P-3A, P-4, P-5, P-8, P-9)
0.9	26	74	>75% Grass cover, Good, HSG C (P-10, P-2, P-3, P-4, P-5, P-9)
0.0	47	72	Dirt roads, HSG A (P-9)
0.1	01	76	Gravel roads, HSG A (P-2, P-3, P-3A)
1.5	43	98	Paved parking, HSG A (P-2, P-3A, P-4, P-5, P-6, P-7, P-8)
0.1	66	98	Roofs, HSG A (R-14, R-3)
0.1	34	98	Unconnected pavement, HSG A (P-3, P-9)
1.1	57	98	Unconnected roofs, HSG A (P-10, R-1, R-10, R-11, R-12, R-13, R-15, R-16, R-17, R-2,
			R-4, R-5, R-6, R-7, R-8, R-9)
2.4	35	30	Woods, Good, HSG A (P-1, P-3, P-9)
0.3	23	55	Woods, Good, HSG B (P-1, P-9)
0.2	97	70	Woods, Good, HSG C (P-1, P-3)
0.1	18	77	Woods, Good, HSG D (P-3)
10.0	46	60	TOTAL AREA

Topsfield Prop Prepared by Mic HydroCAD® 10.00	rosoft	droCAD Printed 1/16/2017 81 © 2016 HydroCAD Software Solutions LLC Page 3	Topsfield P Prepared by HydroCAD® 10	Microsoft	-		Software Se	olutions LLC		nted 1/16/2017 Page 4
		Soil Listing (all nodes)				Ground	Covers (a	II nodes)		
Area (acres)	Soil Group	Subcatchment Numbers	HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
8.382	HSG A	P-1, P-10, P-2, P-3, P-3A, P-4, P-5, P-6, P-7, P-8, P-9, R-1, R-10, R-11, R-12, R-13, R-14, R-15, R-16, R-17, R-2, R-3, R-4, R-5, R-6, R-7, R-8, R-9	0.376 2.422	0.000 0.000	0.000 0.926	0.000 0.000	0.000 0.000	0.376 3.348	50-75% Grass cover, Fair >75% Grass cover, Good	P-1, P-10,
0.323 1.223 0.118	HSG B HSG C HSG D	P-1, P-9 P-1, P-10, P-2, P-3, P-4, P-5, P-9 P-3								P-2, P-3, P-3A, P-4, P-5, P-8, P-9
0.000 10.046	Other	TOTAL AREA	0.047 0.101	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.047 0.101	Dirt roads Gravel roads	P-9 P-2, P-3, P-3A
			1.543	0.000	0.000	0.000	0.000	1.543	Paved parking	P-2, P-3A, P-4, P-5, P-6, P-7, P-8
			0.166	0.000	0.000	0.000	0.000	0.166	Roofs	R-14, R-3
			0.134	0.000	0.000	0.000	0.000	0.134	Unconnected pavement	P-3, P-9
			1.157	0.000	0.000	0.000	0.000	1.157	Unconnected roofs	P-10, R-1, R-10, R-11, R-12, R-13, R-15, R-16, R-17, R-2, R-4, R-5, R-6, R-7, R-8, R-9
			2.435	0.323	0.297	0.118	0.000	3.174	Woods, Good	н-о, н-э P-1, P-3, P-9
			8.382	0.323	1.223	0.118	0.000	10.046	TOTAL AREA	,. 0,1 0

Printed 1/16/2017 Page 6	© 2016 HydroCAD Software Solutions LLC	Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 Hydr	nted 1/16/2017 Page 5	FIII	
	ne span=0.00-24.00 hrs, dt=0.01 hrs, 2401 poir off by SCS TR-20 method, UH=SCS, Weighted ov Stor-Ind+Trans method - Pond routing by S	Runoff by SCS	Inside-Fill	Height	'n
npervious Runoff Depth>0.00" =41 Runoff=0.00 cfs 0.001 af		Subcatchment P-1: Northern Grassed Are	(inches) 0.0	(inches) 0.0	s) 0
npervious Runoff Depth>1.03" =75 Runoff=0.83 cfs 0.062 af	und Isolated Runoff Area=31,595 sf 7.29% Flow Length=533' Tc=6.0 min UI Adjusted (Subcatchment P-10: Area Around Isolated Flow L	0.0 0.0	0.0 0.0 0.0	0 0 0
npervious Runoff Depth>1.39" =81 Runoff=0.86 cfs 0.061 af		Subcatchment P-2: Existing Drive to Exis	0.0	0.0 0.0 0.0	0 0 0
npervious Runoff Depth>0.11" =50 Runoff=0.01 cfs 0.006 af		Subcatchment P-3: Area Around Isolated	0.0	0.0	0
npervious Runoff Depth>0.82" =71 Runoff=0.10 cfs 0.008 af		Subcatchment P-3A: Gravel Road to Dete			
npervious Runoff Depth>1.08" =76 Runoff=0.60 cfs 0.045 af		Subcatchment P-4: Sloped Entrance Drive			
npervious Runoff Depth>0.97" =74 Runoff=0.97 cfs 0.073 af		Subcatchment P-5: Driveway - Units 25-1			
npervious Runoff Depth>1.20" =78 Runoff=0.60 cfs 0.044 af		Subcatchment P-6: Pavement Units 12-19			
npervious Runoff Depth>0.82" =71 Runoff=0.31 cfs 0.024 af		Subcatchment P-7: Driveway - Units 20-24			
npervious Runoff Depth>0.01" =43 Runoff=0.00 cfs 0.000 af		Subcatchment P-8: Surface Infiltration Po			
	ass Northwest Runoff Area=102,567 sf 2.25% Flow Length=502' Tc=10.8 min UI Adjusted	Subcatchment P-9: Woods/Grass Northw Flow Le			
npervious Runoff Depth>2.87" =98 Runoff=0.22 cfs 0.017 af		Subcatchment R-1: Roof - Units 1&2 (C&E			
npervious Runoff Depth>2.87" =98 Runoff=0.27 cfs 0.021 af		Subcatchment R-10: Roof - Units 19&20 -			
npervious Runoff Depth>2.87" =98 Runoff=0.25 cfs 0.020 af	nits 21&22 - (A&B Runoff Area=3,625 sf 100.00% Tc=6.0 min (Subcatchment R-11: Roof - Units 21&22 -			
npervious Runoff Depth>2.87" =98 Runoff=0.27 cfs 0.021 af		Subcatchment R-12: Roof - Units 23&24 -			
npervious Runoff Depth>2.87" =98 Runoff=0.27 cfs 0.021 af		Subcatchment R-13: Roof - Units 25&26 -			

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	D-1	70.00	65.40	252.0	0.0183	0.015	15.0	0.0	0.0
2	UIS-3	73.40	70.70	30.0	0.0900	0.011	6.0	0.0	0.0
3	UIS-4	74.20	74.06	30.0	0.0047	0.011	6.0	0.0	0.0
4	UIS-5	74.80	74.60	22.0	0.0091	0.011	6.0	0.0	0.0
5	UIS-6	74.00	72.18	106.0	0.0172	0.011	6.0	0.0	0.0
6	UIS-7	73.50	73.00	17.5	0.0286	0.011	6.0	0.0	0.0
7	UIS-8	72.80	72.18	37.0	0.0168	0.011	6.0	0.0	0.0
8	UIS-9	72.18	71.38	79.0	0.0101	0.011	6.0	0.0	0.0

Topsfield Proposed HydroCAD Type III 24-hr 2-Year Rainfall=3	3.10" Topsfield Proposed Hyd	roCAD Type III 24-hr 2-Year Rainfall=3.10
Prepared by Microsoft Printed 1/16/2	2017 Prepared by Microsoft	Printed 1/16/201 1 © 2016 HydroCAD Software Solutions LLC Page
Subcatchment R-14: Roof Units 27&28 - A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.25 cfs 0.0		n Basin Peak Elev=58.07' Storage=2,675 cf Inflow=0.86 cfs 0.061 Outflow=0.00 cfs 0.000
Subcatchment R-15: Roof Units 29&30 - (B & C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.22 cfs 0.0		y Access Road Peak Elev=63.24' Storage=81 cf Inflow=0.10 cfs 0.008 Discarded=0.02 cfs 0.008 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.008
Bubcatchment R-16: Front Units 29&30 Runoff Area=1,490 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.10 cfs 0.0		Peak Elev=61.91' Storage=4,105 cf Inflow=2.23 cfs 0.170 Discarded=0.08 cfs 0.099 af Primary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.099
ubcatchment R-17: Mailbox Structure Rood Runoff Area=120 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.01 cfs 0.0		Site Peak Elev=63.15' Storage=1,100 cf Inflow=1.26 cfs 0.100 Discarded=0.23 cfs 0.100 af Primary=0.00 cfs 0.000 af Outflow=0.23 cfs 0.100
ubcatchment R-2: Roof Units 3&4 - (B & C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.22 cfs 0.0		Peak Elev=73.67' Storage=130 cf Inflow=0.25 cfs 0.020 Discarded=0.00 cfs 0.004 af Primary=0.25 cfs 0.013 af Outflow=0.25 cfs 0.017
ubcatchment R-3: Roof Units 5&6 - A&B Units Runoff Area=3,625 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.25 cfs 0.0		Peak Elev=74.55' Storage=134 cf Inflow=0.22 cfs 0.018 Discarded=0.00 cfs 0.004 af Primary=0.21 cfs 0.011 af Outflow=0.22 cfs 0.015
Subcatchment R-4: Roof - Units 7&8 - (A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.25 cfs 0.0		Peak Elev=75.17' Storage=136 cf Inflow=0.25 cfs 0.020 Discarded=0.00 cfs 0.004 af Primary=0.24 cfs 0.013 af Outflow=0.24 cfs 0.017
ubcatchment R-5: Roof - Units 9&10 - (B&C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.22 cfs 0.0		Peak Elev=74.39' Storage=137 cf Inflow=0.27 cfs 0.021 Discarded=0.00 cfs 0.004 af Primary=0.26 cfs 0.015 af Outflow=0.26 cfs 0.019
ubcatchment R-6: Roof - Units 11&12 - (B&A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.25 cfs 0.0		Peak Elev=73.87' Storage=136 cf Inflow=0.25 cfs 0.020 Discarded=0.00 cfs 0.004 af Primary=0.24 cfs 0.013 af Outflow=0.24 cfs 0.017
ubcatchment R-7: Roof - Units 13&14 - (A Runoff Area=3,895 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.27 cfs 0.0		Peak Elev=73.17' Storage=136 cf Inflow=0.25 cfs 0.020 Discarded=0.00 cfs 0.004 af Primary=0.24 cfs 0.013 af Outflow=0.24 cfs 0.017
ubcatchment R-8: Roof - Units 15&16 - (B&A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.25 cfs 0.0		Peak Elev=72.57' Storage=81 cf Inflow=0.27 cfs 0.021 Discarded=0.00 cfs 0.004 af Primary=0.26 cfs 0.016 af Outflow=0.26 cfs 0.020
ubcatchment R-9: Roof - Units 17&18 - (A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth> Tc=6.0 min CN=98 Runoff=0.25 cfs 0.0		off Area = 10.046 ac Runoff Volume = 0.627 af Average Runoff Depth = 0.7 70.14% Pervious = 7.046 ac 29.86% Impervious = 3.000
leach SP-1: Wetlands South of Driveway Inflow=0.01 cfs 0.0 Outflow=0.01 cfs 0.0		
each SP-2: Large Wetland Area East Inflow=0.00 cfs 0.0 Outflow=0.00 cfs 0.0		
each SP-3: Large Wetland Area West Inflow=0.00 cfs 0.0 Outflow=0.00 cfs 0.0		
ond 1P: Combined Study Points - Northern Wetlands Inflow=0.01 cfs 0.0 Primary=0.01 cfs 0.0		
Pond D-1: Surface Infiltration Pond Peak Elev=68.76' Storage=7,349 cf Inflow=3.58 cfs 0.2 Discarded=0.09 cfs 0.086 af Primary=0.00 cfs 0.000 af Outflow=0.09 cfs 0.0		

	I Proposed HydroCAD Type III 24-hr 2-Year Rainfall=3.10' by Microsoft Printed 1/16/2017 0 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 9
	Summary for Subcatchment P-1: Northern Grassed Area to Wetlands
3] Warnii	ng: Peak may fall outside time span
unoff	= 0.00 cfs @ 23.74 hrs, Volume= 0.001 af, Depth> 0.00"
	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs -hr 2-Year Rainfall=3.10"
Area	a (sf) CN Description
	3,137 30 Woods, Good, HSG A
),782 70 Woods, Good, HSG C),419 55 Woods, Good, HSG B
	3,184 39 >75% Grass cover, Good, HSG A
	,522 41 Weighted Average ,522 100.00% Pervious Area
Tc L (min)	ength Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)
6.0	Direct Entry,
	Subcatchment P-1: Northern Grassed Area to Wetlands
	Hydrograph
1	
0.002	,
0.002	Type III 24-hr
0.001	2-Year Rainfall=3.10"
0.001	Runoff Area=81,522 sf
0.001	Runoff Volume=0.001 af
0.001 (f) 0.001	Runoff Depth>0.00"
LION (cls) 0.001	Tc=6.0 min
0.001	1 CN=41
0.001	
0.001	
0.001	
0.001	
0.001 0.001 0.000 0.000 0.000	

Prepare	d by Mic			Type III 24-hr 2-Year Rainfall=3.10" Printed 1/16/2017 D Software Solutions LLC Page 10
	S	ummary for	Subcatchmer	nt P-10: Area Around Isolated Wetland
Runoff	=	0.83 cfs @	12.10 hrs, Volu	ume= 0.062 af, Depth> 1.03"
		R-20 method, I /ear Rainfall=3		hted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
А	rea (sf)	CN Adj	Description	
	2,304		Unconnected ro	
	29,291			ver, Good, HSG C
	31,595			age, UI Adjusted
	29,291 2,304		92.71% Perviou 7.29% Impervio	
	2,304		100.00% Uncon	
	,			
Tc	Length		ocity Capacity	Description
<u>(min)</u>	(feet)		sec) (cfs)	
2.9	50	0.1100	0.29	Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.10"
2.9	483	0.1600	2.80	Shallow Concentrated Flow, B-C
2.0		0.1000	2.00	Short Grass Pasture Kv= 7.0 fps
5.8	533	Total, Increa	sed to minimum	1 Tc = 6.0 min
		Subcat	tchment P-10:	: Area Around Isolated Wetland
			Hydr	rograph
0.9 0.85	1 1		+	0.83 cfs
0.85] / Tv	pe III 24-h)r	
0.75			fall=3.10"	
0.7	₹ ↓	JJ		
0.65	∦ I_KU	inott Area	1=31,595 sf	

Runoff Area=31,595 sf Runoff Volume=0.062 af Runoff Depth>1.03" Flow Length=533' Tc=6.0 min 0.65 0.6 (s) 0.55 0.45 0.45 0.3 0.35 0.25 0.15 UI Adjusted CN=75 0.1

0.05



Summary for Subcatchment P-2: Existing Drive to Existing Basin	
Cuminary for Cubbatonment 1 2. Existing Drive to Existing Dusin	Summary for Subcatchment P-3: Area Around Isolated Wetland
Runoff = 0.86 cfs @ 12.09 hrs, Volume= 0.061 af, Depth> 1.39"	Runoff = 0.01 cfs @ 13.62 hrs, Volume= 0.006 af, Depth> 0.11"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"	Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"
Area (sf) CN Description	Area (sf) CN Adj Description
13,815 98 Paved parking, HSG A 1,353 76 Gravel roads, HSG A 4,896 39 >75% Grass cover, Good, HSG A 3,050 74 >75% Grass cover, Good, HSG C	3,54598Unconnected pavement, HSG A1,22476Gravel roads, HSG A21274>75% Grass cover, Good, HSG C2,16670Woods, Good, HSG C
23,11481Weighted Average9,29940.23% Pervious Area13,81559.77% Impervious Area	5,125 77 Woods, Good, HSG D 14,867 30 Woods, Good, HSG A 443 39 >75% Grass cover, Good, HSG A 27,582 53 50 Weighted Average, UI Adjusted
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Min. 6.0 TC	24,037 87.15% Pervious Area 3,545 12.85% Impervious Area 3,545 100.00% Unconnected
Subcatchment P-2: Existing Drive to Existing Basin	Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)
Hydrograph	6.0 Direct Entry,
0.95	Subcatchment P-3: Area Around Isolated Wetland
	Hydrograph
0.75 1 2-Year Rainfall=3.10"	0.011
	0.010 0.009
0.6 € 0.55 0.55 0.55 Runoff Depth>1.39"	0.009 0.008 2-Year Rainfall=3.10
	0.008 0.007 Runoff Area=27,582 sf
	0.007
0.35 0.3	ਿ 0.006 A Runoff Depth>0.11
0.15	0.004 UI Adjusted CN=50
0 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)	

Topsfield Proposed HydroCAD	Type III 24-hr 2-Year Rainfall=3.10"
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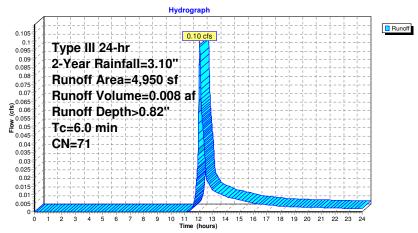
Summary for Subcatchment P-3A: Gravel Road to Detention Basin

Runoff = 0.10 cfs @ 12.10 hrs, Volume= 0.008 af, Depth> 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

A	rea (sf)	CN	Description		
	1,552	98	Paved park	ing, HSG A	
	1,841	76	Gravel road	ls, HSG A	
	1,557	39	>75% Gras	s cover, Go	ood, HSG A
	4,950	71	Weighted A		
	3,398		68.65% Per		
	1,552		31.35% lmp	pervious Are	ea
Tc (min)	Length	Slop		Capacity	Description
	(ieel)	(11/11) (11/Sec)	(CIS)	
6.0					Direct Entry,
<u>(min)</u> 6.0	(feet)	(ft/ft) (ft/sec)	(cfs)	Direct Entry,

Subcatchment P-3A: Gravel Road to Detention Basin



Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC	Type III 24-hr 2-Year Rainfall=3.10" Printed 1/16/2017 Solutions LLC Page 14			
Summary for Subcatchment P-4: Sloped Entra	nce Drive - Units 1-5			
Runoff = 0.60 cfs @ 12.09 hrs, Volume= 0.045 af,	Depth> 1.08"			
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= Type III 24-hr 2-Year Rainfall=3.10"	0.00-24.00 hrs, dt= 0.01 hrs			
Area (sf) CN Description				
12,066 98 Paved parking, HSG A 6,808 39 >75% Grass cover, Good, HSG A 2,699 74 >75% Grass cover, Good, HSG C				
21,573 76 Weighted Average 9,507 44.07% Pervious Area 12,066 55.93% Impervious Area				
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)				
6.0 Direct Entry,				
Subcatchment P-4: Sloped Entrance Dr Hydrograph 0.60 cfs 7.ype III 24-hr 2-Year Rainfall=3.10" Runoff Area=21,573 sf Runoff Volume=0.045 af Runoff Depth>1.08" Tc=6.0 min CN=76	Runoff			
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 Time (hours)	18 19 20 21 22 23 24			

Prepared	Id Proposed HydroCAD d by Microsoft x® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions L	<i>Type III 24-hr 2-Year Rainfall=3.10"</i> Printed 1/16/2017 LC Page 15
	Summary for Subcatchment P-5: Drive	way - Units 25-11
Runoff	= 0.97 cfs @ 12.10 hrs, Volume= 0.073	af, Depth> 0.97"
	/ SCS TR-20 method, UH=SCS, Weighted-CN, Time Spar 4-hr 2-Year Rainfall=3.10"	n= 0.00-24.00 hrs, dt= 0.01 hrs
	ea (sf) CN Description	
1	20,251 98 Paved parking, HSG A 14,308 39 >75% Grass cover, Good, HSG A 4,713 74 >75% Grass cover, Good, HSG C	
1	39,272 74 Weighted Average 19,021 48.43% Pervious Area 20,251 51.57% Impervious Area	
(min)	Length Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)	
6.0	Direct Entry,	
	Subcatchment P-5: Driveway - L	Jnits 25-11
,	Hydrograph	· · · · · · · · · · · · · · · · · · ·
Flow (cfs)	Type III 24-hr 2-Year Rainfall=3.10" Runoff Area=39,272 sf Runoff Volume=0.073 af Runoff Depth>0.97" Tc=6.0 min CN=74	Runoff
0-	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Time (hours)	17 18 19 20 21 22 23 24

Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC	Type III 24-hr 2-Year Rainfall=3.10" Printed 1/16/2017 Printed 1/16/2017 Page 16 Page 16
Summary for Subcatchment P-6: Pavement	ent Units 12-19
Runoff = 0.60 cfs @ 12.09 hrs, Volume= 0.044 af	, Depth> 1.20"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= Type III 24-hr 2-Year Rainfall=3.10"	0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
11,455 98 Paved parking, HSG A 7,682 49 50-75% Grass cover, Fair, HSG A	
19,137 78 Weighted Average 7,682 40.14% Pervious Area 11,455 59.86% Impervious Area	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment P-6: Pavement Uni	its 12-19
Hydrograph 0.65 0.60 cfs 0.55 0.60 cfs 0.55 0.5 0.55 0.5 0.45 0.45 0.45 0.45 0.45 0.44 0.35 0.45 0.45 0.45 0.45 0.45 0.45 0.44 0.35 0.45 0.45 0.45 0.45 0.45 0.45 0.44 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45	Runoff

Topsfield Proposed HydroCAD	Type III 24-hr 2-Year Rainfall=3.10"
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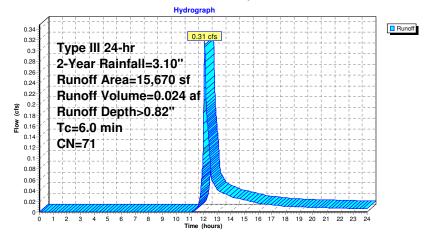
Summary for Subcatchment P-7: Driveway - Units 20-24

Runoff = 0.31 cfs @ 12.10 hrs, Volume= 0.024 af, Depth> 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

_	A	rea (sf)	CN	Description			
		6,983	98	Paved park	ing, HSG A	N	
_		8,687	49	50-75% Grass cover, Fair, HSG A			
		15,670	71	Weighted A	verage		
		8,687	55.44% Pervious Area				
		6,983		44.56% Imp	pervious Ar	ea	
_	Tc (min)	Length (feet)	Slop (ft/ft		Capacity (cfs)	Description	
	6.0					Direct Entry,	

Subcatchment P-7: Driveway - Units 20-24



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	Summary for Subcatchment P-8: Surface	ce Infiltration Pond Area
unoff =	0.00 cfs @ 21.26 hrs, Volume= 0.0	000 af, Depth> 0.01"
	CS TR-20 method, UH=SCS, Weighted-CN, Time S r 2-Year Rainfall=3.10"	Span= 0.00-24.00 hrs, dt= 0.01 hrs
Area	(sf) CN Description	
	072 98 Paved parking, HSG A 235 39 >75% Grass cover, Good, HSG A	
15,: 14,:	307 43 Weighted Average 325 93.00% Pervious Area 372 7.00% Impervious Area	
Tc Le	ngth Slope Velocity Capacity Description ieet) (ft/ft) (ft/sec) (cfs)	
6.0	Direct Entry,	
	Subcatchment P-8: Surface Infilt	ration Pond Area
	Hydrograph	
0.001		
0.001		
0.001	Type III 24-hr	
0.001	2-Year Rainfall=3.10"	
0.000	Runoff Area=15,307 sf	
0.000	Runoff Volume=0.000 af	
(cts)	Runoff Depth>0.01"	
0.000 H	-Tc=6.0 min	
0.000	CN=43	
0.000		
0.000		
0		
0	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 Time (hours)	16 17 18 19 20 21 22 23 24
	(10010)	

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 Type III 24-hr
 2-Year Rainfall=3.10"

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Summary for Subcatchment P-9: Woods/Grass Northwest Site to NW Wetlands

Walking path in woods described as "Dirt road," closest CN value in HydroCAD, actual material to be mulch, wood chips or packed earth

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

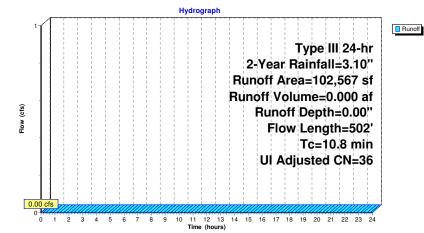
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

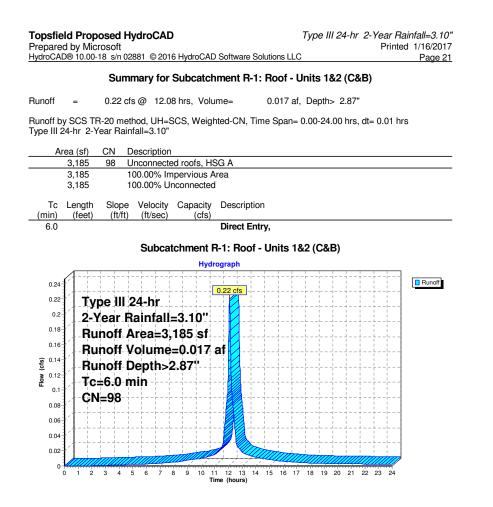
	A	rea (sf)	CN A	Adj Desc	ription	
		2,068	72	Dirt r	oads, HSG	i A
		40,086	39	>75%	6 Grass co	ver, Good, HSG A
		357	74	>75%	6 Grass co	ver, Good, HSG C
		53,082	30	Woo	ds, Good, H	HSG A
		4,670	55	Woo	ds, Good, H	HSG B
		2,304	98	Unco	onnected pa	avement, HSG A
	102,567 37 36 Weighted Avera					
	100,263 97.75% Pervious			97.7	5% Perviou	is Area
		2,304			% Impervio	
		2,304		100.0	00% Uncon	nected
	Та	مانسمي	Clana	Valasity	Canaaitu	Description
	Tc (min)	Length	Slope		Capacity	Description
-	· /	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	4.9	50	0.0300	0.17		Sheet Flow, A-B
		0.40				Grass: Short $n = 0.150$ P2= 3.10"
	4.9	342	0.0280	1.17		Shallow Concentrated Flow, B-C
	10	110	0 4 0 7 0	4 70		Short Grass Pasture Kv= 7.0 fps
	1.0	110	0.1270	1.78		Shallow Concentrated Flow, C-D
						Woodland Kv= 5.0 fps

10.8 502 Total

Topsfield Proposed HydroCAD	Type III 24-hr 2-Year Rainfall=3.10"
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Subcatchment P-9: Woods/Grass Northwest Site to NW Wetlands





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Summary for Subcatch	ment R-10: Roof - Units 19&20 - (A Units)
noff = 0.27 cfs @ 12.08 hrs, V	Volume= 0.021 af, Depth> 2.87"
	eighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
be III 24-hr 2-Year Rainfall=3.10"	
Area (sf) CN Description	
3,895 98 Unconnected roofs 3,895 100.00% Imperviou	
3,895 100.00% Inconne	
Tc Length Slope Velocity Capa	city Description
min) (feet) (ft/ft) (ft/sec) (d	ofs)
6.0	Direct Entry,
Subcatchment R	R-10: Roof - Units 19&20 - (A Units)
	Hydrograph
0.3	Runoff
0.28	0.27 cfs
0.26 Type III 24-hr 0.24 2-Year Rainfall=3.10	
0.24 2-Year Bainfall=3 10	
0.22 Runoff Area=3,895	
Runoff Area=3,895 Constant Runoff Volume=0.02	21 af
0.22 0.2 0.18 © 0.16 © 0.16 © 0.16 © 0.16 © 0.16 © 0.16 © 0.16 © 0.17 © 0.17	21 af
0.22 0.2 0.18 € 0.16 € 0.16 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14	21 af
0.22 0.2 0.18 2 0.18 2 0.18 2 0.18 2 0.18 2 0.16 2 0.16 2 0.16 2 0.17 2 0.17 2 0.18 2 0.16 2 0.17 2 0.17 2 0.17 2 0.18 2 0.18 2 0.18 2 0.18 2 0.18 2 0.16 2 0.17 2 0.18 2 0.	21 af
0.22 0.2 0.2 0.16 € 0.16 € 0.16 • 0.14 • 0.14 • 0.14 • 0.14 • 0.14 • 0.14 • 0.14 • 0.14 • 0.14 • 0.15 • 0.15 • 0.15 • 0.15 • 0.2 • 0.15 • 0.	21 af
0.22 Runoff Area=3,895 0.2 Runoff Volume=0.02 0.18 Runoff Depth>2.87" 0.14 Tc=6.0 min 0.12 CN=98	21 af
0.22 0.2 0.18 E 0.16 E 0.16 CN=98 0.06 0.04 0.22 0.18 0.18 CN=98 0.02 0.18 0.18 0.18 CN=98 0.04 0.04 0.04 0.02 0.18	21 af
0.22 0.2 0.18 E 0.16 E 0.16 E 0.16 C 0.17 C 0.17 C 0.17 C 0.17 C 0.17 C 0.18 0.12 0.1 0.12 0.1 C 0.2 0.18 C 0.2 C 0.18 C 0.2 C 0.18 C 0.2 C 0.18 C 0.2 C 0.18 C 0.2 C 0.18 C 0.2 C 0.18 C 0.2 C 0.2 C 0.18 C 0.2 C 0.18 C 0.2 C	21 af
0.22 0.2 0.18 0.18 0.18 0.16 0.14 0.12 0.1 0.12 0.14 0.14 0.12 0.14 0.14 0.12 0.14 0.	
0.22 0.2 0.18 0.18 0.18 0.16 0.14 0.12 0.1 0.12 0.14 0.14 0.12 0.14 0.14 0.12 0.14 0.	21 af

Topsfield Proposed HydroCAD	Type III 24-hr 2-Year Rainfall=3.10"
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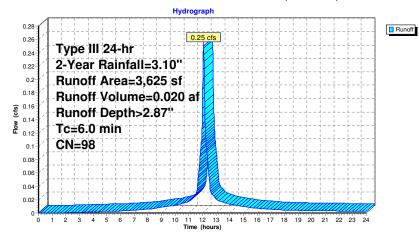
Summary for Subcatchment R-11: Roof - Units 21&22 - (A&B Units)

Runoff = 0.25 cfs @ 12.08 hrs, Volume= 0.020 af, Depth> 2.87"

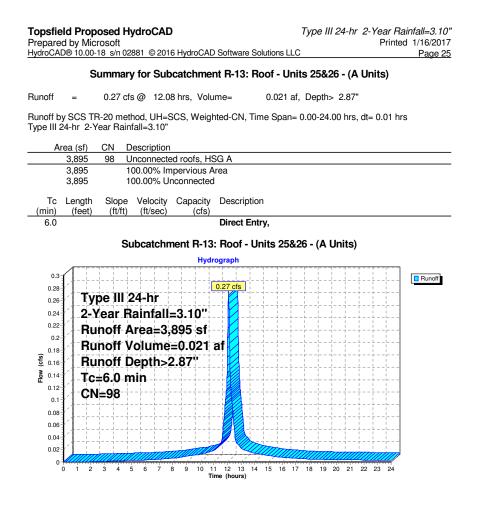
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

	A	rea (sf)	CN	Description				
		3,625	98	Unconnected roofs, HSG A				
		3,625		100.00% In	pervious A	vrea		
		3,625		100.00% U	nconnected	1		
	Tc (min)	Length (feet)	Slope (ft/ft)		Capacity (cfs)	Description		
-	6.0					Direct Entry,		

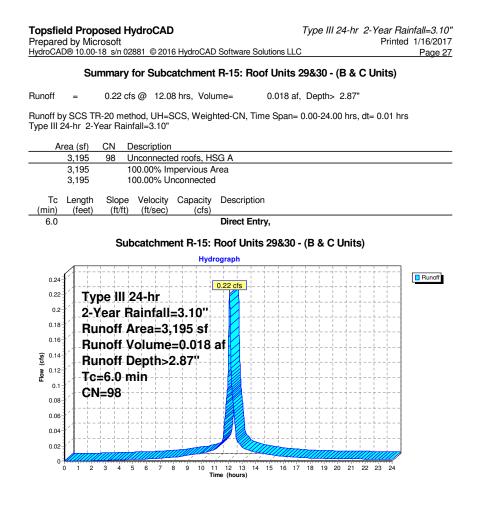
Subcatchment R-11: Roof - Units 21&22 - (A&B Units)



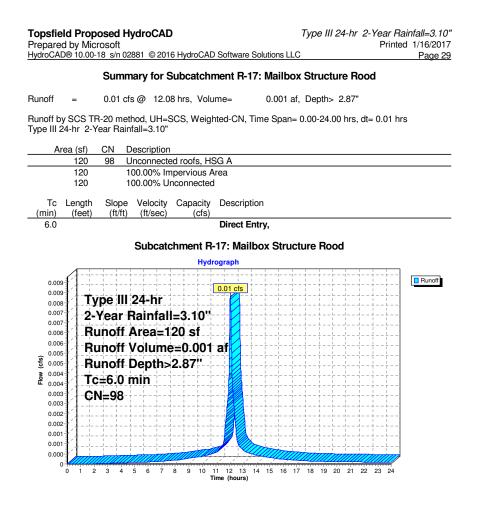
Summary for Subcatchment R-12: Roof - Units 23&24 Runoff = 0.27 cfs @ 12.08 hrs, Volume= 0.021 af, Depth> Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 Time Span= 0.00-24.00 Type III 24-hr 2-Year Rainfall=3.10" Area (sf) CN Description 3,895 100.00% Impervious Area 3,895 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) 6.0 Direct Entry, Subcatchment R-12: Roof - Units 23&24 - (A Units 2	2.87"	
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 Fype III 24-hr 3,895 98 0.00% Impervious Area 3,895 100.00% 100.00% Impervious Area 3,895 100.00% 100.00% Impervious Area 3,895 100.00% 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) 6.0 Direct Entry, Subcatchment R-12: Roof - Units 23&24 - (A U		
ype III 24-hr 2-Year Rainfall=3.10" Area (sf) CN Description 3,895 98 Unconnected roofs, HSG A 3,895 100.00% Impervious Area 3,895 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-12: Roof - Units 23&24 - (A Units 23&24	hrs, dt= 0.01 hrs	
3,895 98 Unconnected roofs, HSG A 3,895 100.00% Impervious Area 3,895 100.00% Unconnected Tc Length (fet) Slope Velocity Capacity Description (min) (feet) (ft/ft) 6.0 Direct Entry, Subcatchment R-12: Roof - Units 23&24 - (A Units 23&24		
3,895 100.00% Impervious Area 3,895 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) Direct Entry, 6.0 Direct Entry, Subcatchment R-12: Roof - Units 23&24 - (A Units 23&24 -		
3,895 100.00% Unconnected Tc Length Slope Velocity Capacity Description (fiet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-12: Roof - Units 23&24 - (A Un Hydrograph 0.27 cfs 0.26 0.26 0.27 cfs 0.27 cfs 0		
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-12: Roof - Units 23&24 - (A Units		
Subcatchment R-12: Roof - Units 23&24 - (A Units 23&24 -		
Hydrograph 0.28 0.27 cfs 0.26 0.27 cfs 0.24 2-Year Rainfall=3.10" 0.22 0.2 0.21 Runoff Area=3,895 sf 0.14 Runoff Depth>2.87" 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.15 0.14 0.14 0.14 0.15 0.14 0.15 0.14 0.15 0.14		
Hydrograph 0.28 0.27 cfs 0.26 0.27 cfs 0.24 2-Year Rainfall=3.10" 0.22 0.2 0.21 Runoff Area=3,895 sf 0.14 Runoff Depth>2.87" 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.14 0.15 0.14 0.14 0.14 0.15 0.14 0.15 0.14 0.15 0.14	ite)	
0.3 0.28 0.26 0.24 0.16 Runoff Area=3,895 sf Runoff Volume=0.021 af Runoff Depth>2.87'' Tc=6.0 min CN=98	10)	
0.08 0.06 0.04 0.02		Runoff
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 Time (hours)	21 22 23 24	



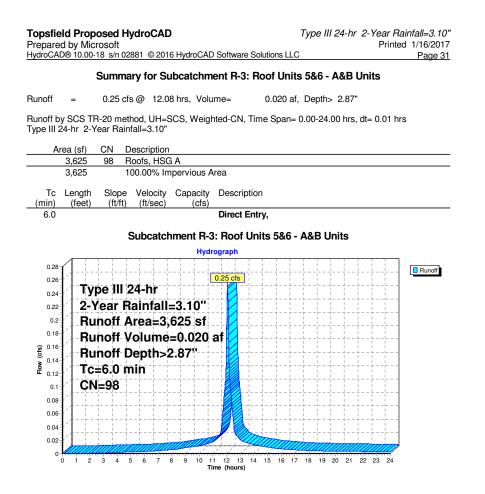
epared by Mi	posed HydroCAD crosoft D-18 s/n 02881 © 2016 HydroCAD Software		Year Rainfall=3.10 Printed 1/16/2017 Page 26
:	Summary for Subcatchment R-14:	Roof Units 27&28 - A&B U	nits
unoff =	0.25 cfs @ 12.08 hrs, Volume=	0.020 af, Depth> 2.87"	
	R-20 method, UH=SCS, Weighted-CN, Year Rainfall=3.10"	Time Span= 0.00-24.00 hrs, dt=	0.01 hrs
Area (sf)	CN Description		
3,625	98 Roofs, HSG A		
3,625	100.00% Impervious Area		
Tc Length (min) (feet)		otion	
6.0	Direct I	Entry,	
	Subcatchment R-14: Roof L	Inits 27&28 - A&B Inits	
	Hydrograph		
0.22 0.22 0.22 0.18 0.18 0.16 0.16 0.16 0.16 0.16 0.16 0.16	/pe III 24-hr Year Rainfall=3.10" unoff Area=3,625 sf unoff Volume=0.020 af unoff Depth>2.87" 2=6.0 min N=98		
0 1 2	2 3 4 5 6 7 8 9 10 11 12 13 Time (hours)	14 15 16 17 18 19 20 21 22	23 24



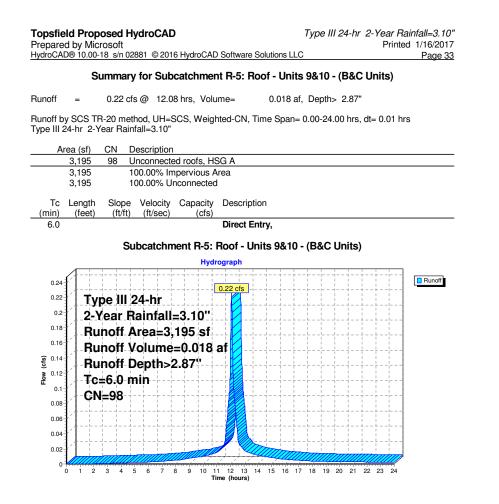
Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC	Type III 24-hr 2-Year Rainfall=3.10" Printed 1/16/2017 C Page 28
Summary for Subcatchment R-16: From	nt Units 29&30
Runoff = 0.10 cfs @ 12.08 hrs, Volume= 0.008 af	, Depth> 2.87"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= Type III 24-hr 2-Year Rainfall=3.10"	0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
1,490 98 Unconnected roofs, HSG A	
1,490 100.00% Impervious Area 1,490 100.00% Unconnected	
Tc Length Slope Velocity Capacity Description	
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry,	
0.0 Direct Lift y,	
Subcatchment R-16: Front Units	s 29&30
Hydrograph	
0.115 0.10 cfs 0.115 0.10 cfs 0.10 0.10 cfs 0.09 2-Year Rainfall=3.10" 0.085 0.065 0.005 Runoff Area=1,490 sf 0.0055 0.065 0.0055 Runoff Depth>2.87" 0.044 CN=98 0.045 0.045 0.045 CN=98 0.045 0.045 0.045 0.045 0.045 CN=98 0.045 0.045 0.045 0.045 0.045 0.045 0.045 CN=98 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045 0.045	Runoff



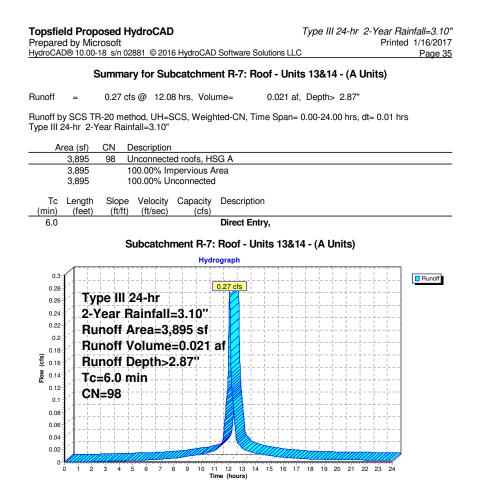
repared by M /droCAD® 10.0		016 HydroCAD Software	e Solutions LLC	;	Printed 1/16/201 Page 3
	Summary for S	ubcatchment R-2:	Roof Units	3&4 - (B & C I	Units)
unoff =	0.22 cfs @ 12	2.08 hrs, Volume=	0.018 af,	Depth> 2.87"	
	TR-20 method, UH -Year Rainfall=3.10	l=SCS, Weighted-CN, 0"	Time Span=	0.00-24.00 hrs,	dt= 0.01 hrs
Area (sf)	CN Descripti				
3,195		cted roofs, HSG A			
3,195 3,195		Impervious Area Unconnected			
To Longet			tion		
Tc Lengtl (min) (feet			DUON		
6.0		Direct	Entry,		
	Subcato	hment R-2: Roof U	nits 3&4 - (l	B & C Units)	
		Hydrograph			
A				+	+
0.24		0.22 cfs			+
	ype III 24-hr				
1/1	Year Rainfa				
	unoff Area=	3,195 sf 🔣			
	unoff Volum	e=0.018 af 💋 -			
(\$) 0.14 0.12 0.12	unoff Depth	>2.87''			
₽ ^{0.12}	c=6.0 min		+++		+
^{0.1}	N=98	· - +	++		+
0.08			+++		+
0.06					
0.04			¥		
0.02			UIIIIIIII		
0	2 3 4 5 6 7	8 9 10 11 12 13	14 15 16 17	18 19 20 21	22 23 24
		Time (hours)			



hand for a constraint of the second s	repare	Id Proposed HydroCAD d by Microsoft)® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solu		Year Rainfall=3.10 Printed 1/16/2017 Page 32
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs ype III 24-hr 2-Year Rainfall=3.10" Area (sf) CN Description 3,625 98 Unconnected roofs, HSG A 3,625 100.00% Impervious Area 3,625 Impervious Area 1,2 Impervious Area 3,625 Impervious Area 1,2 Impervious Area 3,625 Impervious Area 3,625 Impervious Area 1,2 Impervious Area 1,2 Impervious Area 3,625 Impervious Area 1,2 Impervious Area 3,625 Impervious Area 1,2 Impervious Area 3,625 Impervious Area 1,2 Impervious Area 3,625 Impervious Area 1,2		Summary for Subcatchment R-4: Root	f - Units 7&8 - (A&B Ur	nits)
Type III 24-hr 2-Year Rainfall=3.10" Area (sf) CN Description 3,625 98 Unconnected roofs, HSG A 3,625 100.00% Impervious Area 3,625 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sc) (cfs) 6.0 Direct Entry, Subcatchment R-4: Roof - Units 7&8 - (A&B Units) Hydrograph 0.25 cfs 0.25 cfs 0.26 cfs 0.25 cfs 0.25 cfs 0.27 class Runoff Area=3,625 sf Runoff Runoff Runoff 8unoff Volume=0.020 af Runoff 0.28 cfs Runoff Runoff 0.29 cfs 0.01 11 12 13 14 15 16 17 18 19 20 21 22 23 24	unoff	= 0.25 cfs @ 12.08 hrs, Volume= 0	0.020 af, Depth> 2.87"	
3,625 98 Unconnected roofs, HSG A 3,625 100.00% Impervious Area 3,625 100.00% Unconnected Tc Length (ff/ft) Slope (ft/ft) Velocity (ft/sec) Capacity (cfs) Description 6.0 Direct Entry, Subcatchment R-4: Roof - Units 7&8 - (A&B Units) Hydrograph 0.28 0.24 0.25 cfs 0.25 cfs 0.29 0.24 0.25 cfs 0.25 cfs 0.25 cfs 0.29 0.20 af Runoff Depth>2.87" 0.20 af 0.20 af 0.08 0.04 0.02 0.04 0.04 0.04 0.09 0.1 2 3 4 5 6 7 8 9 10			e Span= 0.00-24.00 hrs, dt	= 0.01 hrs
3,625 3,625 100.00% Impervious Area 3,625 100.00% Unconnected Tc Length Slope Velocity Capacity Description (furth) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-4: Roof - Units 7&8 - (A&B Units) Hydrograph 0.25 cfs 12. Year Rainfall=3.10" Runoff Area=3,625 sf Runoff Area=3,625 sf Runoff Volume=0.020 af Runoff Depth>2.87' Tc=6.0 min CN=98 0.06 0.06 0.07 0.0	Ar	ea (sf) CN Description		
3,625 100.00% Unconnected Tc Length Slope Velocity Capacity Description 6.0 Direct Entry, Subcatchment R-4: Roof - Units 7&8 - (A&B Units) Hydrograph 0.25 cfs 7 ype III 24-hr 2-Year Rainfall=3.10" Runoff Area=3,625 sf Runoff Volume=0.020 af Runoff Depth>2.87' Tc=6.0 min CN=98 0.44 0.25 cfs 1 c = 6.0 min CN=98 0.44 0.25 cfs 1 c = 6.0 min CN=98 0.44 0.25 cfs 1 c = 6.0 min CN=98 0.44 0.44 0.44 0.45				
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-4: Roof - Units 7&8 - (A&B Units) Hydrograph 0.28 0.26 0.24 0.26 0.26 0.27 0.28 0.26 0.24 0.29 0.01 0.29 0.02 0.02 0.02 0.02 0.01 0.02 0.				
6.0 Direct Entry, Subcatchment R-4: Roof - Units 7&8 - (A&B Units) Hydrograph				
Hydrograph 0.28 0.24 0.24 0.24 0.24 0.25 cfs Type III 24-hr 2-Year Rainfall=3.10" Runoff Area=3,625 sf Runoff Volume=0.020 af Runoff Depth>2.87" Tc=6.0 min CN=98 0.06 0.04 0.02 0.01 0.05 0.01 0.02 0.02 0.01 0.02 0.01 0.02 0.01 0.02 0.02 0.02 0.01 0.02 0.02 0.02 0.02 0.01 0.02 0.0			,	
Hydrograph 0.28 0.24 0.24 0.24 0.24 0.25 cfs Type III 24-hr 2-Year Rainfall=3.10" Runoff Area=3,625 sf Runoff Volume=0.020 af Runoff Depth>2.87" Tc=6.0 min CN=98 0.6 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.7 0.7		Subastahmant P.4: Poof - Unit	78.9 - (ASR Lipite)	
0.28 0.26 0.25 cfs 0.25 cfs 0.24 0.29 cfs 0.26 cfs 0.21 cfs 0.29 0.29 cfs 0.20 cfs 0.20 cfs 0.29 0.29 cfs 0.20 cfs 0.20 cfs 0.29 0.29 cfs 0.20 cfs 0.20 cfs 0.20 0.16 cfs 0.20 cfs 0.20 cfs 0.16 cfs 0.14 cfs 0.20 cfs 0.20 cfs 0.16 cfs 0.16 cfs 0.20 cfs 0.20 cfs 0.16 cfs 0.16 cfs 0.20 cfs 0.20 cfs 0.16 cfs 0.20 cfs 0.20 cfs 0.20 cfs 0.016 cfs 0.20 cfs 0.20 cfs 0.20 cfs 0.02 cfs 0.20 cfs 0.20 cfs 0.20 cfs			S / do - (Adb Units)	
0.26 0.27 0.24 0.24 0.24 0.24 0.24 2-Year Rainfall=3.10" 0.26 0.16 0.16 Runoff Area=3,625 sf 0.16 Runoff Depth>2.87" 0.16 CN=98 0.16 CN=98 0.17 CN=98 0.19 CN=98 0.11 12 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 22 24		nyarograph		
0.24 Type III 24-hr 0.22 2-Year Rainfall=3.10" 0.23 Runoff Area=3,625 sf 0.16 Runoff Volume=0.020 af 0.16 Tc=6.0 min 0.17 CN=98 0.08 CN=98 0.04 CN=98 0.05 CN=98 0.06 CN=98 0.07 CN=98 0.08 CN=98 0.04 CN=98 0.05 CN=98 0.06 CN=98 0.07 CN=98 0.08 CN=98 0.04 CN=98 0.05 CN=98 0.06 CN=98 0.07 CN=98 0.08 CN=98 0.09 CN=98 0.01 CN=98 0.02 CN=98 0.03 CN=98 0.04 CN=98 0.05 CN=98 0.06 CN=98 0.07 CN=98 0.08 CN=98 0.09 CN=98 0.01 CN=98				Runoff
2-Year Rainfall=3.10" Runoff Area=3,625 sf Runoff Volume=0.020 af Runoff Depth>2.87" Tc=6.0 min CN=98 0.16 0.16 0.16 0.16 0.17 18 19 20 21 22 23 24			· - +	
02 0.16 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.17 0.14 0.18 0.14 0.19 0.14 0.14 0.14 0.15 0.14 0.16 0.14 0.17 0.14 0.18 0.14 0.19 0.14 0.14 0.14 0.15 0.14 0.14 0.14 0.15 0.14 0.14 0.14 0.15 0.14 0.15 0.14 0.15 0.14 0.15 0.14 0.15 0.14 0.15 0.14 0.15 0.14 0.15 0.14 0.15 0.14 0.15				+
0.16 -Runoff Volume=0.020 af 0.16 -Runoff Depth>2.87" 0.16 -Tc=6.0 min 0.17 -Tc=6.0 min 0.08		*		
9 0.16 Runoff Depth>2.87" 0.12 0.1 CN=98 0.06 0.04 0.06 0.04 0.01 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 12 22 24				
5 0.14 0.12 0.1 CN=98 0.14 CN=98 0.14 CN=98 0.14 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24		[} -Runoff-Volume=0.020 af 💋		L
CN=98 CN=98 CN=98 CN=2	(sj)	Runoff Depth>2.87"	· - +	+
CN=98 CN=98 CN=98 CN=2	NO 0.14	Tc=6.0 min		
	- 0.12			
			· - + + + + +	+
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24		· · · · · · · · · · · · · · · · · · ·		
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24				
Time (hours)			5 16 17 18 19 20 21 22	23 24
		Time (hours)		



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	Summary for Subcatchment R-6: Roof - Units 11&12 - (B&A Units)
Runoff	= 0.25 cfs @ 12.08 hrs, Volume= 0.020 af, Depth> 2.87"
	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs -hr 2-Year Rainfall=3.10"
,,	
	a (sf) CN Description 3.625 98 Unconnected roofs, HSG A
	3,625 100.00% Impervious Area
	3,625 100.00% Unconnected
	ength Slope Velocity Capacity Description
(min) 6.0	(feet) (ft/ft) (ft/sec) (cfs) Direct Entry,
0.0	Direct End y,
	Subcatchment R-6: Roof - Units 11&12 - (B&A Units)
	Hydrograph
0.28	
0.26	0.25 cfs
0.24	Type III 24-hr
0.22	2-Year Rainfall=3.10"
0.2	Runoff Area=3,625 sf
0.18	-Runoff Volume=0.020 af
(S) 0.16	Runoff Depth>2.87"
0.16 0.14	Tc=6.0 min
0.12	
0.1	CN=98
0.08	
0.06	
0.04	
0.02	



	Summary for Subcatchment R-8: Roof - Units 15&16 - (B&A Units)
Runoff	= 0.25 cfs @ 12.08 hrs, Volume= 0.020 af, Depth> 2.87"
	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
	4-hr 2-Year Rainfall=3.10"
	ea (sf) CN Description 3.625 98 Unconnected roofs, HSG A
	3,625 100.00% Impervious Area
	3,625 100.00% Unconnected
Тс	Length Slope Velocity Capacity Description
(min)	(feet) (ft/ft) (ft/sec) (cfs)
6.0	Direct Entry,
	Subcatchment R-8: Roof - Units 15&16 - (B&A Units)
	Hydrograph
0.28	
0.26	
0.24	Type III 24-hr
0.22	2-Year Rainfall=3.10"
0.2 0.18	Runoff Area=3,625 sf
	/-Runoff Volume=0.020 af
(cts) 0.16	Runoff Depth>2.87"
출 0.12	∕ † Tc=6.0 min
0.1	/ CN=98
0.08	
0.06	
0.04	
0.02	



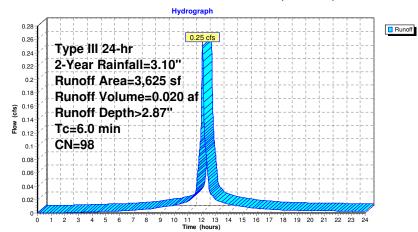
Summary for Subcatchment R-9: Roof - Units 17&18 - (A&B Units)

Runoff = 0.25 cfs @ 12.08 hrs, Volume= 0.020 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

A	rea (sf)	CN I	Description				
	3,625	98	8 Unconnected roofs, HSG A				
	3,625		100.00% In	pervious A	rea		
	3,625		100.00% Ui	nconnected			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description		
6.0					Direct Entry,		

Subcatchment R-9: Roof - Units 17&18 - (A&B Units)



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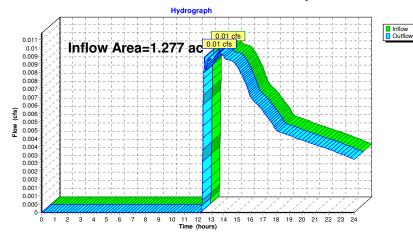
Summary for Reach SP-1: Wetlands South of Driveway

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

Inflow Area =	1.277 ac, 33.99% Impervious, Inflow	v Depth > 0.05"	for 2-Year event
Inflow =	0.01 cfs @ 13.62 hrs, Volume=	0.006 af	
Outflow =	0.01 cfs @ 13.62 hrs, Volume=	0.006 af, Atte	en= 0%, Lag= 0.0 min

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

Reach SP-1: Wetlands South of Driveway



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 Type III 24-hr
 2-Year Rainfall=3.10"

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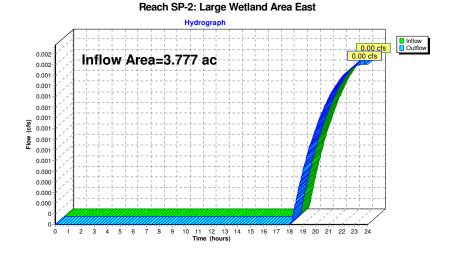
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Summary for Reach SP-2: Large Wetland Area East

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

Inflow Area =	3.777 ac, 26.87% Impervious, Inflow Depth > 0.00" for 2-Year event
Inflow =	0.00 cfs @ 23.74 hrs, Volume= 0.001 af
Outflow =	0.00 cfs @ 23.74 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

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



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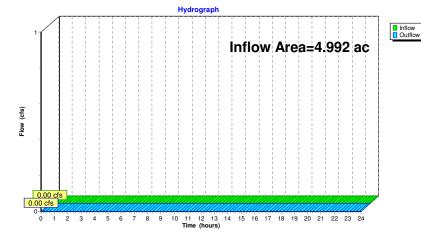
Summary for Reach SP-3: Large Wetland Area West

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

Inflow Area =	4.992 ac, 3	1.07% Impervious, Inflow	v Depth = 0.00"	for 2-Year event
Inflow =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	
Outflow =	0.00 cfs @	0.00 hrs, Volume=	0.000 af, Atte	en= 0%, Lag= 0.0 min

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

Reach SP-3: Large Wetland Area West



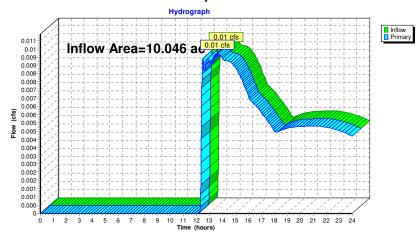
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Summary for Pond 1P: Combined Study Points - Northern Wetlands

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

Inflow Area =	10.046 ac, 29.86% Impervious, Inflow Depth > 0.01" for 2-Year event
Inflow =	0.01 cfs @ 13.62 hrs, Volume= 0.006 af
Primary =	0.01 cfs @ 13.62 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min

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



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Summary for Pond D-1: Surface Infiltration Pond

Inflow Area =	2.637 ac, 56.80% Impervious, Inflow De	epth > 1.07" for 2-Year event
Inflow =	3.58 cfs @ 12.10 hrs, Volume=	0.236 af
Outflow =	0.09 cfs @ 17.35 hrs, Volume=	0.086 af, Atten= 98%, Lag= 315.0 min
Discarded =	0.09 cfs @ 17.35 hrs, Volume=	0.086 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= 68.76' @ 17.35 hrs Surf.Area= 3,625 sf Storage= 7,349 cf Flood Elev= 71.10' Surf.Area= 5,491 sf Storage= 17,958 cf

Plug-Flow detention time= 352.4 min calculated for 0.086 af (36% of inflow) Center-of-Mass det. time= 241.3 min (1,068.4 - 827.1)

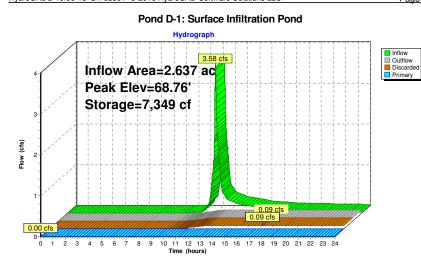
Volume	Invert	Avail.Sto	rage Storage	e Description	
#1	66.00	56,23	33 cf Custor	n Stage Data (Pris	matic) Listed below (Recalc)
Elevatio	-	urf.Area	Inc.Store	Cum.Store	
(fee	et)	(sq-ft)	(cubic-feet)	(cubic-feet)	
66.0	00	1,817	0	0	
67.0	00	2,361	2,089	2,089	
68.0	00	3,059	2,710	4,799	
69.0	00	3,800	3,430	8,229	
70.0	00	4,583	4,192	12,420	
71.0	00	5,403	4,993	17,413	
72.0	00	6,280	5,842	23,255	
73.0	00	7,213	6,747	30,001	
74.0	00	8,202	7,708	37,709	
75.0	00	9,248	8,725	46,434	
76.0	00	10,350	9,799	56,233	
Device	Routing	Invert	Outlet Devic	es	
#1 #2	Discarded Primary	66.00' 70.00'	15.0" Round Inlet / Outlet		

Discarded OutFlow Max=0.09 cfs @ 17.35 hrs HW=68.76' (Free Discharge) 1=Exfiltration (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=66.00' (Free Discharge)

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Summary for Pond D-2: Existing Detention Basin

Inflow Area =	0.531 ac, 59.77% Impervious, Inflow Depth > 1.39" for 2-Year event
Inflow =	0.86 cfs @ 12.09 hrs, Volume= 0.061 af
Outflow =	0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary =	0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.07' @ 24.00 hrs Surf.Area= 3,090 sf Storage= 2,675 cf Flood Elev= 58.08' Surf.Area= 3,090 sf Storage= 2,719 cf

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

Volume	Inve	ert Avail.Sto	orage Storage	Description	
#1	57.2	20' 9,0	20 cf Custom	Stage Data (Prism	atic) Listed below (Recalc)
Elevatio	on	Surf.Area	Inc.Store	Cum.Store	
(fee	et)	(sq-ft)	(cubic-feet)	(cubic-feet)	
57.2	20	3,090	0	0	
58.0	00	3,090	2,472	2,472	
59.0	00	3,090	3,090	5,562	
59.4	40	3,550	1,328	6,890	
60.0	00	3,550	2,130	9,020	
Device	Routing	Invert	Outlet Device	S	
#1	Primary	58.08'	4.0" Vert. Orif	ice/Grate C= 0.6	00
#2	Primary	58.80'	8.0" Vert. Orif	ice/Grate C= 0.6	00

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=57.20' (Free Discharge) 1=Orifice/Grate (Controls 0.00 cfs) 2=Orifice/Grate (Controls 0.00 cfs)

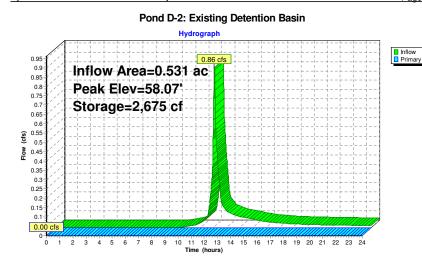
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Summary for Pond D-3: Detention Pond by Access Road

Inflow Area =	0.114 ac, 31.35% Impervious, Inflow De	epth > 0.82" for 2-Year event
Inflow =	0.10 cfs @ 12.10 hrs, Volume=	0.008 af
Outflow =	0.02 cfs @ 12.58 hrs, Volume=	0.008 af, Atten= 78%, Lag= 28.7 min
Discarded =	0.02 cfs @ 12.58 hrs, Volume=	0.008 af
Primary =	0.00 cfs @ 0.00 hrs, Volume=	0.000 af

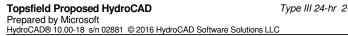
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 63.24' @ 12.58 hrs Surf.Area= 386 sf Storage= 81 cf

Plug-Flow detention time= 26.9 min calculated for 0.008 af (100% of inflow) Center-of-Mass det. time= 26.3 min (899.9 - 873.6)

Volume	Inve	ert Avail.Stor	age Storage	e Description
#1	63.0	0' 47	'8 cf Custom	n Stage Data (Prismatic) Listed below (Recalc)
Elevatio	on s	Surf.Area	Inc.Store	Cum.Store
(fee	t)	(sq-ft)	(cubic-feet)	(cubic-feet)
63.0	0	305	0	0
64.0	0	650	478	478
Device	Routing	Invert	Outlet Device	es
#1	Primary	64.00'	5.0' long x 5.	5.0' breadth Broad-Crested Rectangular Weir
			Head (feet) C	0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00
			2.50 3.00 3.	.50 4.00 4.50 5.00 5.50
			Coef. (Englisl	sh) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2
			2.67 2.66 2.0	.68 2.70 2.74 2.79 2.88
#2	Discarde	d 63.00'	2.410 in/hr Ex	xfiltration over Horizontal area

Discarded OutFlow Max=0.02 cfs @ 12.58 hrs HW=63.24' (Free Discharge) **12=Exfiltration** (Exfiltration Controls 0.02 cfs)

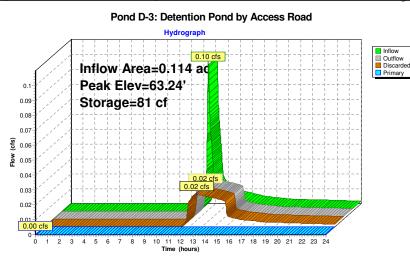
Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=63.00' (Free Discharge)



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Summary for Pond UIS-1: UIS at Entrance

Inflow Area	=	1.487 ac, 4	0.11% Imp	ervious,	Inflow Depth	ı> 1.37	7" for 2-Ye	ear event
Inflow :	=	2.23 cfs @	12.09 hrs,	Volume	= 0.1	70 af		
Outflow :	=	0.08 cfs @	11.39 hrs,	Volume	= 0.0	99 af, A	Atten= 96%,	Lag= 0.0 min
Discarded :	=	0.08 cfs @	11.39 hrs,	Volume	= 0.0	99 af		
Primary :	-	0.00 cfs @	0.00 hrs,	Volume	= 0.0	00 af		

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 61.91' @ 16.20 hrs Surf.Area= 3,486 sf Storage= 4,105 cf Flood Elev= 68.40' Surf.Area= 3,486 sf Storage= 13,284 cf

Plug-Flow detention time= 292.9 min calculated for 0.099 af (58% of inflow) Center-of-Mass det. time= 172.7 min (993.1 - 820.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	60.00'	5,089 cf	50.50'W x 69.03'L x 6.00'H Field A
			20,917 cf Overall - 8,195 cf Embedded = 12,722 cf x 40.0% Voids
#2A	61.00'	8,195 cf	Cultec R-902HD x 126 Inside #1
			Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
			Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
			7 Rows of 18 Chambers
			Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
		12 294 of	Total Available Storage

13,284 cf Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices	
#1	Discarded	60.00'	1.020 in/hr Exfiltration over Surface	ce area
#2	Primary	68.40'	24.0" x 24.0" Horiz. Orifice/Grate	C= 0.600
	-		Limited to weir flow at low heads	

Discarded OutFlow Max=0.08 cfs @ 11.39 hrs HW=60.08' (Free Discharge)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.00' (Free Discharge)

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Pond UIS-1: UIS at Entrance - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)

Effective Size= $69.8''W \times 48.0''H \Rightarrow 17.65 \text{ sf } x 3.67'L = 64.7 \text{ cf}$ Overall Size= $78.0''W \times 48.0''H \times 4.10'L \text{ with } 0.44' \text{ Overlap}$ Cap Storage= $+2.8 \text{ cf } x 2 \times 7 \text{ rows} = 38.6 \text{ cf}$

78.0" Wide + 6.0" Spacing = 84.0" C-C Row Spacing

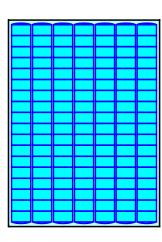
18 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 67.03' Row Length +12.0" End Stone x 2 = 69.03' Base Length 7 Rows x 78.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 50.50' Base Width 12.0" Base + 48.0" Chamber Height + 12.0" Cover = 6.00' Field Height

126 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 8,195.2 cf Chamber Storage

20,917.1 cf Field - 8,195.2 cf Chambers = 12,721.9 cf Stone x 40.0% Voids = 5,088.7 cf Stone Storage

Chamber Storage + Stone Storage = 13,284.0 cf = 0.305 af Overall Storage Efficiency = 63.5%Overall System Size = $69.03' \times 50.50' \times 6.00'$

126 Chambers 774.7 cy Field 471.2 cy Stone





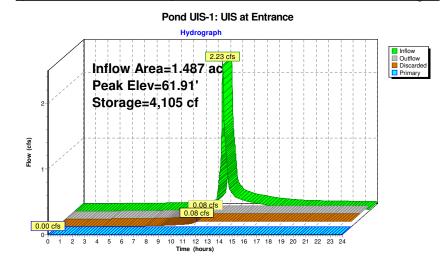
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Summary for Pond UIS-2: UIS at North of Site

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Inflow Area =	0.419 ac,100.00% Impervious, Inflow D	Depth > 2.87" for 2-Year event
Inflow =	1.26 cfs @ 12.08 hrs, Volume=	0.100 af
Outflow =	0.23 cfs @ 11.70 hrs, Volume=	0.100 af, Atten= 82%, Lag= 0.0 min
Discarded =	0.23 cfs @ 11.70 hrs, Volume=	0.100 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= 63.15' @ 12.53 hrs Surf.Area= 1,176 sf Storage= 1,100 cf Flood Elev= 68.25' Surf.Area= 1,176 sf Storage= 2,860 cf

Plug-Flow detention time= 26.6 min calculated for 0.100 af (100% of inflow) Center-of-Mass det. time= 26.4 min (782.9 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	61.50'	1,262 cf	16.00'W x 73.50'L x 4.04'H Field A
			4,753 cf Overall - 1,598 cf Embedded = 3,155 cf x 40.0% Voids
#2A	62.50'	1,598 cf	Cultec R-330XLHD x 30 Inside #1
			Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
			Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
			Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		2,860 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	61.50'	8.270 in/hr Exfiltration over Surface area
#2	Primary	68.25'	6.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.23 cfs @ 11.70 hrs HW=61.57' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=61.50' (Free Discharge)

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Pond UIS-2: UIS at North of Site - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

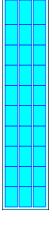
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length 3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width 12.0" Base + 30.5" Chamber Height + 6.0" Cover = 4.04' Field Height

30 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 1,598.2 cf Chamber Storage

4,753.0 cf Field - 1,598.2 cf Chambers = 3,154.8 cf Stone x 40.0% Voids = 1,261.9 cf Stone Storage

Chamber Storage + Stone Storage = 2,860.1 cf = 0.066 af Overall Storage Efficiency = 60.2% Overall System Size = 73.50' x 16.00' x 4.04'

30 Chambers 176.0 cy Field 116.8 cy Stone



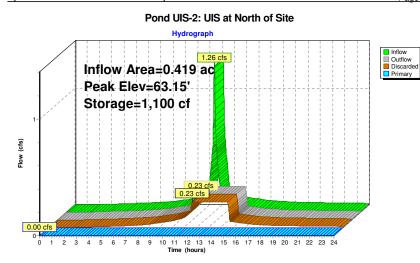
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Summary for Pond UIS-3: UIS-3

[58] Hint: Peaked 1.46' above defined flood level

Inflow Area =	0.083 ac,100.00% Impervious, Inflow De	epth > 2.87" for 2-Year event
Inflow =	0.25 cfs @ 12.08 hrs, Volume=	0.020 af
Outflow =	0.25 cfs @ 12.10 hrs, Volume=	0.017 af, Atten= 1%, Lag= 0.7 min
Discarded =	0.00 cfs @ 5.30 hrs, Volume=	0.004 af
Primary =	0.25 cfs @ 12.10 hrs, Volume=	0.013 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 73.67' @ 12.10 hrs Surf.Area= 103 sf Storage= 130 cf Flood Elev= 72.21' Surf.Area= 103 sf Storage= 22 cf

Plug-Flow detention time= 87.7 min calculated for 0.017 af (87% of inflow) Center-of-Mass det. time= 29.7 min (786.3 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	71.69'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	72.19'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	71.69'	1.020 in/hr Exfiltration over Surface area
#2	Primary	73.40'	6.0" Round Culvert L= 30.0' Ke= 0.200 Inlet / Outlet Invert= 73.40' / 70.70' S= 0.0900 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 5.30 hrs HW=71.72' (Free Discharge)

Primary OutFlow Max=0.24 cfs @ 12.10 hrs HW=73.67' (Free Discharge) -2=Culvert (Inlet Controls 0.24 cfs @ 2.23 fps)
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Pond UIS-3: UIS-3 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

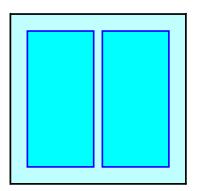
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

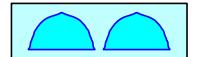
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

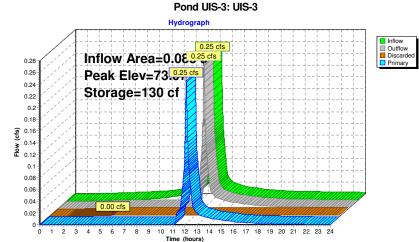
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$









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Type III 24-hr 2-Year Rainfall=3.10" Printed 1/16/2017 Page 57

Summary for Pond UIS-4: UIS-4

[58] Hint: Peaked 0.35' above defined flood level

Inflow Area =	0.073 ac,100.00% Impervious, Inflow Depth > 2.87" for 2-Year event
Inflow =	0.22 cfs @ 12.08 hrs, Volume= 0.018 af
Outflow =	0.22 cfs @ 12.10 hrs, Volume= 0.015 af, Atten= 2%, Lag= 1.1 min
Discarded =	0.00 cfs @ 5.85 hrs, Volume= 0.004 af
Primary =	0.21 cfs @ 12.10 hrs, Volume= 0.011 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 74.55' @ 12.10 hrs Surf.Area= 103 sf Storage= 134 cf Flood Elev= 74.20' Surf.Area= 103 sf Storage= 111 cf

Plug-Flow detention time= 94.4 min calculated for 0.015 af (86% of inflow) Center-of-Mass det. time= 32.3 min (788.8 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	72.50'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	73.00'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	72.50'	1.020 in/hr Exfiltration over Surface area
#2	Primary	74.20'	6.0" Round Culvert L= 30.0' Ke= 1.000 Inlet / Outlet Invert= 74.20' / 74.06' S= 0.0047 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 5.85 hrs HW=72.53' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.21 cfs @ 12.10 hrs HW=74.55' (Free Discharge) -2=Culvert (Barrel Controls 0.21 cfs @ 2.01 fps)

Topsfield Proposed HydroCAD	Type III 24-hr 2-Year Rainfall=3.10"
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Pond UIS-4: UIS-4 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

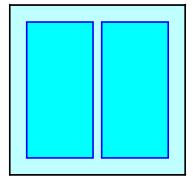
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

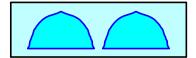
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

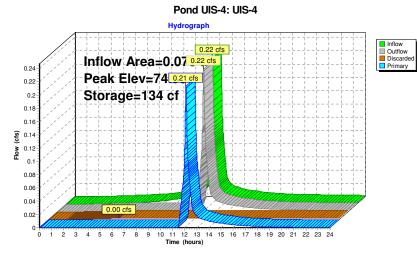
Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'







Type III 24-hr 2-Year Rainfall=3.10" Printed 1/16/2017 Page 59



	by Microso ® 10.00-18 s		Printed 1/16/201 HydroCAD Software Solutions LLC Page 6
		Su	mmary for Pond UIS-5: UIS-5
	$ \begin{array}{c} = & 0.2 \\ = & 0.2 \\ = & 0.2 \\ 1 = & 0.0 \\ = & 0.2 \end{array} $	25 cfs @ 12.08 24 cfs @ 12.10 00 cfs @ 5.30 24 cfs @ 12.10	hrs, Volume= 0.017 af, Atten= 2%, Lag= 1.0 min hrs, Volume= 0.004 af
Plug-Flow	detention til	me= 88.8 min ca	Area= 103 sf Storage= 136 cf Iculated for 0.017 af (87% of inflow)
Center-of-	Mass det. til	me= 30.6 min (7	(87.1 - 756.5)
Volume	Invert		Storage Description
#1A	73.09'	94 cf	10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	73.59'	97 cf	
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
0		191 cf reated with Char	nber Wizard
Device I #1 I	e Group A c Routing Discarded Primary	reated with Char Invert Out 73.09' 1.0 74.80' 6.0 Inle	Total Available Storage mber Wizard tlet Devices 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900
Device #1 #2 Discarded	Routing Discarded Primary	reated with Char <u>Invert</u> Out 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 9	Total Available Storage mber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 t/ Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge)
Device #1 #2 Discarded	Routing Discarded Primary	reated with Char <u>Invert</u> Ou 73.09' 1.0 74.80' 6.0 Inle n=	Total Available Storage mber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 t/ Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge)
Device I #1 I #2 I Discardec 1=Exfil Primary C	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Char Invert Out 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 9 iltration Controls	Total Available Storage nber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge) 0.000 cfs) .10 hrs HW=75.17' (Free Discharge)
Device I #1 I #2 I Discardec 1=Exfil Primary C	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Char <u>Invert</u> Ou 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 1 iltration Controls x=0.24 cfs @ 12	Total Available Storage nber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge) 0.000 cfs) .10 hrs HW=75.17' (Free Discharge)
Device I #1 I #2 I Discardec 1=Exfil Primary C	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Char <u>Invert</u> Ou 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 1 iltration Controls x=0.24 cfs @ 12	Total Available Storage nber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge) 0.00 cfs) .10 hrs HW=75.17' (Free Discharge)
Device I #1 I #2 I Discardec 1=Exfil Primary C	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Char <u>Invert</u> Ou 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 1 iltration Controls x=0.24 cfs @ 12	Total Available Storage nber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge) 0.00 cfs) .10 hrs HW=75.17' (Free Discharge)
Device I #1 I #2 I Discardec 1=Exfil Primary C	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Char <u>Invert</u> Ou 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 1 iltration Controls x=0.24 cfs @ 12	Total Available Storage nber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge) 0.00 cfs) .10 hrs HW=75.17' (Free Discharge)
Device I #1 I #2 I Discardec 1=Exfil Primary C	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Char <u>Invert</u> Ou 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 1 iltration Controls x=0.24 cfs @ 12	Total Available Storage nber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge) 0.000 cfs) .10 hrs HW=75.17' (Free Discharge)
Device I #1 I #2 I Discardec 1=Exfil Primary C	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Char <u>Invert</u> Ou 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 1 iltration Controls x=0.24 cfs @ 12	Total Available Storage nber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge) 0.000 cfs) .10 hrs HW=75.17' (Free Discharge)
Device I #1 I #2 I Discardec 1=Exfil Primary C	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Char <u>Invert</u> Ou 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 1 iltration Controls x=0.24 cfs @ 12	Total Available Storage nber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge) 0.00 cfs) .10 hrs HW=75.17' (Free Discharge)
Device I #1 I #2 I Discardec 1=Exfil Primary C	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Char <u>Invert</u> Ou 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 1 iltration Controls x=0.24 cfs @ 12	Total Available Storage nber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge) 0.000 cfs) .10 hrs HW=75.17' (Free Discharge)
Device I #1 I #2 I Discardec 1=Exfil Primary C	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Char <u>Invert</u> Ou 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 1 iltration Controls x=0.24 cfs @ 12	Total Available Storage nber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge) 0.000 cfs) .10 hrs HW=75.17' (Free Discharge)
Device I #1 I #2 I Discardec 1=Exfil Primary C	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Char <u>Invert</u> Ou 73.09' 1.0 74.80' 6.0 Inle n= Max=0.00 cfs @ 1 iltration Controls x=0.24 cfs @ 12	Total Available Storage nber Wizard <u>tlet Devices</u> 20 in/hr Exfiltration over Surface area " Round Culvert L= 22.0' Ke= 1.000 et / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=73.12' (Free Discharge) 0.000 cfs) .10 hrs HW=75.17' (Free Discharge)

 Topsfield Proposed HydroCAD
 Type

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 Type III 24-hr
 2-Year Rainfall=3.10"

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Pond UIS-5: UIS-5 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

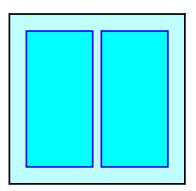
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

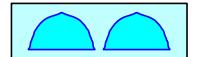
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

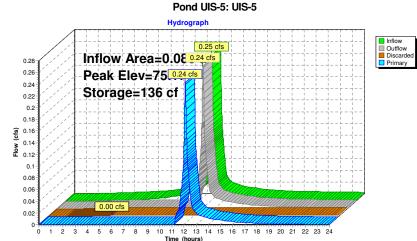
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$









		Sur	mmary for Pond UIS-6: UIS-6
		Cui	
nflow Area	•• ••		Impervious, Inflow Depth > 2.87" for 2-Year event
nflow Dutflow		27 cfs @ 12.08 h 26 cfs @ 12.10 h	
Discarded		0 cfs @ 5.03 h	
Primary	= 0.2	26 cfs @ 12.10 h	nrs, Volume= 0.015 af
D			- 0.00.04.00 km
			n= 0.00-24.00 hrs, dt= 0.01 hrs .rea= 103 sf Storage= 137 cf
	- / 1.00 @	12.10110 Gall	
			culated for 0.019 af (88% of inflow)
		me= 85.5 min cal me= 30.0 min (78	
Center-of-	Mass det. ti	me= 30.0 min (78	86.5 - 756.5)
		me= 30.0 min (78	86.5 - 756.5) Storage Description
Center-of-	Mass det. tii Invert	me= 30.0 min (78 Avail.Storage	86.5 - 756.5) Storage Description
Center-of-	Mass det. tii Invert	me= 30.0 min (78 Avail.Storage	86.5 - 756.5) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1
Center-of- <u>Volume</u> #1A	Mass det. tii Invert 72.29'	me= 30.0 min (78 <u>Avail.Storage</u> 94 cf	86.5 - 756.5) 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf
Center-of- <u>Volume</u> #1A	Mass det. tii Invert 72.29'	me= 30.0 min (78 <u>Avail.Storage</u> 94 cf	86.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Center-of- <u>Volume</u> #1A	Mass det. tii Invert 72.29'	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf 97 cf	86.5 - 756.5) 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
Center-of- <u>Volume</u> #1A	Mass det. tii Invert 72.29'	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf 97 cf	86.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Center-of- Volume #1A #2A	Mass det. tin <u>Invert</u> 72.29' 72.79'	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf 97 cf	86.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage
Volume #1A #2A Storage	Mass det. til Invert 72.29' 72.79' e Group A cr	me= 30.0 min (78 Avail.Storage 94 cf 97 cf 191 cf reated with Cham	86.5 - 756.5) 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.0''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage
Center-of- #1A #2A Storage Device F	Mass det. tii <u>Invert</u> 72.29' 72.79' e Group A ci Routing	me= 30.0 min (78 Avail.Storage 94 cf 97 cf 191 cf reated with Cham Invert Outl	86.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage Nber Wizard let Devices
Center-of- <u>Volume</u> #1A #2A Storage <u>Device F</u> #1 E	Mass det. tii <u>Invert</u> 72.29' 72.79' e Group A cr <u>Routing</u> Discarded	me= 30.0 min (78 <u>Avail.Storage</u> 94 cf 97 cf 191 cf reated with Cham <u>Invert</u> <u>Outl</u> 72.29' 1.02	86.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage aber Wizard let Devices 20 in/hr Exfiltration over Surface area
Center-of- <u>Volume</u> #1A #2A Storage <u>Device F</u> #1 E	Mass det. tii <u>Invert</u> 72.29' 72.79' e Group A ci Routing	me= 30.0 min (74 Avail.Storage 94 cf 97 cf 191 cf reated with Cham Invert Outl 72.29' 1.02 74.00' 6.0"	86.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage Nber Wizard let Devices

Discarded OutFlow Max=0.00 cfs @ 5.03 hrs HW=72.32' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.26 cfs @ 12.10 hrs HW=74.39' (Free Discharge) -2=Culvert (Inlet Controls 0.26 cfs @ 1.59 fps)

Topsfield Proposed HydroCAD	Type III 24-hr 2-Year Rainfall=3.10"
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Pond UIS-6: UIS-6 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

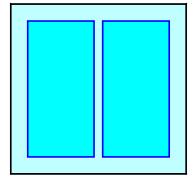
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

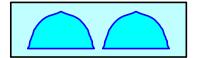
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

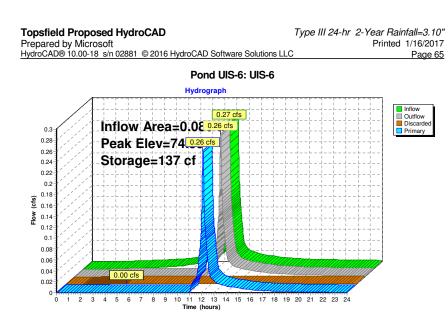
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

 $\begin{array}{l} \mbox{Chamber Storage + Stone Storage = 190.9 cf = 0.004 af} \\ \mbox{Overall Storage Efficiency = 57.6\%} \\ \mbox{Overall System Size = 10.00' x 10.33' x 3.21'} \end{array}$







HydroCA	D® 10.00-18	s/n 02881 © 2	016 H	HydroCAD Software Solutions LLC Page 6
			Sur	mmary for Pond UIS-7: UIS-7
Inflow An Inflow Outflow Discarde Primary	= 0. = 0. ed = 0.	25 cfs @ 12 24 cfs @ 12 00 cfs @ 5	2.08 h 2.10 h 5.30 h	Impervious, Inflow Depth > 2.87" for 2-Year event rrs, Volume= 0.020 af rrs, Volume= 0.017 af, Atten= 2%, Lag= 1.0 min rrs, Volume= 0.004 af rrs, Volume= 0.013 af
				n= 0.00-24.00 hrs, dt= 0.01 hrs .rea= 103 sf Storage= 136 cf
				culated for 0.017 af (87% of inflow) 87.1 - 756.5)
Volume	Invert	Avail Stor	ane	Storage Description
#1A	71.79			
#2A	72.29'		7 cf	332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
				Overall Size= 47.0"W x 26.5"H x 8.00"L with 1.00 Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		19	1 cf	Total Available Storage
Stora		created with C	:ham	
Silla	ige Group A c		man	iber Wizard
	Routing	Invert		iber Wizard let Devices
	0 1		Outl 1.02 6.0" Inlet	
Device #1 #2 Discarde	Routing Discarded Primary	Invert 71.79' 73.50'	Outl 1.02 6.0'' Inlet n= 0 : @ 5	let Devices 20 in/hr Exfiltration over Surface area 7 Round Culvert L= 17.5' Ke= 1.000 t / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=71.82' (Free Discharge)
Device #1 #2 Discarde —1=Ext Primary	Routing Discarded Primary ed OutFlow filtration (Ex OutFlow Ma	Invert 71.79' 73.50' Max=0.00 cfs filtration Cont	Outl 1.02 6.0'' Inlet n= 0 6.0'' inlet n= 0 6.0'' 12.1	Iet Devices 20 in/hr Exfiltration over Surface area ' Round Culvert L= 17.5' Ke= 1.000 t / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=71.82' (Free Discharge) 0.00 cfs) 10 hrs HW=73.87' (Free Discharge)
Device #1 #2 Discarde —1=Ext Primary	Routing Discarded Primary ed OutFlow filtration (Ex OutFlow Ma	Invert 71.79' 73.50' Max=0.00 cfs filtration Cont ax=0.24 cfs @	Outl 1.02 6.0'' Inlet n= 0 6.0'' inlet n= 0 6.0'' 12.1	Iet Devices 20 in/hr Exfiltration over Surface area ' Round Culvert L= 17.5' Ke= 1.000 t / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=71.82' (Free Discharge) 0.00 cfs) 10 hrs HW=73.87' (Free Discharge)
Device #1 #2 Discarde —1=Ext Primary	Routing Discarded Primary ed OutFlow filtration (Ex OutFlow Ma	Invert 71.79' 73.50' Max=0.00 cfs filtration Cont ax=0.24 cfs @	Outl 1.02 6.0'' Inlet n= 0 6.0'' inlet n= 0 6.0'' 12.1	Iet Devices 20 in/hr Exfiltration over Surface area ' Round Culvert L= 17.5' Ke= 1.000 t / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=71.82' (Free Discharge) 0.00 cfs) 10 hrs HW=73.87' (Free Discharge)
Device #1 #2 Discarde —1=Ext Primary	Routing Discarded Primary ed OutFlow filtration (Ex OutFlow Ma	Invert 71.79' 73.50' Max=0.00 cfs filtration Cont ax=0.24 cfs @	Outl 1.02 6.0'' Inlet n= 0 6.0'' inlet n= 0 6.0'' 12.1	Iet Devices 20 in/hr Exfiltration over Surface area ' Round Culvert L= 17.5' Ke= 1.000 t / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=71.82' (Free Discharge) 0.00 cfs) 10 hrs HW=73.87' (Free Discharge)
Device #1 #2 Discarde —1=Ext Primary	Routing Discarded Primary ed OutFlow filtration (Ex OutFlow Ma	Invert 71.79' 73.50' Max=0.00 cfs filtration Cont ax=0.24 cfs @	Outl 1.02 6.0'' Inlet n= 0 6.0'' inlet n= 0 6.0'' 12.1	Iet Devices 20 in/hr Exfiltration over Surface area ' Round Culvert L= 17.5' Ke= 1.000 t / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=71.82' (Free Discharge) 0.00 cfs) 10 hrs HW=73.87' (Free Discharge)
Device #1 #2 Discarde —1=Ext Primary	Routing Discarded Primary ed OutFlow filtration (Ex OutFlow Ma	Invert 71.79' 73.50' Max=0.00 cfs filtration Cont ax=0.24 cfs @	Outl 1.02 6.0'' Inlet n= 0 6.0'' inlet n= 0 6.0'' 12.1	Iet Devices 20 in/hr Exfiltration over Surface area ' Round Culvert L= 17.5' Ke= 1.000 t / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=71.82' (Free Discharge) 0.00 cfs) 10 hrs HW=73.87' (Free Discharge)
Device #1 #2 Discarde —1=Ext Primary	Routing Discarded Primary ed OutFlow filtration (Ex OutFlow Ma	Invert 71.79' 73.50' Max=0.00 cfs filtration Cont ax=0.24 cfs @	Outl 1.02 6.0'' Inlet n= 0 6.0'' inlet n= 0 6.0'' 12.1	Iet Devices 20 in/hr Exfiltration over Surface area ' Round Culvert L= 17.5' Ke= 1.000 t / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=71.82' (Free Discharge) 0.00 cfs) 10 hrs HW=73.87' (Free Discharge)
Device #1 #2 Discarde —1=Ext Primary	Routing Discarded Primary ed OutFlow filtration (Ex OutFlow Ma	Invert 71.79' 73.50' Max=0.00 cfs filtration Cont ax=0.24 cfs @	Outl 1.02 6.0'' Inlet n= 0 6.0'' inlet n= 0 6.0'' 12.1	Iet Devices 20 in/hr Exfiltration over Surface area ' Round Culvert L= 17.5' Ke= 1.000 t / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=71.82' (Free Discharge) 0.00 cfs) 10 hrs HW=73.87' (Free Discharge)
Device #1 #2 Discarde —1=Ext Primary	Routing Discarded Primary ed OutFlow filtration (Ex OutFlow Ma	Invert 71.79' 73.50' Max=0.00 cfs filtration Cont ax=0.24 cfs @	Outl 1.02 6.0'' Inlet n= 0 6.0'' inlet n= 0 6.0'' 12.1	Iet Devices 20 in/hr Exfiltration over Surface area ' Round Culvert L= 17.5' Ke= 1.000 t / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 5.30 hrs HW=71.82' (Free Discharge) 0.00 cfs) 10 hrs HW=73.87' (Free Discharge)

 Topsfield Proposed HydroCAD
 Type

 Prepared by Microsoft
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 Type III 24-hr
 2-Year Rainfall=3.10"

 Printed
 1/16/2017

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Pond UIS-7: UIS-7 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

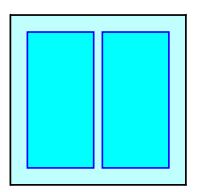
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

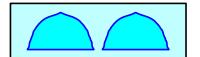
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

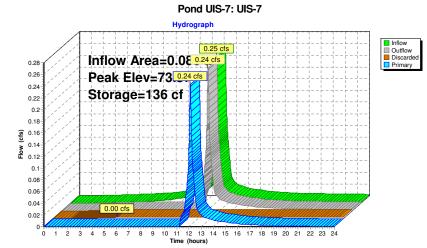
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$









			· · · · · · · · · · · · · · · · · · ·
		Sur	mmary for Pond UIS-8: UIS-8
Inflow Area			Impervious, Inflow Depth > 2.87" for 2-Year event
0		25 cfs @ 12.08 h	
Discarded		24 cfs @ 12.10 h 10 cfs @ 5.30 h	
		4 cfs @ 12.10 h	
			n= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev=	= 73.17' @ '	12.10 hrs Surf.A	Area= 103 sf Storage= 136 cf
Plug-Flow	dotontion ti		
			lculated for 0.017 af (87% of inflow)
			lculated for 0.017 af (87% of inflow) 787.1 - 756.5)
		me = 38.8 min caime = 30.6 min (78	
	Mass det. tii Invert	me= 30.6 min (78	
Center-of-N	Mass det. ti	me= 30.6 min (78	787.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A
Center-of-N <u>Volume</u> #1A	Mass det. tii Invert 71.09'	ne= 30.6 min (78 <u>Avail.Storage</u> 94 cf	 '87.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
Center-of-N Volume	Mass det. tii Invert	me= 30.6 min (78 Avail.Storage	 '87.1 - 756.5) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1
Center-of-N <u>Volume</u> #1A	Mass det. tii Invert 71.09'	ne= 30.6 min (78 <u>Avail.Storage</u> 94 cf	 '87.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Center-of-N <u>Volume</u> #1A	Mass det. tii Invert 71.09'	ne= 30.6 min (78 <u>Avail.Storage</u> 94 cf	'87.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap
Center-of-N <u>Volume</u> #1A	Mass det. tii Invert 71.09'	ne= 30.6 min (78 <u>Avail.Storage</u> 94 cf 97 cf	 '87.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Center-of-N <u>Volume</u> #1A	Mass det. tii Invert 71.09'	ne= 30.6 min (78 <u>Avail.Storage</u> 94 cf 97 cf	787.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
Center-of-M Volume #1A #2A	Mass det. til <u>Invert</u> 71.09' 71.59'	ne= 30.6 min (78 <u>Avail.Storage</u> 94 cf 97 cf	'87.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage
Center-of-M Volume #1A #2A Storage	Mass det. til Invert 71.09' 71.59' e Group A cr	ne= 30.6 min (78 Avail.Storage 94 cf 97 cf 191 cf reated with Cham	787.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage nber Wizard
Center-of-M Volume #1A #2A Storage Device R	Mass det. tin Invert 71.09' 71.59' e Group A cr Routing	ne= 30.6 min (78 Avail.Storage 94 cf 97 cf 191 cf reated with Cham Invert Outl	787.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage nber Wizard tlet Devices
Center-of-M Volume #1A #2A Storage Device R #1 D	Mass det. tii Invert 71.09' 71.59' e Group A cr Routing	ne= 30.6 min (78 <u>Avail.Storage</u> 94 cf 97 cf 191 cf reated with Cham <u>Invert</u> Outl 71.09' 1.02	787.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage nber Wizard tet Devices 20 in/hr Exfiltration over Surface area
Center-of-M Volume #1A #2A Storage Device R #1 D	Mass det. tin Invert 71.09' 71.59' e Group A cr Routing	ne= 30.6 min (78 <u>Avail.Storage</u> 94 cf 97 cf 191 cf reated with Cham <u>Invert</u> Outl 71.09' 1.02 72.80' 6.0 ''	787.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage nber Wizard tlet Devices

Discarded OutFlow Max=0.00 cfs @ 5.30 hrs HW=71.12' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.24 cfs @ 12.10 hrs HW=73.17' (Free Discharge) -2=Culvert (Inlet Controls 0.24 cfs @ 1.55 fps)

Topsfield Proposed HydroCAD	Type III 24-hr 2-Year Rainfall=3.10"
Prepared by Microsoft	Printed 1/16/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC	Page 70

Pond UIS-8: UIS-8 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

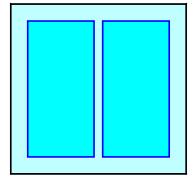
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

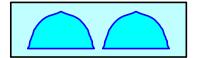
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

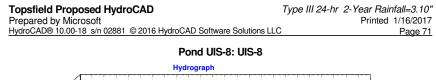
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

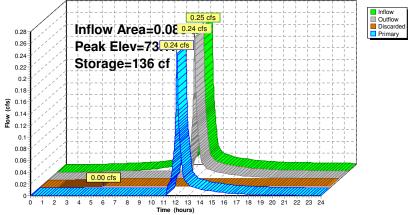
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

 $\begin{array}{l} \mbox{Chamber Storage + Stone Storage = 190.9 cf = 0.004 af} \\ \mbox{Overall Storage Efficiency = 57.6\%} \\ \mbox{Overall System Size = 10.00' x 10.33' x 3.21'} \end{array}$









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			lydroCAD Software Solutions LLC Page
		Sur	nmary for Pond UIS-9: UIS-9
Inflow A Inflow Outflow Discarde Primary Bouting	$ = 0.2 \\ = 0.2 \\ ed = 0.0 \\ = 0.2 $	27 cfs @ 12.08 h 26 cfs @ 12.10 h 00 cfs @ 5.03 h 26 cfs @ 12.10 h	rrs, Volume= 0.020 af, Atten= 3%, Lag= 1.2 min rrs, Volume= 0.004 af
			rea= 103 sf Storage= 81 cf
		me= 51.1 min cal me= 19.6 min (72	culated for 0.020 af (94% of inflow) 76.1 - 756.5)
Volume	Invert	Avail.Storage	Storage Description
#1A	71.28	94 cf	10.33'W x 10.00'L x 3.21'H Field A
#2A	71.78'	97 cf	Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
		191 cf	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage
Stora		reated with Cham Invert Outl	
#1	Discarded		0 in/hr Exfiltration over Surface area
#2	Primary	Inlet	Round Culvert L= 79.0' Ke= 1.000 / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 .011 PVC, smooth interior, Flow Area= 0.20 sf
		1ax=0.00 cfs @ 5 iltration Controls	.03 hrs HW=71.31' (Free Discharge) 0.00 cfs)
		x=0.26 cfs @ 12. ontrols 0.26 cfs @	10 hrs HW=72.57' (Free Discharge) 1.59 fps)

 Topsfield Proposed HydroCAD
 Type

 Prepared by Microsoft
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 Type III 24-hr
 2-Year Rainfall=3.10"

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Pond UIS-9: UIS-9 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

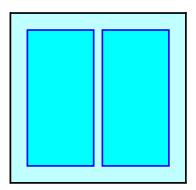
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

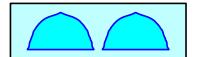
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

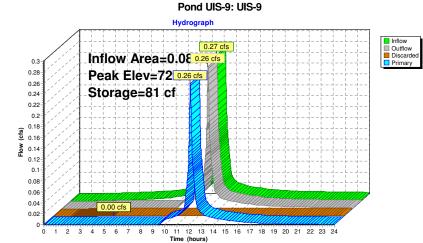
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$









Type III 24-hr 10-Year Rainfall=4.50' Printed 1/16/2017 CAD Software Solutions LLC Page 76	Topsfield Proposed HydroCAD Prepared by Microsoft <u>HydroCAD® 10.00-18 s/n 02881</u> © 2016 HydroCAD	Type III 24-hr 10-Year Rainfall=4.50" Printed 1/16/2017 Software Solutions LLC Page 75	opsfield Proposed HydroCAD repared by Microsoft ydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAI
B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030 af	Subcatchment R-14: Roof Units 27&28 - A&B	.00 hrs, dt=0.01 hrs, 2401 points) method, UH=SCS, Weighted-CN s method - Pond routing by Stor-Ind method	Runoff by SCS TR-2
& C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.32 cfs 0.026 af	Subcatchment R-15: Roof Units 29&30 - (B & C	Runoff Area=81,522 sf 0.00% Impervious Runoff Depth>0.16" Tc=6.0 min CN=41 Runoff=0.05 cfs 0.026 af	ubcatchment P-1: Northern Grassed Area to
Runoff Area=1,490 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.15 cfs 0.012 af	Subcatchment R-16: Front Units 29&30	Runoff Area=31,595 sf 7.29% Impervious Runoff Depth>2.05" =533' Tc=6.0 min UI Adjusted CN=75 Runoff=1.73 cfs 0.124 af	ubcatchment P-10: Area Around Isolated Flow Lengti
Dd Runoff Area=120 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.01 cfs 0.001 af	Subcatchment R-17: Mailbox Structure Rood	Runoff Area=23,114 sf 59.77% Impervious Runoff Depth>2.55" Tc=6.0 min CN=81 Runoff=1.59 cfs 0.113 af	ubcatchment P-2: Existing Drive to Existing
Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.32 cfs 0.026 af	Subcatchment R-2: Roof Units 3&4 - (B & C	Runoff Area=27,582 sf 12.85% Impervious Runoff Depth>0.50" Tc=6.0 min UI Adjusted CN=50 Runoff=0.18 cfs 0.026 af	ubcatchment P-3: Area Around Isolated
Jnits Runoff Area=3,625 sf 100.00% Impervious Runoff Depth⊳4.26" Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030 af	Subcatchment R-3: Roof Units 5&6 - A&B Units	Runoff Area=4,950 sf 31.35% Impervious Runoff Depth>1.74" Tc=6.0 min CN=71 Runoff=0.23 cfs 0.017 af	ubcatchment P-3A: Gravel Road to Detention
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030 af	Subcatchment R-4: Roof - Units 7&8 - (A&B	Runoff Area=21,573 sf 55.93% Impervious Runoff Depth>2.13" Tc=6.0 min CN=76 Runoff=1.23 cfs 0.088 af	ubcatchment P-4: Sloped Entrance Drive -
C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.32 cfs 0.026 af	Subcatchment R-5: Roof - Units 9&10 - (B&C	Runoff Area=39,272 sf 51.57% Impervious Runoff Depth>1.97" Tc=6.0 min CN=74 Runoff=2.06 cfs 0.148 af	ubcatchment P-5: Driveway - Units 25-11
&A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030 af	Subcatchment R-6: Roof - Units 11&12 - (B&A	Runoff Area=19,137 sf 59.86% Impervious Runoff Depth>2.29" Tc=6.0 min CN=78 Runoff=1.18 cfs 0.084 af	bcatchment P-6: Pavement Units 12-19
Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af	Subcatchment R-7: Roof - Units 13&14 - (A	Runoff Area=15,670 sf 44.56% Impervious Runoff Depth>1.74" Tc=6.0 min CN=71 Runoff=0.72 cfs 0.052 af	ocatchment P-7: Driveway - Units 20-24
A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030 af	Subcatchment R-8: Roof - Units 15&16 - (B&A	Runoff Area=15,307 sf 7.00% Impervious Runoff Depth>0.23" Tc=6.0 min CN=43 Runoff=0.02 cfs 0.007 af	ocatchment P-8: Surface Infiltration Pond
&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030 af	Subcatchment R-9: Roof - Units 17&18 - (A&B	Runoff Area=102,567 sf 2.25% Impervious Runoff Depth>0.05" 502' Tc=10.8 min UI Adjusted CN=36 Runoff=0.01 cfs 0.009 af	bcatchment P-9: Woods/Grass Northwest
Inflow=0.18 cfs 0.070 af Outflow=0.18 cfs 0.070 af	Reach SP-1: Wetlands South of Driveway	Runoff Area=3,185 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.32 cfs 0.026 af	bcatchment R-1: Roof - Units 1&2 (C&B)
Inflow=0.05 cfs 0.026 af Outflow=0.05 cfs 0.026 af	Reach SP-2: Large Wetland Area East	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af	bcatchment R-10: Roof - Units 19&20 - (A
Inflow=0.21 cfs 0.065 af Outflow=0.21 cfs 0.065 af	Reach SP-3: Large Wetland Area West	Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030 af	bcatchment R-11: Roof - Units 21&22 - (A&
rn Wetlands Inflow=0.36 cfs 0.160 af Primary=0.36 cfs 0.160 af	Pond 1P: Combined Study Points - Northern W	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af	bcatchment R-12: Roof - Units 23&24 - (A
Peak Elev=70.18' Storage=13,275 cf Inflow=6.42 cfs 0.451 af 1 cfs 0.116 af Primary=0.20 cfs 0.056 af Outflow=0.31 cfs 0.172 af	Pond D-1: Surface Infiltration Pond Discarded=0.11 cf:	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af	ubcatchment R-13: Roof - Units 25&26 - (A

Topsfield Proposed Hydr Prepared by Microsoft					10-Year Rainfa Printed 1/	
HydroCAD® 10.00-18 s/n 02881	© 2016 HydroCAD	Software S	Solutions LL	.C		Page 77
Pond D-2: Existing Detention	Basin	Peak E	Elev=58.28'	Storage=3,324 c	f Inflow=1.59 cfs Outflow=0.08 cfs	
Pond D-3: Detention Pond by	Access Road Discarded=0.03 cfs				f Inflow=0.23 cfs Outflow=0.03 cfs	
Pond UIS-1: UIS at Entrance	Discarded=0.08 cfs				f Inflow=4.13 cfs Outflow=0.08 cfs	
Pond UIS-2: UIS at North of S	ite Discarded=0.23 cfs				f Inflow=1.84 cfs Outflow=0.23 cfs	
Pond UIS-3: UIS-3	Discarded=0.00 cfs				f Inflow=0.37 cfs Outflow=0.36 cfs	
Pond UIS-4: UIS-4	Discarded=0.00 cfs				f Inflow=0.32 cfs Outflow=0.32 cfs	
Pond UIS-5: UIS-5	Discarded=0.00 cfs				f Inflow=0.37 cfs Outflow=0.35 cfs	
Pond UIS-6: UIS-6	Discarded=0.00 cfs				f Inflow=0.39 cfs Outflow=0.38 cfs	
Pond UIS-7: UIS-7	Discarded=0.00 cfs				f Inflow=0.37 cfs Outflow=0.35 cfs	
Pond UIS-8: UIS-8	Discarded=0.00 cfs				f Inflow=0.37 cfs Outflow=0.35 cfs	
Pond UIS-9: UIS-9	Discarded=0.00 cfs				f Inflow=0.39 cfs Outflow=0.38 cfs	

Total Runoff Area = 10.046 ac Runoff Volume = 1.143 af Average Runoff Depth = 1.37" 70.14% Pervious = 7.046 ac 29.86% Impervious = 3.000 ac

Prepared by Mic	posed HydroCAD crosoft -18 s/n 02881 © 2016 HydroCAD Software S	Type III 24-hr 10-Year Rainfall= Printed 1/16 Solutions LLC Pa	
Sur	nmary for Subcatchment P-1: Nort	hern Grassed Area to Wetlands	
Runoff =	0.05 cfs @ 12.50 hrs, Volume=	0.026 af, Depth> 0.16"	
	R-20 method, UH=SCS, Weighted-CN, T -Year Rainfall=4.50"	īme Span= 0.00-24.00 hrs, dt= 0.01 hrs	
Area (sf)	CN Description		
38,137	30 Woods, Good, HSG A		
10,782 9,419	70 Woods, Good, HSG C55 Woods, Good, HSG B		
23,184	39 >75% Grass cover, Good, HSG /	Δ	
81,522	41 Weighted Average	Υ.	
81,522	100.00% Pervious Area		
To Loweth			
Tc Length (min) (feet)	Slope Velocity Capacity Descripti (ft/ft) (ft/sec) (cfs)	on	
6.0	Direct Er	ntrv.	
	Subcatchment P-1: Northern G	rassed Area to Wetlands	
	Hydrograph		
0.05	0.05 cfs		1011
0.045	/pe III 24-hr		
- 1)-Year Rainfall≑4.50''		
0.04			
0.035	unoff Area=81,522 sf		
	unoff Volume=0.026 af 💋 -		
<u>ع</u> ٥.03 B	unoff Depth>0.16"		
S	c=6.0 min		
1,1-4	N=41		
0.015			
0.01			
0.01			
	+ + + + + + + - +		
0.005			

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Summary for Subcatchment P-10: Area Around Isolated Wetland	Summary for Subcatchment P-2: Existing Drive to Existing Basin
Runoff = 1.73 cfs @ 12.09 hrs, Volume= 0.124 af, Depth> 2.05"	Runoff = 1.59 cfs @ 12.09 hrs, Volume= 0.113 af, Depth> 2.55"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"	Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"
Area (sf) CN Adj Description	Area (sf) CN Description
2,304 98 Unconnected roofs, HSG A	13,815 98 Paved parking, HSG A
29,291 74 >75% Grass cover, Good, HSG C 31,595 76 75 Weighted Average, UI Adjusted	1,353 76 Gravel roads, HSG A 4.896 39 >75% Grass cover, Good, HSG A
31,595 76 75 Weighted Average, UI Adjusted 29,291 92,71% Pervious Area	3,050 74 >75% Grass cover, Good, HSG C
2,304 7.29% Impervious Area	23,114 81 Weighted Average
2,304 100.00% Unconnected	9,299 40.23% Pervious Area
Tc Length Slope Velocity Capacity Description	13,815 59.77% Impervious Area
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	Tc Length Slope Velocity Capacity Description
2.9 50 0.1100 0.29 Sheet Flow, A-B	(min) (feet) (ft/ft) (ft/sec) (cfs)
Grass: Short n= 0.150 P2= 3.10"	6.0 Direct Entry, Min. 6.0 TC
2.9 483 0.1600 2.80 Shallow Concentrated Flow, B-C	
Short Grass Pasture Kv= 7.0 fps 5.8 533 Total, Increased to minimum Tc = 6.0 min	Subcatchment P-2: Existing Drive to Existing Basin
	Hydrograph
Subcatchment P-10: Area Around Isolated Wetland Hydrograph Type III 24-hr 10-Year Rainfall=4.50' Runoff Area=31,595 sf Runoff Volume=0.124 af Runoff Depth>2.05' Flow Length=533' Tc=6.0 min UI Adjusted CN=75	(Type III 24-hr 10-Year Rainfall=4.50" Runoff Area=23,114 sf Runoff Volume=0.113 af Runoff Depth>2.55" Tc=6.0 min CN=81

Topsfield Proposed HydroCAD	Type III 24-hr	10-Year Rainfall=4.50"
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Summary for Subcatchment P-3: Area Around Isolated Wetland

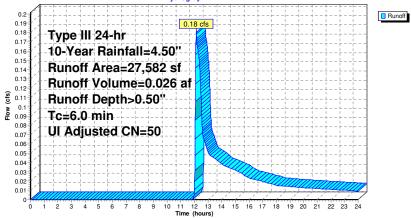
Runoff = 0.18 cfs @ 12.14 hrs, Volume= 0.026 af, Depth> 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"

	A	rea (sf)	CN	Adj	Desc	ription				
		3,545	98		Unco	nnected pa	avement, HSG A			
		1,224	76		Grav	el roads, H	ISG A			
		212	74		>75%	6 Grass cov	ver, Good, HSG C			
		2,166	70		Woo	ds, Good, H	HSG C			
		5,125	77		Woo	ds, Good, H	HSG D			
		14,867	30		Woo	ds, Good, ⊦	HSG A			
		443	39		>75%	6 Grass cov	ver, Good, HSG A			
		27,582	53	50	Weig	hted Avera	age, UI Adjusted			
		24,037			87.1	5% Perviou	is Area			
		3,545			12.8	5% Impervi	ious Area			
		3,545		100.00% Unconnected						
	Tc	Length	Slope		locity	Capacity	Description			
(I	min)	(feet)	(ft/ft)) (ft	/sec)	(cfs)				
	6.0						Direct Entry,			

Subcatchment P-3: Area Around Isolated Wetland

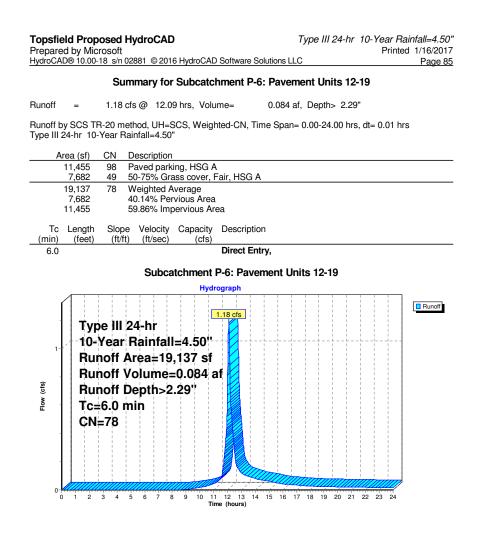
Hydrograph



repare	d by Mici 0® 10.00-	rosoft			ydroCAD	Softwa	e Solu	ions L		be III	24-h	nr 10			ainfall=4.50' d 1/16/2017 Page 82
	Su	mma	ry for s	Subcate	chment	P-3A:	Grav	el Ro	bad	to De	eten	tion	Bas	in	
Runoff	=	0.23	cfs @	12.09 h	rs, Volu	me=	(0.017	af, I	Depth	> 1.7	74"			
	y SCS TF 24-hr 10-				S, Weigł	nted-CN	, Time	Span	= 0.	00-24	.00 h	ırs, di	= 0.0	01 hr	S
A	rea (sf)	CN	Descr												
	1,552 1,841	98 76	Grave	l parking I roads,	HSG A		~ ^								
	1,557 4,950 3,398 1,552	<u>39</u> 71	Weigh 68.65	Grass c ited Ave % Pervic % Imper	rage us Area		<u> </u>								
Tc (min)	Length (feet)	Slop (ft/		ocity C (sec)	apacity (cfs)	Descri	ption								
6.0	()			/	<u> </u>	Direct	Entry								
0.24 0.22 0.18 0.16 (\$) 0.14 0.12 0.12 0.11 0.12 0.13	10- Ru Ru Ru Tc:	Yea nofi nofi nofi	Area Volu	nr nfall= 1=4,95 ime=0 th>1.7	4.50'' 50 sf).017	0.23 cfs									Runoff
0.04 0.02 0-					9 10 1	1 12 13	14 1	5 16	17			<u>+</u> - <u>+</u> - 1 21 22	- <u> </u> 	24	
	-			-	'n	me (hours)								

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs	Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solution	Type III 24-hr 10-Year Rainfall=4.50" Printed 1/16/2017 ns LLC Page 83
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50" Area (sf) CN Description 12,066 98 Paved parking, HSG A 6,808 39 >75% Grass cover, Good, HSG A 2,699 74 >75% Grass cover, Good, HSG C 21,573 76 Weighted Average 9,507 44.07% Pervious Area 12,066 55.93% Impervious Area 12,066 55.93% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment P-4: Sloped Entrance Drive - Units 1-5 Hydrograph Type III 24-hr 10-Year Rainfall=4.50" Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Depth>2.13" Tc=6.0 min	Summary for Subcatchment P-4: Sloped I	Entrance Drive - Units 1-5
Type III 24-hr 10-Year Rainfall=4.50" Area (sf) CN Description 12,066 98 Paved parking, HSG A 6,808 39 >75% Grass cover, Good, HSG A 2,699 74 >75% Grass cover, Good, HSG C 21,573 76 Weighted Average 9,507 44.07% Pervious Area 12,066 55.93% Impervious Area 12,066 55.93% Impervious Area 12,066 55.93% Impervious Area 6.0 Direct Entry, Subcatchment P-4: Sloped Entrance Drive - Units 1-5 Hydrograph Type III 24-hr 10-Year Rainfall=4.50" Runoff Area=21,573 sf Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Depth>2.13" Tc=6.0 min Tc=6.0 min	Runoff = 1.23 cfs @ 12.09 hrs, Volume= 0.0)88 af, Depth> 2.13"
12,066 98 Paved parking, HSG A 6,808 39 >75% Grass cover, Good, HSG A 2,699 74 >75% Grass cover, Good, HSG C 21,573 76 Weighted Average 9,507 44.07% Pervious Area 12,066 55.93% Impervious Area 12,066 55.93% Impervious Area 6.0 Direct Entry, 6.0 Direct Entry, Impervious Area Tc Length Slope Velocity Capacity Description (min) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment P-4: Sloped Entrance Drive - Units 1-5 Hydrograph Type III 24-hr 1.23 ets 10-Year Rainfall=4.50" Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Volume=0.088 af Runoff Depth>2.13" Tc=6.0 min	Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time S Type III 24-hr 10-Year Rainfall=4.50"	pan= 0.00-24.00 hrs, dt= 0.01 hrs
6,808 39 >75% Grass cover, Good, HSG A 2,699 74 >75% Grass cover, Good, HSG C 21,573 76 Weighted Average 9,507 44.07% Pervious Area 12,066 55.93% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment P-4: Sloped Entrance Drive - Units 1-5 Hydrograph Type III 24-hr 1.23 cfs 10-Year Rainfall=4.50" Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Volume=0.088 af Runoff Depth>2.13" Tc=6.0 min		
2,699 74 >75% Grass cover, Good, HSG C 21,573 76 Weighted Average 9,507 44.07% Pervious Area 12,066 55.93% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment P-4: Sloped Entrance Drive - Units 1-5 Hydrograph Type III 24-hr 10-Year Rainfall=4.50" Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Depth>2.13" Tc=6.0 min		
9,507 44.07% Pervious Area 12,066 55.93% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment P-4: Sloped Entrance Drive - Units 1-5 Hydrograph Type III 24-hr 10-Year Rainfall=4.50' Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Depth>2.13'' Tc=6.0 min		
12,066 55.93% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment P-4: Sloped Entrance Drive - Units 1-5 Hydrograph Type III 24-hr 10-Year Rainfall=4.50" Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Depth>2.13" Tc=6.0 min		
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment P-4: Sloped Entrance Drive - Units 1-5 Hydrograph Type III 24-hr 10-Year Rainfall=4.50'' Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Depth>2.13'' Tc=6.0 min		
Subcatchment P-4: Sloped Entrance Drive - Units 1-5 Hydrograph Type III 24-hr 10-Year Rainfall=4.50" Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Depth>2.13" Tc=6.0 min		
Hydrograph Type III 24-hr 10-Year Rainfall=4.50' Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Depth>2.13'' Tc=6.0 min	6.0 Direct Entry,	
Hydrograph Type III 24-hr 10-Year Rainfall=4.50' Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Depth>2.13'' Tc=6.0 min	Subcatchment P-4: Sloped Entrand	ce Drive - Units 1-5
Type III 24-hr 10-Year Rainfall=4.50" Runoff Area=21,573 sf Runoff Volume=0.088 af Runoff Depth>2.13" Tc=6.0 min	•	
	Type III 24-hr10-Year Rainfall=4.50"Runoff Area=21,573 sfRunoff Volume=0.088 afRunoff Depth>2.13"Tc=6.0 min	Runoff

Topsfield Proposed HydroCAD Type III 24-hr 10-Year Rainfall=4.50" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 1/16/2017 Page 84 Summary for Subcatchment P-5: Driveway - Units 25-11 Runoff = 2.06 cfs @ 12.09 hrs, Volume= 0.148 af, Depth> 1.97" Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50" Area (sf) CN Description 20,251 98 Paved parking, HSG A 14.308 39 >75% Grass cover, Good, HSG A 74 >75% Grass cover, Good, HSG C 4,713 39,272 74 Weighted Average 48.43% Pervious Area 19,021 20,251 51.57% Impervious Area Tc Length Slope Velocity Capacity Description (cfs) (min) (feet) (ft/ft) (ft/sec) Direct Entry, 6.0 Subcatchment P-5: Driveway - Units 25-11 Hydrograph Runoff 2.06 cfs Type III 24-hr 10-Year Rainfall=4.50" Runoff Area=39,272 sf Runoff Volume=0.148 af (cfs) Runoff Depth>1.97" Flow Tc=6.0 min CN=74 0 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)



Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software	Type III 24-hr 10-Year Rainfall=4.50 Printed 1/16/2017 are Solutions LLC Page 86					
Summary for Subcatchment P	-7: Driveway - Units 20-24					
Runoff = 0.72 cfs @ 12.09 hrs, Volume=	0.052 af, Depth> 1.74"					
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Type III 24-hr 10-Year Rainfall=4.50"	Time Span= 0.00-24.00 hrs, dt= 0.01 hrs					
Area (sf) CN Description						
6,983 98 Paved parking, HSG A 8,687 49 50-75% Grass cover, Fair, HSG	Δ					
15,670 71 Weighted Average 8,687 55.44% Pervious Area 6,983 44.56% Impervious Area	······					
Tc Length Slope Velocity Capacity Descript (min) (feet) (ft/ft) (ft/sec) (cfs)	tion					
6.0 Direct E	ntry,					
Subcatchment P-7: Driv	veway - Units 20-24					
Hydrograph						
0.72 cfs 0.75 Runoff Area=15,670 sf Runoff Depth>1.74'' TC=6.0 min 0.35 0.45 0.35 0.45	Runoff					

Topsfield Proposed HydroCAD	Type III 24-hr	10-Year Rainfall=4.50"
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HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LL	C	Page 87

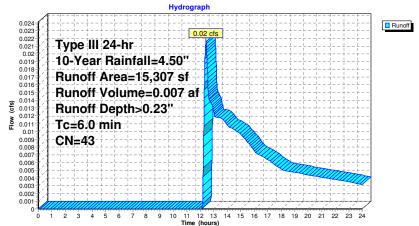
Summary for Subcatchment P-8: Surface Infiltration Pond Area

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Runoff = 0.02 cfs @ 12.42 hrs, Volume= 0.007 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"

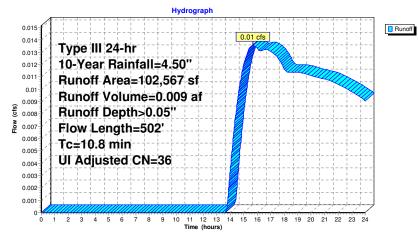
Area (sf)) CN	Description								
1,072	2 98	Paved park	ing, HSG A	N						
14,235	5 39	>75% Gras	s cover, Go	bod, HSG A						
15,307	7 43	Weighted A	verage							
14,235	5	93.00% Per	vious Area							
1,072	2	7.00% Impe	ervious Area	a						
Tc Lengt			Capacity	Description						
(min) (fee	et) (ft/	ft) (ft/sec)	(cfs)							
6.0				Direct Entry,						
	Subcatchment P-8: Surface Infiltration Pond Area									



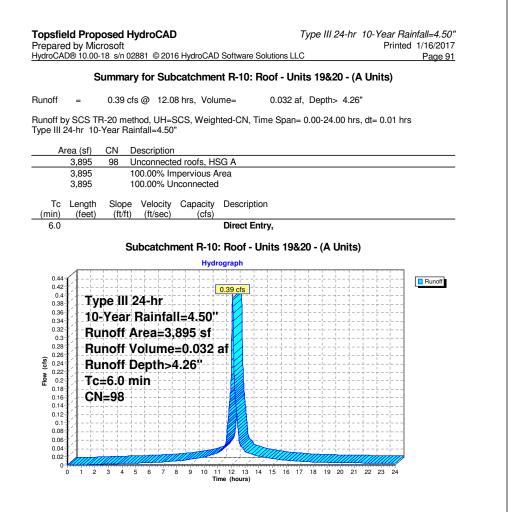
	d by Mic		lydroC/	AD.			Type III 24-ł	nr 10-Year Rainfall=4.50 Printed 1/16/2017
			2881 © 2	016 Hydro	CAD	Software Soluti	ons LLC	Page 88
S	ummary	for Su	bcatch	ment P	·9: V	Voods/Grass	Northwest Site	to NW Wetlands
	path in w vood chip				oad,"	closest CN va	lue in HydroCAD, a	ctual material to be
Runoff	=	0.01 cf	fs@ 15	.71 hrs,	Volu	me= 0	.009 af, Depth> 0.4	05"
	y SCS TF 24-hr 10-				Veigh	nted-CN, Time	Span= 0.00-24.00 h	nrs, dt= 0.01 hrs
A	rea (sf)	CN /	Adj De	scriptior	1			
	2,068	72	Di	t roads,	HSG	A		
	40,086	39				ver, Good, HS0		
	357	74				ver, Good, HS0	ЭС	
	53,082	30		oods, Go				
	4,670	55	W	oods, Go	od, F	ISG B		
	2,304	98				avement, HSG		
	02,567	37				ige, UI Adjuste	b	
1	00,263			.75% Pe				
	2,304			25% Imp				
	2,304		10	0.00% U	ncon	nected		
Тс	Length	Slope	Veloci	y Capa	acitv	Description		
(min)	(feet)	(ft/ft)			cfs)			
4.9	50	0.0300			/	Sheet Flow,	4- В	
							n= 0.150 P2= 3.1	0"
4.9	342	0.0280	1.1	7		Shallow Con	centrated Flow, B-0	
							Pasture Kv= 7.0 fp	
1.0	110	0.1270	1.7	8		Shallow Con	centrated Flow, C-I)
						Woodland K	v= 5.0 fps	
10.8	502	Total						



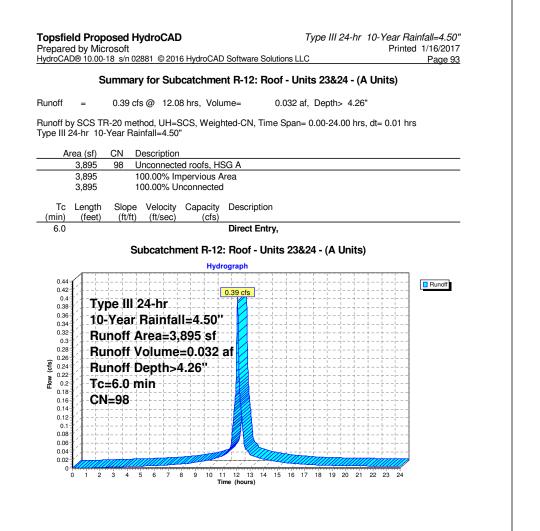
Subcatchment P-9: Woods/Grass Northwest Site to NW Wetlands



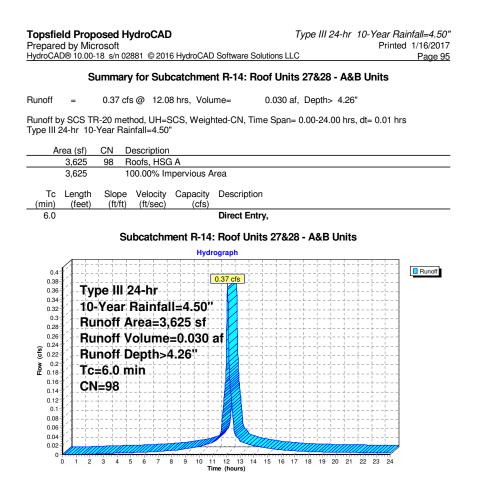
Topsfield Proposed HydroCAD Type III 24-hr 10-Year Rainfall=4.50" Prepared by Microsoft Printed 1/16/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 90 Summary for Subcatchment R-1: Roof - Units 1&2 (C&B) 0.32 cfs @ 12.08 hrs, Volume= Runoff = 0.026 af, Depth> 4.26" Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50" Area (sf) CN Description 3,185 98 Unconnected roofs, HSG A 3,185 100.00% Impervious Area 3,185 100.00% Unconnected Slope Velocity Capacity Description Tc Length (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-1: Roof - Units 1&2 (C&B) Hydrograph 0.36 Runoff 0.34 0.32 cfs Type III 24-hr 0.32 0.3 10-Year Rainfall=4.50" 0.28 0.26 Runoff Area=3,185 sf 0.24 Runoff Volume=0.026 af 0.22 (cfs) 0.2 Runoff Depth>4.26" 0.18 Nol Tc=6.0 min 0.16 0.14 CN=98 0.12 0.1 0.08 0.06 0.04 0.02 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)



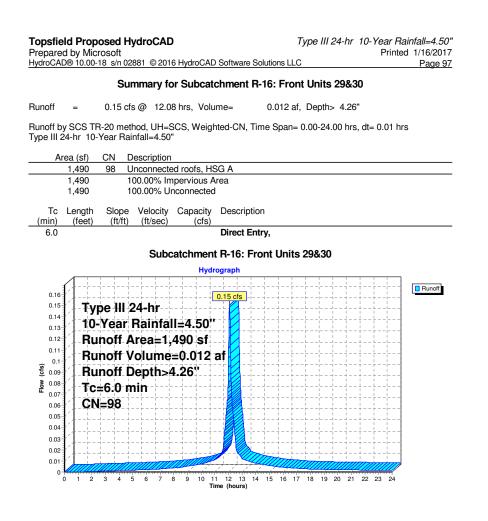
	ed by Micr D® 10.00-1		02881 (© 2016	Hydro	CAD	Softwa	re So	utions	LLC						Page 9
	Sur	nmar	y for S	Subca	tchm	ent	R-11:	Roo	f - Ur	nits 2	21&2	2 - (A&B	Uni	ts)	
noff	=	0.37	cfs @	12.08	hrs,	Volun	ne=		0.030	af, I	Depth	ı> 4	.26"			
noff b	y SCS TR	-20 m	ethod,	UH=S	cs, w	/eight	ed-CN	I, Tim	e Spa	n= 0.	00-24	1.00	hrs, dt	= 0.0	01 hr:	s
be III	24-hr 10-`	Year R	ainfall=	4.50"		-			-							
A	rea (sf)	CN	Descri													
	3,625	98	Uncon			/										
	3,625 3,625		100.00				ea									
-	,	~					_									
Tc min)	Length (feet)	Slop (ft/f		ocity sec)	Capa (c	city cfs)	Descr	iptior								
6.0				,			Direct	Entr	y,							
		S	ubcato	hme	nt R-1	11: F	loof -	Unit	s 218	22 -	(A&	вU	nits)			
							graph	•			(,					
	A		+		+					+			++-			D
0.4 0.38	∦	 					0.37 cfs					1	++-	- 		Runoff
0.36 0.34	11 1		24-ł													
0.32		Yea	r Rai	nfall	=4.5	50"		!		+ +			++-			
0.3 0.28		noff	Area	1=3,6	6 2 5 s	sf		i i		· + +	·		++-	- + - +		
0.26	[∕ -Ru	noff	Volu	me=	:0.0	30 a	If	¦		+	·		++-	- +		
0.22	Ru	noff	Dept	h>4	.26"					+			τ = = τ = ¦ = = ¦ =			
0.2	Tc:	-6.0	min							: .		1		- - L		
0.16 0.14	Ì - CN	=98	++					!					++-			
	1		++							+			++-			
0.12	*/		++			+			+				++-	- +		
0.12 0.1 0.08	{,}									+						
0.1 0.08 0.06	乳汁コウロ				1111		X	<u>U</u>		1111	/////					
0.1 0.08	1 Innin	<u>111111</u>	- All and a second	7 8		. (12 1		15 16	17	18 19	20	21 22	23	24	
0.1 0.08 0.06 0.04		3 4	56	/ 0												
0.1 0.08 0.06 0.04 0.02		3 4	56	/ 0		Tin.	e (hours	5)								



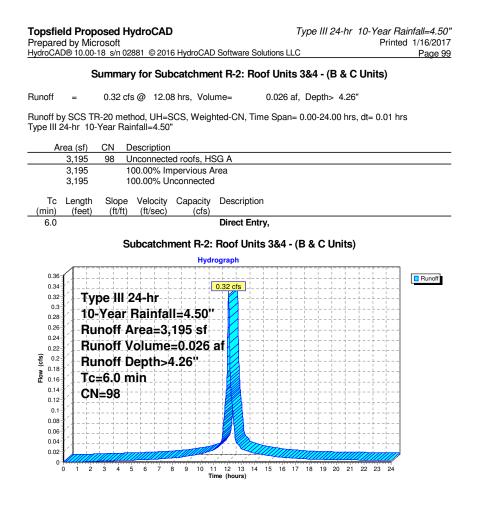
		02881 © 2016					26 - (\ 1	Inite)	Page 94
		•					•	/11(3)	
unoff	= 0.39) cfs @ 12.08	3 hrs, Volu	me=	0.032 a	af, Depth	> 4.26"		
	SCS TR-20 n 4-hr 10-Year l			ted-CN, T	ime Span	= 0.00-24	.00 hrs, d	t= 0.01 hrs	6
Ar	ea (sf) CN	Description							
	3,895 98	Unconnecte							
	3,895	100.00% Im							
	3,895	100.00% Ur	nconnected						
Tc (min)	Length Slop (feet) (ft/		Capacity (cfs)	Descripti	on				
6.0				Direct Er	ntry,				
		Cubastaba	amt D 10		Inite OF		l Inita)		
		Subcatchm	ient R-13	: ROOT - U	Jnits 250	\$26 - (A	Units)		
0.44 0.42 0.4 0.38 0.36		ll 24-hr Ir Rainfal I Area=3,	l=4.50''	0.39 cfs					Runoff
0.22 0.18 0.16 0.14 0.12 0.1 0.08 0.06 0.04	Runofi	f Volume f Depth>4) min	=0.032						
0.32 0.3 0.28 0.26 0.24 0.22 0.18 0.14 0.12 0.14 0.12 0.14 0.08 0.06 0.04 0.02 0.14	Runoff Runoff Tc=6.0 CN=98	f Volume f Depth>4 min	=0.032 i						
0.32 0.3 0.28 0.26 0.24 0.22 0.2 0.2 0.2 0.18 0.16 0.14 0.12 0.11 0.08 0.06 0.04 0.02	Runoff Runoff Tc=6.0 CN=98	f Volume f Depth>4) min	=0.032 .26''		4 15 16	17 18 19	20 21 2		



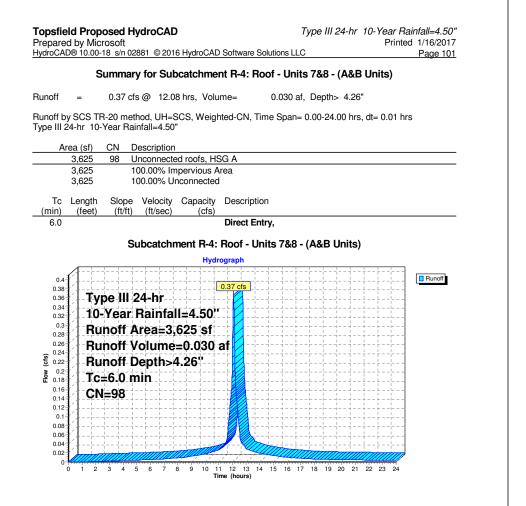
	Summary) Softwa t R-15:				&30	- (B	& C	Uni	ts)	Page 96
Runoff	-	fs@ 12.08				0.026			•			,	
		-	,				,	•					
	SCS TR-20 me -hr 10-Year Ra			nted-CIN	i, Tim	e Spa	n= 0.	00-24	.00 n	rs, a	t= 0.0	01 nr	S
Aro	a (sf) CN I	Description											
		Jnconnecte	d roofs, H	SG A									
	3,195	100.00% Im	pervious /	Area									
(3,195	100.00% Ur	nconnected	ł									
	ength Slope			Descr	iption								
(min) 6.0	(feet) (ft/ft)	(ft/sec)	(cfs)	Direct	Entr								
0.0				Direct	Entry	,							
	Su	bcatchme	nt R-15:	Roof L	Inits	29&3	30 - (B & (C Un	its)			
			Hyd	rograph									
0.36		+	+			+	- + F		+	+- +-	-+	 	Runoff
0.34	}- <u>-</u>		+	0.32 cfs				!		+ -		 	
0.32	Type III				· _			l ·		± -	- L		
0.28	10-Year						-+		+	 -	- 1		
0.26	-Runoff-					+	-+		+	+ -	-+		
0.22	Runoff	/olume	=0.026	af		+	- +		-1+	+-	-+		
0.18 0.18	-Runoff I	Depth>4	.26"			+		!		+-		 	
0.18 0.16	Tc=6.0 r	nin			· -!!								
0.14	CN=98									+ -			
0.12	4				·	+	-+		+	+ -	-+		
0.08	A	+	+			+	- + - - + -		+	+-	-+	 	
0.06	+					+	-+		+	+-		 	
0.04	A		mm			TIT					- L	 	
			under /	1 1	1.1		щn	ЩЦ	/////	1111	////		



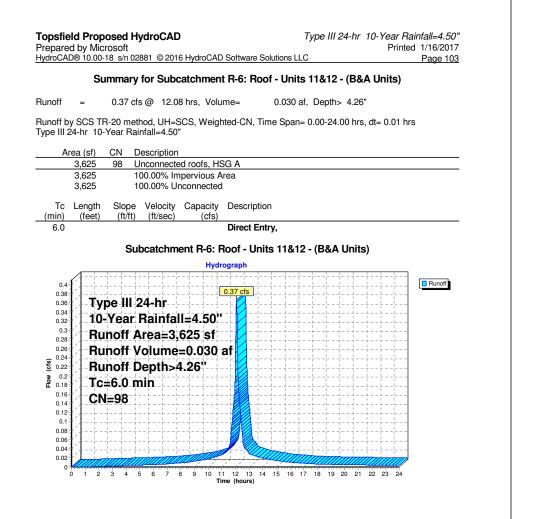
pared by Microsoft droCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions	s LLC	Printed 1/16/2017 Page 98
Summary for Subcatchment R-17: Mai	Ibox Structure Ro	od
noff = 0.01 cfs @ 12.08 hrs, Volume= 0.00	01 af, Depth> 4.26"	
noff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Sp De III 24-hr 10-Year Rainfall=4.50"	oan= 0.00-24.00 hrs, o	dt= 0.01 hrs
Area (sf) CN Description		
120 98 Unconnected roofs, HSG A 120 100.00% Impervious Area		
120 100.00% Impervious Area 120 100.00% Unconnected		
Tc Length Slope Velocity Capacity Description min) (feet) (ft/ft) (ft/sec) (cfs)		
6.0 Direct Entry,		
Subcatchment R-17: Mailbox St	tructure Rood	
Hydrograph		
0.013		<u> </u> <u> </u> Runoff
		- + +
0.011 10-Year Rainfall=4.50"		+
		++
•.001 - Runoff Area=120 sf		
Runoff Volume=0.001 af		
E 0.007 ■ 0.007 ■ 0.006 ■ Tc=6.0 min		
한 0.006 Tc=6.0 min		
0.005 CN=98		
0.004		
0.003		
0.002		
0.001		· - Ţ Ţ
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 1 Time (hours)	16 17 18 19 20 21 2	22 23 24



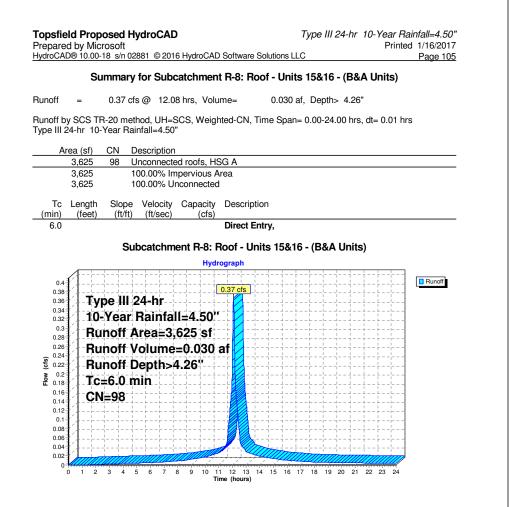
	d by Mic D® 10.00			© 2016	6 Hydr	oCA	D Soft	ware	Solu	tions	LLC							ed 1/16/2017 Page 100
		Sum	mary	for Su	bcat	chn	nent	R-3:	Ro	of U	nits	5&	6 - A	&В	Uni	its		
unoff	=	0.37	7 cfs @	12.08	3 hrs,	Vol	ume=			0.030) af,	Dep	oth>	4.26				
	y SCS T 24-hr 10					Veig	hted-	CN,	Time	e Spa	n= (0.00-	24.0) hrs	, dt=	= 0.0)1 hr	ſS
Ar	ea (sf)	CN	Desc	ription														
	3,625	98		s, HSG														
	3,625		100.0	00% Im	pervi	ous /	Area											
Tc (min)	Length (feet)	Slo (ft/		elocity t/sec)	Cap	acity (cfs)	De	scrip	tion									
6.0	(1001)	(10	<u>, (</u>	1300)		(013)	Dir	ect E	ntrv									
										-								
			Sub	catch	men	t R-	3: Ro	oof l	Jnit	s 58	6	A&E	3 Un	its				
						Hyd	rogra	oh										
0.4 0.38		· ·	-++	·		+ + + + + +	0.37	cfs			- + - + - +			- + - + - +	+ + +	+ + +	 	Runoff
0.36 0.34	V 1 - 1	• i i -	II 24-	i i-		++ 									+	L 		
0.32		1 1	ır Ra	- I I	1	1 1		2							+	+		
0.28	1.1		f Are							+	- +			- +	+	+ +	 	
0.26	Ru	inof	f Vol	ume	=0.0	30	af			- +	+			- +	+			
5 0.22	/-Ri	Inof	f Dep	oth>4	.26	₽ +					- 				+	 		
0.2 0.18	Tc	=6.0) min			++ ++				- +	<u>+</u>	÷			+	<u>+</u>		
0.16		1=98	- I I					8							+	 	 	
0.14 0.12	[/]		-++	- 		+ +				- +	- + 			- +	+	+ +	 	
0.1	(́,∤⊢-		-+-+			++		9-		+				- +	+	 		
0.08	1			· - i i-		i i				- <u>†</u>	÷				÷	÷		
0.04	()}			·		m	1-		T	TTT					<u>i</u>			
0.02-						- The second		,, _, ,		<u>///</u>		<u> </u>	////					
	0 1 2	3 4	1 5 6	678	3 9		11 12 Time (h		14	5 16	17	18	19 20	21	22	23	24	
							(,										



	© 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 1 Summary for Subcatchment R-5: Roof - Units 9&10 - (B&C Units)
unoff	= 0.32 cfs @ 12.08 hrs, Volume= 0.026 af, Depth> 4.26"
	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs -hr 10-Year Rainfall=4.50"
Are	a (sf) CN Description
	3,195 98 Unconnected roofs, HSG A
	3,195 100.00% Impervious Area 3.195 100.00% Unconnected
	,
Tc I (min)	ength Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)
6.0	Direct Entry,
	Subcatchment R-5: Roof - Units 9&10 - (B&C Units)
	Hydrograph
0.36 -	
0.34	
0.32	- Type III 24-hr
0.28	10-Year Rainfall=4.50'
0.26	Runoff Area=3,195 sf
0.24	Runoff Volume=0.026 af
2.0 (cts)	Runoff Depth>4.26"
0.18 0.16	Tc=6.0 min
0.14	CN=98
0.12	
0.08	
0.06	
0.04	



repare	d by Micr	osoft	1ydroCA 2881 © 20		AD Soft	ware So	olutio	ns LL		e III 2	24-hi	r 10-		Rainfall=4.50 nted 1/16/2017 Page 104
	S	umma	iry for Su	ıbcatchı	nent R	-7: Ro	oof -	Uni	its 1	3&14	4 - (/	A Ur	its)	
unoff	=	0.39 c	fs@ 12.	08 hrs, V	olume=		0.0)32 a	ıf, De	epth>	• 4.2	6"		
			thod, UH= ainfall=4.5		eighted-	CN, Tir	ne S	span=	= 0.00)-24.	00 hr	s, dt	= 0.01	hrs
A	rea (sf)	CN	Descriptio	n										
	3,895		Unconnec		HSG A									
	3,895		100.00% l											
	3,895		100.00% l	Jnconnec	ted									
Tc (min)	Length (feet)	Slope (ft/ft)				scriptio	n							
6.0					Dire	ect Ent	ry,							
			Subcatch	mont D	7. Do		,ite	122.	14 -	(A 1)	nite	、		
			Subcalci		ydrograp		iits	ισα	14 -	AU	mits)		
0.44 0.42 0.3 0.36 0.34 0.22 0.3 0.28 0.24 0.24 0.24 0.22 0.24 0.24 0.22 0.24 0.22 0.24 0.22 0.24 0.22 0.24 0.24	10- Ru Ru Tc:	Year noff noff	24-hr Rainfa Area=3 Volumo Depth> nin	,895 s ∋=0.03	f:									Runoff
0	0 1 2	3 4	567	8 9 10			15	16 1	7 18	19	20 2	1 22	23 2	4
					Time (ho	urs)								



	Id Proposed HydroCAD Type III 24-hr 10-Year Ra. Id by Microsoft Printed Image: Non-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC	1/16/2017
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	Summary for Subcatchment R-9: Roof - Units 17&18 - (A&B Units)	
Runoff	= 0.37 cfs @ 12.08 hrs, Volume= 0.030 af, Depth> 4.26"	
Runoff by	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs	
ype III 24	4-hr 10-Year Rainfall=4.50"	
	ea (sf) CN Description	
	3,625 98 Unconnected roofs, HSG A	
	3,625 100.00% Impervious Area 3,625 100.00% Unconnected	
Tc (min)	Length Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)	
6.0	Direct Entry,	
	Cubactalement D.O. Daaf Unite 17810 (ASD Unite)	
	Subcatchment R-9: Roof - Units 17&18 - (A&B Units)	
	Hydrograph	
0.4 0.38	0.37 cfs	Runoff
0.36	Type III 24-hr	
0.34 0.32	10-Year Rainfall=4.50"	
0.3	Runoff Area=3,625 sf	
0.28 0.26	Runoff Volume=0.030 af	
0.24 0.22 (cls)	Runoff Depth>4.26"	
≥ 0.2	Tc=6.0 min	
Ĕ 0.18 0.16		
0.14 0.12	CN=98	
0.12		
0.08		
0.06-1		
0.06 0.04 0.02		

 Topsfield Proposed HydroCAD
 Type III 24-hr
 10-Year Rainfall=4.50"

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 Printed
 1/16/2017

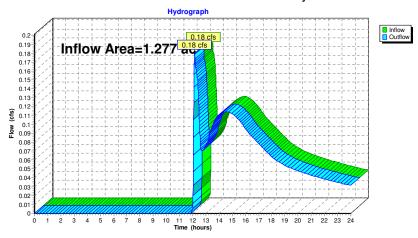
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 Page 107

Summary for Reach SP-1: Wetlands South of Driveway

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

Inflow Area =	1.277 ac, 33.99% Impervious, Inflow Depth > 0.65	5" for 10-Year event
Inflow =	0.18 cfs @ 12.14 hrs, Volume= 0.070 af	
Outflow =	0.18 cfs @ 12.14 hrs, Volume= 0.070 af, A	Atten= 0%, Lag= 0.0 min

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



Reach	SP-1:	Wetlands	South	of	Drivewav
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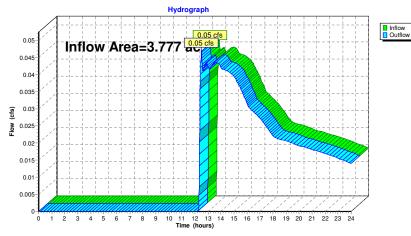
Topsfield Proposed HydroCAD	Type III 24-hr 10-Year Rainfall=4.50"
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Summary for Reach SP-2: Large Wetland Area East

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

Inflow Area =	3.777 ac, 26.87% Impervious, Inflow	Depth > 0.08" for 10-Year event
Inflow =	0.05 cfs @ 12.50 hrs, Volume=	0.026 af
Outflow =	0.05 cfs @ 12.50 hrs, Volume=	0.026 af, Atten= 0%, Lag= 0.0 min

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



Reach SP-2: Large Wetland Area East

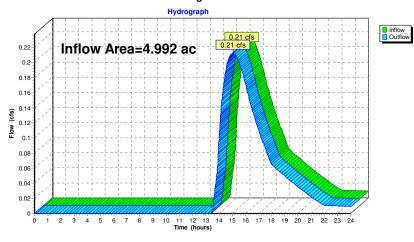
Topsfield Proposed HydroCAD	Type III 24-hr 1	0-Year Rainfall=4.50"
Prepared by Microsoft		Printed 1/16/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions	LLC	Page 109

Summary for Reach SP-3: Large Wetland Area West

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

Inflow Area =	4.992 ac, 31.07% Impervious, Inflow Depth > 0.16" for 10-Year event
Inflow =	0.21 cfs @ 15.04 hrs, Volume= 0.065 af
Outflow =	0.21 cfs @ 15.04 hrs, Volume= 0.065 af, Atten= 0%, Lag= 0.0 min

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



Reach SP-3: Large Wetland Area West

Topsfield Proposed HydroCAD	Type III 24-hr 10-Year Rainfall=4.50"
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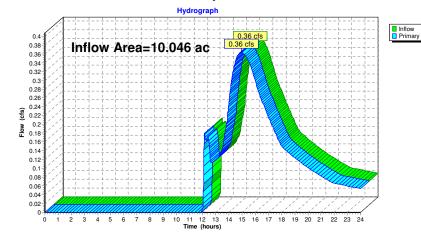
Summary for Pond 1P: Combined Study Points - Northern Wetlands

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

Inflow Area =	10.046 ac, 29.86% Impervious, Inflow	Depth > 0.19" for 10-Year event
Inflow =	0.36 cfs @ 14.94 hrs, Volume=	0.160 af
Primary =	0.36 cfs @ 14.94 hrs, Volume=	0.160 af, Atten= 0%, Lag= 0.0 min

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

Pond 1P: Combined Study Points - Northern Wetlands



Topsfield Proposed HydroCAD Type III 24-hr 10-Year Rainfall=4.50" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

Summary for Pond D-1: Surface Infiltration Pond

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Inflow Area =	2.637 ac, 56.80% Impervious, Inflow I	Depth > 2.05" for 10-Year event
Inflow =	6.42 cfs @ 12.10 hrs, Volume=	0.451 af
Outflow =	0.31 cfs @ 15.01 hrs, Volume=	0.172 af, Atten= 95%, Lag= 174.7 min
Discarded =	0.11 cfs @ 15.01 hrs, Volume=	0.116 af
Primary =	0.20 cfs @ 15.01 hrs, Volume=	0.056 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 70.18' @ 15.01 hrs Surf.Area= 4,734 sf Storage= 13,275 cf Flood Elev= 71.10' Surf.Area= 5,491 sf Storage= 17,958 cf

Plug-Flow detention time= 319.1 min calculated for 0.172 af (38% of inflow) Center-of-Mass det. time= 204.0 min (1,023.0 - 819.1)

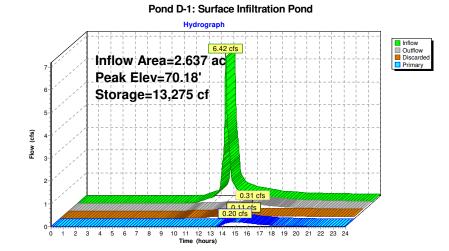
Volume	Invert	Avail.Sto	rage Storage	Description	
#1	66.00'	56,23	33 cf Custom	Stage Data (Prism	natic) Listed below (Recalc)
Elevation (feet)		rf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
66.00		1,817	0	0	
67.00		2,361	2,089	2,089	
68.00		3,059	2,710	4,799	
69.00		3,800	3,430	8,229	
70.00		4,583	4,192	12,420	
71.00		5,403	4,993	17,413	
72.00		6,280	5,842	23,255	
73.00		7,213	6,747	30,001	
74.00		8,202	7,708	37,709	
75.00		9,248	8,725	46,434	
76.00		10,350	9,799	56,233	
Device I	Routing	Invert	Outlet Device	S	-

Device	Routing	Invent	Outlet Devices
#1	Discarded	66.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	70.00'	15.0" Round Culvert L= 252.0' Ke= 0.200
			Inlet / Outlet Invert= 70.00' / 65.40' S= 0.0183 '/' Cc= 0.900
			n= 0.015 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Discarded OutFlow Max=0.11 cfs @ 15.01 hrs HW=70.18' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.19 cfs @ 15.01 hrs HW=70.18' (Free Discharge) -2=Culvert (Barrel Controls 0.19 cfs @ 2.60 fps)





Topsfield Proposed HydroCAD Type III 24-hr 10-Year Rainfall=4.50" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

Summary for Pond D-2: Existing Detention Basin

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[58] Hint: Peaked 0.20' above defined flood level

Inflow Area =	0.531 ac, 59.77% Impervious, Inflow Depth > 2.55" for 10-Year event
Inflow =	1.59 cfs @ 12.09 hrs, Volume= 0.113 af
Outflow =	0.08 cfs @ 14.85 hrs, Volume= 0.043 af, Atten= 95%, Lag= 165.6 min
Primary =	0.08 cfs @ 14.85 hrs, Volume= 0.043 af
Primary =	0.08 cfs @ 14.85 hrs, Volume= 0.043 af

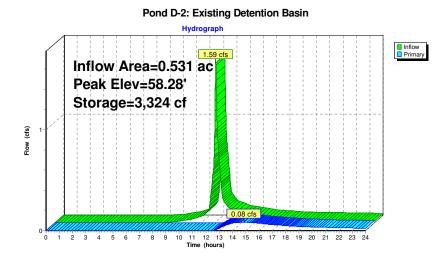
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.28' @ 14.85 hrs Surf.Area= 3,090 sf Storage= 3,324 cf Flood Elev= 58.08' Surf.Area= 3,090 sf Storage= 2,719 cf

Plug-Flow detention time= 341.1 min calculated for 0.043 af (38% of inflow) Center-of-Mass det. time= 218.2 min (1,041.1 - 822.9)

Volume	Inve	ert Avail.Sto	rage Storag	e Description	
#1	57.2	9,02	20 cf Custo	m Stage Data (Pr	ismatic) Listed below (Recalc)
Elevatio (fee	t)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
57.2		3,090	0	0	
58.0	0	3,090	2,472	2,472	
59.0	00	3,090	3,090	5,562	
59.4	0	3,550	1,328	6,890	
60.0	00	3,550	2,130	9,020	
Device	Routing	Invert	Outlet Devic	ces	
#1	Primary	58.08'	4.0" Vert. O	rifice/Grate C=	0.600
#2	Primary	58.80'	8.0" Vert. O	rifice/Grate C=	0.600
Primary	OutFlow	Max=0.08 cfs (@ 14.85 hrs I	HW=58.28' (Free	e Discharge)

1=Orifice/Grate (Orifice Controls 0.08 cfs @ 1.51 fps) **2=Orifice/Grate** (Controls 0.00 cfs)

Topsfield Proposed HydroCAD	Type III 24-hr	10-Year Rainfall=4.50"
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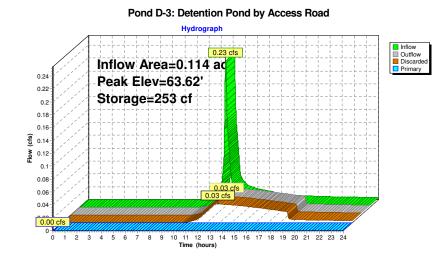


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HydroCAD®	10.00-18 s/n	02881 © 2	016 HydroCAD	Software Solu	utions LLC		Page 11
	Sur	nmary fo	or Pond D-3	: Detention	Pond by Acc	cess Ro	ad
Inflow Area	= 0.23	cfs @ 12	85% Impervio 2.09 hrs, Volu 2.89 hrs, Volu	ime=	epth > 1.74" 1 0.017 af 0.017 af, Atten		
Discarded	= 0.03	cfs @ 12	89 hrs, Volu 89 hrs, Volu 00 hrs, Volu	ime=	0.017 af 0.017 af 0.000 af	= 07 %,	Lay= 40.1 11111
			Span= 0.00-2				
Peak Elev=	63.62 @ 12	.89 115 5	urf.Area= 517	si Storage=	= 253 CI		
Plug-Flow c	detention time	e= 83.5 mi	n calculated f	or 0.016 af (1	00% of inflow)		
			n calculated f n (933.0 - 85		00% of inflow)		
Center-of-N	lass det. time	e= 83.0 mi	n (933.0 - 85	0.0)	00% of inflow)		
	lass det. time	e= 83.0 mi Avail.Stor	n (933.0 - 85 age Storage	0.0)	00% of inflow) (Prismatic) List	ed below	/ (Recalc)
Center-of-N Volume	lass det. time	e= 83.0 mi <u>Avail.Stor</u> 47	n (933.0 - 85 age Storage	0.0)	(Prismatic) List	ed below	ı (Recalc)
Center-of-M <u>Volume</u> #1	lass det. time Invert 63.00' Surf.A	e= 83.0 mi <u>Avail.Stor</u> 47 rea	n (933.0 - 85 <u>age Storage</u> 8 cf Custon	0.0) e Description n Stage Data	(Prismatic) List	ed below	ı (Recalc)
Center-of-M Volume #1 Elevation (feet) 63.00	lass det. time Invert 63.00' Surf.A (so	e 83.0 mi Avail.Stor 47 rea ₁-ft) (305	n (933.0 - 85 age Storage 8 cf Custon Inc.Store (<u>cubic-feet)</u> 0	0.0) <u>e Description</u> n Stage Data Cum.Stc (cubic-fee	(Prismatic) List re et) 0	ed below	/ (Recalc)
Center-of-M Volume #1 Elevation (feet)	lass det. time Invert 63.00' Surf.A (so	e= 83.0 mi <u>Avail.Stor</u> 47 rea 1-ft)	n (933.0 - 85 age Storage 8 cf Custon Inc.Store (cubic-feet)	0.0) <u>e Description</u> n Stage Data Cum.Stc (cubic-fee	(Prismatic) List re et)	ed below	/ (Recalc)
Center-of-M <u>Volume</u> #1 Elevation (feet) 63.00 64.00	lass det. time Invert 63.00' Surf.A (so	e 83.0 mi Avail.Stor 47 rea ₁-ft) (305	n (933.0 - 85 age Storage 8 cf Custon Inc.Store (cubic-feet) 0 478	0.0) <u>e Description</u> n Stage Data Cum.Sto (cubic-fer 4	(Prismatic) List re et) 0	ed below	ı (Recalc)
Center-of-M <u>Volume</u> #1 Elevation (feet) 63.00 64.00 Device Re	lass det. time <u>Invert</u> 63.00' Surf.A (sc	e 83.0 mi <u>Avail.Stor</u> 47 rea a-ft) (305 650	n (933.0 - 85 age Storage 8 cf Custon Inc.Store (cubic-feet) 0 478 <u>Outlet Devic</u>	0.0) <u>e Description</u> n Stage Data Cum.Sto (cubic-fer 4 es	(Prismatic) List re et) 0		、 <i>,</i>
Center-of-M <u>Volume</u> #1 Elevation <u>(feet)</u> 63.00 64.00 Device Re	Aass det. time Invert 63.00' Surf.A Surf.A (sc (sc (sc (sc)) (sc) (sc) (sc) (sc) (e 83.0 mi <u>Avail.Stor</u> 47 rea 1-ft) (305 650 Invert	n (933.0 - 85 age Storage 8 cf Custon Inc.Store (cubic-feet) 0 478 Outlet Devic 5.0' long x 5 Head (feet)	0.0) <u>e Description</u> n Stage Data Cum.Sta (cubic-fer 4' es 5.0' breadth E 0.20 0.40 0.	(Prismatic) List ore 0 78 Froad-Crested F 60 0.80 1.00	Rectangu	、 <i>,</i>
Center-of-M <u>Volume</u> #1 Elevation <u>(feet)</u> 63.00 64.00 Device Re	Aass det. time Invert 63.00' Surf.A Surf.A (sc (sc (sc (sc)) (sc) (sc) (sc) (sc) (e 83.0 mi <u>Avail.Stor</u> 47 rea 1-ft) (305 650 Invert	n (933.0 - 85 age Storage 8 cf Custon Inc.Store (cubic-feet) 0 478 Outlet Device 5.0' long x 5 Head (feet) 2.50 3.00 3	0.0) <u>e Description</u> n Stage Data Cum.Sto (cubic-fer 4 es 5.0' breadth E 0.20 0.40 0. 50 4.00 4.51	(Prismatic) List ore <u>et)</u> 0 78 Broad-Crested F 60 0.80 1.00 5 5.00 5.50	Rectangu	ılar Weir 0 1.60 1.80 2.00
Center-of-M <u>Volume</u> #1 Elevation <u>(feet)</u> 63.00 64.00 Device Re	Aass det. time Invert 63.00' Surf.A Surf.A (sc (sc (sc (sc)) (sc) (sc) (sc) (sc) (e 83.0 mi <u>Avail.Stor</u> 47 rea 1-ft) (305 650 Invert	n (933.0 - 85 age Storage 8 cf Custon Inc.Store (cubic-feet) 0 478 Outlet Devic 5.0' long x 5 Head (feet) 2.50 3.00 3 Coef. (Englis	0.0) <u>e Description</u> n Stage Data Cum.Sto (cubic-fer 4 es 5.0' breadth E 0.20 0.40 0.5 50 4.00 4.55 sh) 2.34 2.50	(Prismatic) List are <u>et)</u> 0 78 Broad-Crested F 0 0.80 1.00 5.00 5.50 0 2.70 2.68 2.6	Rectangu	ılar Weir
Center-of-N <u>Volume</u> #1 Elevation <u>(feet)</u> 63.00 64.00 Device Ro #1 Pr	Aass det. time Invert 63.00' Surf.A Surf.A (sc (sc (sc (sc)) (sc) (sc) (sc) (sc) (e 83.0 mi <u>Avail.Stor</u> 47 rea 1-ft) (305 650 Invert	n (933.0 - 85 age Storage 8 cf Custon Inc.Store (cubic-feet) 0 478 Outlet Devic 5.0' long x 5 Head (feet) 2.50 3.00 3 Coef. (Englis 2.67 2.66 2	0.0) <u> <u> a Description</u> n Stage Data Cum.Sto (cubic-fee 4 es 5.0' breadth E 0.20 0.40 0. .50 4.00 4.5 h) 2.34 2.55 .68 2.70 2.7'</u>	(Prismatic) List are <u>et)</u> 0 78 Broad-Crested F 0 0.80 1.00 5.00 5.50 0 2.70 2.68 2.6	Rectangu 1.20 1.40	ılar Weir 0 1.60 1.80 2.00

Discarded OutFlow Max=0.03 cfs @ 12.89 hrs HW=63.62' (Free Discharge) **-2=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=63.00' (Free Discharge) 1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Topsfield Proposed HydroCAD	Type III 24-hr	10-Year Rainfall=4.50"
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Topsfield Proposed HydroCAD	Type III 24-hr	10-Year Rainfall=4.50"
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Summary for Pond UIS-1: UIS at Entrance

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Inflow Area =	1.487 ac, 40.11% Impervious, Inflow E	Depth > 2.47" for 10-Year event
Inflow =	4.13 cfs @ 12.09 hrs, Volume=	0.306 af
Outflow =	0.08 cfs @ 10.34 hrs, Volume=	0.108 af, Atten= 98%, Lag= 0.0 min
Discarded =	0.08 cfs @ 10.34 hrs, Volume=	0.108 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= 63.66' @ 18.75 hrs Surf.Area= 3,486 sf Storage= 8,986 cf Flood Elev= 68.40' Surf.Area= 3,486 sf Storage= 13,284 cf

Plug-Flow detention time= 285.0 min calculated for 0.108 af (35% of inflow) Center-of-Mass det. time= 142.9 min (953.6 - 810.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	60.00'	5,089 cf	50.50'W x 69.03'L x 6.00'H Field A
			20,917 cf Overall - 8,195 cf Embedded = 12,722 cf x 40.0% Voids
#2A	61.00'	8,195 cf	Cultec R-902HD x 126 Inside #1
			Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
			Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
			7 Rows of 18 Chambers
			Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
		13,284 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices	
#1	Discarded	60.00'	1.020 in/hr Exfiltration over Surface area	•
#2	Primary	68.40'	24.0" x 24.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads	0

Discarded OutFlow Max=0.08 cfs @ 10.34 hrs HW=60.08' (Free Discharge) 1=Exfiltration (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.00' (Free Discharge)

Topsfield Proposed HydroCAD	Type III 24-hr 10-Year Rainfall=4.50'	"
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Pond UIS-1: UIS at Entrance - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD) Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf

78.0" Wide + 6.0" Spacing = 84.0" C-C Row Spacing

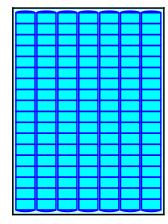
18 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 67.03' Row Length +12.0" End Stone x 2 = 69.03' Base Length 7 Rows x 78.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 50.50' Base Width 12.0" Base + 48.0" Chamber Height + 12.0" Cover = 6.00' Field Height

126 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 8,195.2 cf Chamber Storage

20,917.1 cf Field - 8,195.2 cf Chambers = 12,721.9 cf Stone x 40.0% Voids = 5,088.7 cf Stone Storage

Chamber Storage + Stone Storage = 13,284.0 cf = 0.305 af Overall Storage Efficiency = 63.5% Overall System Size = 69.03' x 50.50' x 6.00'

126 Chambers 774.7 cy Field 471.2 cy Stone



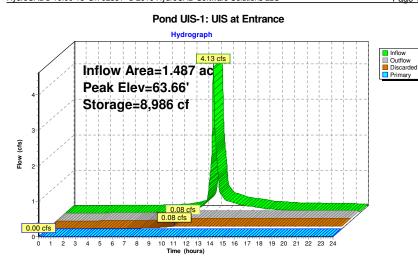




 Type III 24-hr
 10-Year Rainfall=4.50"

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Topsfield Proposed HydroCAD	Type III 24-hr	10-Year Rainfall=4.50"
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Summary for Pond UIS-2: UIS at North of Site

Inflow Area =	0.419 ac,100.00% Impervious, Inflow D	epth > 4.26" for 10-Year event
Inflow =	1.84 cfs @ 12.08 hrs, Volume=	0.149 af
Outflow =	0.23 cfs @ 11.60 hrs, Volume=	0.149 af, Atten= 88%, Lag= 0.0 min
Discarded =	0.23 cfs @ 11.60 hrs, Volume=	0.149 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= 64.08' @ 12.64 hrs Surf.Area= 1,176 sf Storage= 1,956 cf Flood Elev= 68.25' Surf.Area= 1,176 sf Storage= 2,860 cf

Plug-Flow detention time= 53.5 min calculated for 0.149 af (100% of inflow) Center-of-Mass det. time= 53.3 min (802.5 - 749.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	61.50'	1,262 cf	16.00'W x 73.50'L x 4.04'H Field A
			4,753 cf Overall - 1,598 cf Embedded = 3,155 cf x 40.0% Voids
#2A	62.50'	1,598 cf	Cultec R-330XLHD x 30 Inside #1
			Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
			Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
			Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		2.860 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices		
#1	Discarded		8.270 in/hr Exfiltration ov		
#2	Primary	68.25	6.0" Horiz. Orifice/Grate	C = 0.600	Limited to weir flow at low heads

Discarded OutFlow Max=0.23 cfs @ 11.60 hrs HW=61.57' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=61.50' (Free Discharge)

 Topsfield Proposed HydroCAD
 Type III 24

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 Type III 24-hr
 10-Year Rainfall=4.50"

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Pond UIS-2: UIS at North of Site - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

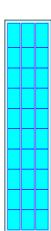
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length 3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width 12.0" Base + 30.5" Chamber Height + 6.0" Cover = 4.04' Field Height

30 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 1,598.2 cf Chamber Storage

4,753.0 cf Field - 1,598.2 cf Chambers = 3,154.8 cf Stone x 40.0% Voids = 1,261.9 cf Stone Storage

Chamber Storage + Stone Storage = 2,860.1 cf = 0.066 af Overall Storage Efficiency = 60.2% Overall System Size = 73.50' x 16.00' x 4.04'

30 Chambers 176.0 cy Field 116.8 cy Stone



Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 122 Pond UIS-2: UIS at North of Site Hydrograph Inflow Area=0.419 ac Peak Elev=64.08' Storage=1,956 cf

Type III 24-hr 10-Year Rainfall=4.50"

Topsfield Proposed HydroCAD

Flow

0.00 cts 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Time (hours)

Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 10-Year Rainfall=4.50" Printed 1/16/2017 Page 123

Summary for Pond UIS-3: UIS-3

[58] Hint: Peaked 1.53' above defined flood level

Inflow Area =	0.083 ac,100.00% Impervious, Inflow Depth > 4.26" for 10-Year event
Inflow =	0.37 cfs @ 12.08 hrs, Volume= 0.030 af
Outflow =	0.36 cfs @ 12.09 hrs, Volume= 0.027 af, Atten= 1%, Lag= 0.7 min
Discarded =	0.00 cfs @ 3.34 hrs, Volume= 0.004 af
Primary =	0.36 cfs @ 12.09 hrs, Volume= 0.023 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 73.74' @ 12.09 hrs Surf.Area= 103 sf Storage= 135 cf Flood Elev= 72.21' Surf.Area= 103 sf Storage= 22 cf

Plug-Flow detention time= 72.9 min calculated for 0.027 af (91% of inflow) Center-of-Mass det. time= 28.0 min (777.3 - 749.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	71.69'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	72.19'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	71.69'	1.020 in/hr Exfiltration over Surface area
#2	Primary	73.40'	6.0" Round Culvert L= 30.0' Ke= 0.200
			Inlet / Outlet Invert= 73.40' / 70.70' S= 0.0900 '/' Cc= 0.900
			n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 3.34 hrs HW=71.72' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.36 cfs @ 12.09 hrs HW=73.74' (Free Discharge) -2=Culvert (Inlet Controls 0.36 cfs @ 2.50 fps)

Topsfield Proposed HydroCAD	Type III 24-hr	10-Year Raii	nfall=4.50"
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Pond UIS-3: UIS-3 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

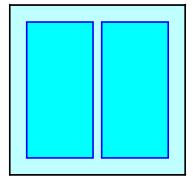
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

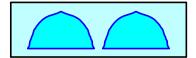
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

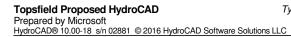
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'



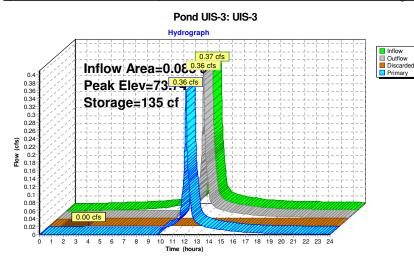




 Type III 24-hr
 10-Year Rainfall=4.50"

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Topsfield Proposed HydroCAD	Type III 24-hr	10-Year Rainfall=4.50"
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Summary for Pond UIS-4: UIS-4

[58] Hint: Peaked 0.45' above defined flood level

Inflow Area =	0.073 ac,100.00% Impervious, Inflow De	epth > 4.26" for 10-Year event
Inflow =	0.32 cfs @ 12.08 hrs, Volume=	0.026 af
Outflow =	0.32 cfs @ 12.10 hrs, Volume=	0.023 af, Atten= 2%, Lag= 1.0 min
Discarded =	0.00 cfs @ 3.68 hrs, Volume=	0.004 af
Primary =	0.31 cfs @ 12.10 hrs, Volume=	0.019 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 74.65' @ 12.10 hrs Surf.Area= 103 sf Storage= 141 cf Flood Elev= 74.20' Surf.Area= 103 sf Storage= 111 cf

Plug-Flow detention time= 78.6 min calculated for 0.023 af (90% of inflow) Center-of-Mass det. time= 29.9 min (779.1 - 749.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	72.50'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	73.00'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	72.50'	1.020 in/hr Exfiltration over Surface area
#2	Primary	74.20'	6.0" Round Culvert L= 30.0' Ke= 1.000 Inlet / Outlet Invert= 74.20' / 74.06' S= 0.0047 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 3.68 hrs HW=72.53' (Free Discharge)

Primary OutFlow Max=0.31 cfs @ 12.10 hrs HW=74.65' (Free Discharge) -2=Culvert (Barrel Controls 0.31 cfs @ 2.20 fps)
 Topsfield Proposed HydroCAD
 Type I

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 Type III 24-hr
 10-Year Rainfall=4.50"

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Pond UIS-4: UIS-4 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

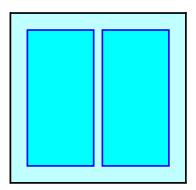
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

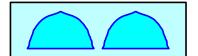
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

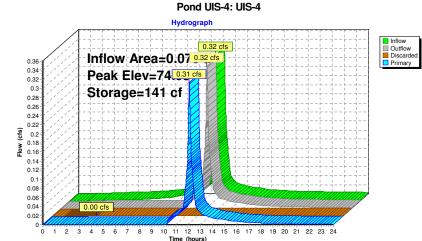
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'









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			Summary for Por	nd UIS-5: UIS-5
Inflow A	rea = 0	.083 ac,100.	.00% Impervious, Inflo	ow Depth > 4.26" for 10-Year event
Inflow			2.08 hrs, Volume=	0.030 af
Outflow			2.10 hrs, Volume=	0.027 af, Atten= 3%, Lag= 1.3 min
Discard			3.34 hrs, Volume=	0.004 af
Primary	= 0	.35 cfs @ 12	2.10 hrs, Volume=	0.023 af
Routing	by Stor-Ind r	nothod Time	e Span= 0.00-24.00 hrs	c. dt_ 0.01 brs
			Surf.Area = 103 sf Sto	
Plug-Flo	w detention	ime= 73.6 m	in calculated for 0.027	5
				5
Center-o	of-Mass det.	ime= 28.5 m	in calculated for 0.027 iin (777.8 - 749.3)	af (91% of inflow)
Center-o Volume	of-Mass det. 1 Invert	ime= 28.5 m Avail.Sto	iin calculated for 0.027 iin(777.8 - 749.3) rage Storage Descri	r af (91% of inflow)
Center-o	of-Mass det.	ime= 28.5 m Avail.Sto	iin calculated for 0.027 iin (777.8 - 749.3) rage <u>Storage Descri</u> 94 cf 10.33'W x 10.00	² af (91% of inflow) ption D'L x 3.21'H Field A
Center-o <u>Volume</u> #1A	of-Mass det. t Invert 73.09'	ime= 28.5 m Avail.Sto	in calculated for 0.027 in (777.8 - 749.3) rage Storage Descri 94 cf 10.33'W x 10.00 332 cf Overall -	² af (91% of inflow) <u>ption</u> D'L x 3.21'H Field A • 97 cf Embedded = 234 cf x 40.0% Voids
Center-o Volume	of-Mass det. 1 Invert	ime= 28.5 m Avail.Sto	in calculated for 0.027 in (777.8 - 749.3) rage Storage Descri 94 cf 10.33'W x 10.00 332 cf Overall - 97 cf Cultec R-280HI	2 af (91% of inflow) ption D'L x 3.21'H Field A • 97 cf Embedded = 234 cf x 40.0% Voids D x 2 Inside #1
Center-o <u>Volume</u> #1A	of-Mass det. t Invert 73.09'	ime= 28.5 m Avail.Sto	in calculated for 0.027 in (777.8 - 749.3) rage Storage Descri 94 cf 10.33'W x 10.0 332 cf Overall - 97 cf Cultec R-280HI Effective Size=	² af (91% of inflow) <u>ption</u> D'L x 3.21'H Field A • 97 cf Embedded = 234 cf x 40.0% Voids
Center-o <u>Volume</u> #1A	of-Mass det. t Invert 73.09'	ime= 28.5 m Avail.Sto	in calculated for 0.027 in (777.8 - 749.3) rage Storage Descri 94 cf 10.33'W x 10.00 332 cf Overal - 97 cf Cultec R-280H Effective Size= Overall Size= 4	Y af (91% of inflow) ption YL x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids D x 2 Inside #1 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Center-o <u>Volume</u> #1A	of-Mass det. t Invert 73.09'	ime= 28.5 m Avail.Sto	in calculated for 0.027 in (777.8 - 749.3) rage Storage Descri 94 cf 10.33'W x 10.00 332 cf Overal - 97 cf Cultec R-280H Effective Size= Overall Size= 4	² af (91% of inflow) ption D'L x 3.21'H Field A • 97 cf Embedded = 234 cf x 40.0% Voids D x 2 Inside #1 • 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap bjustment= +1.00' x 6.07 sf x 2 rows
Center-o <u>Volume</u> #1A #2A	of-Mass det. 1 <u>Invert</u> 73.09' 73.59'	ime= 28.5 m	in calculated for 0.027 in (777.8 - 749.3) rage Storage Descri 94 cf 10.33'W x 10.0 332 cf Overall- 97 cf Cultec R-280HI Effective Size= Overall Size= 4 Row Length Ac	² af (91% of inflow) ption D'L x 3.21'H Field A • 97 cf Embedded = 234 cf x 40.0% Voids D x 2 Inside #1 • 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap bjustment= +1.00' x 6.07 sf x 2 rows
Center-o <u>Volume</u> #1A #2A	of-Mass det. 1 <u>Invert</u> 73.09' 73.59'	ime= 28.5 m	in calculated for 0.027 in (777.8 - 749.3) rage Storage Descri 94 cf 10.33'W x 10.00 332 cf Overall - 97 cf Cultec R-280H Effective Size= Overall Size= 4 Row Length Ac	² af (91% of inflow) ption D'L x 3.21'H Field A • 97 cf Embedded = 234 cf x 40.0% Voids D x 2 Inside #1 • 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap bjustment= +1.00' x 6.07 sf x 2 rows
Center-o Volume #1A #2A Stora	of-Mass det. 1 Invert 73.09' 73.59' 73.59'	ime= 28.5 m Avail.Sto	in calculated for 0.027 in (777.8 - 749.3) rage Storage Descri 94 cf 10.33'W x 10.00 332 cf Overall - 97 cf Cultec R-280H Effective Size= Overall Size= 4 Row Length Ac 91 cf Total Available Chamber Wizard	² af (91% of inflow) ption D'L x 3.21'H Field A • 97 cf Embedded = 234 cf x 40.0% Voids D x 2 Inside #1 • 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap bjustment= +1.00' x 6.07 sf x 2 rows
Center-o Volume #1A #2A Stora Device	of-Mass det. 1 Invert 73.09' 73.59' 73.59' nge Group A Routing	ime= 28.5 m Avail.Sto	in calculated for 0.027 in (777.8 - 749.3) rage Storage Descri 94 cf 10.33'W x 10.00 332 cf Overall - 97 cf Cultec R-280HI Effective Size= Overall Size= 4 Row Length Ac 91 cf Total Available Chamber Wizard Outlet Devices	² af (91% of inflow) ption [℃] Y 3.21'H Field A • 97 cf Embedded = 234 cf x 40.0% Voids D x 2 Inside #1 • 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf #7.0"W x 26.5"H × 8.00'L with 1.00' Overlap jjustment= +1.00' x 6.07 sf x 2 rows Storage
Center-o Volume #1A #2A Stora Device #1	of-Mass det. i Invert 73.09' 73.59' 73.59' age Group A (<u>Routing</u> Discarded	ime= 28.5 m Avail.Sto S S Created with Invert 73.09'	in calculated for 0.027 in (777.8 - 749.3) rage Storage Descri 94 cf 10.33'W x 10.0 332 cf Overall- 97 cf Cultec R-280HI Effective Size= Overall Size= 4 Row Length Ac 91 cf Total Available Chamber Wizard Outlet Devices 1.020 in/hr Exfiltratio	Y af (91% of inflow) ption D'L x 3.21'H Field A • 97 cf Embedded = 234 cf x 40.0% Voids D x 2 Inside #1 • 46.9"W x 26.0"H ⇒ 6.07 sf x 7.00'L = 42.5 cf 17.0"W x 26.5"H ≈ 8.00'L with 1.00' Overlap bjustment= +1.00' x 6.07 sf x 2 rows Storage on over Surface area
Center-o Volume #1A #2A Stora Device	of-Mass det. 1 Invert 73.09' 73.59' 73.59' nge Group A Routing	ime= 28.5 m Avail.Sto	in calculated for 0.027 in (777.8 - 749.3) rage Storage Descri 94 cf 10.33 ° W x 10.0 332 cf Overall- 97 cf Cultec R-280HI Effective Size= Overall Size= 4 Row Length Ac 91 cf Total Available Chamber Wizard <u>Outlet Devices</u> 1.020 in/hr Exfiltrati 6.0" Round Culvert	² af (91% of inflow) ption [℃] Y 3.21'H Field A • 97 cf Embedded = 234 cf x 40.0% Voids D x 2 Inside #1 • 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf #7.0"W x 26.5"H × 8.00'L with 1.00' Overlap jjustment= +1.00' x 6.07 sf x 2 rows Storage

Discarded OutFlow Max=0.00 cfs @ 3.34 hrs HW=73.12' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.35 cfs @ 12.10 hrs HW=75.29' (Free Discharge) -2=Culvert (Inlet Controls 0.35 cfs @ 1.80 fps)

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Pond UIS-5: UIS-5 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

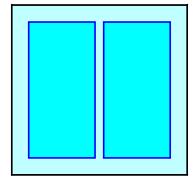
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

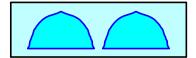
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

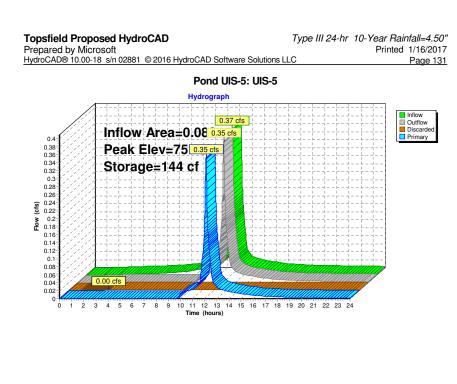
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

 $\begin{array}{l} \mbox{Chamber Storage + Stone Storage = 190.9 cf = 0.004 af} \\ \mbox{Overall Storage Efficiency = 57.6\%} \\ \mbox{Overall System Size = 10.00' x 10.33' x 3.21'} \end{array}$







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IJUIOAD	0 10.00 10 3	1102001 @ 201	o Hydroorab Gortware C		Fage 13
		ę	Summary for Pond	UIS-6: UIS-6	
Inflow Are Inflow Outflow Discarded Primary	= 0.3 = 0.3 d = 0.0	89 cfs @ 12.0 88 cfs @ 12.1 90 cfs @ 3.1	% Impervious, Inflow 8 hrs, Volume= 1 hrs, Volume= 7 hrs, Volume= 1 hrs, Volume=	Depth > 4.26" for 1 0.032 af 0.029 af, Atten= 4% 0.004 af 0.025 af	
			oan= 0.00-24.00 hrs, o f.Area= 103 sf Stora		
			calculated for 0.029 at (777.1 - 749.3)	f (92% of inflow)	
Volume	Invert	Avail.Storad	e Storage Descripti	on	
#1A	72.29'	94	cf 10.33'W x 10.00'L	x 3.21'H Field A	
#2A	72.79'	97	cf Cultec R-280HD Effective Size= 46	6.9"W x 26.0"H => 6.07	sf x 7.00'L = 42.5 cf
		191	Row Length Adjust cf Total Available St	0"W x 26.5"H x 8.00'L v stment= +1.00' x 6.07 s orage	
Device I	e Group A ci Routing Discarded	reated with Ch	Row Length Adju	stment= +1.00' x 6.07 s orage	
Device F #1 [Routing	reated with Ch Invert C 72.29' 1 74.00' 6	Row Length Adju: cf Total Available St amber Wizard 0utlet Devices .020 in/hr Exfiltration .0" Round Culvert L hlet / Outlet Invert= 74	stment= +1.00' x 6.07 s orage over Surface area	f x 2 rows
Device F #1 [#2 F	Routing Discarded Primary	reated with Ch Invert C 72.29' 1 74.00' 6 In	Row Length Adju: cf Total Available St amber Wizard Outlet Devices .020 in/hr Exfiltration .0" Round Culvert L hlet / Outlet Invert= 74 = 0.011 PVC, smooth 0 3.17 hrs HW=72.32	stment= +1.00' x 6.07 s orage over Surface area = 106.0' Ke= 1.000 .00' / 72.18' S= 0.0172 i interior, Flow Area= 0	f x 2 rows
Device F #1 [#2 F Discarded 1=Exfil	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Ch Invert C 72.29' 1 74.00' 6 In Nax=0.00 cfs @ iltration Control	Row Length Adju: cf Total Available St amber Wizard Dutlet Devices .020 in/hr Exfiltration .0" Round Culvert L hlet / Outlet Invert= 74 = 0.011 PVC, smooth @ 3.17 hrs HW=72.32 bls 0.00 cfs) 12.11 hrs HW=74.53'	stment= +1.00' x 6.07 s orage over Surface area _= 106.0' Ke= 1.000 .00' / 72.18' S= 0.0172 n interior, Flow Area= 0 ?' (Free Discharge)	f x 2 rows
Device F #1 [#2 F Discarded 1=Exfil	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Ch Invert C 72.29 1 74.00 6 In 74.00 cfs (Itration Contro (=0.38 cfs (2))	Row Length Adju: cf Total Available St amber Wizard Dutlet Devices .020 in/hr Exfiltration .0" Round Culvert L hlet / Outlet Invert= 74 = 0.011 PVC, smooth @ 3.17 hrs HW=72.32 bls 0.00 cfs) 12.11 hrs HW=74.53'	stment= +1.00' x 6.07 s orage over Surface area _= 106.0' Ke= 1.000 .00' / 72.18' S= 0.0172 n interior, Flow Area= 0 ?' (Free Discharge)	f x 2 rows
Device F #1 [#2 F Discarded 1=Exfil	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Ch Invert C 72.29 1 74.00 6 In 74.00 cfs (Itration Contro (=0.38 cfs (2))	Row Length Adju: cf Total Available St amber Wizard Dutlet Devices .020 in/hr Exfiltration .0" Round Culvert L hlet / Outlet Invert= 74 = 0.011 PVC, smooth @ 3.17 hrs HW=72.32 bls 0.00 cfs) 12.11 hrs HW=74.53'	stment= +1.00' x 6.07 s orage over Surface area _= 106.0' Ke= 1.000 .00' / 72.18' S= 0.0172 n interior, Flow Area= 0 ?' (Free Discharge)	f x 2 rows
Device F #1 [#2 F Discarded 1=Exfil	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Ch Invert C 72.29 1 74.00 6 In 74.00 cfs (Itration Contro (=0.38 cfs (2))	Row Length Adju: cf Total Available St amber Wizard Dutlet Devices .020 in/hr Exfiltration .0" Round Culvert L hlet / Outlet Invert= 74 = 0.011 PVC, smooth @ 3.17 hrs HW=72.32 bls 0.00 cfs) 12.11 hrs HW=74.53'	stment= +1.00' x 6.07 s orage over Surface area _= 106.0' Ke= 1.000 .00' / 72.18' S= 0.0172 n interior, Flow Area= 0 ?' (Free Discharge)	f x 2 rows
Device F #1 [#2 F Discarded 1=Exfil	Routing Discarded Primary d OutFlow M Itration (Exf	reated with Ch Invert C 72.29 1 74.00 6 In 74.00 cfs (Itration Contro (=0.38 cfs (2))	Row Length Adju: cf Total Available St amber Wizard Dutlet Devices .020 in/hr Exfiltration .0" Round Culvert L hlet / Outlet Invert= 74 = 0.011 PVC, smooth @ 3.17 hrs HW=72.32 bls 0.00 cfs) 12.11 hrs HW=74.53'	stment= +1.00' x 6.07 s orage over Surface area _= 106.0' Ke= 1.000 .00' / 72.18' S= 0.0172 n interior, Flow Area= 0 ?' (Free Discharge)	f x 2 rows

 Topsfield Proposed HydroCAD
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 10-Year Rainfall=4.50"

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Pond UIS-6: UIS-6 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

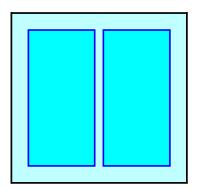
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

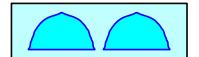
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

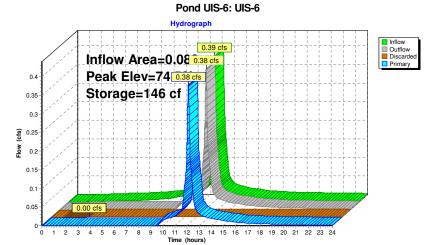
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'









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		S	Summary for Pond UIS-7: UIS-7
nflow Are	ea = 0.	.083 ac.100.00%	% Impervious, Inflow Depth > 4.26" for 10-Year event
nflow			8 hrs, Volume= 0.030 af
Dutflow			0 hrs, Volume= 0.027 af, Atten= 3%, Lag= 1.3 min
Discarded			4 hrs, Volume= 0.004 af
Primary	= 0.3	35 cfs @ 12.10	0 hrs, Volume= 0.023 af
Routina b	v Stor-Ind m	ethod Time Sp	pan= 0.00-24.00 hrs, dt= 0.01 hrs
			f.Area= 103 sf Storage= 144 cf
			calculated for 0.027 af (91% of inflow)
			calculated for 0.027 af (91% of inflow) (777.8 - 749.3)
Center-of	-Mass det. ti	me= 28.5 min ((777.8 - 749.3)
		me= 28.5 min ((777.8 - 749.3) ge Storage Description
Center-of	-Mass det. ti Invert	me= 28.5 min (Avail.Storage	(777.8 - 749.3) ge Storage Description
Center-of	-Mass det. ti Invert	me= 28.5 min (Avail.Storage	(777.8 - 749.3) <u>e</u> Storage Description cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1
Center-of- /olume #1A	-Mass det. ti Invert 71.79'	me= 28.5 min (<u>Avail.Storage</u> 94 c	 (777.8 - 749.3) ge Storage Description cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf
Center-of- /olume #1A	-Mass det. ti Invert 71.79'	me= 28.5 min (<u>Avail.Storage</u> 94 c	 (777.8 - 749.3) <u>te</u> Storage Description cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap
Center-of- /olume #1A	-Mass det. ti Invert 71.79'	me= 28.5 min (<u>Avail.Storage</u> 94 c 97 c	 (777.8 - 749.3) ge Storage Description f 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
Center-of- /olume #1A	-Mass det. ti Invert 71.79'	me= 28.5 min (<u>Avail.Storage</u> 94 c 97 c	 (777.8 - 749.3) <u>te</u> Storage Description cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap
Center-of /olume #1A #2A	-Mass det. ti Invert 71.79' 72.29'	me= 28.5 min (<u>Avail.Storage</u> 94 c 97 c 191 c	 (777.8 - 749.3) ge Storage Description cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows cf Total Available Storage
Center-of /olume #1A #2A	-Mass det. ti Invert 71.79' 72.29'	me= 28.5 min (<u>Avail.Storage</u> 94 c 97 c	 (777.8 - 749.3) ge Storage Description cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows cf Total Available Storage
Center-of- /olume #1A #2A Storag	-Mass det. ti Invert 71.79' 72.29'	me= 28.5 min (<u>Avail.Storage</u> 94 c 97 c 191 c 191 c	 (777.8 - 749.3) ge Storage Description cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows cf Total Available Storage
Center-of- / <u>olume</u> #1A #2A Storag <u>Device</u> #1	-Mass det. ti Invert 71.79' 72.29' e Group A c <u>Routing</u> Discarded	me= 28.5 min (<u>Avail.Storage</u> 94 c 97 c 191 c reated with Cha <u>Invert Ot</u> 71.79' 1.	<pre>(777.8 - 749.3)</pre>
Center-of- / <u>olume</u> #1A #2A Storag <u>Device</u> #1	-Mass det. ti Invert 71.79' 72.29' e Group A c Routing	me= 28.5 min (<u>Avail.Storage</u> 94 c 97 c 191 c reated with Cha <u>Invert Ot</u> 71.79' 1.1 73.50' 6.1	 (777.8 - 749.3) ge Storage Description cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows cf Total Available Storage amber Wizard Dutlet Devices .020 in/hr Exfiltration over Surface area .00' Round Culvert L= 17.5' Ke= 1.000
Center-of- / <u>olume</u> #1A #2A Storag <u>Device</u> #1	-Mass det. ti Invert 71.79' 72.29' e Group A c <u>Routing</u> Discarded	me= 28.5 min (<u>Avail.Storage</u> 94 c 97 c 191 c reated with Cha <u>Invert</u> Oi 71.79' 1. 73.50' 6. Inl	<pre>(777.8 - 749.3)</pre>

Discarded OutFlow Max=0.00 cfs @ 3.34 hrs HW=71.82' (Free Discharge) **1=Extiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.35 cfs @ 12.10 hrs HW=73.99' (Free Discharge) -2=Culvert (Inlet Controls 0.35 cfs @ 1.80 fps)

Topsfield Proposed HydroCAD	Type III 24-hr	10-Year Rainfall=4.50"
Prepared by Microsoft		Printed 1/16/2017
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Pond UIS-7: UIS-7 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

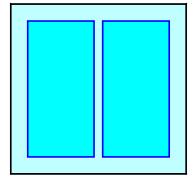
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

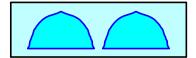
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

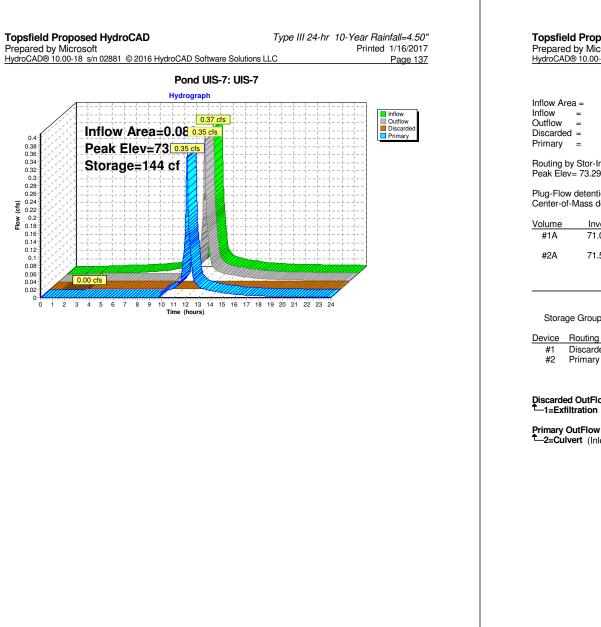
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

 $\begin{array}{l} \mbox{Chamber Storage + Stone Storage = 190.9 cf = 0.004 af} \\ \mbox{Overall Storage Efficiency = 57.6\%} \\ \mbox{Overall System Size = 10.00' x 10.33' x 3.21'} \end{array}$







	ed by Microsoft		16 HydroCAD Softwa	re Solutions LLC		Printed 1/16/2017 Page 138
			Summary for Po	nd UIS-8: UIS-8	3	
Inflow A Inflow Outflow Discarde Primary	= 0.37 = 0.35 ed = 0.00	cfs @ 12. cfs @ 12. cfs @ 3.	0% Impervious, Infl 08 hrs, Volume= 10 hrs, Volume= 34 hrs, Volume= 10 hrs, Volume=	0.030 af	" for 10-Yea tten= 3%, La	
			Span= 0.00-24.00 hr Irf.Area= 103 sf Sto			
			calculated for 0.02 (777.8 - 749.3)	7 af (91% of inflov	v)	
Volume	Invert	Avail.Stora	ge Storage Descr	intion		
#1A	71.09'			0'L x 3.21'H Field	Α	
#1/\ #2A	71.59'	•	332 cf Overall cf Cultec R-280H	- 97 cf Embedder D x 2 Inside #1	d = 234 cf x 4	
			Overall Size=	= 46.9"W x 26.0"H 47.0"W x 26.5"H djustment= +1.00	x 8.00'L with 1	.00' Overlap
		191	cf Total Available		x 0.07 31 x Z	
Stora	age Group A cre			eter age		
Device	Routing	Invert	Outlet Devices			
#1 #2 Discard	Discarded Primary	71.09' 72.80' ax=0.00 cfs	1.020 in/hr Exfiltrati 6.0" Round Culver Inlet / Outlet Invert= n= 0.011 PVC, smc @ 3.34 hrs HW=71	t L= 37.0' Ke= 72.80' / 72.18' S poth interior, Flow	1.000 S= 0.0168 '/' (Area= 0.20 s	
#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow Ma filtration (Exfilt	71.09' 72.80' ax=0.00 cfs ration Contr =0.35 cfs @	1.020 in/hr Exfiitrati 6.0" Round Culver Inlet / Outlet Invert= n= 0.011 PVC, smo @ 3.34 hrs HW=71 rols 0.00 cfs) 12.10 hrs HW=73.:	t L= 37.0' Ke= 72.80' / 72.18' S both interior, Flow .12' (Free Disch	1.000 S= 0.0168 '/' (v Area= 0.20 s arge)	
#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow Ma filtration (Exfilt OutFlow Max=	71.09' 72.80' ax=0.00 cfs ration Contr =0.35 cfs @	1.020 in/hr Exfiitrati 6.0" Round Culver Inlet / Outlet Invert= n= 0.011 PVC, smo @ 3.34 hrs HW=71 rols 0.00 cfs) 12.10 hrs HW=73.:	t L= 37.0' Ke= 72.80' / 72.18' S both interior, Flow .12' (Free Disch	1.000 S= 0.0168 '/' (v Area= 0.20 s arge)	
#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow Ma filtration (Exfilt OutFlow Max=	71.09' 72.80' ax=0.00 cfs ration Contr =0.35 cfs @	1.020 in/hr Exfiitrati 6.0" Round Culver Inlet / Outlet Invert= n= 0.011 PVC, smo @ 3.34 hrs HW=71 rols 0.00 cfs) 12.10 hrs HW=73.:	t L= 37.0' Ke= 72.80' / 72.18' S both interior, Flow .12' (Free Disch	1.000 S= 0.0168 '/' (v Area= 0.20 s arge)	
#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow Ma filtration (Exfilt OutFlow Max=	71.09' 72.80' ax=0.00 cfs ration Contr =0.35 cfs @	1.020 in/hr Exfiitrati 6.0" Round Culver Inlet / Outlet Invert= n= 0.011 PVC, smo @ 3.34 hrs HW=71 rols 0.00 cfs) 12.10 hrs HW=73.:	t L= 37.0' Ke= 72.80' / 72.18' S both interior, Flow .12' (Free Disch	1.000 S= 0.0168 '/' (v Area= 0.20 s arge)	
#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow Ma filtration (Exfilt OutFlow Max=	71.09' 72.80' ax=0.00 cfs ration Contr =0.35 cfs @	1.020 in/hr Exfiitrati 6.0" Round Culver Inlet / Outlet Invert= n= 0.011 PVC, smo @ 3.34 hrs HW=71 rols 0.00 cfs) 12.10 hrs HW=73.:	t L= 37.0' Ke= 72.80' / 72.18' S both interior, Flow .12' (Free Disch	1.000 S= 0.0168 '/' (v Area= 0.20 s arge)	
#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow Ma filtration (Exfilt OutFlow Max=	71.09' 72.80' ax=0.00 cfs ration Contr =0.35 cfs @	1.020 in/hr Exfiitrati 6.0" Round Culver Inlet / Outlet Invert= n= 0.011 PVC, smo @ 3.34 hrs HW=71 rols 0.00 cfs) 12.10 hrs HW=73.:	t L= 37.0' Ke= 72.80' / 72.18' S both interior, Flow .12' (Free Disch	1.000 S= 0.0168 '/' (v Area= 0.20 s arge)	
#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow Ma filtration (Exfilt OutFlow Max=	71.09' 72.80' ax=0.00 cfs ration Contr =0.35 cfs @	1.020 in/hr Exfiitrati 6.0" Round Culver Inlet / Outlet Invert= n= 0.011 PVC, smo @ 3.34 hrs HW=71 rols 0.00 cfs) 12.10 hrs HW=73.:	t L= 37.0' Ke= 72.80' / 72.18' S both interior, Flow .12' (Free Disch	1.000 S= 0.0168 '/' (v Area= 0.20 s arge)	

 Topsfield Proposed HydroCAD
 Type I

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 Type III 24-hr
 10-Year Rainfall=4.50"

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Pond UIS-8: UIS-8 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

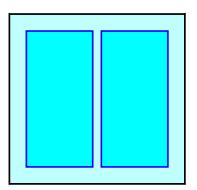
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

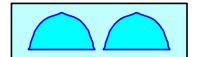
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

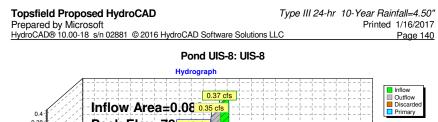
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

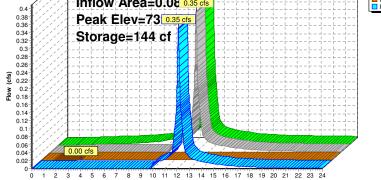
Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$

2 Chambers 12.3 cy Field 8.7 cy Stone









Time (hours)

	d by Microso		D Type III 24-hr 10-Year Rainfall=4.50" Printed 1/16/2017 16 HydroCAD Software Solutions LLC Page 141	Prep Hydro
1190100712			Summary for Pond UIS-9: UIS-9	<u>- iyun</u>
Inflow Ar	ea = 01	089 ac 100 00	% Impervious, Inflow Depth > 4.26" for 10-Year event	Char
Inflow	•••		0.032 af	Effec
Outflow			11 hrs, Volume= 0.031 af, Atten= 4%, Lag= 1.5 min	Over
Discarde	d = 0.0	0 cfs @ 3.1	17 hrs, Volume= 0.004 af	Row
Primary	= 0.3	37 cfs @ 12.1	11 hrs, Volume= 0.026 af	
Denthearth		- H Time - O	ware 0.00.04.00 km at 0.04 km	47.0
			pan= 0.00-24.00 hrs, dt= 0.01 hrs rf.Area= 103 sf Storage= 91 cf	
	v= 12.11 @	12.111113 Out	n.niea 100 si Otolage 31 ci	1 Ch
Plua-Flov	v detention tir	me= 40.7 min	calculated for 0.031 af (96% of inflow)	Base
			(766.8 - 749.3)	2 Ro
				6.0"
Volume	Invert		ge Storage Description	0.01
Volume #1A	Invert 71.28'		cf 10.33'W x 10.00'L x 3.21'H Field A	2 Ch
#1A	71.28'	94	cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids	_
-		94	cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1	_
#1A	71.28'	94	cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf	331.5
#1A	71.28'	94	cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap	331. Char
#1A	71.28'	94	cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows	331. Char Over
#1A #2A	71.28' 71.78'	94 97 191	cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows	331. Char Over Over
#1A #2A Storag	71.28' 71.78' ge Group A cr	94 97 191 reated with Ch	cf10.33'W x 10.00'L x 3.21'H Field A332 cf Overall - 97 cf Embedded = 234 cf x 40.0% VoidscfCultec R-280HD x 2 Inside #1Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cfOverall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' OverlapRow Length Adjustment= $+1.00' \times 6.07$ sf x 2 rowscfTotal Available Storagenamber Wizard	331. Char Over Over 2 Ch
#1A #2A Storag Device	71.28' 71.78' ge Group A cr Routing	94 97 191 reated with Ch Invert C	cf10.33'W x 10.00'L x 3.21'H Field A332 cf Overall - 97 cf Embedded = 234 cf x 40.0% VoidscfCultec R-280HD x 2 Inside #1Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cfOverall Size= $47.0"W x 26.5"H x 8.00'L with 1.00' OverlapRow Length Adjustment= +1.00' x 6.07 sf x 2 rowscfTotal Available Storagenamber WizardDutlet Devices$	331. Char Over Over 2 Ch 12.3
#1A #2A Storag <u>Device</u> #1	71.28' 71.78' ge Group A cr Routing Discarded	94 97 191 reated with Cr <u>Invert (</u> 71.28' 1	cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows cf Total Available Storage namber Wizard Dutlet Devices 1.020 in/hr Exfiltration over Surface area	331. Char Over Over 2 Ch 12.3
#1A #2A Storag <u>Device</u> #1	71.28' 71.78' ge Group A cr Routing	94 97 191 reated with Ch <u>Invert (</u> 71.28' 1 72.18' 6	cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0'H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows cf Total Available Storage namber Wizard Dutlet Devices I.020 in/hr Exfiltration over Surface area 6.0'' Round Culvert L= 79.0' Ke= 1.000	331. Char Over Over 2 Ch 12.3
#1A #2A Storag <u>Device</u> #1	71.28' 71.78' ge Group A cr Routing Discarded	94 97 191 reated with Ch <u>Invert (</u> 71.28' 1 72.18' 6 1	cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows cf Total Available Storage namber Wizard Dutlet Devices 1.020 in/hr Exfiltration over Surface area	2 Ch 331. Char Over Over 2 Ch 12.3 8.7 c

Discarded OutFlow Max=0.00 cfs @ 3.17 hrs HW=71.31' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.37 cfs @ 12.11 hrs HW=72.71' (Free Discharge) -2=Culvert (Inlet Controls 0.37 cfs @ 1.90 fps)

Topsfield Proposed HydroCAD	Type III 24-hr	10-Year Rainfall=4.50"
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Pond UIS-9: UIS-9 - Chamber Wizard Field A

lodel = Cultec R-280HD (Cultec Recharger® 280HD)

ze= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf e= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Adjustment= +1.00' x 6.07 sf x 2 rows

+ 6.0" Spacing = 53.0" C-C Row Spacing

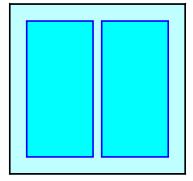
s/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' 7.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

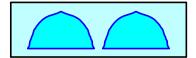
s x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

eld - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

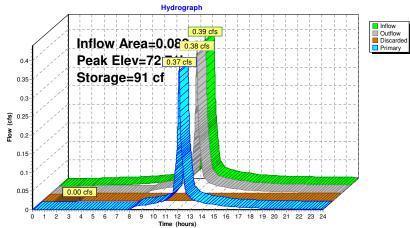
torage + Stone Storage = 190.9 cf = 0.004 af rage Efficiency = 57.6% stem Size = 10.00' x 10.33' x 3.21'

d









Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD	Type III 24-hr 25-Year Rainfall=5.40" Printed 1/16/2017 Software Solutions LLC Page 144
Runoff by SCS TR-20	.00 hrs, dt=0.01 hrs, 2401 points method, UH=SCS, Weighted-CN s method - Pond routing by Stor-Ind method
Subcatchment P-1: Northern Grassed Area to	Runoff Area=81,522 sf 0.00% Impervious Runoff Depth>0.37" Tc=6.0 min CN=41 Runoff=0.27 cfs 0.058 af
Subcatchment P-10: Area Around Isolated Flow Length	Runoff Area=31,595 sf 7.29% Impervious Runoff Depth>2.77" =533' Tc=6.0 min UI Adjusted CN=75 Runoff=2.36 cfs 0.168 af
Subcatchment P-2: Existing Drive to Existing	Runoff Area=23,114 sf 59.77% Impervious Runoff Depth>3.34" Tc=6.0 min CN=81 Runoff=2.07 cfs 0.148 af
Subcatchment P-3: Area Around Isolated	Runoff Area=27,582 sf 12.85% Impervious Runoff Depth>0.86" Tc=6.0 min UI Adjusted CN=50 Runoff=0.45 cfs 0.045 af
Subcatchment P-3A: Gravel Road to Detention	Runoff Area=4,950 sf 31.35% Impervious Runoff Depth>2.42" Tc=6.0 min CN=71 Runoff=0.32 cfs 0.023 af
Subcatchment P-4: Sloped Entrance Drive -	Runoff Area=21,573 sf 55.93% Impervious Runoff Depth>2.87" Tc=6.0 min CN=76 Runoff=1.67 cfs 0.118 af
Subcatchment P-5: Driveway - Units 25-11	Runoff Area=39,272 sf 51.57% Impervious Runoff Depth>2.68" Tc=6.0 min CN=74 Runoff=2.84 cfs 0.202 af
Subcatchment P-6: Pavement Units 12-19	Runoff Area=19,137 sf 59.86% Impervious Runoff Depth>3.05" Tc=6.0 min CN=78 Runoff=1.57 cfs 0.112 af
Subcatchment P-7: Driveway - Units 20-24	Runoff Area=15,670 sf 44.56% Impervious Runoff Depth>2.42" Tc=6.0 min CN=71 Runoff=1.01 cfs 0.073 af
Subcatchment P-8: Surface Infiltration Pond	Runoff Area=15,307 sf 7.00% Impervious Runoff Depth>0.47" Tc=6.0 min CN=43 Runoff=0.07 cfs 0.014 af
Subcatchment P-9: Woods/Grass Northwest Flow Lenath=	Runoff Area=102,567 sf 2.25% Impervious Runoff Depth>0.17" 502' Tc=10.8 min UI Adjusted CN=36 Runoff=0.06 cfs 0.034 af
Subcatchment R-1: Roof - Units 1&2 (C&B)	Runoff Area=3,185 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.031 af
Subcatchment R-10: Roof - Units 19&20 - (A	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038 af
Subcatchment R-11: Roof - Units 21&22 - (A&B	Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af
Subcatchment R-12: Roof - Units 23&24 - (A	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038 af
Subcatchment R-13: Roof - Units 25&26 - (A	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038 af

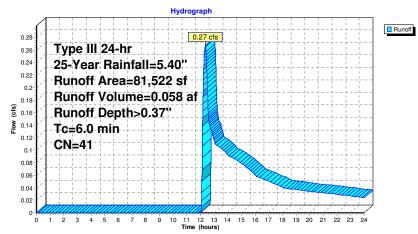
Topsfield Proposed HydroCAD Type III 24-hr 25-Year Rainfall=5.40"	Topsfield Proposed HydroCAD Type III 24-hr 25-Year Rainfall=5.40"
Printed 1/16/2017 Printed 1/16/2017 Printed 1/16/2017 Printed 1/16/2017 Page 145	Prepared by Microsoft Printed 1/16/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 146
Subcatchment R-14: Roof Units 27&28 - A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Pond D-2: Existing Detention Basin Peak Elev=58.41' Storage=3,752 cf Inflow=2.07 cfs 0.148 af Outflow=0.17 cfs 0.078 af
Subcatchment R-15: Roof Units 29&30 - (B & C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af	Pond D-3: Detention Pond by Access RoadPeak Elev=63.86' Storage=390 cfInflow=0.32 cfs0.023 afDiscarded=0.03 cfs0.023 afPrimary=0.00 cfs0.000 afOutflow=0.03 cfs0.023 af
Runoff Area=1,490 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.18 cfs 0.015 af	Pond UIS-1: UIS at Entrance Peak Elev=65.55' Storage=12,660 cf Inflow=5.43 cfs 0.401 af Discarded=0.08 cfs 0.113 af Primary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.113 af
Bubcatchment R-17: Mailbox Structure Rood Runoff Area=120 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.01 cfs 0.001 af	Pond UIS-2: UIS at North of Site Peak Elev=64.89' Storage=2,548 cf Inflow=2.21 cfs 0.180 af Discarded=0.23 cfs 0.180 af Primary=0.00 cfs 0.000 af Outflow=0.23 cfs 0.180 af
Subcatchment R-2: Roof Units 3&4 - (B & C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af	Pond UIS-3: UIS-3 Peak Elev=73.79' Storage=137 cf Inflow=0.44 cfs 0.036 af Discarded=0.00 cfs 0.004 af Primary=0.43 cfs 0.029 af Outflow=0.44 cfs 0.033 af
Subcatchment R-3: Roof Units 5&6 - A&B Units Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Pond UIS-4: UIS-4 Peak Elev=74.73' Storage=146 cf Inflow=0.39 cfs 0.032 af Discarded=0.00 cfs 0.004 af Primary=0.37 cfs 0.024 af Outflow=0.38 cfs 0.029 af
Subcatchment R-4: Roof - Units 7&8 - (A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Pond UIS-5: UIS-5 Peak Elev=75.40' Storage=151 cf Inflow=0.44 cfs 0.036 af Discarded=0.00 cfs 0.004 af Primary=0.42 cfs 0.029 af Outflow=0.42 cfs 0.033 af
Subcatchment R-5: Roof - Units 9&10 - (B&C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af	Pond UIS-6: UIS-6 Peak Elev=74.65' Storage=154 cf Inflow=0.47 cfs 0.038 af Discarded=0.00 cfs 0.005 af Primary=0.45 cfs 0.031 af Outflow=0.45 cfs 0.036 af
Subcatchment R-6: Roof - Units 11&12 - (B&A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Pond UIS-7: UIS-7 Peak Elev=74.10' Storage=151 cf Inflow=0.44 cfs 0.036 af Discarded=0.00 cfs 0.004 af Primary=0.42 cfs 0.029 af Outflow=0.42 cfs 0.033 af
Subcatchment R-7: Roof - Units 13&14 - (A Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038 af	Pond UIS-8: UIS-8 Peak Elev=73.40' Storage=151 cf Inflow=0.44 cfs 0.036 af Discarded=0.00 cfs 0.004 af Primary=0.42 cfs 0.029 af Outflow=0.42 cfs 0.033 af
Subcatchment R-8: Roof - Units 15&16 - (B&A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Pond UIS-9: UIS-9 Peak Elev=72.82' Storage=99 cf Inflow=0.47 cfs 0.038 af Discarded=0.00 cfs 0.005 af Primary=0.44 cfs 0.033 af Outflow=0.45 cfs 0.037 af
Subcatchment R-9: Roof - Units 17&18 - (A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Total Runoff Area = 10.046 ac Runoff Volume = 1.540 af Average Runoff Depth = 1.84" 70.14% Pervious = 7.046 ac 29.86% Impervious = 3.000 ac
Reach SP-1: Wetlands South of Driveway Inflow=0.45 cfs 0.123 af Outflow=0.45 cfs 0.123 af	
Reach SP-2: Large Wetland Area East Inflow=0.27 cfs 0.058 af Outflow=0.27 cfs 0.058 af	
Reach SP-3: Large Wetland Area West Inflow=0.93 cfs 0.229 af Outflow=0.93 cfs 0.229 af	
Pond 1P: Combined Study Points - Northern Wetlands Inflow=1.33 cfs 0.410 af Primary=1.33 cfs 0.410 af	
Pond D-1: Surface Infiltration Pond Peak Elev=70.39' Storage=14,288 cf Inflow=8.39 cfs 0.603 af Discarded=0.12 cfs 0.122 af Primary=0.89 cfs 0.195 af Outflow=1.00 cfs 0.318 af	

Topsfie Prepare		crosoft	CAD	Type III 24-hr 2	5-Year Rainfall=5.40" Printed 1/16/2017	
HydroCAI	D® 10.00	-18 s/n 02881	© 2016 Hydr	oCAD Softwa	are Solutions LLC	Page 147
	Sur	nmary for S	ubcatchm	ent P-1: N	orthern Grassed Area to W	/etlands
Runoff	=	0.27 cfs @	12.36 hrs,	Volume=	0.058 af, Depth> 0.37"	
		R-20 method, -Year Rainfall		Veighted-CI	N, Time Span= 0.00-24.00 hrs, o	dt= 0.01 hrs

Ar	ea (sf)	CN	Description				
	38,137	30	Woods, Go	od, HSG A			
	10,782	70	Woods, Good, HSG C				
	9,419	55	Woods, Go	od, HSG B			
:	23,184	39	>75% Gras	s cover, Go	ood, HSG A		
	81,522	41	Weighted A	verage			
;	81,522		100.00% Pe	ervious Area	а		
Tc	Length	Slop	e Velocity	Capacity	Description		
(min)	(feet)	(ft/f	t) (ft/sec)	(cfs)			
6.0					Direct Entry,		

Direct Entry,

Subcatchment P-1: Northern Grassed Area to Wetlands



Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 Hyd	Type III 24-hr 25-Year Rainfall=5.40" Printed 1/16/2017 oCAD Software Solutions LLC Page 148
Summary for Subcatcl	nment P-10: Area Around Isolated Wetland
Runoff = 2.36 cfs @ 12.09 hrs,	Volume= 0.168 af, Depth> 2.77"
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr 25-Year Rainfall=5.40"	Neighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Adj Descriptio	
	ted roofs, HSG A ss cover, Good, HSG C
/	Average, UI Adjusted
29,291 92.71% Pe	ervious Area
	pervious Area Inconnected
2,304 100.00 %	nconnected
	acity Description
(min) (feet) (ft/ft) (ft/sec)	(cfs)
2.9 50 0.1100 0.29	Sheet Flow, A-B Grass: Short $n= 0.150$ P2= 3.10"
2.9 483 0.1600 2.80	Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
5.8 533 Total, Increased to min	imum Tc = 6.0 min
Subcatchment	P-10: Area Around Isolated Wetland
Subcatchinient	
Type III 24-hr 25-Year Rainfall=5. Runoff Area=31,595 Runoff Volume=0.1 Runoff Depth>2.77' Flow Length=533' Tc=6.0 min UI Adjusted CN=75	isf 68 af

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)

HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 149 Summary for Subcatchment P-2: Existing Drive to Existing Basin	HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page Summary for Subcatchment P-3: Area Around Isolated Wetland
Runoff = 2.07 cfs @ 12.09 hrs, Volume= 0.148 af, Depth> 3.34"	Runoff = 0.45 cfs @ 12.11 hrs, Volume= 0.045 af, Depth> 0.86"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Fype III 24-hr 25-Year Rainfall=5.40"	Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40"
Area (sf) CN Description 13,815 98 Paved parking, HSG A 1,353 76 Gravel roads, HSG A 1,353 76 Gravel roads, HSG A 4,896 39 >75% Grass cover, Good, HSG A 3,050 74 >75% Grass cover, Good, HSG C 23,114 81 Weighted Average 9,299 40.23% Pervious Area 13,815 59.77% Impervious Area Tc Length Slope Velocity (min) (feet) (ft/ft) (ft/sec) 6.0 Direct Entry, Min. 6.0 TC	Area (sf) CN Adj Description 3,545 98 Unconnected pavement, HSG A 1,224 76 Gravel roads, HSG A 212 74 >75% Grass cover, Good, HSG C 2,166 70 Woods, Good, HSG D 14,867 30 Woods, Good, HSG A 27,582 53 50 27,582 53 50 24,037 87.15% Pervious Area 3,545 100.00% Unconnected Tc Length Slope
Subcatchment P-2: Existing Drive to Existing Basin Hydrograph Type III 24-hr 25-Year Rainfall=5.40'' Runoff Area=23,114 sf Runoff Depth>3.34'' Tc=6.0 min CN=81 CN	(min) Length Global Vision Global Description 6.0 Direct Entry, Subcatchment P-3: Area Around Isolated Wetland Hydrograph 0.46 cts 0.45 cts 1 Type III 24-hr 25-Year Rainfall=5.40'' Runoff Area=27,582 sf Runoff Depth>0.86'' 1 C = 6.0 min UI Adjusted CN=50

Topsfield Proposed HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
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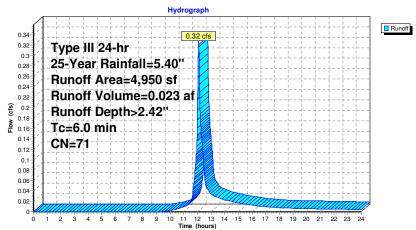
Summary for Subcatchment P-3A: Gravel Road to Detention Basin

Runoff = 0.32 cfs @ 12.09 hrs, Volume= 0.023 af, Depth> 2.42"

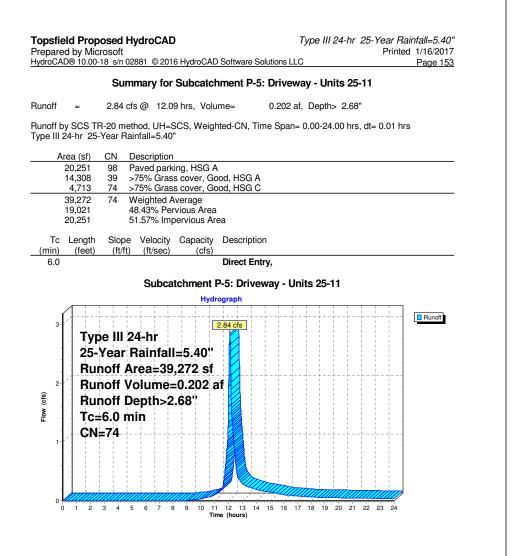
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40"

A	rea (sf)	CN	Description							
	1,552	98	Paved park	ing, HSG A	A					
	1,841	76	Gravel road	ls, HSG A						
	1,557	39	>75% Gras	s cover, Go	bod, HSG A					
	4,950	71	Weighted A	verage						
	3,398		68.65% Per	vious Area	l					
	1,552		31.35% Impervious Area							
-		~		.						
Tc	Length	Slop	,	Capacity	Description					
(min)	(feet)	(ft/f	t) (ft/sec)	(cfs)						
6.0					Direct Entry,					
					•					

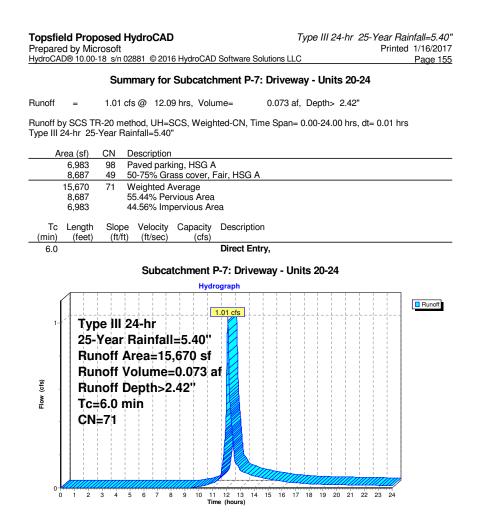
Subcatchment P-3A: Gravel Road to Detention Basin



IydroCAL	by Microsoft 10.00-18 s/n	02881 ©201	6 HydroCAD) Softwar	e Solutio	ons LLC)				mile	d 1/16/201 Page 15
	Summar	y for Subc	atchmen	t P-4: S	loped	Entra	ance	Drive	e - U	nits	1-5	
Runoff	= 1.67	cfs @ 12.0	9 hrs, Volu	ume=	0.	118 af	, Dep	th> 2	.87"			
	/ SCS TR-20 m 4-hr 25-Year F			hted-CN	, Time S	Span=	0.00-2	24.00	hrs,	dt= 0.	01 hr	S
	ea (sf) CN	Description										
-	2,066 98 6,808 39 2,699 74	Paved park >75% Gras >75% Gras	s cover, Go	ood, HSC								
	21,573 76 9,507 12,066	Weighted A 44.07% Per 55.93% Imp	vious Area									
Tc (min)	Length Slop (feet) (ft/f		Capacity (cfs)	Descri	ption							
6.0				Direct	Entry,							
	S	ubcatchm	ent P-4: S	loped l	Entrar	ice Di	rive -	Unit	s 1-5	5		
			Hyd	rograph								
Flow (cfs)	Runoff Runoff	Rainfall Area=21 Volume= Depth>2	,573 sf ⊧0.118 á	1.67 cfs								Runoff
0-4		5 6 7 8	9 10 1	1 12 13						2 23		



Summary for Subcatchment P-6: Pavement Units 12-19 Runoff = 1.57 cfs @ 12.09 hrs, Volume= 0.112 af, Depth> 3.05" Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr Area (sf) CN Description 11,455 98 Paved parking, HSG A 7,682 49 50-75% Grass cover, Fair, HSG A 7,682 40.14% Pervious Area 11,455 9.86% Impervious Area 11,455 59.86% Impervious Area 6.0 Direct Entry, Subcatchment P-6: Pavement Units 12-19 Import to the state of th	Topsfield Proposed HydroCAD Type III 24-hr 25-Year Rate Prepared by Microsoft Printed HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed	<i>infall=5.40"</i> d 1/16/2017 Page 154
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40" Area (sf) CN Description 11,455 98 Paved parking, HSG A 7,682 49 50-75% Grass cover, Fair, HSG A 19,137 78 Weighted Average 7,682 40.14% Pervious Area 11,455 59.86% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment P-6: Pavement Units 12-19 Hydrograph Type III 24-hr 25-Year Rainfall=5.40" Runoff Area=19,137 sf Runoff Volume=0.112 af Runoff Depth>3.05" Tc=6.0 min	Summary for Subcatchment P-6: Pavement Units 12-19	
Area (sf) CN Description 11,455 98 Paved parking, HSG A 7,682 49 50-75% Grass cover, Fair, HSG A 19,137 78 Weighted Average 7,682 40.14% Pervious Area 11,455 59.86% Impervious Area 11,455 59.86% Impervious Area 11,455 59.86% Impervious Area Tc Length Slope Velocity Capacity 0 Direct Entry, Bubcatchment P-6: Pavement Units 12-19 Hydrograph Type III 24-hr 1.57 cfs Isonoff Area=19,137 sf Runoff Area=19,137 sf Runoff Volume=0.112 af Runoff Depth>3.05" Tc=6.0 min	Runoff = 1.57 cfs @ 12.09 hrs, Volume= 0.112 af, Depth> 3.05"	
11,455 98 Paved parking, HSG A 7,682 49 50-75% Grass cover, Fair, HSG A 19,137 78 Weighted Average 7,682 40.14% Pervious Area 11,455 59.86% Impervious Area 11,455 59.86% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment P-6: Pavement Units 12-19 Hydrograph Type III 24-hr 1.57 cfs 25-Year Rainfall=5.40" Runoff Area=19,137 sf Runoff Area=19,137 sf Runoff Depth>3.05" Tc=6.0 min Tc=6.0 min		3
7,682 49 50-75% Grass cover, Fair, HSG A 19,137 78 Weighted Average 7,682 40.14% Pervious Area 11,455 59.86% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/scc) (cfs) 6.0 Direct Entry, Subcatchment P-6: Pavement Units 12-19 Hydrograph Type III 24-hr 1.57 cfs 25-Year Rainfall=5.40'' Runoff Area=19,137 sf Runoff Area=19,137 sf Runoff Depth>3.05'' Tc=6.0 min		
7,682 11,455 40.14% Pervious Area 59.86% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment P-6: Pavement Units 12-19 Hydrograph Type III 24-hr 25-Year Rainfall=5.40'' 1.57 cfs Runoff Area=19,137 sf Runoff Area=19,137 sf Runoff Depth>3.05'' Tc=6.0 min		
11,455 59.86% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/fsc) (cfs) 6.0 Direct Entry, Subcatchment P-6: Pavement Units 12-19 Hydrograph Type III 24-hr 25-Year Rainfall=5.40" Runoff Area=19,137 sf Runoff Volume=0.112 af Runoff Depth>3.05" Tc=6.0 min		
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment P-6: Pavement Units 12-19 Hydrograph Type III 24-hr 25-Year Rainfall=5.40'' Runoff Area=19,137 sf Runoff Volume=0.112 af Runoff Depth>3.05'' Tc=6.0 min		
6.0 Direct Entry, Subcatchment P-6: Pavement Units 12-19 Hydrograph Type III 24-hr 25-Year Rainfall=5.40'' Runoff Area=19,137 sf Runoff Volume=0.112 af Runoff Depth>3.05'' Tc=6.0 min		
Hydrograph Type III 24-hr 25-Year Rainfall=5.40'' Runoff Area=19,137 sf Runoff Volume=0.112 af Runoff Depth>3.05'' Tc=6.0 min		
Type III 24-hr 25-Year Rainfall=5.40'' Runoff Area=19,137 sf Runoff Volume=0.112 af Runoff Depth>3.05'' Tc=6.0 min	Subcatchment P-6: Pavement Units 12-19	
Type III 24-hr 25-Year Rainfall=5.40" Runoff Area=19,137 sf Runoff Volume=0.112 af Runoff Depth>3.05" Tc=6.0 min	Hydrograph	
	Type III 24-hr 25-Year Rainfall=5.40" Runoff Area=19,137 sf Runoff Volume=0.112 af Runoff Depth>3.05" Tc=6.0 min	Runoff
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	
····· (····· ·,		



	/licrosoft 00-18 s/n 02881 © 2016 HydroCAD Software Sol		ed 1/16/2017 Page 156
	Summary for Subcatchment P-8: Sur	face Infiltration Pond Area	
inoff =	0.07 cfs @ 12.31 hrs, Volume=	0.014 af, Depth> 0.47"	
	TR-20 method, UH=SCS, Weighted-CN, Tim 25-Year Rainfall=5.40"	e Span= 0.00-24.00 hrs, dt= 0.01	nrs
Area (sf			
1,072			
14,23			
14,23	5 93.00% Pervious Area		
1,072	2 7.00% Impervious Area		
Tc Leng min) (fee			
6.0	Direct Entr	у,	
	Subcatchment P-8: Surface In	filtration Dond Area	
		Intration Fond Area	
	Hydrograph		Г
0.08	0.07 cfs		Runoff
0.075	Type III 24-hr		-
	25-Year Rainfall=5.40''		-
1/1-	Runoff Area=15,307 sf		-
0.055-1	Runoff Volume=0.014 af		-
- 1 1 -			-
· · ·	Runoff Depth>0.47"	· - · · · · · · · · · · · · · · · · · ·	
0.000	Tc=6.0 min	·	-
	CN=43	· - · - · · · · · · · · · · · · · · · ·	-
0.025			-
0.015			
0.01			
0.005			ļ
0 1	2 3 4 5 6 7 8 9 10 11 12 13 14 Time (hours)	15 16 17 18 19 20 21 22 23 24	
	Time (nours)		

 Topsfield Proposed HydroCAD
 Type III 24

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Summary for Subcatchment P-9: Woods/Grass Northwest Site to NW Wetlands

Walking path in woods described as "Dirt road," closest CN value in HydroCAD, actual material to be mulch, wood chips or packed earth

Runoff = 0.06 cfs @ 13.79 hrs, Volume= 0.034 af, Depth> 0.17"

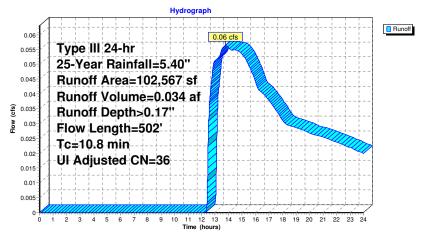
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40"

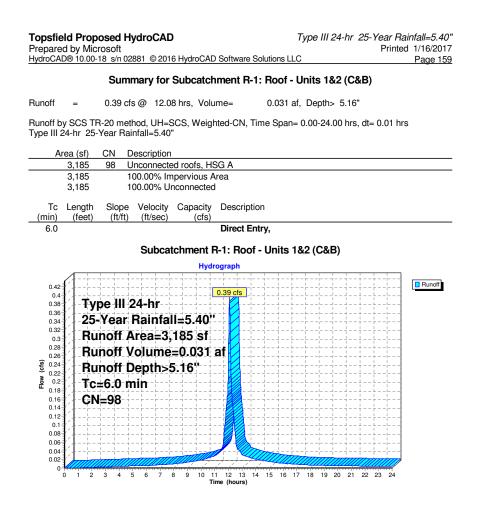
	A	rea (sf)	CN	Adj Desc	cription						
		2,068	72	Dirt r	oads, HSG	à A					
		40,086	39	>75%	6 Grass co	ver, Good, HSG A					
		357	74	>75%	6 Grass co	ver, Good, HSG C					
		53,082	30	Woo	ds, Good, I	HSG A					
		4,670	55	Woo	ds, Good, H	HSG B					
	2,304 98 Unconnected pavement, HSG A										
	102,567 37 36 Weighted Average, UI Adjusted										
100,263 97.75% Pervious Area											
		2,304			% Impervio						
		2,304		100.0	00% Uncon	nnected					
	-		~		. .						
	Tc	Length	Slope		Capacity	Description					
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	a 2 and a 3					
	4.9	50	0.0300	0.17		Sheet Flow, A-B					
						Grass: Short n= 0.150 P2= 3.10"					
	4.9	342	0.0280	1.17		Shallow Concentrated Flow, B-C					
				. ==		Short Grass Pasture Kv= 7.0 fps					
	1.0	110	0.1270	1.78		Shallow Concentrated Flow, C-D					
						Woodland Kv= 5.0 fps					
	10.0		T-+-1								

10.8 502 Total

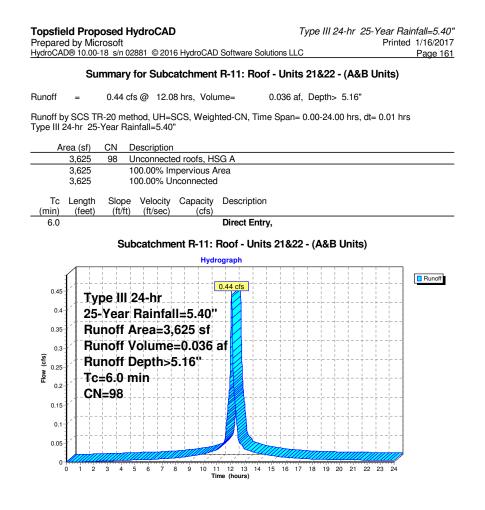
Topsfield Proposed HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
Prepared by Microsoft	Printed 1/16/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solution	ns LLC Page 158

Subcatchment P-9: Woods/Grass Northwest Site to NW Wetlands

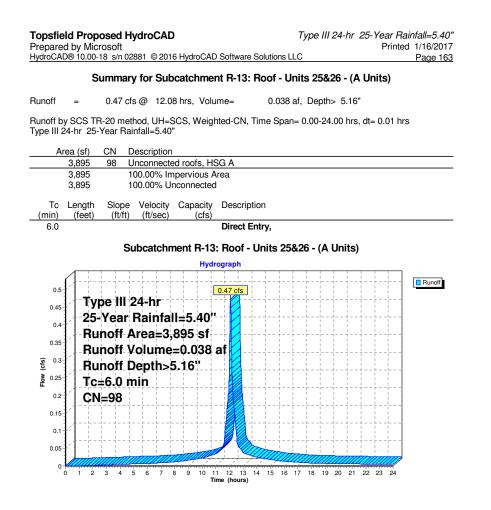




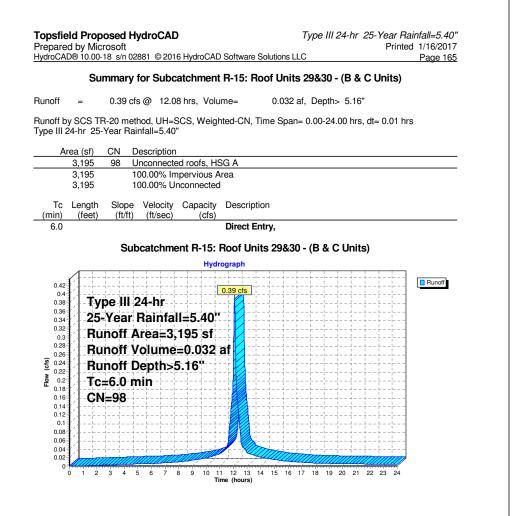
Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC	Printed 1/16/2017 Page 160
Summary for Subcatchment R-10: Roof - Units 19	&20 - (A Units)
Runoff = 0.47 cfs @ 12.08 hrs, Volume= 0.038 af, Dep	th> 5.16"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-	24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"	
Area (sf) CN Description 3.895 98 Unconnected roofs, HSG A	
3,895 100.00% Impervious Area	
3,895 100.00% Unconnected	
Tc Length Slope Velocity Capacity Description	
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry,	
Cubestshment D 10: De of Unite 10800 /	A 1 In ite)
Subcatchment R-10: Roof - Units 19&20 - (A UNITS)
Hydrograph	
0.5	
0.4 - 25-Year Rainfall=5.40"	
0.35 Runoff Area=3,895 sf	
Runoff Volume=0.038 af	
(² ^{0.3} Runoff Depth>5.16''	
ॾ ^{8 0.25} Tc =6.0 min	
^{0.2} CN=98	
0.15	
0.05	
	19 20 21 22 23 24



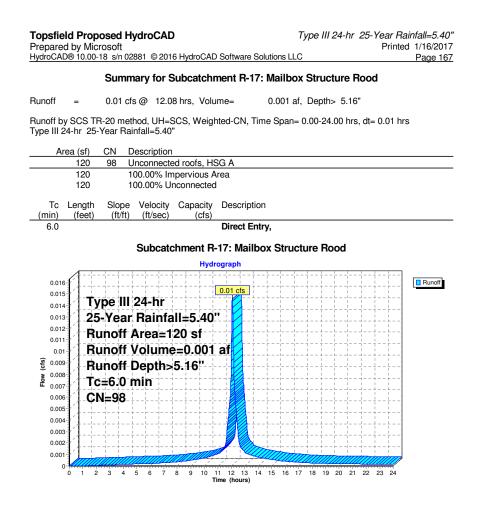
ydroCAD®	by Microsoft 10.00-18 s/n 02881 © 2016 HydroCAD Software	Solutions LLC	Printed 1/16/2017 Page 162
	Summary for Subcatchment R-12:	: Roof - Units 23&24 - (A Uni	ts)
lunoff	= 0.47 cfs @ 12.08 hrs, Volume=	0.038 af, Depth> 5.16"	
	CS TR-20 method, UH=SCS, Weighted-CN, hr 25-Year Rainfall=5.40"	Time Span= 0.00-24.00 hrs, dt=	0.01 hrs
Area	(sf) CN Description		
	895 98 Unconnected roofs, HSG A		
	895 100.00% Impervious Area 895 100.00% Unconnected		
	ength Slope Velocity Capacity Descrip (feet) (ft/ft) (ft/sec) (cfs)	otion	
6.0	Direct	Entry,	
	Subcatchment R-12: Roof -	Units 23&24 - (A Units)	
	Hydrograph		
0.5 0.45 0.4 0.35 0.25 0.25 0.25 0.15 0.15	Type III 24-hr 25-Year Rainfall=5.40" Runoff Area=3,895 sf Runoff Volume=0.038 af Runoff Depth>5.16" Tc=6.0 min CN=98		Runoff
1		14 15 16 17 18 19 20 21 22 2	3 24
0	Time (hours)		
	Time (hours)		



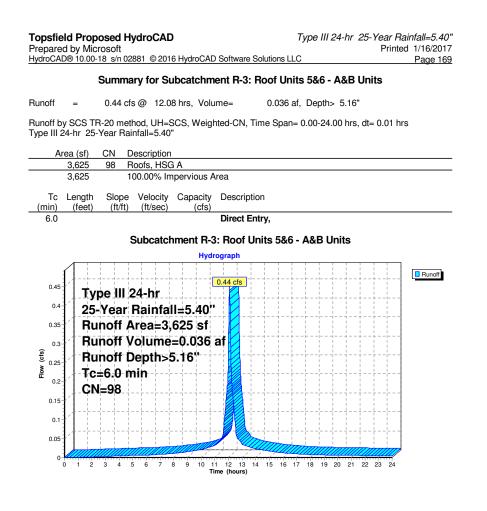
	Su	Immary	for Sub	catchme	nt R-14	: Root	f Unit	s 278	<u> </u>	A&E	8 Unit	s	
unoff	=	0.44 cfs	@ 12.0	8 hrs, Vol	ume=	0	.036 a	f, De	pth> {	5.16"			
				SCS, Weig	hted-CN	Time	Span=	= 0.00	-24.00	hrs,	dt= 0.0	01 hr	s
ype III 2	24-hr 25-`	rear Rain	fall=5.40	•									
A	ea (sf)		scription										
	3,625		ofs, HSC		A # 0.0								
	3,625	10	0.00% III	pervious /	Area								
Tc	Length		Velocity	Capacity	Descri	otion							
(min) 6.0	(feet)	(ft/ft)	(ft/sec)	(cfs)	Direct	Entry.							
						• •							
		Sub	ocatchn	nent R-14	: Roof	Units	27&2	8 - A	&B U	nits			
				Hyd	rograph						1		
	[]				0.44 cfs	 -	-++		 		+	 	Runoff
0.45	Tvr	be III 2	4-hr										
0.4				ll=5.40'	•		+				+		
0.35	A			625 sf			- + +			+			
				=0.036	af		- + +						
0.3- Se		noff De											
Flow (cfs) 0.52.				5.10			11				į		
문 0.2·	k ()	:6.0 m	I n	·		-ii - ·	- † †		ii	· i i	· +		
0.15	_ CN	=98		++			- + +			++	·		
0.15	, 						$-\frac{1}{1}\frac{1}{1}$		 		$\frac{1}{1}$		
0.1											1		
0.05						m					1		
0	///////////////////////////////////////					<u>,</u>	4////	<u>/////</u>	//////				
	0 1 2	3 4 5	6 7		11 12 13 Time (hours)	14 15	16 1	7 18	19 20	21	22 23	24	



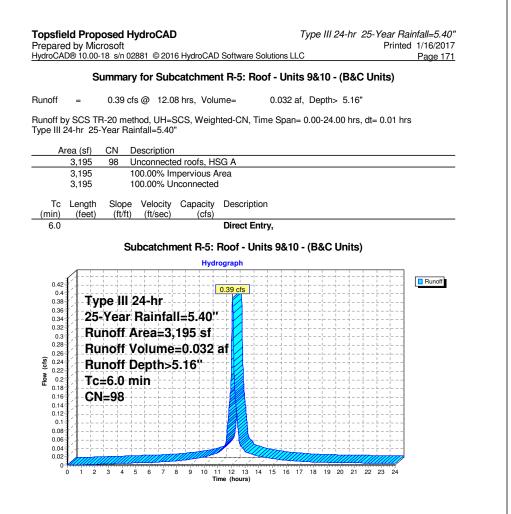
Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Sol	Type III 24-hr 25-Year Rainfall=5.40" Printed 1/16/2017 Iutions LLC Page 166
Summary for Subcatchment R-	16: Front Units 29&30
Runoff = 0.18 cfs @ 12.08 hrs, Volume=	0.015 af, Depth> 5.16"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Tim Type III 24-hr 25-Year Rainfall=5.40"	ne Span= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
1,490 98 Unconnected roofs, HSG A	
1,490 100.00% Impervious Area 1,490 100.00% Unconnected	
,	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	I
6.0 Direct Entr	у,
Subcatchment R-16: Fro	nt Units 29&30
Hydrograph	
0.2	1
0.19 0.18 Type III 24-hr	
0.16 25-Year Rainfall=5.40'	
0.14 0.14 0.13	
a 0.11 Runoff Depth>5.16	
Ê 0.09 ↓ - Tc=6.0-min	
0.08 0.07 CN=98	4 + - + - + - + +
0.04	· - · · · · · · · · · · · · · · · · · ·
0.01	
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 Time (hours)	15 16 17 18 19 20 21 22 23 24



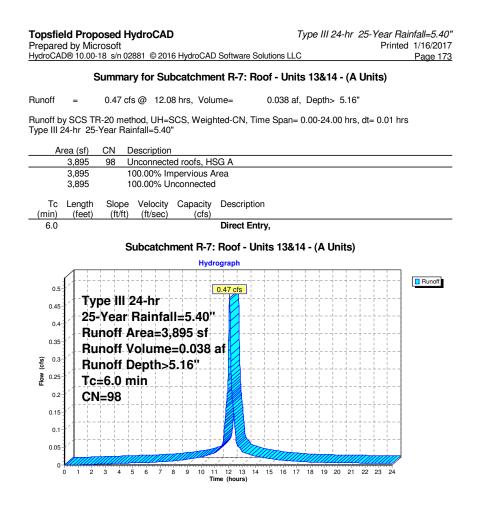
<pre>bummary for subcatchment P-2: Roof Units 3&4 - (B & C Units) unit</pre>	repared by N /droCAD® 10.0	/licrosoft 00-18 s/n 02881 ©2016 HydroCAD Sof	tware Solutions LLC P	16/2017 age 168
unoff Depth>5.16" Type III 24-hr 25-Year Rainfall=5.40" Area (sf) CN Description 3.195 98 Unconnected roofs, HSG A 3.195 100.00% Impervious Area 3.195 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-2: Roof Units 3&4 - (B & C Units) Hydrograph Type III 24-hr 25-Year Rainfall=5.40" Runoff Area=3,195 sf Runoff Colume=0.032 af Runoff Depth>5.16" Tc=6.0 min CN=98		Summary for Subcatchment F	R-2: Roof Units 3&4 - (B & C Units)	
Area (sf) CN Description 3,195 98 Unconnected roofs, HSG A 3,195 100.00% Impervious Area 3,195 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-2: Roof Units 3&4 - (B & C Units) Hydrograph 0.42 0.43 0.39 cfs 0.39 cfs 0.42 0.39 cfs 0.42 0.39 cfs 0.42	unoff =	0.39 cfs @ 12.08 hrs, Volume=	= 0.032 af, Depth> 5.16"	
3,195 98 Unconnected roofs, HSG A 3,195 100.00% Impervious Area 3,195 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-2: Roof Units 3&4 - (B & C Units) Hydrograph 0.39 cfs 0.39 cfs			-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs	
3,195 100.00% Impervious Area 3,195 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (teet) (t/tft) (tt/sec) (cfs) 6.0 Direct Entry, Subcatchment R-2: Roof Units 3&4 - (B & C Units) Hydrograph 0.39 cfs 0.42 0.44 0				
3,195 100.00% Unconnected Tc Length Slope Velocity Capacity Description (teet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-2: Roof Units 3&4 - (B & C Units) Hydrograph 0.39 cfs 0.42 0.44 0.	,			
Tc Length (feet) Slope Velocity (ft/sec) Capacity (cfs) Direct Entry, 6.0 Direct Entry, Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B & C Units) Image: Subcatchment R-2: Roof Units 3&4 - (B				
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-2: Roof Units 3&4 - (B & C Units) Hydrograph 0.42 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.42 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.4 0.42 0.42 0.4 0.42				
6.0 Direct Entry, Subcatchment R-2: Roof Units 3&4 - (B & C Units) Hydrograph			scription	
Hydrograph 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24		Dir	rect Entry,	
Hydrograph 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24		Subcatchment B-2: Bo	of Unite 3&4 - (B & C Unite)	
0.42 0.39 cfs 0.39 cfs 0.42 Type III 24-hr 0.39 cfs 0.34 25-Year Rainfall=5.40" 0.39 cfs 0.28 Runoff Area=3,195 sf 0.30 cfs 0.28 0.24 Runoff Volume=0.032 af 0.29 0.18 CN=98 0.19 0.19 cfs 0.19 cfs 0.10 CN=98 0.10 cfs 0.10 0.11 cfs 0.11 cfs 0.09 0.1 cfs 0.11 cfs 0.11 cfs 0.1 cfs 0.1 cfs 0.11 cfs 0.1 cfs 0.1 cfs 0.01 cfs 0.1 cfs 0.1 cfs 0.11 cfs 0.1 cfs <td< td=""><td></td><td></td><td></td><td></td></td<>				
0.39 c/s 0.39 c/s 0.39 c/s Type III 24-hr 0.39 c/s 25-Year Rainfall=5.40" 0.39 c/s Runoff Area=3,195 sf 0.29 c/s Runoff Depth>5.16" 0.19 c/s Tc=6.0 min 0.19 c/s Composition 0.19 c/s Composition 0.10 c/s Composition 0.10 c/s Composition 0.10 c/s Composition 0.11 c/s 3.4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	<u> </u>	······································	· 	
0.38 Cype III 24-hr 0.34 25-Year Rainfall=5.40" 0.34 Runoff Area=3,195 sf 0.24 Runoff Volume=0.032 af 0.24 Runoff Depth>5.16" 0.18 CN=98 0.16 CN=98 0.16 CN=98 0.17 CN=98 0.18 CN=98 0.19 CN=98 0.11 12 3 4 5 6 7 8 9 10 11 12 13 14 15 16 7 18 19 20 21 22 23 24				Runoff
0.34 0.34 0.33 0.34 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26	0.38	ype III 24-hr		
0.3 0.3 Runoff Area=3,195 st 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.26 0.14 0.14 0.14 0.16 0.14 0.14 0.16 0.14 0.14 0.16 0.14 0.14 0.16 0.14 0.14 0.16 0.14 0.14 0.17 1.2 3.4 5.6 7 8.9 10 11 12 13 14 15 15 17 18 19 20 21 22 23 24	0.36	5-Year Rainfall=5.40''		
0.28 0.24 0.24 0.24 0.24 Runoff Volume=0.032 at Runoff Depth>5.16" 0.28 0.24 0.24 0.24 Runoff Depth>5.16" 0.28 0.18 0.16 0.14 0.12 0.18 0.06 0.04 0.02 0.28 0.18 0.18 0.16 0.14 0.12 0.18 0.16 0.14 0.12 CN=98 0.18 0.06 0.04 0.02 0.18 0.06 0.04 0.02 0.18 0.06 0.04 0.02 0.11 1.2 3.4 5.6 7.8 9.10 11.12 13.14 15.16 17.18 19.20 21.22 23.24		Runoff Area=3.195 sf		
gg 0.24 gg 0.24 0.24 0.24 0.24 0.24 0.18 0.16 0.14 0.16 0.17 18 19 20 21 22 23 24	0.28	.		
B 0 0 0 0 0 0 0 0 0 0 0 0 0	\$ 0.24			
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0.14 0.12 0.1 0.08 0.06 0.04 0.02 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	0.18			
0.1 0.8 0.6 0.04 0.02 0 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	0.14	71 =30		
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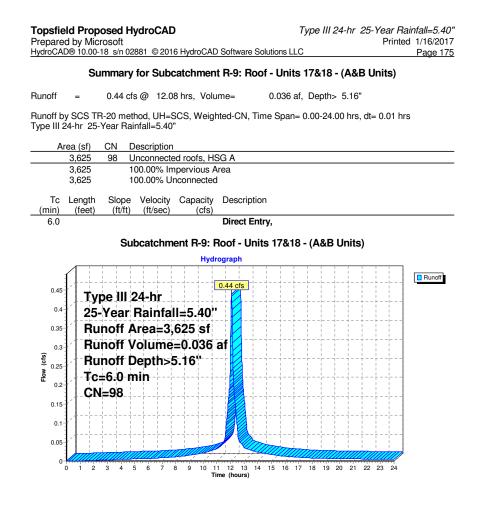
repare	d by Mic 0® 10.00-	rosoft	•			lydro	CAD	Sof	tware	e So	lutio	ns L		pe		24-1	11 2	20-			ainfall=5.40" d 1/16/2017 Page 170
	S	umm	ary f	or S	ubc	atch	me	nt R	8-4:	Ro	of -	Un	its	7&	8 -	(Að	βB	Un	its))	
unoff	=	0.44	cfs @) 12	2.08 ł	ırs,	Volu	me=			0.0)36	af,	Dep	oth>	5 .	16"				
	y SCS TF 24-hr 25-					S, W	/eigł	nted-	CN,	Tim	ie S	par	n= 0	.00-	24.	00 I	nrs,	dt=	0.0)1 hr	ſS
A	rea (sf)	CN		criptio																	
	3,625	98		onne					۱												
	3,625 3,625			00% 00%																	
Tc (min)	Length (feet)	Slop (ft/f		elocit ft/sec			city cfs)		scrip												
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					-		+	0.44	cfs			 							 ↓		Runoff
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(cfs)	l∕†-Ru	noff	Der	oth:	>5.	16"	+-		2												
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droCAD® 10.00	crosoft <u>0-18 s/n 02881 © 2016 HydroCAD Software</u>	Solutions LLC		Printed 1/16/2 Page	
s	ummary for Subcatchment R-6: R	oof - Units 118	12 - (B&A	Units)	
unoff =	0.44 cfs @ 12.08 hrs, Volume=	0.036 af, De	pth> 5.16"		
	R-20 method, UH=SCS, Weighted-CN, 5-Year Rainfall=5.40"	Time Span= 0.00	-24.00 hrs, d	t= 0.01 hrs	
Area (sf)	CN Description				
3,625	98 Unconnected roofs, HSG A				
3,625 3,625	100.00% Impervious Area 100.00% Unconnected				
Tc Length (min) (feet)	(ft/ft) (ft/sec) (cfs)				
6.0	Direct E	intry,			
	Subcatchment R-6: Roof - U	nits 11&12 - (B	&A Units)		
	Hydrograph				
	/pe III 24-hr				off
1 4-72	5-Year Rainfall=5.40'' unoff Area=3,625 sf	 		-+	
	unoff Volume=0.036 af		++-		
_	unoff Depth>5.16"				
0.23					
0.2	e=6.0-min				
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0.05		14 15 16 17 18	19 20 21 22	23 24	
0.05		14 15 16 17 18	19 20 21 22	. 23 24	



Summary for Subcatchment R-8: Roof - Units 15&16 - (B&A Units) Runoff = 0.44 cfs @ 12.08 hrs, Volume= 0.036 af, Depth> 5.16" Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40" Area (sf) CN Description 3.625 98 Unconnected roofs, HSG A 3.625 100.00% Impervious Area 3.625 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-8: Roof - Units 15&16 - (B&A Units) Hydrograph Type III 24-hr 25-Year Rainfall=5.40" 0.44 cfs Guada for the state of
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40" Area (sf) CN Description 3.625 98 Unconnected roofs, HSG A 3.625 100.00% Impervious Area 3.625 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) 6.0 Direct Entry, Subcatchment R-8: Roof - Units 15&16 - (B&A Units) Hydrograph 0.45 0 0.45 0 0.44 cts 0.45 25-Year Rainfall=5.40" Funoff
Type III 24-hr 25-Year Rainfall=5.40" Area (sf) CN Description 3,625 98 Unconnected roofs, HSG A 3,625 100.00% Impervious Area 3,625 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) 6.0 Direct Entry, Subcatchment R-8: Roof - Units 15&16 - (B&A Units) Hydrograph 0.45 0.45 0.45 0.44 25-Year Rainfall=5.40'' Image: Part of the second
3,625 98 Unconnected roofs, HSG A 3,625 100.00% Impervious Area 3,625 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/scc) (cfs) 6.0 Direct Entry, Subcatchment R-8: Roof - Units 15&16 - (B&A Units) Hydrograph Type III 24-hr 0.44 O.44 Question O.44
3,625 100.00% Impervious Area 3,625 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-8: Roof - Units 15&16 - (B&A Units) Hydrograph Uncompared to the second state of the second state
3,625 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-8: Roof - Units 15&16 - (B&A Units) Hydrograph Type III 24-hr 25-Year Rainfall=5.40''
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-8: Roof - Units 15&16 - (B&A Units) Hydrograph 0.45 0.4 Type III 24-hr 25-Year Rainfall=5.40''
Subcatchment R-8: Roof - Units 15&16 - (B&A Units) Hydrograph
Hydrograph 0.45 0.45 0.45 Type III 24-hr 25-Year Rainfall=5.40'
^{0.45} Type III 24-hr ^{0.4} 25-Year Rainfall=5.40'
^{0.45} Type III 24-hr ⁰⁴ 25-Year Rainfall=5.40'
⁰⁴ 25-Year Rainfall=5.40''
^{0.3} Runoff Volume=0.036 af ຮູ້ Runoff Depth>5.16"
ີຍັ _{0.25} ໄປ Tc=6.0 min
^a 0.2 CN=98
0.1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)



Topsfield Proposed HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
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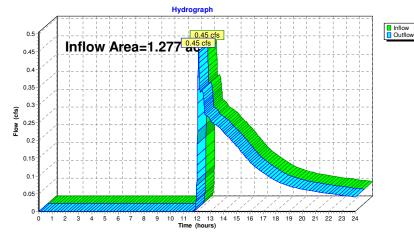
Summary for Reach SP-1: Wetlands South of Driveway

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

Inflow Area =	1.277 ac, 33.99% Impervious, Inflow	v Depth > 1.15" for 25-Year event	
Inflow =	0.45 cfs @ 12.11 hrs, Volume=	0.123 af	
Outflow =	0.45 cfs @ 12.11 hrs, Volume=	0.123 af, Atten= 0%, Lag= 0.0 min	n

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

Reach SP-1: Wetlands South of Driveway



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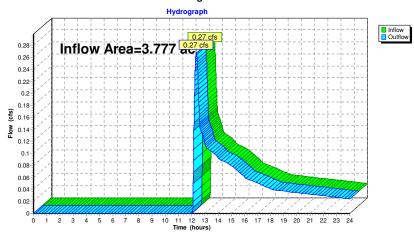
Summary for Reach SP-2: Large Wetland Area East

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

Inflow Area =	3.777 ac, 26.87% Impervious, Inflow Depth > 0.19" for 25-Year event
Inflow =	0.27 cfs @ 12.36 hrs, Volume= 0.058 af
Outflow =	0.27 cfs @ 12.36 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.0 min

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



Reach SP-2: Large Wetland Area East

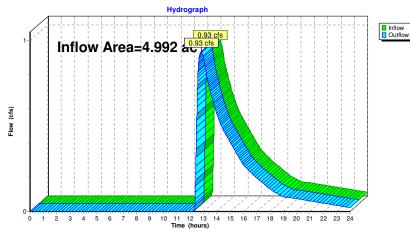
Topsfield Proposed HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
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Summary for Reach SP-3: Large Wetland Area West

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

Inflow Are	ea =	4.992 ac, 31.07% Impervious, Inflow Depth > 0.55	for 25-Year event
Inflow	=	0.93 cfs @ 12.83 hrs, Volume= 0.229 af	
Outflow	=	0.93 cfs @ 12.83 hrs, Volume= 0.229 af, A	tten= 0%, Lag= 0.0 min

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



Reach SP-3: Large Wetland Area West

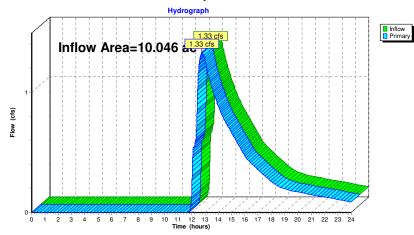
Topsfield Proposed HydroCAD Type III 24-hr 25-Year Rainfall=5.40" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

Summary for Pond 1P: Combined Study Points - Northern Wetlands

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

Inflow Area =	10.046 ac, 29.86% Impervious, Inflow D	epth > 0.49" for 25-Year event
Inflow =	1.33 cfs @ 12.80 hrs, Volume=	0.410 af
Primary =	1.33 cfs @ 12.80 hrs, Volume=	0.410 af, Atten= 0%, Lag= 0.0 min

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



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Summary for Pond D-1: Surface Infiltration Pond

Inflow Area =	2.637 ac, 56.80% Impervious, Inflow D	epth > 2.74" for 25-Year event
Inflow =	8.39 cfs @ 12.10 hrs, Volume=	0.603 af
Outflow =	1.00 cfs @ 12.82 hrs, Volume=	0.318 af, Atten= 88%, Lag= 43.5 min
Discarded =	0.12 cfs @ 12.82 hrs, Volume=	0.122 af
Primary =	0.89 cfs @ 12.82 hrs, Volume=	0.195 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 70.39'@ 12.82 hrs Surf.Area= 4,906 sf Storage= 14,288 cf Flood Elev= 71.10' Surf.Area= 5,491 sf Storage= 17,958 cf

Plug-Flow detention time= 236.6 min calculated for 0.317 af (53% of inflow) Center-of-Mass det. time= 130.0 min (944.0 - 814.0)

Volume	Inver	t Avail.Sto	orage Storage	e Description	
#1	66.00	' 56,2	33 cf Custon	n Stage Data (Prisi	matic) Listed below (Recalc)
Elevatio	on S	urf.Area	Inc.Store	Cum.Store	
(fee	-	(sq-ft)	(cubic-feet)	(cubic-feet)	
66.0	00	1,817	0	0	
67.0	00	2,361	2,089	2,089	
68.0	00	3,059	2,710	4,799	
69.0	00	3,800	3,430	8,229	
70.0	00	4,583	4,192	12,420	
71.0		5,403	4,993	17,413	
72.0		6,280	5,842	23,255	
73.0		7,213	6,747	30,001	
74.0		8,202	7,708	37,709	
75.0		9,248	8,725	46,434	
76.0	00	10,350	9,799	56,233	
Device	Routing	Invert	Outlet Device	es	
#1	Discarded	66.00'	1.020 in/hr E	xfiltration over Su	Irface area
#2	Primary	70.00'	15.0" Round	Culvert L= 252.	0' Ke= 0.200
			Inlet / Outlet	Invert= 70.00' / 65.	40' S= 0.0183 '/' Cc= 0.900
			n= 0.015 Co	rrugated PE, smoo	oth interior, Flow Area= 1.23 sf

Discarded OutFlow Max=0.12 cfs @ 12.82 hrs HW=70.39' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.88 cfs @ 12.82 hrs HW=70.39' (Free Discharge) -2=Culvert (Inlet Controls 0.88 cfs @ 2.67 fps)

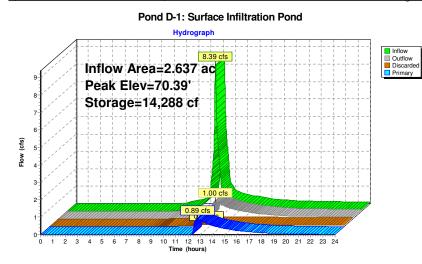
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 Type III 24-hr

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 Type III 24-hr
 25-Year Rainfall=5.40"

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Summary for Pond D-2: Existing Detention Basin

[58] Hint: Peaked 0.33' above defined flood level

Inflow Area	. =	0.531 ac, \$	59.77% Impervious	, Inflow Depth >	3.34"	for 25-Y	ear event
Inflow	=	2.07 cfs @	12.09 hrs, Volum	e= 0.148	af		
Outflow	=	0.17 cfs @	13.19 hrs, Volum	e= 0.078	af, Atte	en= 92%,	Lag= 66.3 min
Primary	=	0.17 cfs @	13.19 hrs, Volum	e= 0.078	af		-

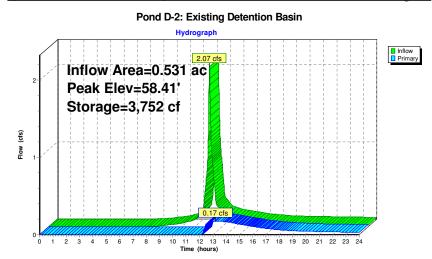
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.41' @ 13.19 hrs Surf.Area= 3,090 sf Storage= 3,752 cf Flood Elev= 58.08' Surf.Area= 3,090 sf Storage= 2,719 cf

Plug-Flow detention time= 269.3 min calculated for 0.078 af (53% of inflow) Center-of-Mass det. time= 158.1 min (973.3 - 815.2)

Volume	Inv	rert Avai	I.Storage	Storage I	Descriptior	ı			
#1	57.	20'	9,020 cf	Custom	Stage Data	a (Prismati	c) Listed belo	ow (Recalc)	
Elevatio		Surf.Area		.Store	Cum.St				
(fee	- /	(sq-ft)	(CUDI	c-feet)	(cubic-fe	eet)			
57.2	20	3,090		0		0			
58.0	00	3,090		2,472	2,4	472			
59.0	00	3,090		3,090	5.	562			
59.4	40	3,550		1,328	6,8	890			
60.0	00	3,550		2,130	9,0	020			
Device	Routing	In	vert Out	let Devices	5				
#1	Primarv	58	.08' 4.0 '	Vert. Orifi	ice/Grate	C= 0.600			
#2	Primary	58	.80' 8.0'	Vert. Orif	ice/Grate	C= 0.600			

Primary OutFlow Max=0.17 cfs @ 13.19 hrs HW=58.41' (Free Discharge) 1=Orifice/Grate (Orifice Controls 0.17 cfs @ 1.97 fps) 2=Orifice/Grate (Controls 0.00 cfs)





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Summary for Pond D-3: Detention Pond by Access Road

Inflow Area =	0.114 ac, 31.35% Impervious, Inflow De	epth > 2.42" for 25-Year event
Inflow =	0.32 cfs @ 12.09 hrs, Volume=	0.023 af
Outflow =	0.03 cfs @ 13.03 hrs, Volume=	0.023 af, Atten= 90%, Lag= 56.1 min
Discarded =	0.03 cfs @ 13.03 hrs, Volume=	0.023 af
Primary =	0.00 cfs @ 0.00 hrs, Volume=	0.000 af

Plug-Flow detention time= 118.7 min calculated for 0.023 af (100% of inflow) Center-of-Mass det. time= 118.2 min (958.6 - 840.3)

Volume	Inve	ert Avail.Stor	age Storage	e Description
#1	63.0	00' 47	8 cf Custom	n Stage Data (Prismatic) Listed below (Recalc)
Elevatio	on a	Surf.Area	Inc.Store	Cum.Store
(fee	et)	(sq-ft)	(cubic-feet)	(cubic-feet)
63.0	00	305	0	0
64.0	00	650	478	478
Device	Routing	Invert	Outlet Device	es
#1	Primary	64.00'	5.0' long x 5	5.0' breadth Broad-Crested Rectangular Weir
			Head (feet) (0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00
			2.50 3.00 3.	.50 4.00 4.50 5.00 5.50
			Coef. (Englis	sh) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2
			2.67 2.66 2.	.68 2.70 2.74 2.79 2.88
#2	Discarde	d 63.00'	2.410 in/hr Ex	xfiltration over Horizontal area

Discarded OutFlow Max=0.03 cfs @ 13.03 hrs HW=63.86' (Free Discharge) **12=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=63.00' (Free Discharge)

 Topsfield Proposed HydroCAD
 Type

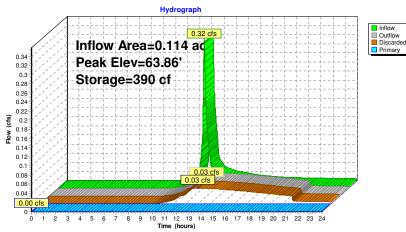
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Pond D-3: Detention Pond by Access Road



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Summary for Pond UIS-1: UIS at Entrance

Inflow Area =	1.487 ac, 40.11% Impervious, Inflow D	epth > 3.23" for 25-Year event
Inflow =	5.43 cfs @ 12.09 hrs, Volume=	0.401 af
Outflow =	0.08 cfs @ 9.67 hrs, Volume=	0.113 af, Atten= 98%, Lag= 0.0 min
Discarded =	0.08 cfs @ 9.67 hrs, Volume=	0.113 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= 65.55' @ 21.11 hrs Surf.Area= 3,486 sf Storage= 12,660 cf Flood Elev= 68.40' Surf.Area= 3,486 sf Storage= 13,284 cf

Plug-Flow detention time= 282.9 min calculated for 0.113 af (28% of inflow) Center-of-Mass det. time= 127.3 min (932.9 - 805.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	60.00'	5,089 cf	50.50'W x 69.03'L x 6.00'H Field A
			20,917 cf Overall - 8,195 cf Embedded = 12,722 cf x 40.0% Voids
#2A	61.00'	8,195 cf	Cultec R-902HD x 126 Inside #1
			Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
			Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
			7 Rows of 18 Chambers
			Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
		12 294 of	Total Available Storage

13,284 cf Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices	
#1	Discarded	60.00'	1.020 in/hr Exfiltration over Surface	ce area
#2	Primary	68.40'	24.0" x 24.0" Horiz. Orifice/Grate	C= 0.600
	-		Limited to weir flow at low heads	

Discarded OutFlow Max=0.08 cfs @ 9.67 hrs HW=60.08' (Free Discharge)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.00' (Free Discharge)

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Pond UIS-1: UIS at Entrance - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)

Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf

78.0" Wide + 6.0" Spacing = 84.0" C-C Row Spacing

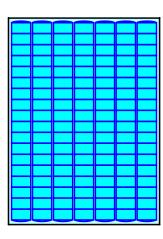
18 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 67.03' Row Length +12.0" End Stone x 2 = 69.03' Base Length 7 Rows x 78.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 50.50' Base Width 12.0" Base + 48.0" Chamber Height + 12.0" Cover = 6.00' Field Height

126 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 8,195.2 cf Chamber Storage

20,917.1 cf Field - 8,195.2 cf Chambers = 12,721.9 cf Stone x 40.0% Voids = 5,088.7 cf Stone Storage

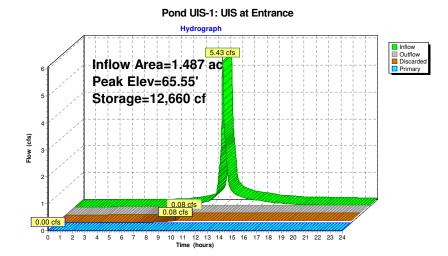
Chamber Storage + Stone Storage = 13,284.0 cf = 0.305 af Overall Storage Efficiency = 63.5% Overall System Size = 69.03' x 50.50' x 6.00'

126 Chambers 774.7 cy Field 471.2 cy Stone





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Summary for Pond UIS-2: UIS at North of Site

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Inflow Area =	0.419 ac,100.00% Impervious, Inflow D	Depth > 5.16" for 25-Year event
Inflow =	2.21 cfs @ 12.08 hrs, Volume=	0.180 af
Outflow =	0.23 cfs @ 11.43 hrs, Volume=	0.180 af, Atten= 90%, Lag= 0.0 min
Discarded =	0.23 cfs @ 11.43 hrs, Volume=	0.180 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= 64.89' @ 12.81 hrs Surf.Area= 1,176 sf Storage= 2,548 cf Flood Elev= 68.25' Surf.Area= 1,176 sf Storage= 2,860 cf

Plug-Flow detention time= 74.0 min calculated for 0.180 af (100% of inflow) Center-of-Mass det. time= 73.8 min (820.0 - 746.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	61.50'	1,262 cf	16.00'W x 73.50'L x 4.04'H Field A
			4,753 cf Overall - 1,598 cf Embedded = 3,155 cf x 40.0% Voids
#2A	62.50'	1,598 cf	Cultec R-330XLHD x 30 Inside #1
			Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
			Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
			Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		2,860 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	61.50'	8.270 in/hr Exfiltration over Surface area
#2	Primary	68.25'	6.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.23 cfs @ 11.43 hrs HW=61.57' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=61.50' (Free Discharge)

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Pond UIS-2: UIS at North of Site - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

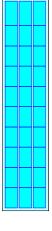
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length 3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width 12.0" Base + 30.5" Chamber Height + 6.0" Cover = 4.04' Field Height

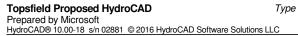
30 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 1,598.2 cf Chamber Storage

4,753.0 cf Field - 1,598.2 cf Chambers = 3,154.8 cf Stone x 40.0% Voids = 1,261.9 cf Stone Storage

Chamber Storage + Stone Storage = 2,860.1 cf = 0.066 af Overall Storage Efficiency = 60.2% Overall System Size = 73.50' x 16.00' x 4.04'

30 Chambers 176.0 cy Field 116.8 cy Stone

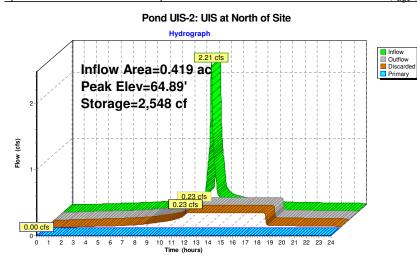




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 25-Year Rainfall=5.40"

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Summary for Pond UIS-3: UIS-3

[58] Hint: Peaked 1.58' above defined flood level

Inflow Area =	0.083 ac,100.00% Impervious, Inflow D	epth > 5.16" for 25-Year event
Inflow =	0.44 cfs @ 12.08 hrs, Volume=	0.036 af
Outflow =	0.44 cfs @ 12.09 hrs, Volume=	0.033 af, Atten= 1%, Lag= 0.6 min
Discarded =	0.00 cfs @ 2.62 hrs, Volume=	0.004 af
Primary =	0.43 cfs @ 12.09 hrs, Volume=	0.029 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 73.79' @ 12.09 hrs Surf.Area= 103 sf Storage= 137 cf Flood Elev= 72.21' Surf.Area= 103 sf Storage= 22 cf

Plug-Flow detention time= 65.9 min calculated for 0.033 af (93% of inflow) Center-of-Mass det. time= 26.7 min (772.9 - 746.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	71.69'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	72.19'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	71.69'	1.020 in/hr Exfiltration over Surface area
#2	Primary	73.40'	6.0" Round Culvert L= 30.0' Ke= 0.200 Inlet / Outlet Invert= 73.40' / 70.70' S= 0.0900 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=71.72' (Free Discharge)

Primary OutFlow Max=0.43 cfs @ 12.09 hrs HW=73.79' (Free Discharge) -2=Culvert (Inlet Controls 0.43 cfs @ 2.65 fps)

 Type III 24-hr
 25-Year Rainfall=5.40"

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Pond UIS-3: UIS-3 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

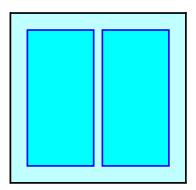
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

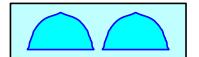
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

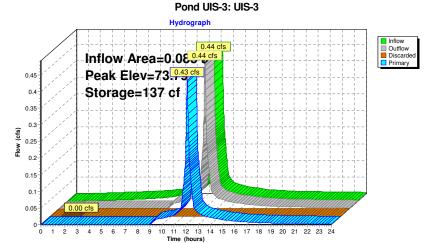
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$









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Type III 24-hr 25-Year Rainfall=5.40" Printed 1/16/2017 Page 195

Summary for Pond UIS-4: UIS-4

[58] Hint: Peaked 0.53' above defined flood level

Inflow Area =	0.073 ac,100.00% Impervious, Inflow Depth > 5.16" for 25-Year event
Inflow =	0.39 cfs @ 12.08 hrs, Volume= 0.032 af
Outflow =	0.38 cfs @ 12.10 hrs, Volume= 0.029 af, Atten= 3%, Lag= 1.2 min
Discarded =	0.00 cfs @ 2.88 hrs, Volume= 0.004 af
Primary =	0.37 cfs @ 12.10 hrs, Volume= 0.024 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 74.73' @ 12.10 hrs Surf.Area= 103 sf Storage= 146 cf Flood Elev= 74.20' Surf.Area= 103 sf Storage= 111 cf

Plug-Flow detention time= 71.7 min calculated for 0.029 af (92% of inflow) Center-of-Mass det. time= 28.8 min (775.0 - 746.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	72.50'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	73.00'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	72.50'	1.020 in/hr Exfiltration over Surface area
#2	Primary	74.20'	6.0" Round Culvert L= 30.0' Ke= 1.000 Inlet / Outlet Invert= 74.20' / 74.06' S= 0.0047 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 2.88 hrs HW=72.53' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.37 cfs @ 12.10 hrs HW=74.73' (Free Discharge) -2=Culvert (Inlet Controls 0.37 cfs @ 1.90 fps)

Topsfield Proposed HydroCAD	Type III 24-hr	25-Year Rainfall=5.40"
Prepared by Microsoft		Printed 1/16/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions L	LC	Page 196

Pond UIS-4: UIS-4 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

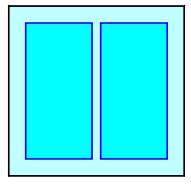
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

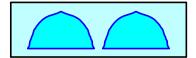
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

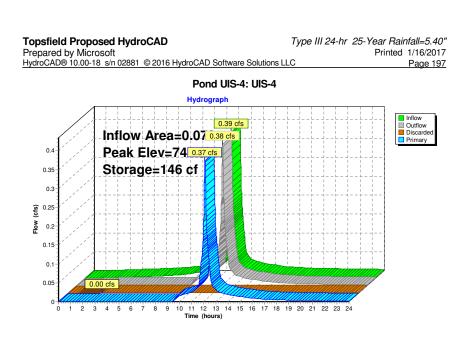
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'







HydroCAL	D® 10.00-18 s	/n 02881 © 20	16 HydroCA	D Software	Solutions LL	.C		inted 1/16/2017 Page 198
			Summary	for Pond	1 UIS-5: L	IIS-5		
Inflow Ar Inflow Outflow Discarde Primary	= 0.4 = 0.4 d = 0.0	083 ac,100.00 14 cfs @ 12. 12 cfs @ 12. 00 cfs @ 2. 12 cfs @ 12.	08 hrs, Vol 11 hrs, Vol 62 hrs, Vol	ume= ume= ume=	0.036 a	uf af, Atten= 49 af	25-Year eve %, Lag= 1.4	
		ethod, Time S 12.11 hrs Su						
		me= 66.5 min me= 27.3 min			af (93% of i	nflow)		
Volume	Invert	Avail.Stora	ge Storac	e Descript	tion			
#1A	73.09'		<u> </u>		L x 3.21'H I	ield A		
#2A	73.59'	97	332 cf cf Culted Effecti	Overall - 9 R-280HD ve Size= 4	97 cf Embe x 2 Inside 6.9"W x 26	dded = 234 #1 6.0"H => 6.0	cf x 40.0% ' 7 sf x 7.00'L with 1.00' O	= 42.5 cf
						1.00' x 6.07		venap
Device #1	Routing Discarded		Outlet Devie 1.020 in/hr		n over Surf	ace area		
#1 #2	Discarded Primary	74.80'	6.0" Round Inlet / Outle	t Culvert t Invert= 74	L= 22.0' k	(e= 1.000	1 '/' Cc= 0.	900
			1= 0.011 P	VC. SIIIOOL	h interior.	Flow Area=	0.20 sf	
Discarde 1=Exf	d OutFlow M iltration (Ext			,	,	Flow Area= ischarge)	0.20 sf	
Primary	OutFlow Ma		@ 2.62 hrs ols 0.00 cfs 12.11 hrs 1	HW=73.13) HW=75.40	2' (Free D	ischarge)	0.20 sf	
Primary	OutFlow Ma	Max=0.00 cfs iltration Contr x=0.42 cfs @	@ 2.62 hrs ols 0.00 cfs 12.11 hrs 1	HW=73.13) HW=75.40	2' (Free D	ischarge)	0.20 sf	
Primary	OutFlow Ma	Max=0.00 cfs iltration Contr x=0.42 cfs @	@ 2.62 hrs ols 0.00 cfs 12.11 hrs 1	HW=73.13) HW=75.40	2' (Free D	ischarge)	0.20 sf	
Primary	OutFlow Ma	Max=0.00 cfs iltration Contr x=0.42 cfs @	@ 2.62 hrs ols 0.00 cfs 12.11 hrs 1	HW=73.13) HW=75.40	2' (Free D	ischarge)	0.20 sf	
Primary	OutFlow Ma	Max=0.00 cfs iltration Contr x=0.42 cfs @	@ 2.62 hrs ols 0.00 cfs 12.11 hrs 1	HW=73.13) HW=75.40	2' (Free D	ischarge)	0.20 sf	

 Type III 24-hr
 25-Year Rainfall=5.40"

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Pond UIS-5: UIS-5 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

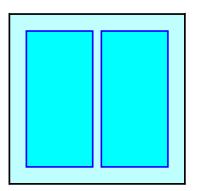
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

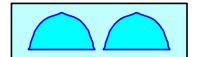
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

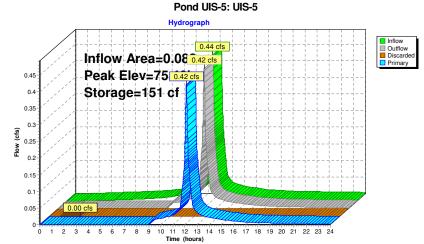
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$









	by Microso 10.00-18		2016 HydroC	CAD Software Sol	lutions LLC		Printed	1/16/2017 Page 201
			Summa	ry for Pond U	JIS-6: UIS-6			
nflow Area	a = 0	.089 ac,100.0	.00% Imper	rvious, Inflow D	epth > 5.16"	for 25-Ye	ar event	
nflow	= 0.	47 cfs 🧔 12	2.08 hrs, V	/olume=	0.038 af			
ounon		45 cfs @ 12			0.036 af, Atte	en= 4%, La	g= 1.4 min	
Discarded		00 cfs @ 2			0.005 af			
Primary	= 0.	45 cfs @ 12	2.11 hrs, V	/olume=	0.031 af			
		me= 63.7 mi me= 26.6 mi		ed for 0.036 af (§ - 746.2)	93% of inflow)			
		me= 26.6 mi	iin (772.8 - <u>rage Stor</u>	- 746.2)	1			
Center-of-N	Mass det. ti	me= 26.6 mi Avail.Stor	iin (772.8 - <u>rage Stor</u> 94 cf 10.3	- 746.2) rage Description 33'W x 10.00'L x	3.21'H Field A	ι		
Center-of-N <u>Volume</u> #1A	Mass det. ti Invert 72.29'	me= 26.6 mi <u>Avail.Stor</u> 9	iin (772.8 - <u>rage Stor</u> 94 cf 10.3 332	- 746.2) rage Description 33'W x 10.00'L x cf Overall - 97 c	1 : 3.21'H Field A cf Embedded =	ι	0.0% Voids	
Center-of-N Volume	Mass det. ti Invert	me= 26.6 mi <u>Avail.Stor</u> 9	iin (772.8 - r <u>age Stor</u> 94 cf 10.3 332 97 cf Cult	- 746.2) rage Description 33'W x 10.00'L x cf Overall - 97 c tec R-280HD x 2	1 : 3.21'H Field A cf Embedded = 2 Inside #1	A = 234 cf x 4		
Center-of-N <u>Volume</u> #1A	Mass det. ti Invert 72.29'	me= 26.6 mi <u>Avail.Stor</u> 9	nin (772.8 - rage Stor 94 cf 10.3 332 97 cf Cult Effe	- 746.2) rage Description 33'W x 10.00'L x c of Overall - 97 of tec R-280HD x 2 ective Size= 46.9	3.21'H Field A 5 Embedded = 2 Inside #1 9"W x 26.0"H =	1 = 234 cf x 4 => 6.07 sf x	7.00'L = 42	.5 cf
Center-of-N <u>Volume</u> #1A	Mass det. ti Invert 72.29'	me= 26.6 mi <u>Avail.Stor</u> 9	nin (772.8 - rage Stor 94 cf 10.3 332 97 cf Cult Effe Ove	- 746.2) rage Description 33'W x 10.00'L x c f Overall - 97 c tec R-280HD x 2 sective Size= 46.2 erall Size= 47.0"	3.21'H Field A cf Embedded = 2 Inside #1 9"W x 26.0"H = W x 26.5"H x 8	• = 234 cf x 4 => 6.07 sf x 3.00'L with 1	7.00'L = 42 .00' Overla	.5 cf
Center-of-N <u>Volume</u> #1A	Mass det. ti Invert 72.29'	me= 26.6 mi <u>Avail.Stor</u> 9 9	in (772.8 - rage Stor 94 cf 10.3 332 97 cf Cult Effe Ove Row	- 746.2) rage Description 33'W x 10.00'L x c of Overall - 97 of tec R-280HD x 2 ective Size= 46.9	1 3.21'H Field A 3.21'H Field A 2 Inside #1 2 Inside #1 2 W x 26.0"H = W x 26.5"H x 8 ment= +1.00' x	• = 234 cf x 4 => 6.07 sf x 3.00'L with 1	7.00'L = 42 .00' Overla	.5 cf
Center-of-N Volume #1A #2A	Mass det. ti <u>Invert</u> 72.29' 72.79'	me= 26.6 mi <u>Avail.Stor</u> 9 9 9 19	iin (772.8 - rage Stor 94 cf 10.3 332 97 cf Cult Effe Ove Row 91 cf Tota	- 746.2) rage Description 33'W x 10.00'L x c f Overall - 97 c tec R-280HD x 2 sctive Size= 46.2 srall Size= 47.0" v Length Adjustr al Available Stor	1 3.21'H Field A 3.21'H Field A 2 Inside #1 2 Inside #1 2 W x 26.0"H = W x 26.5"H x 8 ment= +1.00' x	• = 234 cf x 4 => 6.07 sf x 3.00'L with 1	7.00'L = 42 .00' Overla	.5 cf
Center-of-N Volume #1A #2A	Mass det. ti <u>Invert</u> 72.29' 72.79'	me= 26.6 mi <u>Avail.Stor</u> 9 9	iin (772.8 - rage Stor 94 cf 10.3 332 97 cf Cult Effe Ove Row 91 cf Tota	- 746.2) rage Description 33'W x 10.00'L x c f Overall - 97 c tec R-280HD x 2 sctive Size= 46.2 srall Size= 47.0" v Length Adjustr al Available Stor	1 3.21'H Field A 3.21'H Field A 2 Inside #1 2 Inside #1 2 W x 26.0"H = W x 26.5"H x 8 ment= +1.00' x	• = 234 cf x 4 => 6.07 sf x 3.00'L with 1	7.00'L = 42 .00' Overla	.5 cf
Center-of-N Volume #1A #2A	Mass det. ti <u>Invert</u> 72.29' 72.79' e Group A c	me= 26.6 mi Avail.Stor 9 9 9 19 19 reated with 0	iin (772.8 - rage Stor 94 cf 10.3 332 97 cf Cult Effe Ove Row 91 cf Tota	 746.2) rage Description 33'W x 10.00'L x a cf Overall - 97 c tec R-280HD x 2 ective Size= 46.9 erall Size= 47.0"' v Length Adjustr al Available Store Wizard 	1 3.21'H Field A 3.21'H Field A 2 Inside #1 2 Inside #1 2 W x 26.0"H = W x 26.5"H x 8 ment= +1.00' x	• = 234 cf x 4 => 6.07 sf x 3.00'L with 1	7.00'L = 42 .00' Overla	.5 cf
Center-of-M <u>Volume</u> #1A #2A Storage <u>Device R</u> #1 D	Mass det. ti Invert 72.29' 72.79' e Group A c Routing Discarded	me= 26.6 mi Avail.Stor 9 9 9 19 reated with (<u>Invert</u> 72.29	in (772.8 - rage Stor 94 cf 10.3 332 97 cf Cult Effe Ove Row 91 cf Tota Chamber V Outlet De 1.020 in/t	- 746.2) rage Description 33'W x 10.00'L x c of Overall - 97 of tec R-280HD x 2 sortive Size= 46.2 erall Size= 47.0" w Length Adjustr al Available Store Wizard evices hr Exfiltration or	3.21'H Field A cf Embedded = 2 Inside #1 "W x 26.0"H = W x 26.5"H x 8 ment= +1.00' x age	= 234 cf x 4 => 6.07 sf x 3.00'L with 1 6.07 sf x 2	7.00'L = 42 .00' Overla	.5 cf
Center-of-M <u>Volume</u> #1A #2A Storage <u>Device R</u> #1 D	Mass det. ti Invert 72.29' 72.79' e Group A c Routing	me= 26.6 mi Avail.Stor 9 9 9 19 reated with (<u>Invert</u> 72.29	in (772.8 - rage Stor 94 cf 10.3 332 97 cf Cult Effe Ove Row 91 cf Totz Chamber V Outlet De 1.020 in/f 6.0" Rou	- 746.2) rage Description 33'W x 10.00'L x c of Overall - 97 of tec R-280HD x 2 cotive Size= 46.2 rall Size= 47.0" v Length Adjustr al Available Stor Wizard evices	1 3.21'H Field A cf Embedded = 2 Inside #1 "W x 26.0"H = W x 26.5"H x 8 ment= +1.00' x rage ver Surface ar 106.0' Ke= 1	• = 234 cf x 4 => 6.07 sf x 3.00'L with 1 : 6.07 sf x 2 • • • •	7.00'L = 42 .00' Overla rows	.5 cf

Discarded OutFlow Max=0.00 cfs @ 2.48 hrs HW=72.32' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.45 cfs @ 12.11 hrs HW=74.65' (Free Discharge) -2=Culvert (Inlet Controls 0.45 cfs @ 2.29 fps)

Topsfield Proposed HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
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Pond UIS-6: UIS-6 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

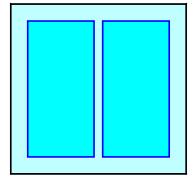
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

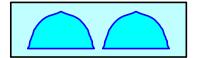
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

 $\begin{array}{l} \mbox{Chamber Storage + Stone Storage = 190.9 cf = 0.004 af} \\ \mbox{Overall Storage Efficiency = 57.6\%} \\ \mbox{Overall System Size = 10.00' x 10.33' x 3.21'} \end{array}$



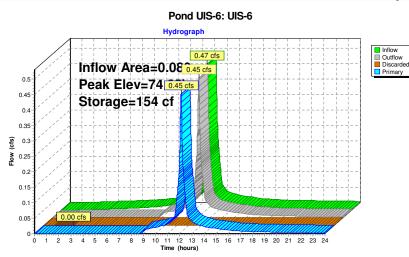




 Type III 24-hr
 25-Year Rainfall=5.40"

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Topsfield Proposed HydroCAD Type III 24-hr 25-Year Rainfall=5.40" Prepared by Microsoft Printed 1/16/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 204 Summary for Pond UIS-7: UIS-7 Inflow Area = 0.083 ac,100.00% Impervious, Inflow Depth > 5.16" for 25-Year event Inflow = 0.44 cfs @ 12.08 hrs, Volume= 0.036 af 0.033 af, Atten= 4%, Lag= 1.4 min 0.42 cfs @ 12.11 hrs, Volume= Outflow = Discarded = 0.00 cfs @ 2.62 hrs, Volume= 0.004 af Primary = 0.42 cfs @ 12.11 hrs, Volume= 0.029 af Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 74.10' @ 12.11 hrs Surf.Area= 103 sf Storage= 151 cf Plug-Flow detention time= 66.5 min calculated for 0.033 af (93% of inflow) Center-of-Mass det. time= 27.3 min (773.5 - 746.2) Volume Invert Avail.Storage Storage Description #1A 94 cf 10.33'W x 10.00'L x 3.21'H Field A 71.79 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids #2A 97 cf Cultec R-280HD x 2 Inside #1 72.29' Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows 191 cf Total Available Storage Storage Group A created with Chamber Wizard Device Routing Invert Outlet Devices #1 Discarded 71.79' 1.020 in/hr Exfiltration over Surface area #2 Primary 73.50' 6.0" Round Culvert L= 17.5' Ke= 1.000 Inlet / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=71.82' (Free Discharge) 1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=74.10' (Free Discharge) -2=Culvert (Inlet Controls 0.42 cfs @ 2.14 fps)

 Type III 24-hr
 25-Year Rainfall=5.40"

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Pond UIS-7: UIS-7 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

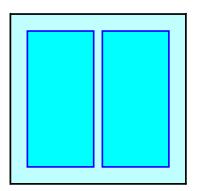
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

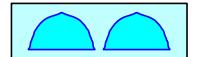
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

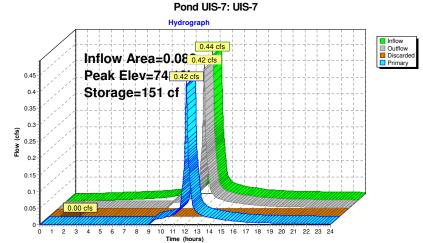
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$









		Su	nmary for Pond UIS-8: UIS-8	
Inflow Are			mpervious, Inflow Depth > 5.16" for 25-Year event	
Inflow		.44 cfs @ 12.08 h		
Outflow		.42 cfs @ 12.11 h		
Discarded Primary		.00 cfs @ 2.62 h .42 cfs @ 12.11 h		
,		-		
Routing by	y Stor-Ind r	nethod, Time Spar	n= 0.00-24.00 hrs, dt= 0.01 hrs	
	, i= 73.40' @	12.11 hrs Surf.A	rea= 103 sf Storage= 151 cf	
Peak Elev	-		rea= 103 sf Storage= 151 cf	
Peak Elev Plug-Flow	detention	time= 66.5 min cal	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow)	
Peak Elev Plug-Flow	detention		rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow)	
Peak Elev Plug-Flow Center-of-	detention	time= 66.5 min cal time= 27.3 min (7	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow)	
Peak Elev Plug-Flow	detention Mass det.	time= 66.5 min cal time= 27.3 min (7 Avail.Storage	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow) 73.5 - 746.2)	
Peak Elev Plug-Flow Center-of- <u>Volume</u> #1A	detention -Mass det. Invert 71.09'	time= 66.5 min cal time= 27.3 min (7 Avail.Storage 94 cf	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow) 73.5 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids	
Peak Elev Plug-Flow Center-of- Volume	detention Mass det.	time= 66.5 min cal time= 27.3 min (7 Avail.Storage 94 cf	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow) 73.5 - 746.2) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1	
Peak Elev Plug-Flow Center-of- <u>Volume</u> #1A	detention -Mass det. Invert 71.09'	time= 66.5 min cal time= 27.3 min (7 Avail.Storage 94 cf	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow) 73.5 - 746.2) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids <u>Cultec R-280HD x 2</u> Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf	
Peak Elev Plug-Flow Center-of- <u>Volume</u> #1A	detention -Mass det. Invert 71.09'	time= 66.5 min cal time= 27.3 min (7 Avail.Storage 94 cf	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow) 73.5 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap	
Peak Elev Plug-Flow Center-of- <u>Volume</u> #1A	detention -Mass det. Invert 71.09'	time= 66.5 min cal time= 27.3 min (7 <u>Avail.Storage</u> 94 cf 97 cf	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow) 73.5 - 746.2) Storage Description 10.33°W x 10.00°L x 3.21°H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9°W x 26.0°H => 6.07 sf x 7.00°L = 42.5 cf Overall Size= 47.0°W x 26.5°H +> 8.00°L with 1.00° Overlap Row Length Adjustment= +1.00° x 6.07 sf x 2 rows	
Peak Elev Plug-Flow Center-of- <u>Volume</u> #1A	detention -Mass det. Invert 71.09'	time= 66.5 min cal time= 27.3 min (7 <u>Avail.Storage</u> 94 cf 97 cf	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow) 73.5 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap	
Peak Elev Plug-Flow Center-of- <u>Volume</u> #1A #2A	v detention Mass det. <u>Invert</u> 71.09' 71.59'	time= 66.5 min cal time= 27.3 min (7 <u>Avail.Storage</u> 94 cf 97 cf	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow) 73.5 - 746.2) Storage Description 10.33 W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage	
Peak Elev Plug-Flow Center-of- <u>Volume</u> #1A #2A Storage	e Group A	time= 66.5 min cal time= 27.3 min (7 <u>Avail.Storage</u> 94 cf 97 cf 191 cf created with Cham	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow) 73.5 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage ber Wizard	
Peak Elev Plug-Flow Center-of- <u>Volume</u> #1A #2A Storage	v detention Mass det. <u>Invert</u> 71.09' 71.59'	time= 66.5 min cal time= 27.3 min (7 <u>Avail.Storage</u> 94 cf 97 cf 191 cf created with Charr <u>Invert</u> Out	rea= 103 sf Storage= 151 cf culated for 0.033 af (93% of inflow) 73.5 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage ber Wizard	

Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=71.12' (Free Discharge)

Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=73.40' (Free Discharge) -2=Culvert (Inlet Controls 0.42 cfs @ 2.14 fps)

Topsfield Proposed HydroCAD	Type III 24-hr 25-Year Rainfall=5.40"
Prepared by Microsoft	Printed 1/16/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions L	LC Page 208

Pond UIS-8: UIS-8 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

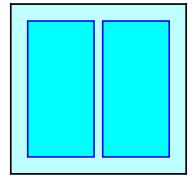
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

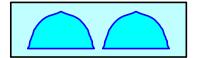
Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

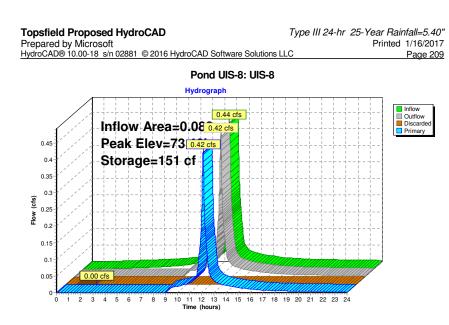
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$







Preparec HydroCAD			6 HydroCAD Software Solutions LLC Printed 1/16/20 Page 2
			ummary for Pond UIS-9: UIS-9
Inflow Are Inflow		0.089 ac,100.00% 0.47 cfs @ 12.08	6 Impervious, Inflow Depth > 5.16" for 25-Year event 8 hrs. Volume= 0.038 af
Outflow		.45 cfs @ 12.11	
Discarded			B hrs, Volume= 0.005 af
Primary	= C	.44 cfs @ 12.11	hrs, Volume= 0.033 af
			an= 0.00-24.00 hrs, dt= 0.01 hrs Area= 103 sf Storage= 99 cf
		time= 36.2 min c time= 16.4 min (alculated for 0.037 af (97% of inflow) 762.7 - 746.2)
Volume	Invert	Avail.Storage	e Storage Description
#1A	71.28'	94 c	
#2A	71.78'	97 c	332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids f Cultec R-280HD x 2 Inside #1
<i>"L</i>	71.70	0, 0	Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
0	, I	191 c created with Cha	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows f Total Available Storage mber Wizard
Device #1	le Group A Routing Discarded Primary	created with Cha Invert O 71.28' 1. 72.18' 6.	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows f Total Available Storage imber Wizard utlet Devices D20 in/hr Extiltration over Surface area 0" Round Culvert L= 79.0' Ke= 1.000
Device #1	Routing Discarded	created with Cha Invert O 71.28' 1. 72.18' 6. In	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows f Total Available Storage Imber Wizard utlet Devices 020 in/hr Exfiltration over Surface area
<u>Device</u> #1 #2 Discarde	Routing Discarded Primary d OutFlow	created with Cha Invert O 71.28' 1. 72.18' 6. In n=	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows f Total Available Storage unber Wizard utlet Devices D20 in/hr Extiltration over Surface area 0" Round Culvert L= 79.0' Ke= 1.000 let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 • 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge)
Device #1 #2 Discarder 1=Exfi Primary (Routing Discarded Primary d OutFlow Itration (E DutFlow M	created with Char Invert O 71.28' 1. 72.18' 6. In n= Max=0.00 cfs @ xfiltration Control	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap <u>Row Length Adjustment= +1.00' x 6.07 sf x 2 rows</u> f Total Available Storage imber Wizard <u>utlet Devices</u> <u>020 in/hr Exfiltration over Surface area</u> <u>0" Round Culvert L= 79.0' Ke= 1.000</u> let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 e 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=72.82' (Free Discharge)
Device #1 #2 Discarder 1=Exfi Primary (Routing Discarded Primary d OutFlow Itration (E DutFlow M	reated with Cha Invert O 71.28' 1.1 72.18' 6.1 In n= Max=0.00 cfs @ xfiltration Control ax=0.44 cfs @ 12	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows f Total Available Storage imber Wizard utlet Devices D20 in/hr Exfiltration over Surface area 0" Round Culvert L= 79.0' Ke= 1.000 let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 e 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=72.82' (Free Discharge)
Device #1 #2 Discarder 1=Exfi Primary (Routing Discarded Primary d OutFlow Itration (E DutFlow M	reated with Cha Invert O 71.28' 1.1 72.18' 6.1 In n= Max=0.00 cfs @ xfiltration Control ax=0.44 cfs @ 12	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows f Total Available Storage imber Wizard utlet Devices D20 in/hr Exfiltration over Surface area 0" Round Culvert L= 79.0' Ke= 1.000 let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 e 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=72.82' (Free Discharge)
Device #1 #2 Discarder 1=Exfi Primary (Routing Discarded Primary d OutFlow Itration (E DutFlow M	reated with Cha Invert O 71.28' 1.1 72.18' 6.1 In n= Max=0.00 cfs @ xfiltration Control ax=0.44 cfs @ 12	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows f Total Available Storage imber Wizard utlet Devices D20 in/hr Exfiltration over Surface area 0" Round Culvert L= 79.0' Ke= 1.000 let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 e 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=72.82' (Free Discharge)
Device #1 #2 Discarder 1=Exfi Primary (Routing Discarded Primary d OutFlow Itration (E DutFlow M	reated with Cha Invert O 71.28' 1.1 72.18' 6.1 In n= Max=0.00 cfs @ xfiltration Control ax=0.44 cfs @ 12	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows f Total Available Storage imber Wizard utlet Devices D20 in/hr Exfiltration over Surface area 0" Round Culvert L= 79.0' Ke= 1.000 let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 e 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=72.82' (Free Discharge)
Device #1 #2 Discarder 1=Exfi Primary (Routing Discarded Primary d OutFlow Itration (E DutFlow M	reated with Cha Invert O 71.28' 1.1 72.18' 6.1 In n= Max=0.00 cfs @ xfiltration Control ax=0.44 cfs @ 12	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows f Total Available Storage imber Wizard utlet Devices D20 in/hr Exfiltration over Surface area 0" Round Culvert L= 79.0' Ke= 1.000 let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 e 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=72.82' (Free Discharge)
Device #1 #2 Discarder 1=Exfi Primary (Routing Discarded Primary d OutFlow Itration (E DutFlow M	reated with Cha Invert O 71.28' 1.1 72.18' 6.1 In n= Max=0.00 cfs @ xfiltration Control ax=0.44 cfs @ 12	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap <u>Row Length Adjustment= +1.00' x 6.07 sf x 2 rows</u> f Total Available Storage imber Wizard <u>utlet Devices</u> <u>020 in/hr Exfiltration over Surface area</u> <u>0" Round Culvert L= 79.0' Ke= 1.000</u> let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 e 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=72.82' (Free Discharge)
Device #1 #2 Discarder 1=Exfi Primary (Routing Discarded Primary d OutFlow Itration (E DutFlow M	reated with Cha Invert O 71.28' 1.1 72.18' 6.1 In n= Max=0.00 cfs @ xfiltration Control ax=0.44 cfs @ 12	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap <u>Row Length Adjustment= +1.00' x 6.07 sf x 2 rows</u> f Total Available Storage imber Wizard <u>utlet Devices</u> <u>020 in/hr Exfiltration over Surface area</u> <u>0" Round Culvert L= 79.0' Ke= 1.000</u> let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 e 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=72.82' (Free Discharge)
Device #1 #2 Discarder 1=Exfi Primary (Routing Discarded Primary d OutFlow Itration (E DutFlow M	reated with Cha Invert O 71.28' 1.1 72.18' 6.1 In n= Max=0.00 cfs @ xfiltration Control ax=0.44 cfs @ 12	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap <u>Row Length Adjustment= +1.00' x 6.07 sf x 2 rows</u> f Total Available Storage imber Wizard utlet Devices 202 in/hr Extiltration over Surface area 0" Round Culvert L= 79.0' Ke= 1.000 let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 c 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=72.82' (Free Discharge)
Device #1 #2 Discarder 1=Exfi Primary (Routing Discarded Primary d OutFlow Itration (E DutFlow M	reated with Cha Invert O 71.28' 1.1 72.18' 6.1 In n= Max=0.00 cfs @ xfiltration Control ax=0.44 cfs @ 12	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap <u>Row Length Adjustment= +1.00' x 6.07 sf x 2 rows</u> f Total Available Storage imber Wizard <u>utlet Devices</u> <u>020 in/hr Exfiltration over Surface area</u> <u>0" Round Culvert L= 79.0' Ke= 1.000</u> let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 e 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=72.82' (Free Discharge)
Device #1 #2 Discarder 1=Exfi Primary (Routing Discarded Primary d OutFlow Itration (E DutFlow M	reated with Cha Invert O 71.28' 1.1 72.18' 6.1 In n= Max=0.00 cfs @ xfiltration Control ax=0.44 cfs @ 12	Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap <u>Row Length Adjustment= +1.00' x 6.07 sf x 2 rows</u> f Total Available Storage imber Wizard <u>utlet Devices</u> <u>020 in/hr Exfiltration over Surface area</u> <u>0" Round Culvert L= 79.0' Ke= 1.000</u> let / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 e 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=72.82' (Free Discharge)

 Type III 24-hr
 25-Year Rainfall=5.40"

 Printed
 1/16/2017

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Pond UIS-9: UIS-9 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

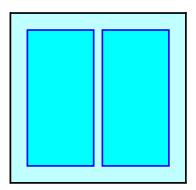
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

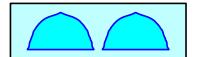
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

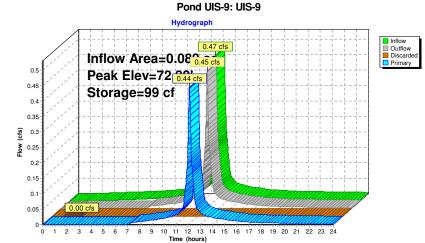
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$









Type III 24-hr 100-Year Rainfall=6.50 Printed 1/16/201 D Software Solutions LLC Page 21	Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD	Type III 24-hr 100-Year Rainfall=6.50" Printed 1/16/2017 Software Solutions LLC Page 213	opsfield Proposed HydroCAD repared by Microsoft _{/droCAD®} 10.00-18 s/n 02881 © 2016 HydroCA
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.043	Subcatchment R-14: Roof Units 27&28 - A&B	0 hrs, dt=0.01 hrs, 2401 points nethod, UH=SCS, Weighted-CN method - Pond routing by Stor-Ind method	Runoff by SCS TR-2
C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038	Subcatchment R-15: Roof Units 29&30 - (B & C	Runoff Area=81,522 sf 0.00% Impervious Runoff Depth>0.73" Tc=6.0 min CN=41 Runoff=0.78 cfs 0.113 af	ubcatchment P-1: Northern Grassed Area to
Runoff Area=1,490 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.22 cfs 0.018	Subcatchment R-16: Front Units 29&30	Runoff Area=31,595 sf 7.29% Impervious Runoff Depth>3.71" 33' Tc=6.0 min UI Adjusted CN=75 Runoff=3.16 cfs 0.224 af	ubcatchment P-10: Area Around Isolated Flow Lengt
Runoff Area=120 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.02 cfs 0.001	Subcatchment R-17: Mailbox Structure Rood	Runoff Area=23,114 sf 59.77% Impervious Runoff Depth>4.34" Tc=6.0 min CN=81 Runoff=2.68 cfs 0.192 af	ubcatchment P-2: Existing Drive to Existing
Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038	Subcatchment R-2: Roof Units 3&4 - (B & C	Runoff Area=27,582 sf 12.85% Impervious Runoff Depth>1.39" Tc=6.0 min UI Adjusted CN=50 Runoff=0.87 cfs 0.074 af	ubcatchment P-3: Area Around Isolated
s Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.043	Subcatchment R-3: Roof Units 5&6 - A&B Units	Runoff Area=4,950 sf 31.35% Impervious Runoff Depth>3.30" Tc=6.0 min CN=71 Runoff=0.44 cfs 0.031 af	ubcatchment P-3A: Gravel Road to Detentio
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.043	Subcatchment R-4: Roof - Units 7&8 - (A&B	Runoff Area=21,573 sf 55.93% Impervious Runoff Depth>3.81" Tc=6.0 min CN=76 Runoff=2.21 cfs 0.157 af	ubcatchment P-4: Sloped Entrance Drive -
Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038	Subcatchment R-5: Roof - Units 9&10 - (B&C	Runoff Area=39,272 sf 51.57% Impervious Runoff Depth>3.61" Tc=6.0 min CN=74 Runoff=3.82 cfs 0.271 af	ubcatchment P-5: Driveway - Units 25-11
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.043	Subcatchment R-6: Roof - Units 11&12 - (B&A	Runoff Area=19,137 sf 59.86% Impervious Runoff Depth>4.02" Tc=6.0 min CN=78 Runoff=2.07 cfs 0.147 af	ubcatchment P-6: Pavement Units 12-19
Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.57 cfs 0.047	Subcatchment R-7: Roof - Units 13&14 - (A	Runoff Area=15,670 sf 44.56% Impervious Runoff Depth>3.30" Tc=6.0 min CN=71 Runoff=1.39 cfs 0.099 af	ubcatchment P-7: Driveway - Units 20-24
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.043	Subcatchment R-8: Roof - Units 15&16 - (B&A	Runoff Area=15,307 sf 7.00% Impervious Runoff Depth>0.86" Tc=6.0 min CN=43 Runoff=0.21 cfs 0.025 af	ubcatchment P-8: Surface Infiltration Pond
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>6.2 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.043	Subcatchment R-9: Roof - Units 17&18 - (A&B	Runoff Area=102,567 sf 2.25% Impervious Runoff Depth>0.42")2' Tc=10.8 min UI Adjusted CN=36 Runoff=0.33 cfs 0.082 af	ubcatchment P-9: Woods/Grass Northwest Flow Length
Inflow=0.90 cfs 0.197 Outflow=0.90 cfs 0.197	Reach SP-1: Wetlands South of Driveway	Runoff Area=3,185 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038 af	ubcatchment R-1: Roof - Units 1&2 (C&B)
Inflow=2.02 cfs 0.222 Outflow=2.02 cfs 0.222	Reach SP-2: Large Wetland Area East	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.57 cfs 0.047 af	ubcatchment R-10: Roof - Units 19&20 - (A
Inflow=3.39 cfs 0.462 Outflow=3.39 cfs 0.462	Reach SP-3: Large Wetland Area West	Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.53 cfs 0.043 af	ubcatchment R-11: Roof - Units 21&22 - (A&
Wetlands Inflow=5.94 cfs 0.881 Primary=5.94 cfs 0.881	Pond 1P: Combined Study Points - Northern W	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.57 cfs 0.047 af	ubcatchment R-12: Roof - Units 23&24 - (A
Peak Elev=70.78' Storage=16,269 cf Inflow=10.97 cfs 0.799 fs 0.128 af Primary=3.06 cfs 0.380 af Outflow=3.18 cfs 0.508	Pond D-1: Surface Infiltration Pond Discarded=0.12 cf	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.57 cfs 0.047 af	ubcatchment R-13: Roof - Units 25&26 - (A

Topsfield Proposed Hydr Prepared by Microsoft	roCAD		Туре	e III 24-hr	100-Year Raini Printed	fall=6.50" 1/16/2017
HydroCAD® 10.00-18 s/n 02881	© 2016 HydroCAD	Software \$	Solutions LLC			Page 215
Pond D-2: Existing Detention	Basin	Peak E	Elev=58.71' Stor	rage=4,665	cf Inflow=2.68 cf Outflow=0.29 cf	
Pond D-3: Detention Pond by	Access Road Discarded=0.04 cfs				cf Inflow=0.44 cf Outflow=0.21 cf	
Pond UIS-1: UIS at Entrance	Discarded=0.08 cfs				cf Inflow=7.07 cf Outflow=1.07 cf	
Pond UIS-2: UIS at North of S	Site Discarded=0.23 cfs				cf Inflow=2.67 cf Outflow=1.59 cf	
Pond UIS-3: UIS-3	Discarded=0.00 cfs				cf Inflow=0.53 cf Outflow=0.53 cf	
Pond UIS-4: UIS-4	Discarded=0.00 cfs				cf Inflow=0.47 cf Outflow=0.45 cf	
Pond UIS-5: UIS-5	Discarded=0.00 cfs				cf Inflow=0.53 cf Outflow=0.51 cf	
Pond UIS-6: UIS-6	Discarded=0.00 cfs				cf Inflow=0.57 cf Outflow=0.54 cf	
Pond UIS-7: UIS-7	Discarded=0.00 cfs				cf Inflow=0.53 cf Outflow=0.51 cf	
Pond UIS-8: UIS-8	Discarded=0.00 cfs				cf Inflow=0.53 cf Outflow=0.51 cf	
Pond UIS-9: UIS-9	Discarded=0.00 cfs				cf Inflow=0.57 cf Outflow=0.53 cf	

 Total Runoff Area = 10.046 ac
 Runoff Volume = 2.078 af
 Average Runoff Depth = 2.48"

 70.14% Pervious = 7.046 ac
 29.86% Impervious = 3.000 ac

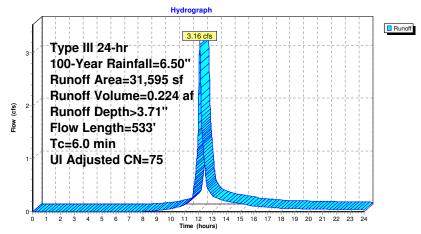
Prepared by Mi		6/201
		<u>ge 21</u>
Su	mmary for Subcatchment P-1: Northern Grassed Area to Wetlands	
Runoff =	0.78 cfs @ 12.14 hrs, Volume= 0.113 af, Depth> 0.73"	
	R-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs	
Type III 24-hr 10	00-Year Rainfall=6.50"	
Area (sf)	CN Description	
38,137 10,782	30 Woods, Good, HSG A 70 Woods, Good, HSG C	
9,419	55 Woods, Good, HSG B	
23,184	39 >75% Grass cover, Good, HSG A	
81,522 81,522	41 Weighted Average 100.00% Pervious Area	
Tc Length (min) (feet)		
<u>(1111)</u> (1881) 6.0	Direct Entry.	
0.7 0.65 0.6 0.55 0.5 0.45 0.45 R R R R R R R R	/pe III 24-hr I0-Year Rainfall=6.50" Unoff Area=81,522 sf Unoff Volume=0.113 af Unoff Depth>0.73" c=6.0 min	unoff
0.3 0.25 0.2 0.15 0.1 0.15		

Prepare	d by Mi			Type III 24-hr 100-Year Rainfall=6.50" Printed 1/16/2017				
HydroCA	HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 21							
	S	Summary for	Subcatchment P-10:	Area Around Isolated W	etland			
Runoff	=	3.16 cfs @	12.09 hrs, Volume=	0.224 af, Depth> 3.71"				
		R-20 method, 0-Year Rainfa		Time Span= 0.00-24.00 hrs, o	dt= 0.01 hrs			

A	rea (sf)	CN A	Adj Desc	cription					
	2,304	98	Unco	onnected ro	ofs, HSG A				
	29,291	74	>75%	% Grass co	ver, Good, HSG C				
	31,595	76	75 Weid	Weighted Average, UI Adjusted					
	29,291		92.7	1% Perviou	s Area				
	2,304		7.29	% Impervio	us Area				
	2,304		100.0	00% Üncon	nected				
Tc	Length	Slope	Velocity	Capacity	Description				
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)					
2.9	50	0.1100	0.29		Sheet Flow, A-B				
					Grass: Short n= 0.150 P2= 3.10"				
2.9	483	0.1600	2.80		Shallow Concentrated Flow, B-C				
					Short Grass Pasture Kv= 7.0 fps				

5.8 533 Total, Increased to minimum Tc = 6.0 min

Subcatchment P-10: Area Around Isolated Wetland



	Su	mma	ry for S	Subca	atchm	ent P	-2: Ex	cistin	g D	rive	to E	xist	ing	Bas	in	Page 218
unoff	=	2.68	cfs @	12.09	hrs, V	olume	-	0.	192 a	af, D	epth	> 4.	34"			
	y SCS TR 24-hr 100					ighted	-CN, T	Time S	Span	= 0.0	0-24	1 00.	nrs, d	t= 0.	01 hr:	s
Ar	ea (sf)	CN	Descri	otion												
	13,815	98 76	Paved													
	1,353 4,896	76 39	Gravel				HSG	A								
	3,050	74	>75% (Grass	cover,											
1	23,114 9,299	81	Weight 40.23%			00										
	9,299 13,815		40.23% 59.77%													
		~		•												
IC (min)	Length (feet)	Slop (ft/f		ocity sec)	Capaci cf		escript	ion								
6.0	()	(., (,	(0.		rect E	ntry, I	Min.	6.0 T	С					
				- I				Duin		-		D -				
		:	Subcat	cnme			Ŭ	Drive	e to	EXIS	ting	ва	sin			
					H	ydrogra	ph				1		-	-		
Flow (cfs)	100 Run Run	-Yea off off off 6.0	24-hi ar Rai Area= Volur Deptr min	nfal =23, ne=(114 s).192	¦f-¦-										Runoff
1-r - -							, , , , , , , , , , , , , , , , , , , 						////			
1-* - - -		/////	*****													
1	1 2	3 4	5 6	7 8	9 10	11 12 Time (h	13 1 ours)	4 15	16	17 18	19	20	21 22	23	24	

Topsfield Proposed HydroCAD	Type III 24-hr 100-Year Rainfall=6.50"	'
Prepared by Microsoft	Printed 1/16/2017	
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solution	ns LLC Page 219	1

Summary for Subcatchment P-3: Area Around Isolated Wetland

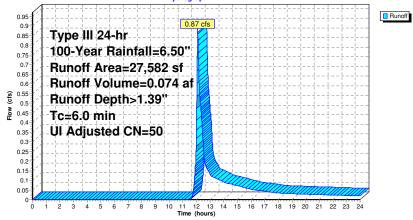
Runoff = 0.87 cfs @ 12.10 hrs, Volume= 0.074 af, Depth> 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

A	vrea (sf)	CN .	Adj D	escription			
	3,545	98	U	nconnected pa	avement, HSG A		
	1,224	76	G	ravel roads, H	SG A		
	212	74	>7	75% Grass cov	ver, Good, HSG C		
	2,166	70	W	loods, Good, H	ISG C		
	5,125	77	W	loods, Good, H	ISG D		
	14,867	30	W	loods, Good, H	ISG A		
	443	39	>7	75% Grass cov	ver, Good, HSG A		
	27,582	53	50 W	eighted Avera	ige, UI Adjusted		
	24,037		87	7.15% Perviou	s Area		
	3,545		12	2.85% Impervi	ous Area		
	3,545		10	100.00% Unconnected			
Tc (min)	Length (feet)	Slope (ft/ft)			Description		
6.0					Direct Entry,		

Subcatchment P-3: Area Around Isolated Wetland

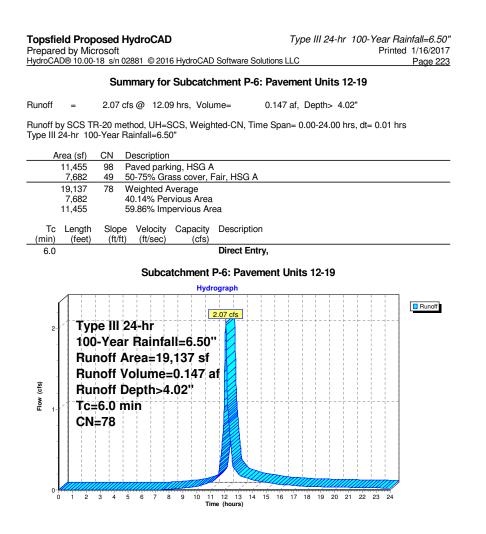
Hydrograph



Topsfield Proposed HydroCAD Type III 24-hr 100-Year Rainfall=6. Prepared by Microsoft Printed 1/16/2 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page	2017
Summary for Subcatchment P-3A: Gravel Road to Detention Basin	
Runoff = 0.44 cfs @ 12.09 hrs, Volume= 0.031 af, Depth> 3.30"	
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"	
Area (sf) CN Description	
1,552 98 Paved parking, HSG A 1,841 76 Gravel roads, HSG A 1,557 39 >75% Grass cover, Good, HSG A	
4.950 71 Weighted Average	
3,398 68.65% Pervious Area 1,552 31.35% Impervious Area	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment P-3A: Gravel Road to Detention Basin	
Hydrograph	
0.45 0.45 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4	ff
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	
Time (hours)	

Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions	Type III 24-hr 100-Year Rainfall=6.50" Printed 1/16/2017 s LLC Page 221
Summary for Subcatchment P-4: Sloped E	ntrance Drive - Units 1-5
Runoff = 2.21 cfs @ 12.09 hrs, Volume= 0.15	7 af, Depth> 3.81"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Sp Type III 24-hr 100-Year Rainfall=6.50"	an= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
12,066 98 Paved parking, HSG A 6,808 39 >75% Grass cover, Good, HSG A 2,699 74 >75% Grass cover, Good, HSG C	
21,573 76 Weighted Average 9,507 44.07% Pervious Area 12,066 55.93% Impervious Area	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment P-4: Sloped Entrance	e Drive - Units 1-5
Hydrograph	
Type III 24-hr 100-Year Rainfall=6.50" Runoff Area=21,573 sf Runoff Volume=0.157 af Runoff Depth>3.81" Tc=6.0 min	Runoff
CN=76	
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 11 Time (hours)	6 17 18 19 20 21 22 23 24

	d by Microsoft D® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solu	lutions LLC Page 22
	Summary for Subcatchment P-5:	Driveway - Units 25-11
Runoff	= 3.82 cfs @ 12.09 hrs, Volume=	0.271 af, Depth> 3.61"
	y SCS TR-20 method, UH=SCS, Weighted-CN, Time 24-hr 100-Year Rainfall=6.50"	ie Span= 0.00-24.00 hrs, dt= 0.01 hrs
A	rea (sf) CN Description	
	20,251 98 Paved parking, HSG A 14,308 39 >75% Grass cover, Good, HSG A 4,713 74 >75% Grass cover, Good, HSG C	
	39,272 74 Weighted Average	
	19,021 48.43% Pervious Area 20,251 51.57% Impervious Area	
-	, I	
Tc (min)	Length Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)	1
6.0	Direct Entry	 y,
	Cubactabreat D.S. Driver	very Unite OF 11
	Subcatchment P-5: Drivew	/ay - Units 25-11
- - - - - - - - - - - - - - - - - - -	Type III 24-hr 100-Year Rainfall=6.50'' Runoff Area=39,272 sf Runoff Volume=0.271 af Runoff Depth>3.61'' Tc=6.0 min CN=74	Runoff
0-	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14	15 16 17 18 19 20 21 22 23 24



Topsfield Proposed HydroCAD Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions	Type III 24-hr 100-Year Rainfall=6.50" Printed 1/16/2017 LLC Page 224
Summary for Subcatchment P-7: Driv	eway - Units 20-24
Runoff = 1.39 cfs @ 12.09 hrs, Volume= 0.09	9 af, Depth> 3.30"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Spa Type III 24-hr 100-Year Rainfall=6.50"	an= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
6,983 98 Paved parking, HSG A 8,687 49 50-75% Grass cover, Fair, HSG A	
15,670 71 Weighted Average 8,687 55.44% Pervious Area 6,983 44.56% Impervious Area	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment P-7: Driveway - Hydrograph	Units 20-24
Type III 24-hr 100-Year Rainfall=6.50" Runoff Area=15,670 sf Runoff Volume=0.099 af	
E Runoff Depth>3.30" Tc=6.0 min CN=71	
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Time (hours)	17 18 19 20 21 22 23 24

Topsfield Proposed HydroCAD	Type III 24-hr	100-Year Rainfall=6.50"
Prepared by Microsoft		Printed 1/16/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions I	LLC	Page 225

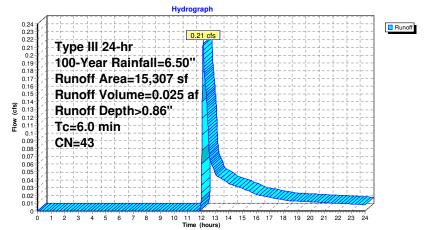
Summary for Subcatchment P-8: Surface Infiltration Pond Area

Page 225

Runoff = 0.21 cfs @ 12.12 hrs, Volume= 0.025 af, Depth> 0.86"

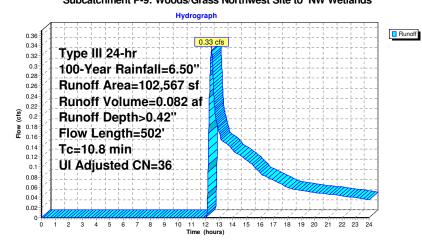
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

Area	(sf) C	CN [Description		
1,0	072			ing, HSG A	
14,2	235	39 >	>75% Gras	s cover, Go	ood, HSG A
15,3	307	43 ۱	Neighted A	verage	
14,2	235	ç	93.00% Per	vious Area	
1,0)72	7	7.00% Impe	ervious Area	a
				_ .	
		Slope		Capacity	Description
(min) (1	feet)	(ft/ft)	(ft/sec)	(cfs)	
6.0					Direct Entry,
		s	ubcatchr	nent P-8:	Surface Infiltration Pond Area

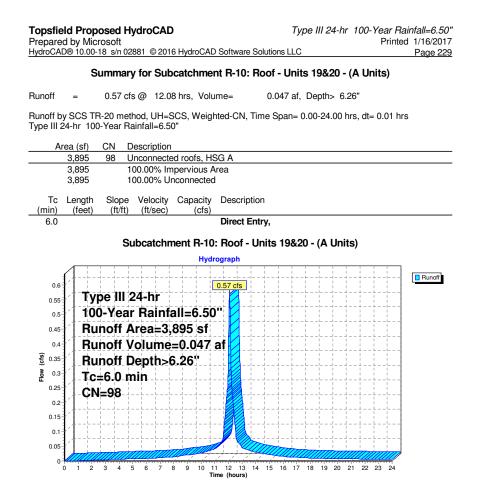


Topsfield Pro Prepared by M		ydroCAE)	Type III 24-hr 100-Year Rainfall=6.50 Printed 1/16/2017
		2881 © 201	6 HydroCAE	D Software Solutions LLC Page 226
Summa	ry for Su	bcatchm	ent P-9: V	Noods/Grass Northwest Site to NW Wetlands
Walking path in mulch, wood ch			"Dirt road,"	closest CN value in HydroCAD, actual material to be
Runoff =	0.33 cf	s@ 12.4	5 hrs, Volu	ume= 0.082 af, Depth> 0.42"
Type III 24-hr 1	00-Year R	ainfall=6.5	0"	hted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf)			ription	
2,068	72		oads, HSG	
40,086	39			ver, Good, HSG A
357	74			ver, Good, HSG C
53,082	30		ds, Good, I	
4,670	55		ds, Good, I	
2,304	98	Unco	onnected pa	avement, HSG A
102,567	37	36 Weig	phted Avera	age, UI Adjusted
100,263		97.7	5% Perviou	us Area
2,304		2.25	% Impervio	bus Area
2,304		100.	00% Uncor	nnected
Tc Length				Description
(min) (feet) (ft/ft)	(ft/sec)	(cfs)	
4.9 50	0.0300	0.17		Sheet Flow, A-B
				Grass: Short n= 0.150 P2= 3.10"
4.9 342	0.0280	1.17		Shallow Concentrated Flow, B-C
				Short Grass Pasture Kv= 7.0 fps
1.0 110	0.1270	1.78		Shallow Concentrated Flow, C-D
				Woodland Kv= 5.0 fps
10.8 502	2 Total			

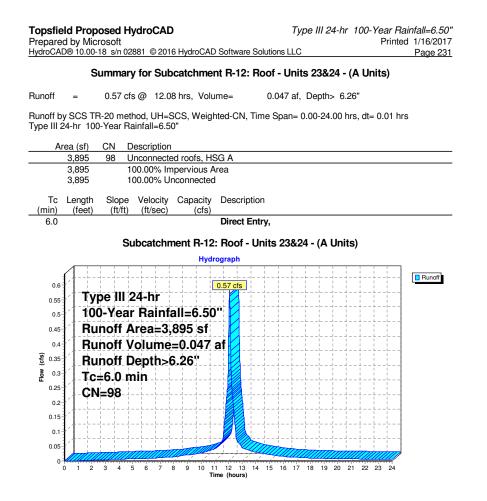




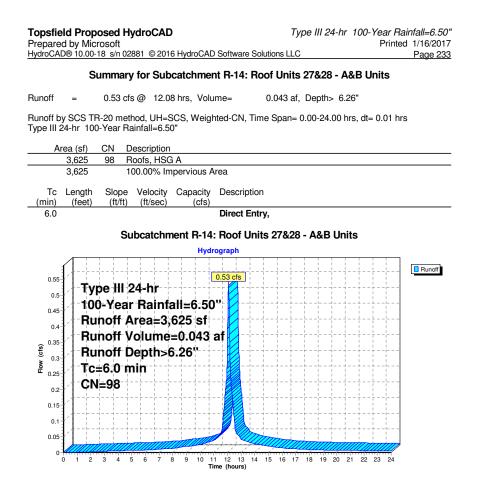
Summary for Subcatchment R-1: Roof - Units 1&2 (C&B) tunoff = 0.47 cfs @ 12.08 hrs, Volume= 0.038 af, Depth> 6.26" tunoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.00 0.000 hrs, dt= 0.00 ype III 24-hr 100-Year Rainfall=6.50" Area (sf) CN Description 3,185 98 Unconnected roofs, HSG A 3,185 100.00% Impervious Area 3,185 100.00% Unconnected Tc Length Slope (min) (fet) (ft/ft) 6.0 Direct Entry, Subcatchment R-1: Roof - Units 1&2 (C&B)	11 hrs
unoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.00 pe III 24-hr 100-Year Rainfall=6.50" Area (sf) CN Description 3,185 98 Unconnected roofs, HSG A 3,185 100.00% Impervious Area 3,185 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry,	11 hrs
Area (sf) CN Description 3,185 98 Unconnected roofs, HSG A 3,185 100.00% Impervious Area 3,185 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) 6.0 Direct Entry,)1 hrs
Area (sf) CN Description 3,185 98 Unconnected roofs, HSG A 3,185 100.00% Impervious Area 3,185 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/sec) (cfs) 6.0 Direct Entry,	
3,185 98 Unconnected roofs, HSG A 3,185 100.00% Impervious Area 3,185 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) 6.0 Direct Entry,	
3,185 100.00% Impervious Area 3,185 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry,	
3,185 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry,	
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry,	
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry,	
Subcatchment R-1: Roof - Units 1&2 (C&B)	
Subcatchment (191, noor - Onits 102 (Gub)	
Hydrograph	
0.5	Runoff
0.45 Type III 24-hr	
100-Year Rainfall=6.50"	
• Runoff Area=3,185 sf	
^{0.35} Runoff Volume=0.038 af	
^{0.2} CN=98	
0.15	
0.1	
0.05	



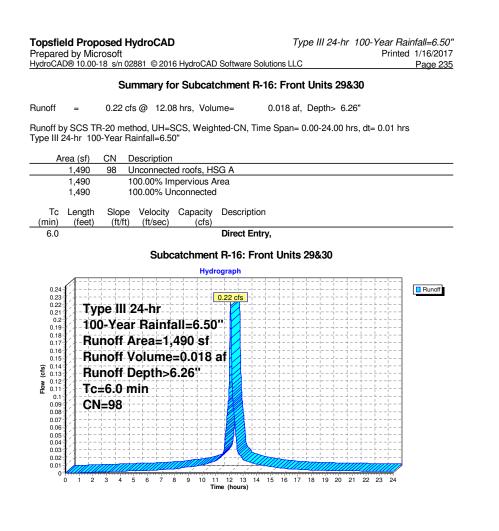
	Summary for Subcatchment R-11: Roof - Units 21&22 - (A&B Units)
Runoff	= 0.53 cfs @ 12.08 hrs, Volume= 0.043 af, Depth> 6.26"
Runoff b Type III 2	y SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs 24-hr 100-Year Rainfall=6.50"
A	rea (sf) CN Description
	3,625 98 Unconnected roofs, HSG A
	3,625 100.00% Impervious Area 3,625 100.00% Unconnected
Тс	Length Slope Velocity Capacity Description
(min)	(feet) (ft/ft) (ft/sec) (cfs)
6.0	Direct Entry,
0.55- 0.5- 0.45- 0.4- (s) 0.35- 0.3- 0.3-	0.53 cfs Type III 24-hr 100-Year Rainfall=6.50" Runoff Area=3,625 sf Runoff Volume=0.043 af Runoff Depth>6.26"
₽ 0.25	Tc=6.0 min
0.2	CN=98
0.15	
0.1	
0.1 0.05	



Runoff = 0.57 cfs @ 12.08 hrs, Volume= 0.047 af, Depth> 6.26" Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50" Area (sf) CN Description 3,895 100.00% Impervious Area 3,895 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-13: Roof - Units 25&26 - (A Units) Hydrograph Type III 24-hr 100-Year Rainfall=6.50" Runoff Area=3,895 sf Runoff Volume=0.047 af Runoff Volume=0.047 af Run	© 2016 HydroCAD Software Solutions LLC Page 7 Subcatchment R-13: Roof - Units 25&26 - (A Units)	e 232	
Area (sf) CN Description 3,895 98 Unconnected roofs, HSG A 3,895 100.00% Impervious Area 3,895 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-13: Roof - Units 25&26 - (A Units) Hydrograph 0.6 0.57 cfs 0.57 0.57 cfs 0.57 0.57 cfs 100-Year Rainfall=6.50" Runoff Area=3,895 sf Runoff Depth>6.26" 0.25 0.25 0.25 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45	12.08 hrs, Volume= 0.047 af, Depth> 6.26"		
Area (sf) CN Description 3,895 98 Unconnected roofs, HSG A 3,895 100.00% Impervious Area 3,895 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-13: Roof - Units 25&26 - (A Units) Hydrograph 0.6 0.57 cfs 7ype III 24-hr 0.57 cfs 100-Year Rainfall=6.50" Runoff Area=3,895 sf Runoff Area=3,895 sf Runoff Depth>6.26" 0.25 CA Tc=6.0 min 0.25 CA CN=98 0.15 CN=98 CN=98	UH=SCS Weighted-CN Time Span= 0.00-24.00 hrs. dt= 0.01 hrs		
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3,895 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-13: Roof - Units 25&26 - (A Units) Hydrograph			
Tc Length (feet) Slope (t/ft) Velocity (ft/sec) Capacity (cfs) Description 6.0 Direct Entry, Subcatchment R-13: Roof - Units 25&26 - (A Units) Hydrograph 0.6 0.57 cfs 100-Year Rainfall=6.50" Runoff Area=3,895 sf Runoff Depth>6.26" Runoff Depth>6.26" 0.25 0.25 0.25 0.25 0.25 0.35 0.4 Runoff Depth>6.26" 0.25 0.25 0.25 0.25 0.25 0.4 0.4 Runoff Depth>6.26" 0.25 0.2 0.25 0.2 0.25 0.2 0.25 0.2 0.4 Runoff Depth>6.26" 0.25 0.2 0.25 0.2 0.25 0.2 0.1 CN=98 0.1 CN=98			
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Image: 0.35 0.25 0.25 0.25 0.25 0.25 0.15 0.1 Runoff Depth>6.26" Image: 0.15 0.1 Image: 0.15 0.1			
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0.2 0.15 0.1			
0.15			
0.1			
0.05			
Time (hours)			



						-									.			
	Su	mmary	for s	Subc	atchr	nent	R-1	5: R	loot	Uni	ts 2	9&3	D - (I	B &	сu	nit	S)	
Runoff	=	0.47	cfs @	12.08	8 hrs,	Volu	me=			0.038	af,	Dep	th> (6.26	•			
Runoff by Type III 24						Veigł	nted-C	CN, ⁻	Time	e Spa	n= 0	.00-2	24.00	hrs	, dt=	0.0	1 hr	S
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	3,195		100.00															
	3,195		100.00	0% Ur	nconn	ected												
	Length	Slop		ocity			Des	cript	tion									
(min)	(feet)	(ft/ft	.) (ft	/sec)		(cfs)	Dire	ot F	inter									
6.0							Dire	CLE	ntry	,								
		S	ubcate	chme	ent R	15:	Roof	Un	its	29&3	0 -	(B &	cı	Jnits	5)			
						Hydr	ograp	h										
0.5- 0.45 0.4- 0.35 0.35 0.25 0.25 0.15 0.15 0.1- 0.05	-10 -Ru -Ru -Ru -Tc	pe III 0-Yea noff noff =6.0 I=98	ar Ra Area Volu Dep	ainfa a=3, ume	195 =0.0	5.50 sf 38												
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	d by Microso D® 10.00-18 s	/n 02881 © 201	6 HydroCA) Software	Soluti	ons LL	C					Printed 1/16/201 Page 23
	Su	Immary for S	Subcatch	ment R-	17: M	ailbo	ox St	ruc	ture	Roo	d	
Runoff	= 0.0)2 cfs @ 12.0	08 hrs, Volu	ume=	0.	001 a	af, De	eptha	> 6.2	6"		
		method, UH= ar Rainfall=6.5		hted-CN,	Time	Span	= 0.00)-24.	.00 hr	s, dt⊧	= 0.0)1 hrs
A	rea (sf) CN	Descriptior	า									
	120 98											
	120 120		npervious A									
т-												
Tc (min)		ope Velocity (ft/ft) (ft/sec)	Capacity (cfs)	Descrip	non							
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		Subcat	chment R	-17• Mai	lboy	Ctru.	oturo	B	bod			
		Subcal			NOX	Juu	clure	; n0	Ju			
			Hyd	rograph				!				
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0.01		off Volum		af	+			- +				
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Topsfield Proposed HydroCAD	Type III 24-hr	100-Year Rainfall=6.50"
Prepared by Microsoft		Printed 1/16/2017
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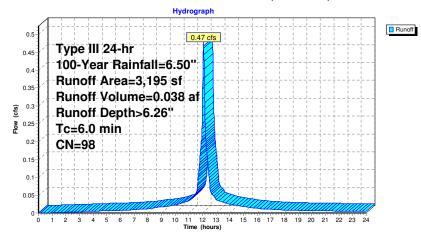
Summary for Subcatchment R-2: Roof Units 3&4 - (B & C Units)

Runoff = 0.47 cfs @ 12.08 hrs, Volume= 0.038 af, Depth> 6.26"

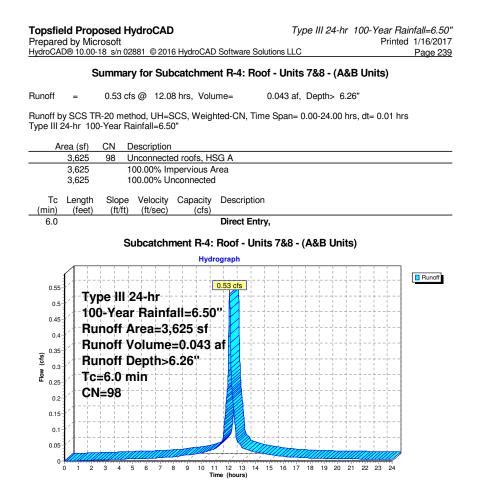
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

_	A	rea (sf)	CN I	Description							
		3,195	98 l	Unconnected roofs, HSG A							
		3,195		100.00% Impervious Area							
		3,195		100.00% Unconnected							
	Тс	Length	Slope	Velocity	Capacity	Description					
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	· · · · · · · · · · · · · · ·					
	6.0					Direct Entry,					

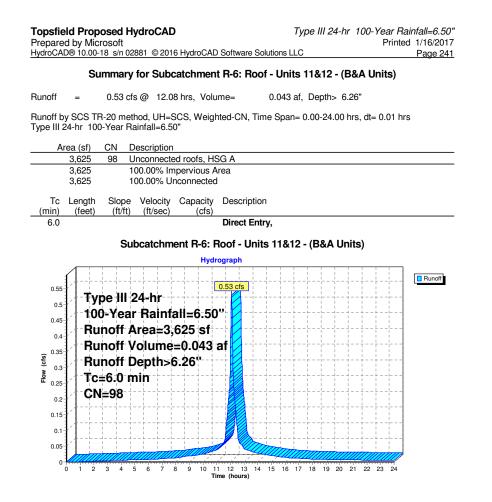
Subcatchment R-2: Roof Units 3&4 - (B & C Units)



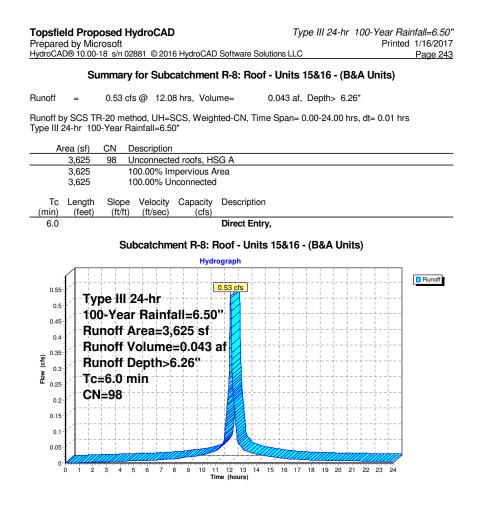
Prepared by M	popsed HydroCAD Type III 24-hr 100-Year Rainfall=6.50 licrosoft Printed 1/16/2013 10-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 238
,	Summary for Subcatchment R-3: Roof Units 5&6 - A&B Units
Runoff =	0.53 cfs @ 12.08 hrs, Volume= 0.043 af, Depth> 6.26"
	TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs 00-Year Rainfall=6.50"
Area (sf)	CN Description
3,625	
3,625	100.00% Impervious Area
Tc Lengt (min) (feet) (ft/ft) (ft/sec) (cfs)
6.0	Direct Entry,
	Subcatchment R-3: Roof Units 5&6 - A&B Units
	Hydrograph
0.45 0.45 0.4 0.4 0.5 0.35 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3	Unoff Area=3,625 sf unoff Volume=0.043 af unoff Depth>6.26" c=6.0 min N=98
0	
0 1	Time (hours)



	AD Softwa								Page 2			
	Sumr	mary for S	ubcatchm	ent R-5:	Roof -	Units	9&10	- (B	&C U	nits))	
Runoff	= 0.4	47 cfs @ 1	2.08 hrs, Vo	olume=	0.	038 af,	Depth	1> 6.	26"			
	y SCS TR-20 24-hr 100-Ye			ighted-CN	, Time S	Span=	0.00-24	4.00 ł	nrs, dt⊧	= 0.01	1 hrs	
A	rea (sf) CN 3.195 98		ected roofs,									
	3,195 90		lmpervious									
	3,195		Unconnect									
Tc (min)		ope Veloc ft/ft) (ft/se			ption							
6.0	(ieel) (1011) (1056	(018	- /	Entry,							
		Subcato	hment R-5	: Roof -	Units 9	9&10 -	(B&C	; Uni	ts)			
			Ну	/drograph								
						1 1		_		1 1		- - <i>«</i>
0.5	A			0.47 cfs	· -¦¦] ¦							Runoff
	Туре	III 24-hr		0.47 cfs]							Runoff
0.45			nfall=6.5								·	Runoff
	100-Y	ear Rai	nfall=6.5	50"								- Runoff
0.45	100-Y Runo	ear Rai ff Area=	nfall=6.5 :3,195 sl	5 0''								Runoff
0.45 0.4 0.35	100-Y Runo Runo	ear Rai ff Area= ff Volun	nfall=6.5 :3,195 st ne=0.038	5 0''							·	Runoff
0.45 0.4 0.35 (5) 0.3	100-Y Runo Runo Runo	ear Rai ff Area= ff Volun ff Depth	nfall=6.5 :3,195 st ne=0.038	5 0''							·	Runoff
0.45 0.4 0.35	100-Y Runo Runo Runo	ear Rai ff Area= ff Volun	nfall=6.5 :3,195 st ne=0.038	5 0''							·	Hunoff
0.45 0.4 0.35 (5) 0.3	100-Y Runo Runo Runo	ear Rai ff Area= ff Volun ff Depth 0 min	nfall=6.5 :3,195 st ne=0.038	5 0''							·	Hunoff
0.45 0.4 0.35 0.3 (cj: 0.25	-100-Y -Runo -Runo -Runo Tc=6.	ear Rai ff Area= ff Volun ff Depth 0 min	nfall=6.5 :3,195 st ne=0.038	5 0''							· · · · ·	Kunoff
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0.45 0.4 0.35 (st) 0.3 (st) 0.25 0.2 0.2 0.15	-100-Y -Runo -Runo -Runo Tc=6.	ear Rai ff Area= ff Volun ff Depth 0 min	nfall=6.5 :3,195 st ne=0.038	5 0''								Kunoff



	© 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page Summary for Subcatchment R-7: Roof - Units 13&14 - (A Units)	
Runoff	= 0.57 cfs @ 12.08 hrs, Volume= 0.047 af, Depth> 6.26"	
	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs I-hr 100-Year Rainfall=6.50"	
	a (sf) CN Description 3,895 98 Unconnected roofs, HSG A	
(3,895 100.00% Impervious Area	
(3,895 100.00% Unconnected	
Tc L	ength Slope Velocity Capacity Description	
(min)	(feet) (ft/ft) (ft/sec) (cfs)	
6.0	Direct Entry,	
	Subcatchment R-7: Roof - Units 13&14 - (A Units)	
	Hydrograph	
ſ		off
0.6	Type III 24-hr	
0.55	100-Year Rainfall=6.50"	
0.5		
0.45	Runoff Area=3,895 sf	
0.4 \$ 0.35	Runoff Volume=0.047 af	
(cl) 0.35	Runoff Depth>6.26"	
E 0.25	Tc=6.0 min	
0.2		
0.15		
0.1		
-		
0.05		
0	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	
	Time (hours)	



		Sumn	nary foi	r Subc	atchm	nent R	-9: R	oof -	Uni	ts 17	&18	- (A8	λΒ L	Inits)	-
Runoff	=	0.	53 cfs @	12.08	۶ hrs, ۱	/olume)=	0).043	af, D	epth	> 6.2	6"			
) method ar Rainf			eighteo	d-CN,	Time	Spa	n= 0.0	0-24	.00 hr	s, dt	= 0.01	l hrs	
A	rea (s	-		ription												
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	3,62 3,62			00% Im 00% Ur			t									
Tc (min)	Len (fe			elocity ft/sec)	Capac (c	fs)	escrip									
6.0						D	irect E	ntry,								
			Subca	atchme	ent R-9	9: Roo	of - U	nits	17& [.]	18 - (/	A&E	8 Unit	ts)			
					. F	lydrogr	aph									
0.55 0.5 0.45 0.35 0.3 0.35 0.2 0.25 0.2 0.15 0.1		100-Y Runo Runo Runo	III 24 fear F ff Are ff Vol ff Dep 0 min 8	lainfa a=3, ume oth>6	625 s =0.04	50'' sf	3 cfs 									U Runoff
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 Topsfield Proposed HydroCAD
 Type III 24-hr
 100-Year Rainfall=6.50"

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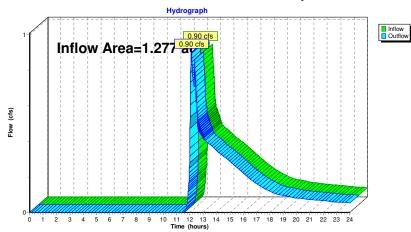
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Summary for Reach SP-1: Wetlands South of Driveway

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

Inflow Area =	1.277 ac, 33.99% Impervious, Inflow D	Depth > 1.85" for 100-Year event
Inflow =	0.90 cfs @ 12.12 hrs, Volume=	0.197 af
Outflow =	0.90 cfs @ 12.12 hrs, Volume=	0.197 af, Atten= 0%, Lag= 0.0 min

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



Reach SP-1: Wetlands South of Driveway

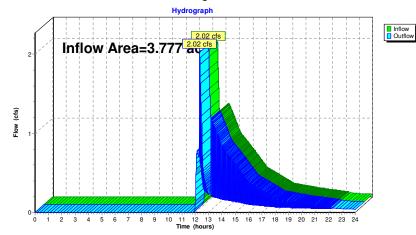
Topsfield Proposed HydroCAD	Type III 24-hr	100-Year Rainfall=6.50"
Prepared by Microsoft		Printed 1/16/2017
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Summary for Reach SP-2: Large Wetland Area East

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

Inflow Area =	3.777 ac, 26.87% Impervious, Inflow	Depth > 0.71"	for 100-Year event
Inflow =	2.02 cfs @ 12.34 hrs, Volume=	0.222 af	
Outflow =	2.02 cfs @ 12.34 hrs, Volume=	0.222 af, Atte	en= 0%, Lag= 0.0 min

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



Reach SP-2: Large Wetland Area East

 Topsfield Proposed HydroCAD
 Type III 24-hr
 100-Year Rainfall=6.50"

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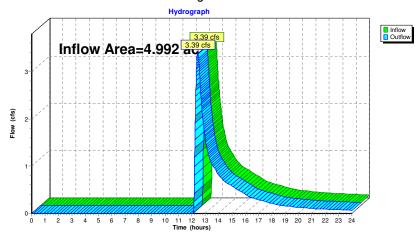
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Summary for Reach SP-3: Large Wetland Area West

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

Inflow Area =	4.992 ac, 31.07% Impervious, Inflow Depth > 1.11" for 100-Yea	r event
Inflow =	3.39 cfs @ 12.45 hrs, Volume= 0.462 af	
Outflow =	3.39 cfs @ 12.45 hrs, Volume= 0.462 af, Atten= 0%, Lag=	0.0 min

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



Reach SP-3: Large Wetland Area West

Topsfield Proposed HydroCAD	Type III 24-hr	100-Year Rainfall=6.50"
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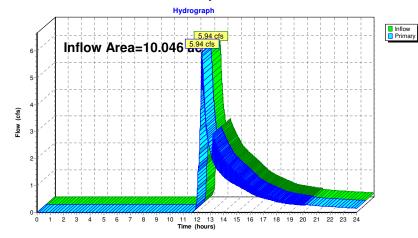
Summary for Pond 1P: Combined Study Points - Northern Wetlands

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

Inflow Area =	10.046 ac, 29.86% Impervious, Inflow	Depth > 1.05" for 100-Year event
Inflow =	5.94 cfs @ 12.38 hrs, Volume=	0.881 af
Primary =	5.94 cfs @ 12.38 hrs, Volume=	0.881 af, Atten= 0%, Lag= 0.0 min

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

Pond 1P: Combined Study Points - Northern Wetlands



Topsfield Proposed HydroCAD Type III 24-hr 100-Year Rainfall=6.50" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

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Summary for Pond D-1: Surface Infiltration Pond

[79] Warning: Submerged Pond UIS-3 Primary device # 2 OUTLET by 0.08'

Inflow Area =	2.637 ac, 56.80% Impervious, Inflow D	epth > 3.63" for 100-Year event
Inflow =	10.97 cfs @ 12.09 hrs, Volume=	0.799 af
Outflow =	3.18 cfs @ 12.45 hrs, Volume=	0.508 af, Atten= 71%, Lag= 21.4 min
Discarded =	0.12 cfs @ 12.45 hrs, Volume=	0.128 af
Primary =	3.06 cfs @ 12.45 hrs, Volume=	0.380 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 70.78' @ 12.45 hrs Surf.Area= 5,227 sf Storage= 16,269 cf Flood Elev= 71.10' Surf.Area= 5,491 sf Storage= 17,958 cf

Plug-Flow detention time= 189.0 min calculated for 0.508 af (64% of inflow) Center-of-Mass det. time= 90.6 min (899.1 - 808.6)

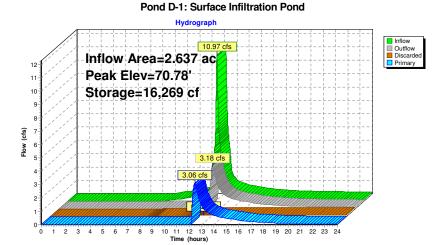
Volume	Invert	Avail.Sto	orage Storage	Description	
#1	66.00	56,2	33 cf Custom	Stage Data (Pri	ismatic) Listed below (Recalc)
Elevatio	t)	urf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
66.0		1,817	0	0	
67.0		2,361	2,089	2,089	
68.0		3,059	2,710	4,799	
69.0	00	3,800	3,430	8,229	
70.0	00	4,583	4,192	12,420	
71.0	00	5,403	4,993	17,413	
72.0	00	6,280	5,842	23,255	
73.0	00	7,213	6,747	30,001	
74.0	00	8,202	7,708	37,709	
75.0	0	9,248	8,725	46,434	
76.0	0	10,350	9,799	56,233	
Device	Routing	Invert	Outlet Device	s	
#1	Discarded	66.00'	1.020 in/hr Ex	xfiltration over S	Surface area

#1	Discarded	66.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	70.00'	15.0" Round Culvert L= 252.0' Ke= 0.200
			Inlet / Outlet Invert= 70.00' / $65.40'$ S= 0.0183 '/' Cc= 0.900 n= 0.015 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Discarded OutFlow Max=0.12 cfs @ 12.45 hrs HW=70.78' (Free Discharge) 1=Exfiltration (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=3.06 cfs @ 12.45 hrs HW=70.78' (Free Discharge) -2=Culvert (Inlet Controls 3.06 cfs @ 3.77 fps)





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Type III 24-hr 100-Year Rainfall=6.50" Printed 1/16/2017 Page 251

Summary for Pond D-2: Existing Detention Basin

[58] Hint: Peaked 0.63' above defined flood level

Inflow Area =	0.531 ac, 59.77% Impervious, Inflow Depth > 4.34" for 100-Year event
Inflow =	2.68 cfs @ 12.09 hrs, Volume= 0.192 af
Outflow =	0.29 cfs @ 12.86 hrs, Volume= 0.121 af, Atten= 89%, Lag= 46.7 min
Primary =	0.29 cfs @ 12.86 hrs, Volume= 0.121 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.71' @ 12.86 hrs Surf.Area= 3,090 sf Storage= 4,665 cf Flood Elev= 58.08' Surf.Area= 3,090 sf Storage= 2,719 cf

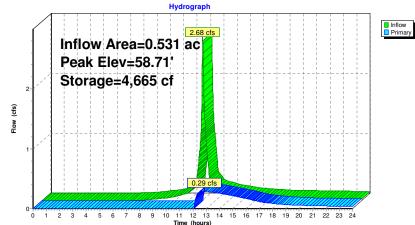
Plug-Flow detention time= 240.7 min calculated for 0.121 af (63% of inflow) Center-of-Mass det. time= 139.7 min (947.4 - 807.7)

Volume	Inve	rt Avail.Sto	rage Storage	 Description 	
#1	57.2	0' 9,02	20 cf Custon	n Stage Data (Pr	ismatic) Listed below (Recalc)
Elevatio (feet		Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
57.2	0	3,090	0	0	
58.0	0	3,090	2,472	2,472	
59.0	0	3,090	3,090	5,562	
59.4	0	3,550	1,328	6,890	
60.0	0	3,550	2,130	9,020	
Device	Routing	Invert	Outlet Device	es	
#1	Primary	58.08'	4.0" Vert. Or	ifice/Grate C=	0.600
#2	Primary	58.80'	8.0" Vert. Or	ifice/Grate C=	0.600
Primary	OutFlow	Max=0.29 cfs (@ 12.86 hrs H	W=58.71' (Free	e Discharge)

1=Orifice/Grate (Orifice Controls 0.29 cfs @ 3.28 fps) 2=Orifice/Grate (Controls 0.00 cfs)

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Pond D-2: Existing Detention Basin



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Summary for Pond D-3: Detention Pond by Access Road

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[93] Warning: Storage range exceeded by 0.06'[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=50)

Inflow Area =	0.114 ac, 31.35% Impervious, Inflow Depth > 3.30" for 100-Year e	vent
Inflow =	0.44 cfs @ 12.09 hrs, Volume= 0.031 af	
Outflow =	0.21 cfs @ 12.36 hrs, Volume= 0.031 af, Atten= 53%, Lag= 1	6.2 min
Discarded =	0.04 cfs @ 12.35 hrs, Volume= 0.029 af	
Primary =	0.17 cfs @ 12.36 hrs, Volume= 0.003 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 64.06' @ 12.36 hrs Surf.Area= 650 sf Storage= 478 cf

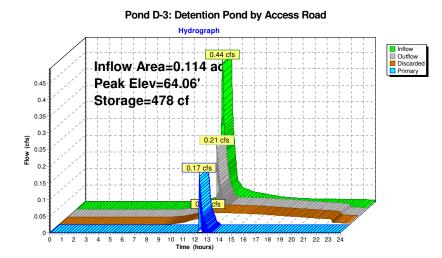
Plug-Flow detention time= 130.5 min calculated for 0.031 af (100% of inflow) Center-of-Mass det. time= 130.1 min (961.4 - 831.3)

Volume	Inve	ert Avail.Sto	rage Storage	Description	
#1	63.0	0' 47	78 cf Custom	Stage Data (Pri	smatic) Listed below (Recalc)
Elevatio (fee		Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
63.0	00	305	0	0	
64.0	00	650	478	478	
Device	Routing	Invert	Outlet Device	s	
#1	Primary	64.00'	Head (feet) 0 2.50 3.00 3.5 Coef. (English	.20 0.40 0.60 50 4.00 4.50 5	70 2.68 2.68 2.66 2.65 2.65 2.65 2.65
#2	Discarde	d 63.00'	2.410 in/hr Ex	filtration over H	lorizontal area

Discarded OutFlow Max=0.04 cfs @ 12.35 hrs HW=64.04' (Free Discharge) **2=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.17 cfs @ 12.36 hrs HW=64.06' (Free Discharge) 1=Broad-Crested Rectangular Weir (Weir Controls 0.17 cfs @ 0.57 fps)

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Summary for Pond UIS-1: UIS at Entrance

[93] Warning: Storage range exceeded by 2.51'
[58] Hint: Peaked 0.11' above defined flood level
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=487)

Inflow Area =	1.487 ac, 40.11% Impervious, Inflow Depth > 4.20" for 100-Year even	ıt
Inflow =	7.07 cfs @ 12.09 hrs, Volume= 0.520 af	
Outflow =	1.07 cfs @ 13.17 hrs, Volume= 0.216 af, Atten= 85%, Lag= 65.0) min
Discarded =	0.08 cfs @ 9.00 hrs, Volume= 0.118 af	
Primary =	0.99 cfs @ 13.17 hrs, Volume= 0.098 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 68.51' @ 13.17 hrs Surf.Area= 3,486 sf Storage= 13,284 cf Flood Elev= 68.40' Surf.Area= 3,486 sf Storage= 13,284 cf

Plug-Flow detention time= 246.1 min calculated for 0.216 af (41% of inflow) Center-of-Mass det. time= 116.2 min (916.6 - 800.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	60.00'	5,089 cf	50.50'W x 69.03'L x 6.00'H Field A
			20,917 cf Overall - 8,195 cf Embedded = 12,722 cf x 40.0% Voids
#2A	61.00'	8,195 cf	Cultec R-902HD x 126 Inside #1
			Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
			Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
			7 Rows of 18 Chambers
			Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
		13,284 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	68.40'	24.0" x 24.0" Horiz. Orifice/Grate C= 0.600
			Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 9.00 hrs HW=60.08' (Free Discharge)

Primary OutFlow Max=0.95 cfs @ 13.17 hrs HW=68.51' (Free Discharge)

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Pond UIS-1: UIS at Entrance - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD) Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf

78.0" Wide + 6.0" Spacing = 84.0" C-C Row Spacing

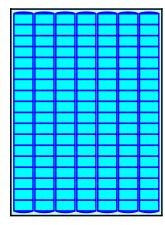
18 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 67.03' Row Length +12.0" End Stone x 2 = 69.03' Base Length 7 Rows x 78.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 50.50' Base Width 12.0" Base + 48.0" Chamber Height + 12.0" Cover = 6.00' Field Height

126 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 8,195.2 cf Chamber Storage

20,917.1 cf Field - 8,195.2 cf Chambers = 12,721.9 cf Stone x 40.0% Voids = 5,088.7 cf Stone Storage

Chamber Storage + Stone Storage = 13,284.0 cf = 0.305 afOverall Storage Efficiency = 63.5%Overall System Size = $69.03' \times 50.50' \times 6.00'$

126 Chambers 774.7 cy Field 471.2 cy Stone

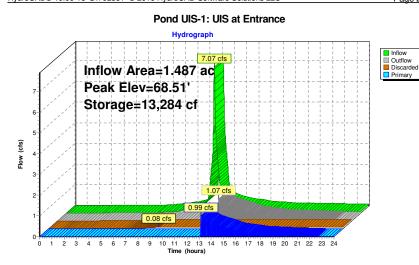




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Summary for Pond UIS-2: UIS at North of Site

[93] Warning: Storage range exceeded by 4.79'
[58] Hint: Peaked 2.08' above defined flood level
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=29)

Inflow Area =	0.419 ac,100.00% Impervious, Inflow Depth > 6.26" for 100-Year event	
Inflow =	2.67 cfs @ 12.08 hrs, Volume= 0.218 af	
Outflow =	1.59 cfs @ 12.34 hrs, Volume= 0.218 af, Atten= 40%, Lag= 15.4 n	nin
Discarded =	0.23 cfs @ 11.24 hrs, Volume= 0.207 af	
Primary =	1.36 cfs @ 12.34 hrs, Volume= 0.011 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 70.33' @ 12.34 hrs Surf.Area= 1,176 sf Storage= 2,860 cf Flood Elev= 68.25' Surf.Area= 1,176 sf Storage= 2,860 cf

Plug-Flow detention time= 82.3 min calculated for 0.218 af (100% of inflow) Center-of-Mass det. time= 82.0 min (825.5 - 743.4)

1	/olume	Invert	Avail.Storage	Storage Description
	#1A	61.50'	1,262 cf	16.00'W x 73.50'L x 4.04'H Field A
				4,753 cf Overall - 1,598 cf Embedded = 3,155 cf x 40.0% Voids
	#2A	62.50'	1,598 cf	Cultec R-330XLHD x 30 Inside #1
				Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
				Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
_				Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
_			2,860 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Devi	ce	Routing	Invert	Outlet Devices	
#	-	Discarded Primary		8.270 in/hr Exfiltration ov 6.0" Horiz. Orifice/Grate	 area Limited to weir flow at low heads

Discarded OutFlow Max=0.23 cfs @ 11.24 hrs HW=61.57' (Free Discharge)

Primary OutFlow Max=1.36 cfs @ 12.34 hrs HW=70.33' (Free Discharge) -2=Orifice/Grate (Orifice Controls 1.36 cfs @ 6.94 fps)

 Type III 24-hr
 100-Year Rainfall=6.50"

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Pond UIS-2: UIS at North of Site - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

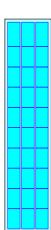
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length 3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width 12.0" Base + 30.5" Chamber Height + 6.0" Cover = 4.04' Field Height

30 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 1,598.2 cf Chamber Storage

4,753.0 cf Field - 1,598.2 cf Chambers = 3,154.8 cf Stone x 40.0% Voids = 1,261.9 cf Stone Storage

Chamber Storage + Stone Storage = 2,860.1 cf = 0.066 af Overall Storage Efficiency = 60.2% Overall System Size = 73.50' x 16.00' x 4.04'

30 Chambers 176.0 cy Field 116.8 cy Stone



 Topsfield Proposed HydroCAD
 Type III 24-hr 100-Year Rainfall=6.50"

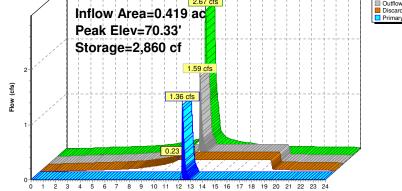
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 Pond UIS-2: UIS at North of Site

 Hydrograph

 Inflow Area=0.419 ac



Time (hours)

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Summary for Pond UIS-3: UIS-3

[58] Hint: Peaked 1.63' above defined flood level

Inflow Area =	0.083 ac,100.00% Impervious, Inflow Depth > 6.26" for 100-Year event
Inflow =	0.53 cfs @ 12.08 hrs, Volume= 0.043 af
Outflow =	0.53 cfs @ 12.09 hrs, Volume= 0.041 af, Atten= 1%, Lag= 0.7 min
Discarded =	0.00 cfs @ 1.97 hrs, Volume= 0.005 af
Primary =	0.52 cfs @ 12.09 hrs, Volume= 0.036 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 73.84' @ 12.09 hrs Surf.Area= 103 sf Storage= 141 cf Flood Elev= 72.21' Surf.Area= 103 sf Storage= 22 cf

Plug-Flow detention time= 59.0 min calculated for 0.041 af (94% of inflow) Center-of-Mass det. time= 25.2 min (768.7 - 743.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	71.69'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	72.19'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	71.69'	1.020 in/hr Exfiltration over Surface area
#2	Primary	73.40'	

Discarded OutFlow Max=0.00 cfs @ 1.97 hrs HW=71.72' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.52 cfs @ 12.09 hrs HW=73.84' (Free Discharge) -2=Culvert (Inlet Controls 0.52 cfs @ 2.83 fps)

Topsfield Proposed HydroCAD	Type III 24-hr 100-Year Rainfall=6.50)"
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Pond UIS-3: UIS-3 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

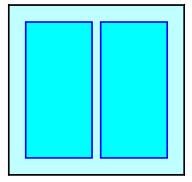
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

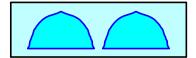
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'



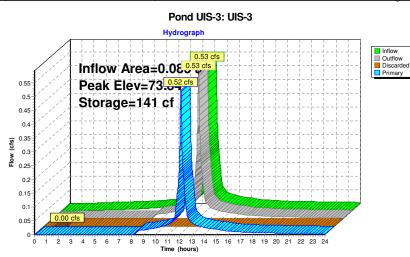




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Summary for Pond UIS-4: UIS-4

[58] Hint: Peaked 0.65' above defined flood level

Inflow Area =	0.073 ac,100.00% Impervious, Inflow De	epth > 6.26" for 100-Year event
Inflow =	0.47 cfs @ 12.08 hrs, Volume=	0.038 af
Outflow =	0.45 cfs @ 12.11 hrs, Volume=	0.036 af, Atten= 4%, Lag= 1.4 min
Discarded =	0.00 cfs @ 2.21 hrs, Volume=	0.005 af
Primary =	0.45 cfs @ 12.11 hrs, Volume=	0.031 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 74.85' @ 12.11 hrs Surf.Area= 103 sf Storage= 153 cf Flood Elev= 74.20' Surf.Area= 103 sf Storage= 111 cf

Plug-Flow detention time= 64.5 min calculated for 0.036 af (93% of inflow)Center-of-Mass det. time= 27.3 min (770.7 - 743.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	72.50'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	73.00'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	72.50'	1.020 in/hr Exfiltration over Surface area
#2	Primary	74.20'	6.0" Round Culvert L= 30.0' Ke= 1.000 Inlet / Outlet Invert= 74.20' / 74.06' S= 0.0047 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 2.21 hrs HW=72.53' (Free Discharge)

Primary OutFlow Max=0.45 cfs @ 12.11 hrs HW=74.84' (Free Discharge) -2=Culvert (Inlet Controls 0.45 cfs @ 2.27 fps)
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 100-Year Rainfall=6.50"

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Pond UIS-4: UIS-4 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

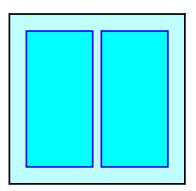
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

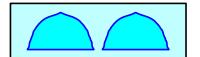
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

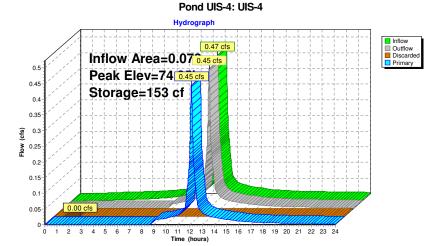
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'









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		Su	mmary for Pond UIS-5: UIS-5
Inflow Are			Impervious, Inflow Depth > 6.26" for 100-Year event
Inflow		3 cfs @ 12.08 h	
Outflow		1 cfs @ 12.11 h	
Discardeo Primary		0 cfs @ 1.97 h 0 cfs @ 12.11 h	
rinary	= 0.5	UUS @ 12.111	115, VOIUITIE= 0.030 ai
Routina b	v Stor-Ind m	ethod. Time Spar	n= 0.00-24.00 hrs, dt= 0.01 hrs
			vrea= 103 sf Storage= 159 cf
	-		·
			culated for 0.041 af (94% of inflow)
		ne= 59.8 min cal ne= 25.9 min (7	
Center-of	-Mass det. tir	ne= 25.9 min (7	69.3 - 743.4)
Center-of	-Mass det. tir Invert	ne= 25.9 min (7 Avail.Storage	69.3 - 743.4) Storage Description
Center-of	-Mass det. tir	ne= 25.9 min (7	69.3 - 743.4) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A
Center-of <u>Volume</u> #1A	-Mass det. tir Invert 73.09'	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf	69.3 - 743.4) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
Center-of	-Mass det. tir Invert	ne= 25.9 min (7 Avail.Storage	69.3 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1
Center-of <u>Volume</u> #1A	-Mass det. tir Invert 73.09'	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf	69.3 - 743.4) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
Center-of <u>Volume</u> #1A	-Mass det. tir Invert 73.09'	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf	69.3 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf
Center-of <u>Volume</u> #1A	-Mass det. tir Invert 73.09'	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf	69.3 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
Center-of Volume #1A #2A	-Mass det. tir <u>Invert</u> 73.09' 73.59'	ne= 25.9 min (7/ <u>Avail.Storage</u> 94 cf 97 cf 191 cf	69.3 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage
Center-of Volume #1A #2A	-Mass det. tir <u>Invert</u> 73.09' 73.59'	ne= 25.9 min (7/ <u>Avail.Storage</u> 94 cf 97 cf	69.3 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage
Center-of- Volume #1A #2A Storag	-Mass det. tir <u>Invert</u> 73.09' 73.59' e Group A cr	ne= 25.9 min (7/ Avail.Storage 94 cf 97 cf 191 cf eated with Charr	69.3 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage her Wizard
Center-of Volume #1A #2A Storag Device	-Mass det. tir <u>Invert</u> 73.09' 73.59' e Group A cr Routing	ne= 25.9 min (74 Avail.Storage 94 cf 97 cf 191 cf eated with Charr Invert Out	69.3 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage hber Wizard let Devices
Center-of- <u>Volume</u> #1A #2A Storag <u>Device</u> #1	-Mass det. tir Invert 73.09' 73.59' e Group A cr <u>Routing</u> Discarded	ne= 25.9 min (7/ <u>Avail.Storage</u> 94 cf 97 cf 191 cf eated with Charr <u>Invert</u> <u>Out</u> 73.09' 1.0 2	69.3 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage aber Wizard let Devices 20 in/hr Exfiltration over Surface area
Center-of- <u>Volume</u> #1A #2A Storag <u>Device</u> #1	-Mass det. tir <u>Invert</u> 73.09' 73.59' e Group A cr Routing	ne= 25.9 min (7/ <u>Avail.Storage</u> 94 cf 97 cf 191 cf eated with Charr <u>Invert</u> <u>Outt</u> 73.09' 1.02 74.80' 6.0 ''	69.3 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage hber Wizard let Devices

Discarded OutFlow Max=0.00 cfs @ 1.97 hrs HW=73.12' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.50 cfs @ 12.11 hrs HW=75.55' (Free Discharge)

Topsfield Proposed HydroCAD	Type III 24-hr	100-Year Rainfall=6.50"
Prepared by Microsoft		Printed 1/16/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions	s LLC	Page 268

Pond UIS-5: UIS-5 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

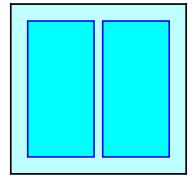
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

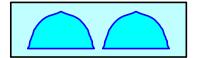
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

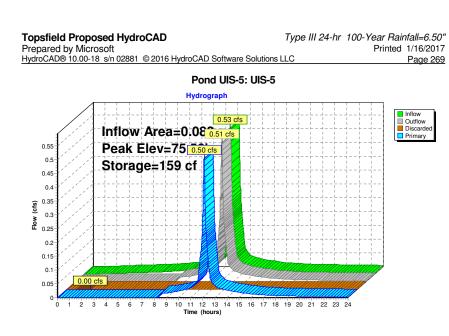
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$







	10.00 10 0	SIT02001 @2010	HydroCAD Software Solutions LLC Page 27
		Su	Immary for Pond UIS-6: UIS-6
Inflow A Inflow Outflow Discarde Primary	= 0.4 = 0.4 ed = 0.4	57 cfs @ 12.08 54 cfs @ 12.11	hrs, Volume= 0.044 af, Atten= 5%, Lag= 1.5 min hrs, Volume= 0.005 af
			an= 0.00-24.00 hrs, dt= 0.01 hrs Area= 103 sf Storage= 163 cf
		me= 57.1 min ca me= 25.0 min (7	alculated for 0.044 af (94% of inflow) 768.4 - 743.4)
Volume	Invert	Avail Storage	Storage Description
#1A	72.29'	94 cf	
#2A	72.79'	97 cf	Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
		191 cf	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage
Device	Routing		tlet Devices
#1 #2	Discarded Primary	74.00' 6.0 Inle	20 in/hr Exfiltration over Surface area "Round Culvert L= 106.0' Ke= 1.000 et / Outlet Invert= 74.00' / 72.18' S= 0.0172 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf
		Max=0.00 cfs @ filtration Controls	1.86 hrs HW=72.32' (Free Discharge) s 0.00 cfs)
		x=0.54 cfs @ 12 ontrols 0.54 cfs @	1.11 hrs HW=74.83' (Free Discharge) @ 2.75 fps)

 Topsfield Proposed HydroCAD
 Type I

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 Type III 24-hr
 100-Year Rainfall=6.50"

 Printed
 1/16/2017

 LC
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Pond UIS-6: UIS-6 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

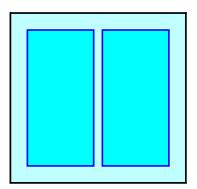
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

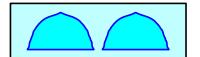
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

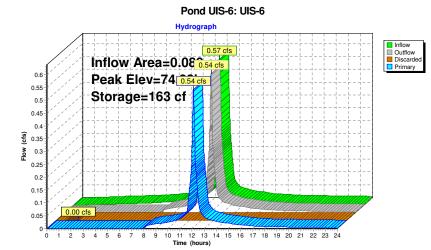
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'









HydroCAD	® 10.00-18 s/	n 02881 © 2016	HydroCAD Software S	olutions LLC		Page 273
		Su	mmary for Pond	UIS-7: UIS-7		
Inflow Are			Impervious, Inflow I		or 100-Year	revent
Inflow		3 cfs @ 12.08		0.043 af		
Outflow		1 cfs @ 12.11		0.041 af, Atten=	= 5%, Lag=	1.5 min
Discarded Primary		0 cfs @ 1.97 0 cfs @ 12.11		0.005 af 0.036 af		
"., j			-,			
Routing by	y Stor-Ind me	ethod, Time Spa	n= 0.00-24.00 hrs, d	t= 0.01 hrs		
Peak Elev	/= 74.26' @ 1	2.11 hrs Surf.A	rea= 103 sf Storag	je= 159 cf		
			Iculated for 0.041 af	(94% of inflow)		
		ne= 59.8 min ca ne= 25.9 min (7		(94% of inflow)		
Center-of-	-Mass det. tir	ne= 25.9 min (7	69.3 - 743.4)	х ,		
Center-of- Volume	-Mass det. tir Invert	ne= 25.9 min (7 Avail.Storage	69.3 - 743.4) Storage Descriptic) on		
Center-of-	-Mass det. tir	ne= 25.9 min (7	69.3 - 743.4) Storage Descriptic	on x 3.21'H Field A	34 cf x 40.0	1% Voids
Center-of- Volume	-Mass det. tir Invert	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf	69.3 - 743.4) Storage Descriptic 10.33'W x 10.00'L :	on x 3.21'H Field A ' cf Embedded = 23	34 cf x 40.0	1% Voids
Center-of- <u>Volume</u> #1A	-Mass det. tir Invert 71.79'	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf	69.3 - 743.4) <u>Storage Descriptic</u> 10.33'W x 10.00'L 332 cf Overall - 97 Cultec R-280HD x Effective Size= 46	on x 3.21'H Field A ' cf Embedded = 23 < 2 Inside #1 .9"W x 26.0"H => (6.07 sf x 7.0	00'L = 42.5 cf
Center-of- <u>Volume</u> #1A	-Mass det. tir Invert 71.79'	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf	69.3 - 743.4) <u>Storage Descriptic</u> 10.33'W x 10.00'L 332 cf Overall - 97 Cultec R-280HD x Effective Size= 46 Overall Size= 47.0	on x 3.21'H Field A cf Embedded = 23 (2 Inside #1 .9"W x 26.0"H => 6 "W x 26.5"H x 8.00	6.07 sf x 7.0 0'L with 1.00	00'L = 42.5 cf)' Overlap
Center-of- <u>Volume</u> #1A	-Mass det. tir Invert 71.79'	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf 97 cf	69.3 - 743.4) Storage Descriptic 10.33'W x 10.00'L 332 cf Overall - 97 Cultec R-280HD x Effective Size= 46 Overall Size= 47.0 Row Length Adjus	on x 3.21'H Field A ' cf Embedded = 2: (2 Inside #1 .9"W x 26.0"H => () "W x 26.5"H x 8.00 tment= +1.00' x 6.1	6.07 sf x 7.0 0'L with 1.00	00'L = 42.5 cf)' Overlap
Center-of- <u>Volume</u> #1A	-Mass det. tir Invert 71.79'	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf 97 cf	69.3 - 743.4) <u>Storage Descriptic</u> 10.33'W x 10.00'L 332 cf Overall - 97 Cultec R-280HD x Effective Size= 46 Overall Size= 47.0	on x 3.21'H Field A ' cf Embedded = 2: (2 Inside #1 .9"W x 26.0"H => () "W x 26.5"H x 8.00 tment= +1.00' x 6.1	6.07 sf x 7.0 0'L with 1.00	00'L = 42.5 cf)' Overlap
Center-of- Volume #1A #2A	-Mass det. tir <u>Invert</u> 71.79' 72.29'	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf 97 cf 191 cf	69.3 - 743.4) Storage Descriptic 10.33'W x 10.00'L 332 cf Overall - 97 Cultec R-280HD x Effective Size= 46 Overall Size= 47.0 Row Length Adjus Total Available Sto	on x 3.21'H Field A ' cf Embedded = 2: (2 Inside #1 .9"W x 26.0"H => () "W x 26.5"H x 8.00 tment= +1.00' x 6.1	6.07 sf x 7.0 0'L with 1.00	00'L = 42.5 cf)' Overlap
Center-of- Volume #1A #2A	-Mass det. tir <u>Invert</u> 71.79' 72.29'	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf 97 cf	69.3 - 743.4) Storage Descriptic 10.33'W x 10.00'L 332 cf Overall - 97 Cultec R-280HD x Effective Size= 46 Overall Size= 47.0 Row Length Adjus Total Available Sto	on x 3.21'H Field A ' cf Embedded = 2: (2 Inside #1 .9"W x 26.0"H => () "W x 26.5"H x 8.00 tment= +1.00' x 6.1	6.07 sf x 7.0 0'L with 1.00	00'L = 42.5 cf)' Overlap
Center-of- Volume #1A #2A Storage	-Mass det. tir <u>Invert</u> 71.79' 72.29'	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf 97 cf 191 cf	69.3 - 743.4) Storage Descriptic 10.33'W x 10.00'L 332 cf Overall - 97 Cultec R-280HD x Effective Size= 46 Overall Size= 47.0 Row Length Adjus Total Available Stor nber Wizard	on x 3.21'H Field A ' cf Embedded = 2: (2 Inside #1 .9"W x 26.0"H => () "W x 26.5"H x 8.00 tment= +1.00' x 6.1	6.07 sf x 7.0 0'L with 1.00	00'L = 42.5 cf)' Overlap
Center-of- Volume #1A #2A Storage Device I	-Mass det. tir Invert 71.79' 72.29' e Group A cr	ne= 25.9 min (7 Avail.Storage 94 cf 97 cf 191 cf reated with Chan Invert Out	69.3 - 743.4) Storage Descriptic 10.33'W x 10.00'L 332 cf Overall - 97 Cultec R-280HD x Effective Size= 46 Overall Size= 47.0 Row Length Adjus Total Available Stor nber Wizard	on x 3.21'H Field A ' cf Embedded = 2: (2 Inside #1 .9"W x 26.0"H => 0 "W x 26.5"H x 8.00 tment= +1.00' x 6.0 orage	6.07 sf x 7.0 0'L with 1.00 07 sf x 2 rov	00'L = 42.5 cf)' Overlap
Center-of- <u>Volume</u> #1A #2A Storag <u>Device I</u> #1 [-Mass det. tir <u>Invert</u> 71.79' 72.29' e Group A cr Routing	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf 97 cf 191 cf reated with Chan <u>Invert Out</u> 71.79' 1.0	69.3 - 743.4) Storage Descriptic 10.33'W x 10.00'L 332 cf Overall - 97 Cultec R-280HD x Effective Size= 46 Overall Size= 47.0 Row Length Adjus Total Available Sto hber Wizard let Devices	on x 3.21'H Field A ' of Embedded = 2' (2 Inside #1 .9"W x 26.0"H => ()"W x 26.5"H x 8.00 tment= +1.00' x 6.0 orage over Surface area	6.07 sf x 7.0 0'L with 1.00 07 sf x 2 rov	00'L = 42.5 cf)' Overlap
Center-of- <u>Volume</u> #1A #2A Storag <u>Device I</u> #1 [-Mass det. tir Invert 71.79' 72.29' e Group A cr <u>Routing</u> Discarded	ne= 25.9 min (7 <u>Avail.Storage</u> 94 cf 97 cf 191 cf eated with Chan <u>Invert Out</u> 71.79' 1.0 73.50' 6.0 '	69.3 - 743.4) Storage Descriptic 10.33'W x 10.00'L 332 cf Overall - 97 Cultec R-280HD x Effective Size= 46 Overall Size= 47.0 Row Length Adjus Total Available Sto her Wizard let Devices 20 in/hr Exfiltration of	on x 3.21'H Field A ' cf Embedded = 2' (2 Inside #1 .9"W x 26.0"H => ()"W x 26.5"H x 8.00 tment= +1.00' x 6.1 orage over Surface area = 17.5' Ke= 1.000	6.07 sf x 7.0 0'L with 1.00 07 sf x 2 rov	0'L = 42.5 cf)' Overlap vs

Discarded OutFlow Max=0.00 cfs @ 1.97 hrs HW=71.82' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.50 cfs @ 12.11 hrs HW=74.25' (Free Discharge)

Topsfield Proposed HydroCAD	Type III 24-hr	100-Year Rainfall=6.50"
Prepared by Microsoft		Printed 1/16/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions I	LLC	Page 274

Pond UIS-7: UIS-7 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

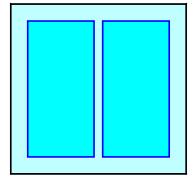
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

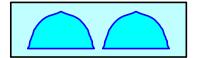
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

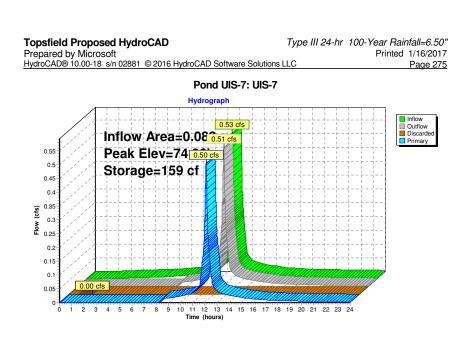
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

 $\begin{array}{l} \mbox{Chamber Storage + Stone Storage = 190.9 cf = 0.004 af} \\ \mbox{Overall Storage Efficiency = 57.6\%} \\ \mbox{Overall System Size = 10.00' x 10.33' x 3.21'} \end{array}$







Prepareo HydroCAD	D® 10.00-18 s	/n 02881 © 2016	B HydroCAD Software Solutions LLC Page 27
		Si	ummary for Pond UIS-8: UIS-8
Inflow Are Inflow Outflow Discardeo Primary	= 0.5 = 0.5 d = 0.0	53 cfs @ 12.08 51 cfs @ 12.11	6 Impervious, Inflow Depth > 6.26" for 100-Year event 3 hrs, Volume= 0.043 af 1 hrs, Volume= 0.041 af, Atten= 5%, Lag= 1.5 min 7 hrs, Volume= 0.005 af 1 hrs, Volume= 0.036 af
			an= 0.00-24.00 hrs, dt= 0.01 hrs .Area= 103 sf Storage= 159 cf
		me= 59.8 min ca me= 25.9 min (alculated for 0.041 af (94% of inflow) 769.3 - 743.4)
Volume	Invert	Avail.Storage	e Storage Description
#1A	71.09'	94 cl	
#2A	71.59'	97 ci	332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids f Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
		101 0	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 ct reated with Cha	f Total Available Storage
Device	Routing	reated with Cha Invert Οι	f Total Available Storage Imber Wizard utlet Devices
Device #1		reated with Cha Invert Ou 71.09' 1.0 72.80' 6.0 Inl	f Total Available Storage
Device #1 #2 Discarde	Routing Discarded Primary d OutFlow	reated with Cha <u>Invert</u> OL 71.09'1.0 72.80'6.0 Inl n=	f Total Available Storage amber Wizard utlet Devices 020 in/hr Exfiltration over Surface area 0" Round Culvert L= 37.0' Ke= 1.000 let / Outlet Invert= 72.80' / 72.18' S= 0.0168 '/ Cc= 0.900 = 0.011 PVC, smooth interior, Flow Area= 0.20 sf 1.1.97 hrs HW=71.12' (Free Discharge)
Device #1 #2 Discarde 1=Exfi Primary (Routing Discarded Primary d OutFlow M iltration (Exf OutFlow Ma	Invert Ou 71.09' 1.0 72.80' 6.0 Ini n= Max=0.00 cfs @ iitration Controls	f Total Available Storage amber Wizard utlet Devices 020 in/hr Extiltration over Surface area 0" Round Culvert L = 37.0' Ke= 1.000 let / Outlet Invert= 72.80' / 72.18' S= 0.0168 '/' Cc= 0.900 = 0.011 PVC, smooth interior, Flow Area= 0.20 sf 0.1.97 hrs HW=71.12' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=73.55' (Free Discharge)
Device #1 #2 Discarde 1=Exfi Primary (Routing Discarded Primary d OutFlow M iltration (Exf OutFlow Ma	reated with Cha <u>Invert</u> Ou 71.09' 1.0 72.80' 6.0 Inl n= Max=0.00 cfs @ iltration Controls x=0.50 cfs @ 12	f Total Available Storage amber Wizard utlet Devices 020 in/hr Extiltration over Surface area 0" Round Culvert L = 37.0' Ke= 1.000 let / Outlet Invert= 72.80' / 72.18' S= 0.0168 '/' Cc= 0.900 = 0.011 PVC, smooth interior, Flow Area= 0.20 sf 0.1.97 hrs HW=71.12' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=73.55' (Free Discharge)
Device #1 #2 Discarde 1=Exfi Primary (Routing Discarded Primary d OutFlow M iltration (Exf OutFlow Ma	reated with Cha <u>Invert</u> Ou 71.09' 1.0 72.80' 6.0 Inl n= Max=0.00 cfs @ iltration Controls x=0.50 cfs @ 12	f Total Available Storage amber Wizard utlet Devices 020 in/hr Extiltration over Surface area 0" Round Culvert L = 37.0' Ke= 1.000 let / Outlet Invert= 72.80' / 72.18' S= 0.0168 '/' Cc= 0.900 = 0.011 PVC, smooth interior, Flow Area= 0.20 sf 0.1.97 hrs HW=71.12' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=73.55' (Free Discharge)
Device #1 #2 Discarde 1=Exfi Primary (Routing Discarded Primary d OutFlow M iltration (Exf OutFlow Ma	reated with Cha <u>Invert</u> Ou 71.09' 1.0 72.80' 6.0 Inl n= Max=0.00 cfs @ iltration Controls x=0.50 cfs @ 12	f Total Available Storage amber Wizard utlet Devices 020 in/hr Extiltration over Surface area 0" Round Culvert L = 37.0' Ke= 1.000 let / Outlet Invert= 72.80' / 72.18' S= 0.0168 '/' Cc= 0.900 = 0.011 PVC, smooth interior, Flow Area= 0.20 sf 0.1.97 hrs HW=71.12' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=73.55' (Free Discharge)
Device #1 #2 Discarde 1=Exfi Primary (Routing Discarded Primary d OutFlow M iltration (Exf OutFlow Ma	reated with Cha <u>Invert</u> Ou 71.09' 1.0 72.80' 6.0 Inl n= Max=0.00 cfs @ iltration Controls x=0.50 cfs @ 12	f Total Available Storage amber Wizard utlet Devices 020 in/hr Extiltration over Surface area 0" Round Culvert L = 37.0' Ke= 1.000 let / Outlet Invert= 72.80' / 72.18' S= 0.0168 '/' Cc= 0.900 = 0.011 PVC, smooth interior, Flow Area= 0.20 sf 0.1.97 hrs HW=71.12' (Free Discharge) s 0.00 cfs) 2.11 hrs HW=73.55' (Free Discharge)

 Topsfield Proposed HydroCAD
 Type

 Prepared by Microsoft
 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

 Type III 24-hr
 100-Year Rainfall=6.50"

 Printed
 1/16/2017

 LC
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Pond UIS-8: UIS-8 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

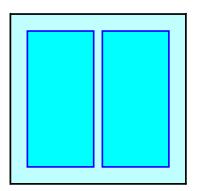
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

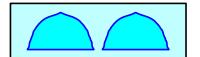
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

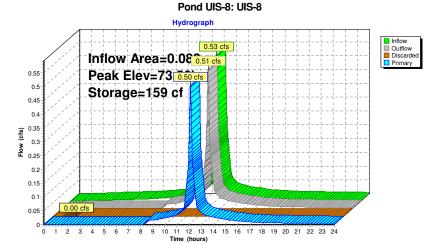
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'









			HydroCAD Software Solutions LLC Page 279
		Su	mmary for Pond UIS-9: UIS-9
Inflow Are	ea = 0.	089 ac,100.00%	Impervious, Inflow Depth > 6.26" for 100-Year event
Inflow		i7 cfs @ 12.08 h	
Outflow		3 cfs @ 12.11 h	
Discarded		0 cfs @ 1.86 h	
Primary	= 0.5	i3 cfs @ 12.11 h	hrs, Volume= 0.041 af
Routing b	v Stor-Ind m	athod Time Snai	n= 0.00-24.00 hrs, dt= 0.01 hrs
			Area = 103 sf Storage = 111 cf
	C		
Plug-Flow	detention til	ne= 32.1 min cal	lculated for 0.045 af (97% of inflow)
		ne= 32.1 min cal ne= 15.2 min (7	
Center-of-	-Mass det. ti	me= 15.2 min (7	58.7 - 743.4)
Center-of- Volume	-Mass det. tii Invert	me= 15.2 min (7 Avail.Storage	58.7 - 743.4) Storage Description
	-Mass det. ti	me= 15.2 min (7	58.7 - 743.4) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A
Center-of- <u>Volume</u> #1A	-Mass det. tii Invert 71.28'	ne= 15.2 min (7 Avail.Storage 94 cf	58.7 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
Center-of- Volume	-Mass det. tii Invert	me= 15.2 min (7 Avail.Storage	58.7 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1
Center-of- <u>Volume</u> #1A	-Mass det. tii Invert 71.28'	ne= 15.2 min (7 Avail.Storage 94 cf	58.7 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Center-of- <u>Volume</u> #1A	-Mass det. tii Invert 71.28'	ne= 15.2 min (7 Avail.Storage 94 cf	58.7 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
Center-of- <u>Volume</u> #1A	-Mass det. tii Invert 71.28'	ne= 15.2 min (7 <u>Avail.Storage</u> 94 cf 97 cf	58.7 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0'W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
Center-of- <u>Volume</u> #1A	-Mass det. tii Invert 71.28'	ne= 15.2 min (7 Avail.Storage 94 cf	58.7 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0'W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
Center-of- Volume #1A #2A	Mass det. tin <u>Invert</u> 71.28' 71.78'	ne= 15.2 min (7 <u>Avail.Storage</u> 94 cf 97 cf 191 cf	Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage
Center-of- Volume #1A #2A	Mass det. tin <u>Invert</u> 71.28' 71.78'	ne= 15.2 min (7 <u>Avail.Storage</u> 94 cf 97 cf	Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage
Center-of- Volume #1A #2A Storage	Mass det. tin <u>Invert</u> 71.28' 71.78'	ne= 15.2 min (7 <u>Avail.Storage</u> 94 cf 97 cf 191 cf	58.7 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage nber Wizard
Center-of- <u>Volume</u> #1A #2A Storage	Mass det. til Invert 71.28' 71.78' e Group A cr	ne= 15.2 min (7 Avail.Storage 94 cf 97 cf 191 cf reated with Cham Invert Out	58.7 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage nber Wizard
Center-of- <u>Volume</u> #1A #2A Storag <u>Device I</u> #1 [Mass det. tin Invert 71.28' 71.78' e Group A ci Routing	ne= 15.2 min (7 <u>Avail.Storage</u> 94 cf 97 cf 191 cf reated with Chan <u>Invert</u> <u>Out</u> 71.28' 1.02	58.7 - 743.4) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage nber Wizard let Devices
Center-of- <u>Volume</u> #1A #2A Storag <u>Device I</u> #1 [Mass det. tii Invert 71.28' 71.78' e Group A cr Routing Discarded	ne= 15.2 min (7 <u>Avail.Storage</u> 94 cf 97 cf 191 cf reated with Chan <u>Invert</u> Out 71.28' 1.02 72.18' 6.0' Inle	$\frac{\text{Storage Description}}{10.33'W \times 10.00'L \times 3.21'H \text{ Field A}}$ $32 \text{ cf Overall - 97 cf Embedded = 234 cf x 40.0\% \text{ Voids}}$ $\frac{\text{Cultec R-280HD}}{\text{Cultec R-280HD}} \times 2 \text{ Inside #1}$ $\frac{\text{Effective Size= 46.9'W \times 26.0''H => 6.07 \text{ sf } x 7.00'L = 42.5 \text{ cf}}{\text{Overall Size= 47.0''W \times 26.5'''H \times 8.00'L with 1.00' \text{ Overlap}}}$ $\frac{\text{Row Length Adjustment= +1.00' \times 6.07 \text{ sf } x 2 \text{ rows}}{\text{Total Available Storage}}$ $\frac{\text{nber Wizard}}{\text{Int Devices}}$ $20 \text{ in/hr Exfiltration over Surface area}$

Discarded OutFlow Max=0.00 cfs @ 1.86 hrs HW=71.31' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.53 cfs @ 12.11 hrs HW=72.99' (Free Discharge) -2=Culvert (Inlet Controls 0.53 cfs @ 2.69 fps)

Topsfield Proposed HydroCAD	Type III 24-hr	100-Year Rainfall=6.50"
Prepared by Microsoft		Printed 1/16/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions I	LC	Page 280

Pond UIS-9: UIS-9 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

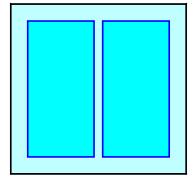
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

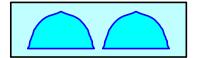
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

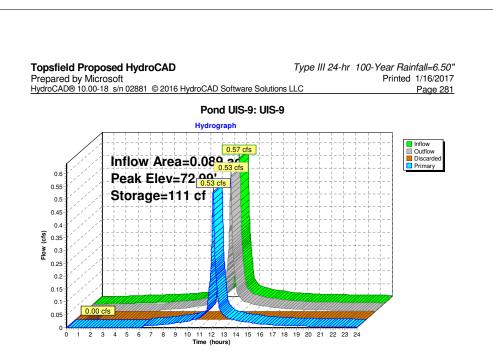
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

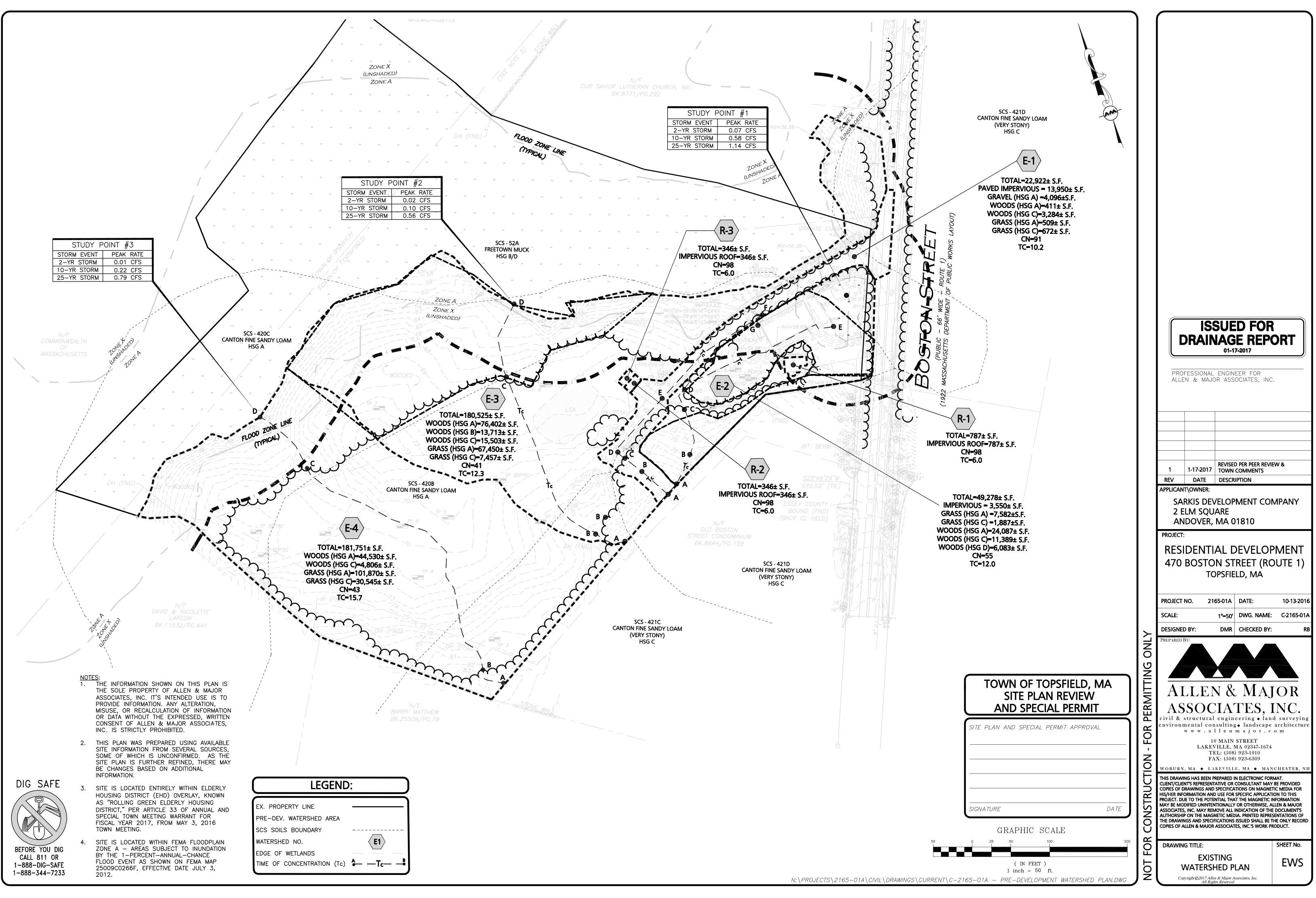
 $\begin{array}{l} \mbox{Chamber Storage + Stone Storage = 190.9 cf = 0.004 af} \\ \mbox{Overall Storage Efficiency = 57.6\%} \\ \mbox{Overall System Size = 10.00' x 10.33' x 3.21'} \end{array}$

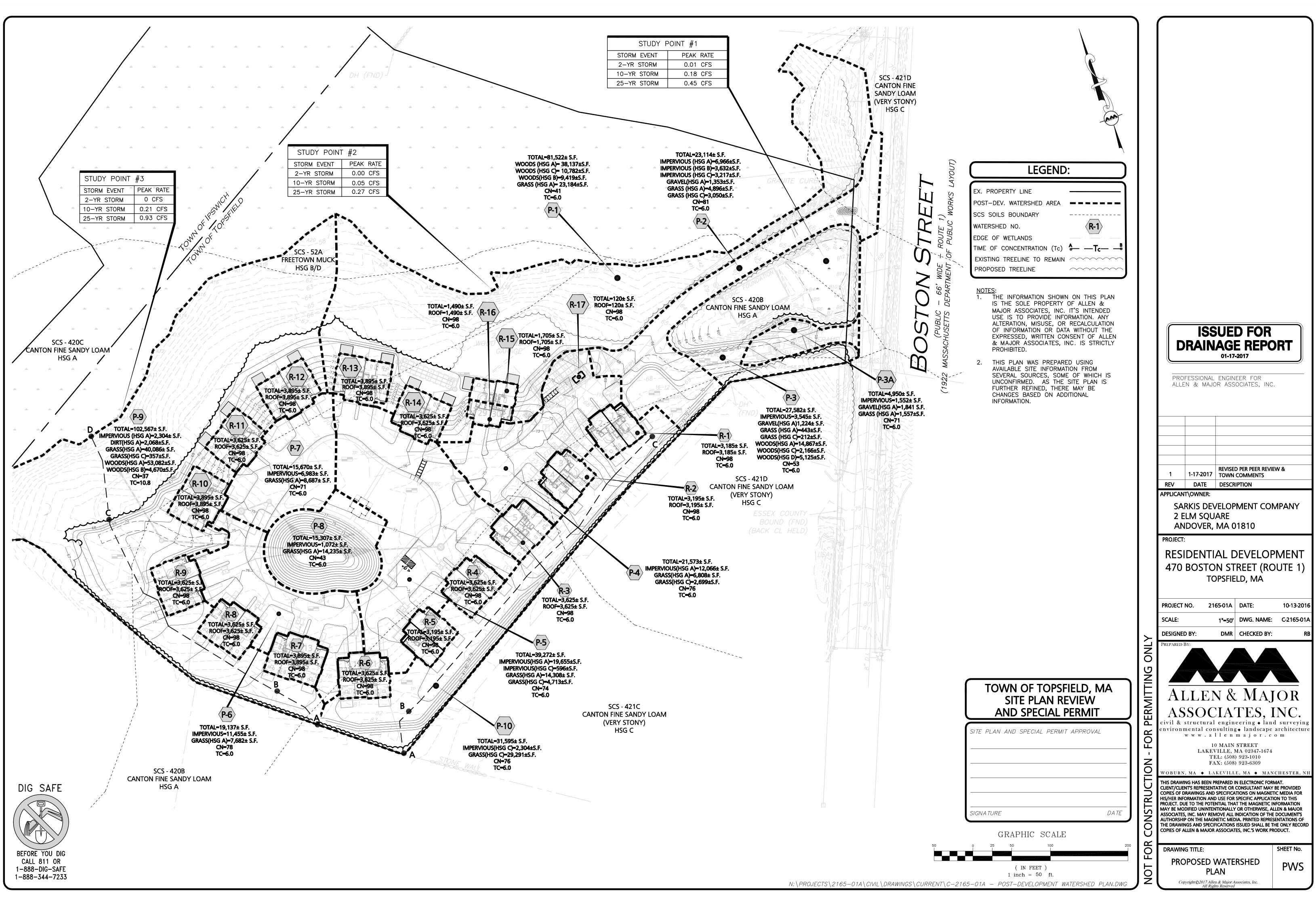


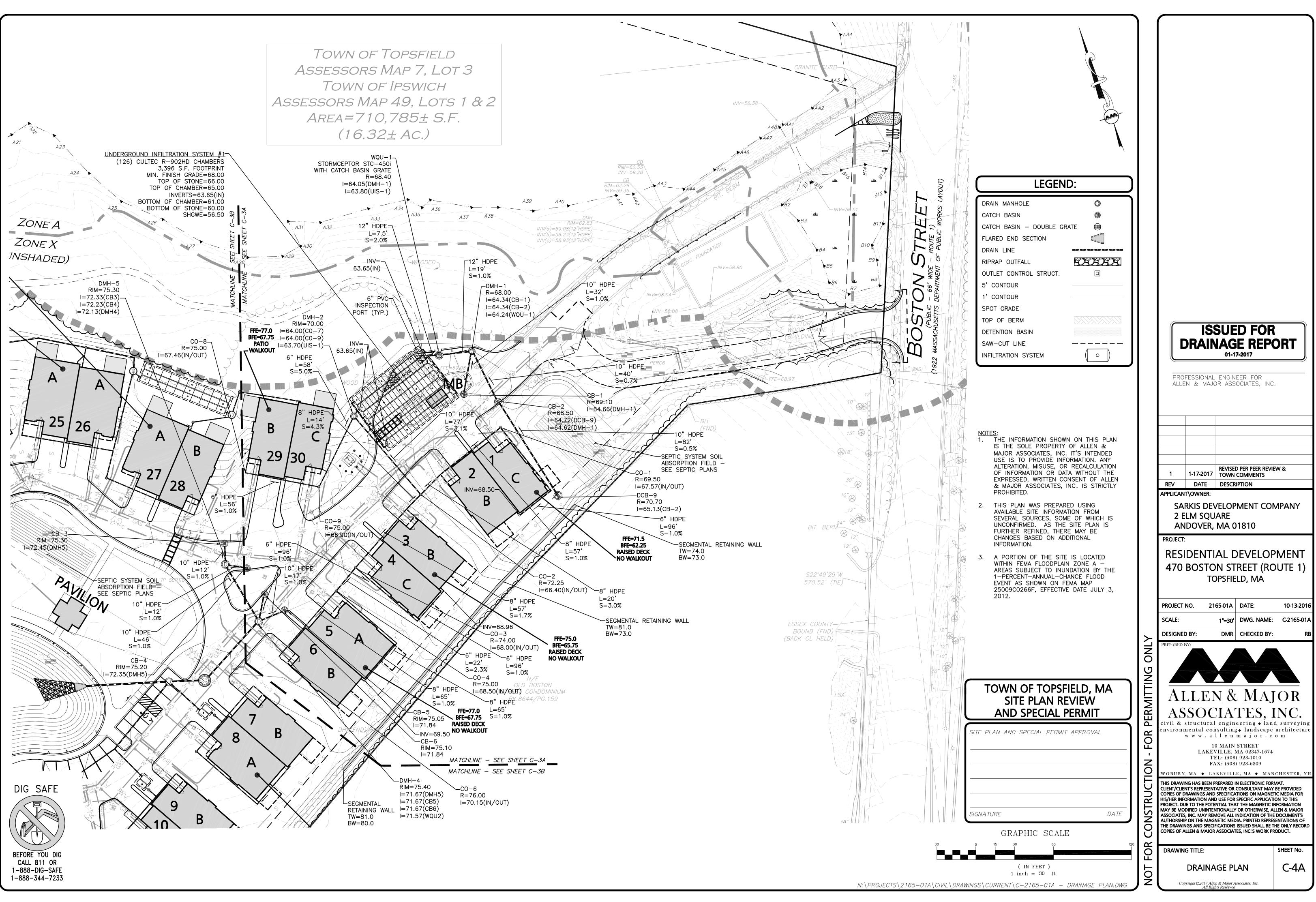


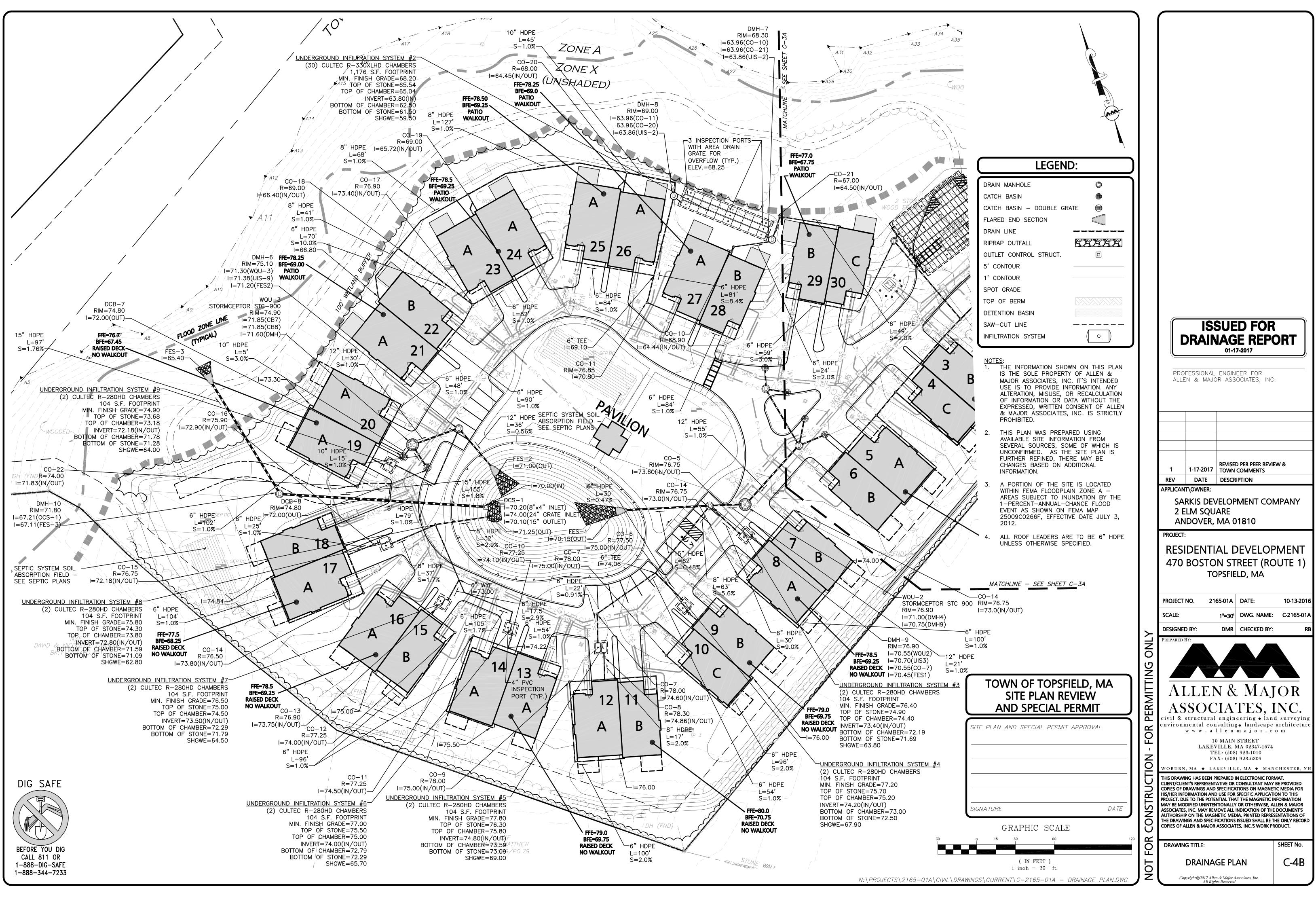


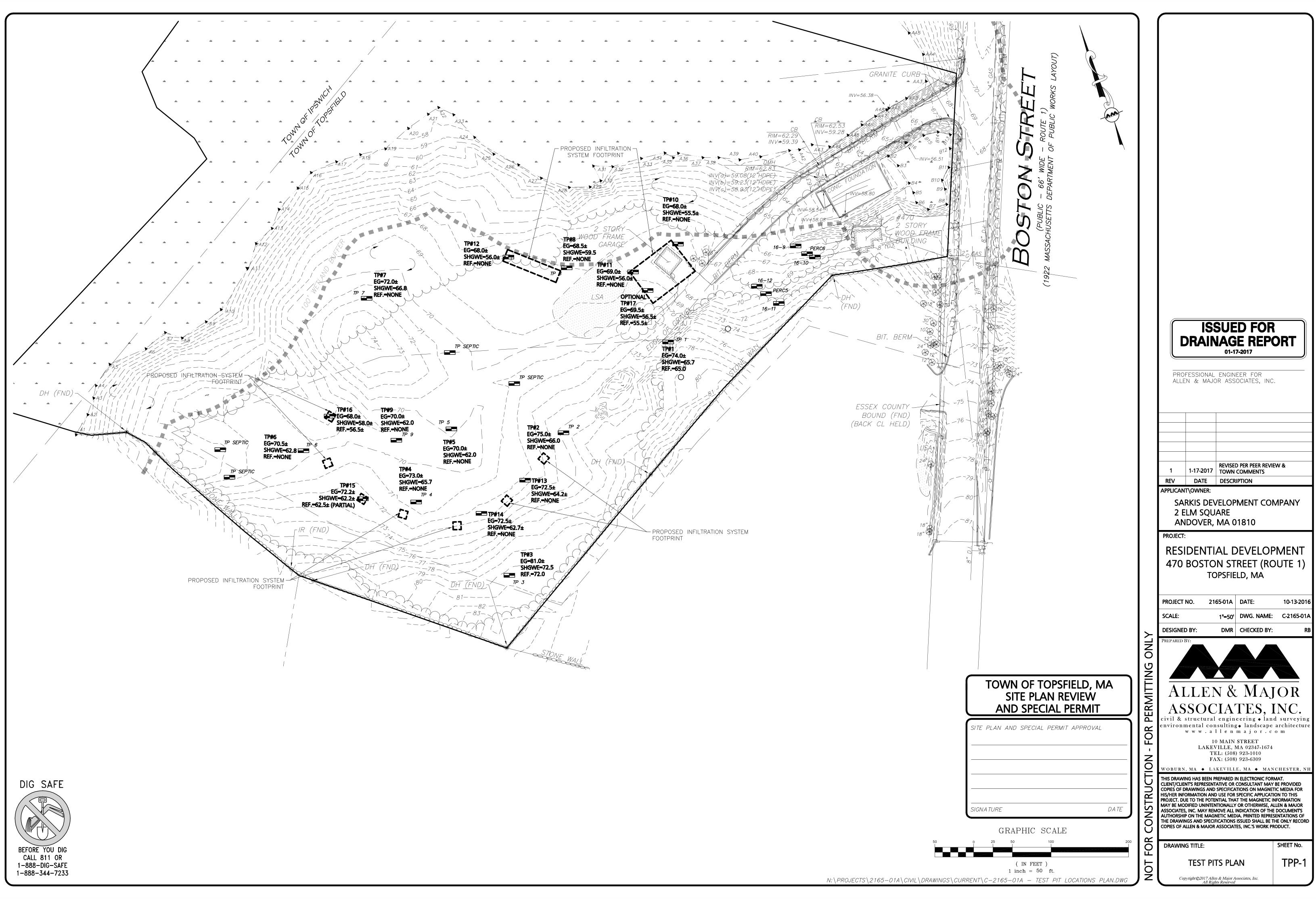
Section 5.0 – Drainage Site Plans











Section 6.0 - Appendix



United States Department of Agriculture

NRCS

Natural Resources Conservation Service A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants Custom Soil Resource Report for Essex County, Massachusetts, Northern Part; and Essex County, Massachusetts, Southern Part





Map Unit Legend

	Essex County, Massachusetts,	Northern Part (MA605)		
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI	
1	Water	1.2	0.6%	
31A	Walpole sandy loam, 0 to 3 percent slopes	1.9	0.9%	
32A	Wareham loamy sand, 0 to 3 percent slopes	0.5	0.2%	
52A	Freetown muck, 0 to 1 percent slopes	31.2	14.3%	
253B	Hinckley loamy sand, 3 to 8 percent slopes	16.9	7.7%	
253C	Hinckley loamy sand, 8 to 15 percent slopes	4.8	2.2%	
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	5.7	2.6%	
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	14.5	6.7%	
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	17.5	8.0%	
420B	Canton fine sandy loam, 3 to 8 percent slopes	6.1	2.8%	
420C	Canton fine sandy loam, 8 to 15 percent slopes	9.8	4.5%	
420D	Canton fine sandy loam, 15 to 25 percent slopes	0.1	0.0%	
421B	Canton fine sandy loam, 3 to 8 percent slopes, very stony	10.2	4.7%	
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	21.1	9.7%	
421D	Canton fine sandy loam, 15 to 25 percent slopes, very stony	17.6	8.1%	
600	Pits, gravel	8.9	4.1%	
651	Udorthents, smoothed 4.0		1.8%	
717E	Rock outcrop-Charlton-Hollis complex, 15 to 35 percent slopes	1.2	0.6%	
Subtotals for Soil Survey A	rea	173.2	79.3%	
Totals for Area of Interest		218.4	100.0%	

Essex County, Massachusetts, Southern Part (MA606)								
Map Unit Symbol Map Unit Name Acres in AOI Percent of AOI								
31B	Walpole fine sandy loam, 3 to 8 percent slopes	2.6	1.2%					
52A	Freetown muck, 0 to 1 percent slopes	13.5	6.2%					

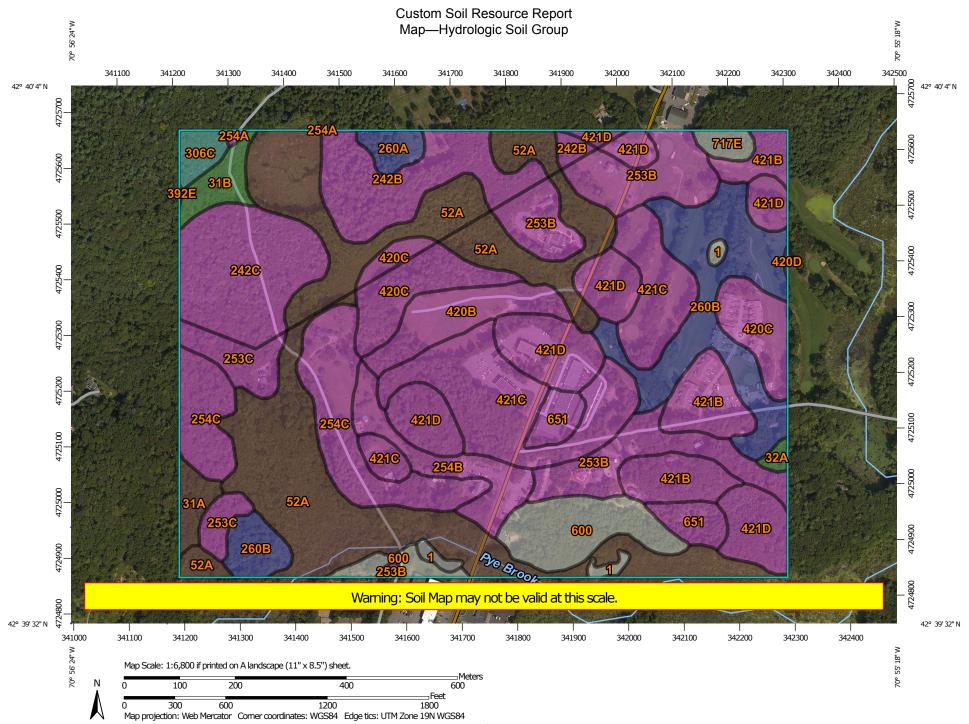
Essex County, Massachusetts, Southern Part (MA606)							
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI				
242B	Hinckley gravelly fine sandy loam, 3 to 8 percent slopes	11.1	5.1%				
242C	Hinckley loamy sand, 8 to 15 percent slopes	12.7	5.8%				
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	0.2	0.1%				
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	1.8	0.8%				
306C	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	1.7	0.8%				
392E	Paxton and Montauk fine sandy loams, 15 to 35 percent slopes, extremely stony	0.0	0.0%				
420C	Canton fine sandy loam, 8 to 20 percent slopes	1.2	0.6%				
421D Canton fine sandy loam, 15 to 25 percent slopes, very stony		0.5	0.2%				
Subtotals for Soil Survey A	rea	45.2	20.7%				
Totals for Area of Interest		218.4	100.0%				

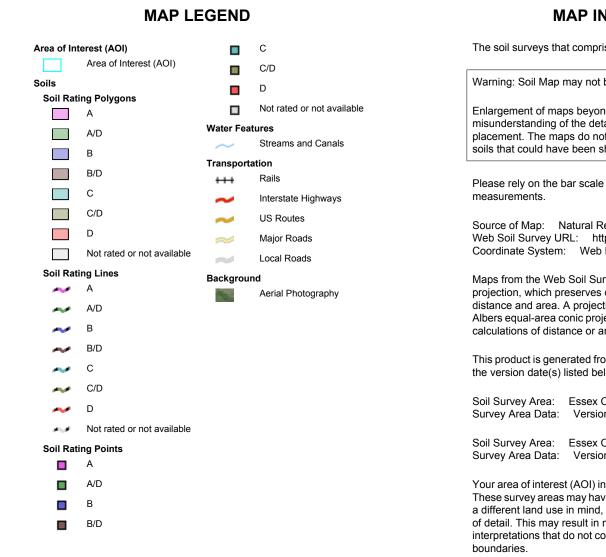
Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic classes rarely, if ever, can be mapped without including areas of other taxonomic classes for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been





MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map

Source of Map: Natural Resources Conservation Service Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Essex County, Massachusetts, Northern Part Survey Area Data: Version 11, Sep 28, 2015

Soil Survey Area: Essex County, Massachusetts, Southern Part Survey Area Data: Version 12, Sep 28, 2015

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		1.2	0.6%
31A	Walpole sandy loam, 0 to 3 percent slopes	B/D	1.9	0.9%
32A	Wareham loamy sand, 0 to 3 percent slopes	A/D	0.5	0.2%
52A	Freetown muck, 0 to 1 percent slopes	B/D	31.2	14.3%
253B	Hinckley loamy sand, 3 to 8 percent slopes	A	16.9	7.7%
253C	Hinckley loamy sand, 8 to 15 percent slopes	A	4.8	2.2%
254B	4B Merrimac fine sandy loam, 3 to 8 percent slopes		5.7	2.6%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes		14.5	6.7%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	В	17.5	8.0%
420B	Canton fine sandy loam, 3 to 8 percent slopes			2.8%
420C	Canton fine sandy loam, 8 to 15 percent slopes	A	9.8	4.5%
420D	Canton fine sandy loam, 15 to 25 percent slopes	A	0.1	0.0%
421B	Canton fine sandy loam, 3 to 8 percent slopes, very stony	A	10.2	4.7%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	A	21.1	9.7%
421D	Canton fine sandy loam, 15 to 25 percent slopes, very stony	A	17.6	8.1%
600	Pits, gravel		8.9	4.1%
651	Udorthents, smoothed	A	4.0	1.8%
717E	Rock outcrop-Charlton- Hollis complex, 15 to 35 percent slopes		1.2	0.6%
Subtotals for Soil Surv	rey Area		173.2	79.3%
Totals for Area of Inter	est		218.4	100.0%

Hydrologic Soil Group— Summary by Map Unit — Essex County, Massachusetts, Southern Part (MA606)							
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI			
31B	Walpole fine sandy loam, 3 to 8 percent slopes	A/D	2.6	1.2%			
52A	Freetown muck, 0 to 1 percent slopes	B/D	13.5	6.2%			
242B	Hinckley gravelly fine sandy loam, 3 to 8 percent slopes	A	11.1	5.1%			
242C	Hinckley loamy sand, 8 to 15 percent slopes	A	12.7	5.8%			
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	A	0.2	0.1%			
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	В	1.8	0.8%			
306C	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	С	1.7	0.8%			
392E	Paxton and Montauk fine sandy loams, 15 to 35 percent slopes, extremely stony	С	0.0	0.0%			
420C	Canton fine sandy loam, 8 to 20 percent slopes	A	1.2	0.6%			
421D	Canton fine sandy loam, 15 to 25 percent slopes, very stony	A	0.5	0.2%			
Subtotals for Soil Surv	vey Area		45.2	20.7%			
Totals for Area of Inter	rest		218.4	100.0%			

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition Component Percent Cutoff: None Specified Tie-break Rule: Higher



Commonwealth of Massachusetts City/Town of Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Owner Na 470 B	^{ame} Boston Street				5	
Street Ad					Map/Lot #	
Tops	field			MA	01983	
City				State	Zip Code	
B. Site I	Information					
1. (Check	one) 🔀 New C	onstruction	Upgrade	🗌 Repair		
2. Soil Su	rvey Available?	x Yes	🗌 No	If yes: UC Davis W	eb Soil Survey	420B, 421C
		<u>K.</u>		Source	· · · · ·	Soil Map Unit
Cant	on Fine Sandy Loam			Bedrock		
Soil Nam	-			Soil Limitations		
Sandy				Morraine		
0	Parent Material			Landform		
3. Surficia	I Geological Report Availa	able? 🔄 Yes	X No	If yes:		
						Map Unit
4. Flood F	Rate Insurance Map					
	he 500-year flood bounda	ary? 🗴 Yes	🗌 No	Within the 100-year flood FEMA Zone A	I boundary? X Yes	🗌 No
5. Within a	a velocity zone?	Yes	X No			
6. Within a	a Mapped Wetland Area	? X Yes	🗌 No	MassGIS Wetland Data	Layer: Wooded Swamp	o Deciduous/Mix
7. Current	Water Resource Condi	tions (USGS):	June, 2016 Month/Year	Range: 🗌 Above Nori	mal 🗌 Normal 🛛 Be	low Normal
B. Other r	eferences reviewed:	N/A				



Commonwealth of Massachusetts City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C.	On-Site Revi	ew (minimum of tw	vo holes req	uired at every pro	oposed prim	ary and reserve dispos	sal area)
	Deep Observation	Hole Number:	TP-1	7/7/2016	8:00AM	Overcast, 65 deg	grees
		-		Date	Time	Weather	
1.	Location						
	Ground Elevation a	t Surface of Hole:	74.0	Latit	ude/Longitude	42.664163 / -70.930328	
	Description of Loca	tion: Crushed	stone drive n	ear end of paved d	riveway		
2.	Land Use Open field				N/A		0-3%
		., woodland, agricultural fiel Grass	d, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, boulders, e N/A	
	Veg	getation		Landform		Position on Landscape (SU, SH,	BS, FS, TS)
3.	Distances from:	Open Water Body	N/A feet	_ Drainage Way	<u>N/A</u> feet	Wetlands	$\frac{200 + feet}{feet}$
		Property Line	110' feet	_ Drinking Water	Well <u>N/A</u>	Other	N/A feet
4.	Parent Material:	Sandy till		Unsuita	able Materials	Present: X Yes	□ No
	If Yes: Dist	urbed Soil 🛛 🗌 F	ill Material	x Impervious Layer(s) 🛛 🖾 (/eathered/Fractured Rock	X Bedrock
5.	Groundwater Obse	rved: 🗌 Yes	x No	If yes:	N/A	N/A	
0.					-	ping from Pit Depth Sta	anding Water in Hole
	Estimated Depth to	High Groundwater:	100"	65.7			
		i	nches	elevation	1		



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-1

Depth (in.)	Soil Horizon/ Layer	/ Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features		Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil	Other	
Depth (m.)			Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	other
2-0	Crushed stone										
0-66	2C1	5R3/6				SL	5%	10%			
66-108	2C2	5R3/6	100	7.5YR6/8	2%	SL	5%	15%			

Additional Notes:

Fractured/weathered rock throughout. No water noted, no weeping.

ESHWT @ 100" (2% mottles - concentrations)

Refusal @ 108" (Ledge)



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure Consistence		Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP- <u>1</u>	Obs. Hole #	
		Depth observed standing	water in observ	ation hole				
		Depth weeping from side		hala	inches		inches	
		Depth weeping from side of	of observation i	noie	inches		inches	
	X	Depth to soil redoximorphic features (mottles)			100"			
	_	-		inches		inches		
		Depth to adjusted seasonal high groundwater (S _h) (USGS methodology)			inches		inches	
		(g))						
		Index Well Number		Reading Date				
		$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$						
		Obs. Hole # S _c S _r		S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	🔀 Yes 🗌 No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	108
			inches		inches
C.	If no, at what depth was impervious material observ	ved? Upper boundary:		Lower boundary:	
			inches		inches
			¥C:		

*Significant amounts fractured rock throughout



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Sarkis Development Company						
	Owner Name 470 Boston Street					Map 2, Lot 5	5
	Street Address					Map/Lot #	
	Topsfield			MA		01983	
	City			State		Zip Code	
B	Site Information						
1.	(Check one) X New Constr	ruction	Upgrade		Repair		
2.	Soil Survey Available?	x Yes	🗌 No	If yes:	UC Davis Web Soil S	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedroc	Source k		Soil Map Unit
	Soil Name			Soil Limita			
	Sandy till			Morra	line		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	🗌 Yes	X No	If yes:			
							Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? If Yes, continue to #5.	X Yes	🗌 No		e 100-year flood boundary A Zone A	/? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	X Yes	🗌 No	MassGI	S Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mixe
7.	Current Water Resource Conditions	(USGS):	June, 2016 Month/Year	Range:	Above Normal	Normal X Bel	ow Normal
8.	Other references reviewed:	J/A					



Commonwealth of Massachusetts City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C.	On-Site Re	eview (minimum of t	wo holes req	uired at every pro	oposed prim	ary and reserve dispo	sal area)
	Deep Observat	tion Hole Number:	TP-2	7/7/2016	8:00AM	Overcast, 65 de	grees
		-		Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	75.0	Latit	ude/Longitude	:42.664163 / -70.930328	3
	Description of L	ocation: Slope al		property line, 110'	from PL		
2.	Land Use	Open field			N/A		3-8%
		(e.g., woodland, agricultural field, vacant lo Grass Vegetation		Morraine	Surface Stones	(e.g., cobbles, stones, boulders, N/A	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH,	BS, FS, TS)
3.	Distances from:	Open Water Body	N/A feet	_ Drainage Way	<u>N/A</u> feet	Wetlands	<u>300+ feet</u>
		Property Line	110' feet	Drinking Water	Well $\frac{N/A}{feet}$	Other	N/A feet
4.	Parent Material	Sandy till		Unsuit	able Materials	Present: X Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material	x Impervious Layer(s) X V	/eathered/Fractured Rock	X Bedrock
5.	Groundwater O	bserved: 🗌 Yes	x No	If yes:	N/A	N/A	
0.					Depth Wee	ping from Pit Depth St	anding Water in Hole
	Estimated Depth to High Groundwater: 108"		66.0 elevation	1			



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-2

Depth (in.)	Soil Horizon/	Horizon/ Soil Matrix: Color-	Red	Redoximorphic Features		Soil Texture	Coarse Fragments % by Volume		Soil Consistence	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)		Cobbles & Stones	(Moist)	Other
0-8	А	10YR5/6				FSL				
8-24	В	10YR4/6				SL	5%	15%		
24-150	С	10YR3/6	108	7.5YR6/8	2%	S&G	5%	15%		

Additional Notes:

Fractured/weathered rock 60"-150". No water noted, no weeping.

ESHWT @ 108" (2% mottles - concentrations)

No Refusal



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure Consistence		Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-2	Obs. Hole #	
		Depth observed standing	water in observ	ation hole				
		Depth weeping from side of	of observation I	nole	inches		inches	
	x	Depth to soil redoximorphi			inches	08	inches	
	11			(100)	inches		inches	
		Depth to adjusted seasona	al high groundv	vater (S _h)				
		(USGS methodology)			inches		inches	
		Index Well Number		Reading Date				
		$S_{h} = S_{c} - [S_{r} \times (OW_{c} - OW_{c})]$	/ _{max})/OW _r]					
		Obs. Hole # S _c		S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	🔀 Yes 🗌 No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	150
			inches		inches
C.	If no, at what depth was impervious material observe	d? Upper boundary:		Lower boundary:	
			inches		inches
			¥C:		

*Significant amounts fractured rock throughout



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Sarkis Development Company						
	Owner Name 470 Boston Street					Map 2, Lot 5	5
	Street Address					Map/Lot #	
	Topsfield			MA		01983	
	City			State		Zip Code	
B	Site Information						
1.	(Check one) X New Constr	ruction	Upgrade		Repair		
2.	Soil Survey Available?	x Yes	🗌 No	If yes:	UC Davis Web Soil S	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedroc	Source k		Soil Map Unit
	Soil Name			Soil Limita			
	Sandy till			Morra	line		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	🗌 Yes	X No	If yes:			
							Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? If Yes, continue to #5.	X Yes	🗌 No		e 100-year flood boundary A Zone A	/? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	X Yes	🗌 No	MassGI	S Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mixe
7.	Current Water Resource Conditions	(USGS):	June, 2016 Month/Year	Range:	Above Normal	Normal X Bel	ow Normal
8.	Other references reviewed:	J/A					



Commonwealth of Massachusetts City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

	Deep Observat	ion Hole Number:	TP-3	7/7/2016 Date	8:00AM Time	Overcast, 65 degre Weather	ees
1.	Location		01.0			10 ((11/2) 50 020220	
	Ground Elevation	on at Surface of Hole:	81.0	Latitu	de/Longitude: ·	42.664163 / -70.930328	
	Description of L	ocation: Southwe	stern corner				
2.	Land Use	Open field			N/A		0-3%
		(e.g., woodland, agricultural fie Grass	ld, vacant lot, etc.)	Morraine	Surface Stones (e	e.g., cobbles, stones, boulders, etc.) $\mathrm{N/A}$	Slope (%)
		Vegetation		Landform	F	Position on Landscape (SU, SH, BS	, FS, TS)
3.	Distances from:	Open Water Body	N/A feet	Drainage Way	N/A feet	Wetlands	<u>500+ feet</u>
		Property Line	45'	_ Drinking Water V	Vell <u>N/A</u>	Other	N/A feet
4.	Parent Material:	Sandy till		Unsuital	ble Materials P	Present: X Yes	🗌 No
	If Yes:	Disturbed Soil	ill Material	x Impervious Layer(s)	X We	eathered/Fractured Rock	Bedrock
5.	Groundwater Ol	bserved: 🗌 Yes	x No	If yes:	N/A	N/A	
	Estimated Dept	h to High Groundwater:	102" nches	72.5 elevation	Depth Weep	ing from Pit Depth Stand	ling Water in Hole



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-3

Depth (in.)	Soil Horizon/	l Horizon/ Soil Matrix: Color- Layer Moist (Munsell)	Red	loximorphic Feat	ures	Soil Texture		ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
0-8	А	10YR4/4				FSL					
8-32	В	10YR3/6				LS		10%			
32-108	С	10YR3/6	102	7.5YR6/8	2%	LS		10%			Ref.@108"

Additional Notes:

No water noted, no weeping. ESHWT @ 102"

Angular cobbles and fractured rock throughout B & C layers

Refusal @ 108" (Ledge)



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	il Horizon/ Soil Matrix: Color- Layer Moist (Munsell)	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-3	Obs. Hole #	
		Depth observed standing	water in observ	ation hole				
		Dopth wooping from side (f obconvotion h		inches		inches	
		Depth weeping from side of	Di observation i	loie	inches		inches	
	X	Depth to soil redoximorphi	c features (mo	ottles)	102"			
					inches		inches	
		Depth to adjusted seasona (USGS methodology)	al high groundw	vater (S _h)	inches		inches	
		(USUS methodology)			menes		mones	
		Index Well Number		Reading Date				
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]					
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	🔀 Yes 🗌 No				
b.	If yes, at what depth was it observed?	Upper boundary:		ower boundary:	108
C.	If no, at what depth was impervious material observed?	Upper boundary:	inches Lo	ower boundary:	inches
0.		oppor boundary:	inches	iner seandary:	inches
			*Significant am	ounts fractured i	ock throughout



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street			Map 2, Lot 5	
	Street Address			Map/Lot #	
	Topsfield		MA	01983	
	City		State	Zip Code	
В.	Site Information				
1.	(Check one) X New Construction	Upgrade	Repair		
2.	Soil Survey Available?	es 🗌 No	If yes: UC Davis Web Soil S	burvey	420B, 421C
			Source		Soil Map Unit
	Canton Fine Sandy Loam		Bedrock		
	Soil Name		Soil Limitations		
	Sandy till		Morraine		
	Geologic/Parent Material		Landform		
3.	Surficial Geological Report Available?	es X No	If yes:		
					Map Unit
4.	Flood Rate Insurance Map				
	Above the 500-year flood boundary? $\boxed{\mathbf{X}}$ Year flood boundary? $\boxed{\mathbf{X}}$ Year flood boundary?	es 🗌 No	Within the 100-year flood boundary FEMA Zone A	/? X Yes	🗌 No
5.	Within a velocity zone?	es 🛛 🗴 No			
6.	Within a Mapped Wetland Area? X	es 🗌 No	MassGIS Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mix
7.	Current Water Resource Conditions (USG	S): June, 2016 Month/Year	Range: 🗌 Above Normal 🗌 I	Normal X Belo	ow Normal
8.	Other references reviewed: N/A				



Commonwealth of Massachusetts City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

	Deep Observat	ion Hole Number:	TP-4	7/7/2016 Date	8:00AM Time	Overcast, 65 degree Weather	28
1.	Location						
	Ground Elevation	on at Surface of Hole:	73.0 feet	Latit	ude/Longitude	e: 42.664163 / -70.930328	_
	Description of L	ocation: Southw	est corner of p	property			
2.	Land Use	Open field			N/A		3-8%
		(e.g., woodland, agricultural fie Grass	eld, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, boulders, etc.) $N/A \label{eq:N}$	Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH, BS,	FS, TS)
3.	Distances from:	Open Water Body	N/A feet	_ Drainage Way	N/A feet	Wetlands	<u>500+ feet</u>
		Property Line	110' feet	_ Drinking Water	Well $\frac{N/A}{feet}$	Other	N/A feet
4.	Parent Material:	Sandy till		Unsuita	able Materials	Present: Yes	X No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer(s) 🗆 V	Neathered/Fractured Rock	Bedrock
5.	Groundwater O	oserved: <u>x</u> Yes	🗌 No	If yes:	N/A	<u>144"</u>	
	Estimated Dept	h to High Groundwater:	88" inches	65.7 elevation		eping from Pit Depth Standir	ng Water in Hole



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-4

Depth (in.)	Soil Horizon/	bil Horizon/ Soil Matrix: Color-	Rec	loximorphic Feat	ures	Soil Texture	Coarse F % by \	ragments /olume	Soil Consistence	Other
Deptin (int.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones	(Moist)	Other
0-10	А	10YR3/1				SL				
10-22	В	10YR3/2				SL				
22-80	B/C	10YR5/6				Sand				
80-144	С	10YR5/4	88	7.5YR5/8	5%	F. Sand				Moist

Additional Notes:

Standing water @ 144". ESHWT @ 88" (Some mottling in B/C transition layer - concentrations & depletions)

Concentrations - 5YR5/8, depletions - 10YR6/1

No Refusal.



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	n/ Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-4	Obs. Hole #	
		Depth observed standing	water in observ	ation hole				
		Depth weeping from side of	of observation I	hole	inches		inches	
	x	Depth to soil redoximorphi			inches 88"		inches	
	11	- op o oo o			inches		inches	
		Depth to adjusted seasona (USGS methodology)	vater (S _h)	inches		inches		
		Index Well Number		Reading Date				
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]					
		Obs. Hole # S _c		S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole # S _c		S _r	OW _c	OW _{max}	OW _r	S _h

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	144
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Sarkis Development Company						
	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	Topsfield			MA		01983	
	City			State		Zip Code	
B	Site Information						<u> </u>
1.	(Check one) X New Construct	tion	Upgrade		Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil S Source	urvey	420B, 421C Soil Map Unit
	Canton Fine Sandy Loam			Bedroc			Soil Map Unit
	Soil Name			Soil Limita	tions		
	Sandy till			Morra	ine		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?] Yes	x No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	Yes	🗌 No		e 100-year flood boundary A Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	Yes	🗌 No	MassGI	S Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mixe
7.	Current Water Resource Conditions (L	JSGS):	June, 2016 Month/Year	Range:	Above Normal	Normal 🛛 Belo	w Normal
8.	Other references reviewed: N/2	A					



Commonwealth of Massachusetts City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C	. On-Site Re	eview (minimum	of two holes red	quired at every pro	posed prin	nary and reserve dispose	al area)
	Deep Observa	tion Hole Number:	TP-5	7/7/2016	8:00AM	Overcast, 65 degr	rees
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole	$\frac{70.0}{\text{feet}}$	Latitu	ude/Longitude	e: 42.664163 / -70.930328	
	Description of L	ocation: Cru		near end of paved di	riveway		
2.	Land Use	Open field			N/A		0-3%
		(e.g., woodland, agricult Grass	ural field, vacant lot, etc.) Morraine	Surface Stones	(e.g., cobbles, stones, boulders, etc N/A	:.) Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH, B	S, FS, TS)
3.	Distances from	: Open Water E	Body N/A	Drainage Way	N/A	Wetlands	375+ feet
			feet		feet		feet
		Property Line	220' feet	Drinking Water \	Well <u>N/A</u>	Other	N/A feet
4.	Parent Material	: Sandy till		Unsuita	ble Materials	Present: 🗌 Yes	X No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer(s)		Weathered/Fractured Rock	Bedrock
5.	Groundwater O	bserved: X Yes	s 🗌 No	If yes:	N/A	132"	
5.						eping from Pit Depth Star	nding Water in Hole
	Estimated Dept	h to High Groundwa	ter: 96"	62.0			-
				elevation			



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-5

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Feat	ures	Soil Texture		ragments /olume	Soil Structure	Soil	Other
Depth (in.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
0-8	А	10YR3/2				SL					
8-34	В	10YR3/1				SL					
34-72	2C1	10YR5/8				M. sand					Moist
72-132	2C2	10YR5/4	96	7.5YR6/8	5%	Sand			Loose, SG		

Additional Notes:

ESHWT @ 96" (5% mottles - concentrations & depletions)

Standing water @ 132" (bottom)

No Refusal, coarse sand layer at 60-70".



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	n/ Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-5	Obs. Hole #		
		Depth observed standing	water in observ	ation hole					
		Depth weeping from side of	of observation I	hole	inches		inches		
					inches		inches		
	х	Depth to soil redoximorphi	ic features (mo	ottles)	96"				
					inches		inches		
		Depth to adjusted seasonal high groundwater (S _h)							
		(USGS methodology)			inches		inches		
		Index Well Number		Reading Date					
		$S_{h} = S_{c} - [S_{r} \times (OW_{c} - OW_{c})]$	/ _{max})/OW _r]						
		Obs. Hole # S _c S _r		S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _r	OW _c	OW _{max}	OW _r	S _h		

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	132
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Sarkis Development Company						
	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	Topsfield			MA		01983	
	City			State		Zip Code	
B	Site Information						
1.	(Check one) X New Construct	ion	Upgrade	[Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil S Source	urvey	420B, 421C Soil Map Unit
	Canton Fine Sandy Loam			Bedroc			Soli Map Onit
	Soil Name			Soil Limitat	tions		
	Sandy till			Morra	ine		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? X If Yes, continue to #5.	Yes	🗌 No		e 100-year flood boundary A Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	Yes	🗌 No	MassGIS	S Wetland Data Layer: $^{ m W}$	Vooded Swamp I Wetland Type	Deciduous/Mixe
7.	Current Water Resource Conditions (U		June, 2016 Month/Year	Range:	Above Normal	Normal X Belov	w Normal
8.	Other references reviewed: N/A						



Commonwealth of Massachusetts City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C.	. On-Site Revie	W (minimum of t	wo holes req	uired at every pr	oposed pr	imary and reserve o	disposal a	area)
	Deep Observation	Hole Number:	TP-6	7/7/2016	8:00AM	Overcast,	65 degree	S
	•			Date	Time	Weather	C	
1.	Location							
	Ground Elevation at	t Surface of Hole:	70.5	Lati	tude/Longitu	de: 42. <u>664163 / -70.9</u>	930328	_
	Description of Locat	tion: Crushe		ear end of paved of	driveway			
2.		pen field			N/A			0-3%
	_	., woodland, agricultural fie rass	eld, vacant lot, etc.)	Morraine	Surface Stor	les (e.g., cobbles, stones, bol $\mathrm{N/A}$	ulders, etc.)	Slope (%)
	Veg	etation		Landform		Position on Landscape (SU, SH, BS, F	FS, TS)
3.	Distances from:	Open Water Body	N/A feet	_ Drainage Way	<u>N</u> feet			$\underbrace{175+feet}_{feet}$
		Property Line	<u>115'</u> feet	Drinking Water	Well <u>N</u>			N/A feet
4.	Parent Material:	Sandy till		Unsuit	able Materia	als Present:	Yes	X No
	If Yes: Distu	urbed Soil	Fill Material	Impervious Layer(s) 🗌	Weathered/Fractured Ro	ock 🗌	Bedrock
5.	Groundwater Obser	ved: 🗌 Yes	x No	If yes:	N/A		N/A	
				,		Veeping from Pit	Depth Standin	g Water in Hole
	Estimated Depth to	High Groundwater:	92"	62.8				-
	-		inches	elevatio	n			



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-6

Depth (in.)	Soil Horizon/	oil Horizon/ Soil Matrix: Color- Layer Moist (Munsell)	Red	loximorphic Feat	ures	Soil Texture	Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Deptin (int.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
0-8	А	10YR4/3				FSL					
8-28	В	10YR6/6				FSL					
28-72	B/C	10YR3/3				FSL	5%	2%			
72-136	С	10YR3/3	92"	7.5YR6/8	2%	FSL	5%	2%			

Additional Notes:

ESHWT @ 92". No refusal, no weeping, no standing water.

Heavy manganese deposits throughout B/C and C layers, color 10R3/3



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	il Horizon/ Soil Matrix: Color- Layer Moist (Munsell)	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-6	Obs. Hole #	
		Depth observed standing v	water in observ	ation hole				
		Depth weeping from side of	of observation I	hole	inches		inches	
					inches		inches	
	х	Depth to soil redoximorphi	c features (mo	ottles)	92"			
					inches		inches	
		Depth to adjusted seasona	al high groundv	vater (S _h)				
		(USGS methodology)			inches		inches	
		Index Well Number		Reading Date				
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]					
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	136
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

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Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



Owner Name 470 Boston Street			Map 2, Lot 5	
Street Address			Map/Lot #	
Topsfield		MA	01983	
City		State	Zip Code	
B. Site Information				
. (Check one) X New Construction	Upgrade	Repair		
2. Soil Survey Available?	es 🗌 No	If yes: UC Davis Web Soil Su	rvey	420B, 421C
		Source	<u> </u>	Soil Map Unit
Canton Fine Sandy Loam		Bedrock		
Soil Name		Soil Limitations		
Sandy till		Morraine		
Geologic/Parent Material		Landform		
8. Surficial Geological Report Available? 🗌 Ye	es <u>x</u> No	If yes:		
				Map Unit
 Flood Rate Insurance Map 				
Above the 500-year flood boundary? $\boxed{\mathbf{x}}$ Ye If Yes, continue to #5.	es 🗌 No	Within the 100-year flood boundary? FEMA Zone A	X Yes	🗌 No
5. Within a velocity zone?	es X No			
6. Within a Mapped Wetland Area? I Y	es 🗌 No	MassGIS Wetland Data Layer: $^{ m Wo}$	ooded Swamp Wetland Type	Deciduous/Mix
7. Current Water Resource Conditions (USG	S): June, 2016 Month/Year	Range: 🗌 Above Normal 🗌 No	ormal X Belo	ow Normal
3. Other references reviewed: N/A				



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

	Deep Observatio	n Hole Number:	TP-7	7/7/2016 Date	8:00AM Time	Overcast, 65 degree	es
1.	Location						
	Ground Elevation	at Surface of Hole:	72.0	Latitu	ide/Longitude	e: 42.664163 / -70.930328	_
	Description of Loc	cation: Woodla	nd area by we	etlands			
2.	Land Use	Woodland			N/A		0-3%
		.g., woodland, agricultural fie Grass	ld, vacant lot, etc.)) Morraine	Surface Stones	σ (e.g., cobbles, stones, boulders, etc.) $$N/A$$	Slope (%)
	V	egetation		Landform		Position on Landscape (SU, SH, BS,	FS, TS)
3.	Distances from:	Open Water Body	N/A feet	Drainage Way	<u>N/A</u> feet	Wetlands	<u>130+ feet</u>
		Property Line	250' feet	Drinking Water \	Vell <u>N/A</u>	Other	N/A feet
4.	Parent Material:	Sandy till		Unsuita	ble Materials	Present: 🗌 Yes	x No
	If Yes: 🗌 Di	sturbed Soil 🛛 🗌 F	Fill Material	Impervious Layer(s)		Weathered/Fractured Rock	Bedrock
5.	Groundwater Obs	erved: 🗌 Yes	x No	If yes:	N/A	N/A	
	Estimated Depth	o High Groundwater:	62" inches	66.8 elevation	Depth we	eping from Pit Depth Standi	ng Water in Hole



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-7

Depth (in.) S 0-8 8-28 28-76 76-144	Soil Horizon/ So	Soil Matrix: Color-	Rec	loximorphic Feat	ures	Soil Texture		ragments /olume		Soil Consistence	Other
Depth (In.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
0-8	А	10YR3/3				FSL					
8-28	В	10YR5/6				FSL	5%	10%			
28-76	B/C	10YR4/4	62	7.5YR6/8	2%	FSL	5%	15%	Massive, fri.		
76-144	С	10YR4/4				FSL			Massive, fri.		5% cobbles

Additional Notes:

No water noted, no weeping. No refusal.

ESHWT @ 62" (Significant mottling - concentrations, color 7.5YR6/8)



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	eld, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	ed/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
				,	Depth Weeping from	n Pit Depth S	Standing Water in Hole
	Estimated Dept	h to High Groundwater:					
	-		inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	on/ Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structuro	Soil Consistence (Moist)	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones			Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-7	Obs. Hole #	
		Depth observed standing	water in observ	ation hole				
		Depth weeping from side of	of observation l	hole	inches		inches	
	x	Depth to soil redoximorphi	ic features (mo	ottles)	inches 62"		inches	
	_		,	inches		inches		
		Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)			inches		inches	
		Index Well Number		Reading Date				
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]					
		Obs. Hole # S _c S		S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole # S _c S _r			OW _c	OW _{max}	OW _r	S _h

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	144
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street			Map 2, Lot 5	
	Street Address			Map/Lot #	
	Topsfield		MA	01983	
	City		State	Zip Code	
В.	Site Information				
1.	(Check one) X New Construction	Upgrade	Repair		
2.	Soil Survey Available?	es 🗌 No	If yes: UC Davis Web Soil S	burvey	420B, 421C
			Source		Soil Map Unit
	Canton Fine Sandy Loam		Bedrock		
	Soil Name		Soil Limitations		
	Sandy till		Morraine		
	Geologic/Parent Material		Landform		
3.	Surficial Geological Report Available?	es X No	If yes:		
					Map Unit
4.	Flood Rate Insurance Map				
	Above the 500-year flood boundary? X Year If Yes, continue to #5.	es 🗌 No	Within the 100-year flood boundary FEMA Zone A	/? X Yes	🗌 No
5.	Within a velocity zone?	es 🛛 🗴 No			
6.	Within a Mapped Wetland Area? X	es 🗌 No	MassGIS Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mix
7.	Current Water Resource Conditions (USG	S): June, 2016 Month/Year	Range: 🗌 Above Normal 🗌 I	Normal X Belo	ow Normal
8.	Other references reviewed: N/A				



Commonwealth of Massachusetts City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C.	On-Site Revie	W (minimum of tw	o holes requ	uired at eve	ry propose	ed primary ar	nd reserve d	disposal	area)
	Deep Observation H	Hole Number:	TP-8	7/7/2016	8:0	0AM	Overcast,	65 degree	es
	•			Date	Time		Weather		
1.	Location								
	Ground Elevation at	Surface of Hole:	68.5		Latitude/Lo	ongitude: 42. <u>66</u> 4	4163 / -70.9	30328	_
	Description of Location	on: Norther	n treeline, 50	' back corner	existing ga	arage			
2.	Land Use Op	en field			N/2	A			0-3%
		(e.g., woodland, agricultural field, Grass Vegetation			Morraine N/A			ulders, etc.)	Slope (%)
	Veget	tation		Landform		Position	on Landscape (S	SU, SH, BS, I	FS, TS)
3.	Distances from:	Open Water Body	N/A feet	Drainage	Way	N/A feet	Wetlands		$\underset{\text{feet}}{\underbrace{115+\text{ feet}}}$
		Property Line	<u>275'</u> feet	Drinking \	Water Well	N/A feet	Other		N/A feet
4.	Parent Material:	Sandy till		L	Insuitable M	laterials Presen	t: 🗌 Y	′es	x No
	If Yes: Distur	rbed Soil 🛛 🗌 Fi	Il Material] Impervious L	ayer(s)	U Weathere	ed/Fractured Ro	ock 🗌	Bedrock
5.	Groundwater Observ	ved: X Yes	🗌 No	If	yes:	N/A		150"	
••					, ee	Depth Weeping fron	n Pit D	Depth Standir	g Water in Hole
	Estimated Depth to H	108"		59.5			-	-	
		in	ches	e	levation				



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-8

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Red	oximorphic Feat	ures	Soil Texture	Coarse F % by \	ragments /olume		Soil Consistence (Moist)	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones			Other
0-8	А	10YR4/3				LS					
8-18	В	10YR56				LS	5%				
18-45	B/C	10YR5/8				LS	20%				
45-150	С	10YR5/6	108	7.5YR6/8	2%	Fine sand			Loose, SG		

Additional Notes:

ESHWT @ 108", some mottling, concentrations, color 7.5YR6/8

Standing water @ 150"

No Refusal. Well defined transition from LS to fine sand.



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	on/ Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structuro	Soil Consistence (Moist)	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones			Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-8	Obs. Hole #		
		Depth observed standing	water in observ	ation hole					
		Depth weeping from side of	of observation h	nole	inches		inches		
					inches		inches		
	х	Depth to soil redoximorphi	c features (mo	ottles)	108"				
					inches		inches		
		Depth to adjusted seasona	vater (S _h)						
		(USGS methodology)		inches					
		Index Well Number		Reading Date					
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]						
		Obs. Hole # S _c		S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	X Yes 🗌 No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	108
			inches		inches
C.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



Owner Name 470 Bostor	n Street					Map 2, Lot 5	i i i i i i i i i i i i i i i i i i i
Street Address						Map/Lot #	
Topsfield				MA		01983	
City				State		Zip Code	
B. Site Info	mation						
1. (Check one)	x New Co	onstruction	Upgrade] Repair		
2. Soil Survey A	vailable?	x Yes	🗌 No	If yes:	UC Davis Web Soil S	urvey	420B, 421C
, een een een een een een een een een ee				•	Source	<u> </u>	Soil Map Unit
Canton Fi	ne Sandy Loam			Bedrock			
Soil Name				Soil Limitatio			
Sandy till				Morraii	ne		
Geologic/Parent				Landform			
3. Surficial Geol	ogical Report Availa	ble? 🔄 Yes	x No	If yes:			
							Map Unit
4. Flood Rate Ir	surance Map						
Above the 500 If Yes, continue)-year flood boundai o #5.	ry? 🗴 Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5. Within a veloc	ity zone?	Yes	X No				
	ped Wetland Area?	Yes	□ No	MassGIS	Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mix
7. Current Wate	r Resource Conditi	ons (USGS):	June, 2016 Month/Year	Range:] Above Normal 🗌 N	lormal X Belo	ow Normal
B. Other referer	ces reviewed:	N/A					



Commonwealth of Massachusetts City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C.	On-Site Review	N (minimum of two	vo holes req	uired at every pro	posed prim	ary and reserve dispos	sal area)
	Deep Observation H	lole Number:	TP-9	7/7/2016	8:00AM	Overcast, 65 deg	grees
	·	_		Date	Time	Weather	
1.	Location						
	Ground Elevation at S	Surface of Hole:	70.0	Latitu	ude/Longitude:	42.664163 / -70.930328	
	Description of Location	on: Open fi	eld, proposed	detention basin			
2.	Land Use Op	en field			N/A		0-3%
	(e.g., v Gra	woodland, agricultural field	d, vacant lot, etc.)	Morraine	Surface Stones (e.g., cobbles, stones, boulders, et N/A	tc.) Slope (%)
	Vegeta	ation		Landform		Position on Landscape (SU, SH, I	BS, FS, TS)
3.	Distances from:	Open Water Body	N/A feet	Drainage Way	<u>N/A</u> feet	Wetlands	<u>225+ feet</u>
		Property Line	<u>175'</u> feet	Drinking Water	Well <u>N/A</u>	Other	N/A feet
4.	Parent Material:	Sandy till		Unsuita	able Materials	Present: 🗌 Yes	x No
	If Yes: Disturb	bed Soil 🛛 🗌 Fi	II Material	Impervious Layer(s)) 🗆 W	/eathered/Fractured Rock	Bedrock
5.	Groundwater Observe	ed: 🗌 Yes	x No	If yes:	120"	138"	
0.				n yes.			anding Water in Hole
	Estimated Depth to H	ligh Groundwater:	96"	62.0	·	'	2
		• _	nches	elevation			



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-9

Depth (in.)	Soil Horizon/	on/ Soil Matrix: Color- Moist (Munsell)	Red	oximorphic Feat	ures	Soil Texture		ragments /olume	Soil Consistence	Other
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones	(Moist)	Other
0-8	А	10YR3/3				LS				
8-32	В	10YR5/4				LS				
32-72	2C1	10YR6/6				Sand				
72-138	2C2	10YR3/6	96	7.5YR6/8	2%	LS	10%			

Additional Notes:

Fractured/weathered rock throughout C layer. Standing water at 138", weeping at 120". ESHWT @ 96" (mottling)

No Refusal.



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:					
			inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features				Coarse F % by \	ragments /olume	— Soil Structure	Soil	Other
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-9	Obs. Hole #		
		Depth observed standing	water in observ	ation hole					
		Dopth waaping from side	fahaanyatian l		inches		inches		
		Depth weeping from side of	of observation i	lole	inches		inches		
	х	Depth to soil redoximorphi	c features (mo	ottles)	96"				
		Denth to adjusted second		(0)	inches		inches		
		Depth to adjusted seasona (USGS methodology)	ai nign groundv	vater (Sh)	inches		inches		
		Index Well Number		Reading Date					
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]						
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	🔀 Yes 🗌 No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	138
C.	If no, at what depth was impervious material observed?	Upper boundary:	inches	Lower boundary:	inches
			inches		inches
			*Significan	t amounts fractured	rock throughout



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

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Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Constru-	ction	Upgrade	Γ	Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil S	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitati			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? [If Yes, continue to #5.	x Yes	🗌 No		e 100-year flood boundary A Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{\mathrm{W}}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (USGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal 🛛 Belo	w Normal
8.	Other references reviewed: N/	А					



Commonwealth of Massachusetts City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

С.	. On-Site Review (minimum of the	vo holes requ	uired at every pro	oposed prim	ary and reserve disposa	l area)
	Deep Observation Hole Number:	TP-10	12/9/2016	7:30AM	Overcast, 35 degr	ees
	•		Date	Time	Weather	
1.	Location					
	Ground Elevation at Surface of Hole:	68.0	Latit	ude/Longitude	42.664163 / -70.930328	
	Description of Location: Northea	st corner exist	ing garage			
2.	Land Use Open field			N/A		0-3%
	(e.g., woodland, agricultural fie Grass	d, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, boulders, etc. N/A) Slope (%)
	Vegetation		Landform		Position on Landscape (SU, SH, BS	S, FS, TS)
3.	Distances from: Open Water Body	N/A feet	Drainage Way	<u>N/A</u> feet	Wetlands	<u>120+/- feet</u>
	Property Line	150'+/- feet	Drinking Water	Well $\frac{N/A}{feet}$	Other	N/A feet
4.	Parent Material: Sandy till		Unsuit	able Materials	Present: 🗌 Yes	X No
	If Yes: Disturbed Soil F	ill Material] Impervious Layer(s) 🗆 V	/eathered/Fractured Rock	Bedrock
5.	Groundwater Observed: X Yes	🗌 No	If yes:	150"	154"	
0.					ping from Pit Depth Stan	ding Water in Hole
	Estimated Depth to High Groundwater:	150"	55.5		· - ·	-
		nches	elevation	า		



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-10

Depth (in.)	Soil Horizon/ Layer	/ Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse F % by \	ragments /olume	Soil e Consistence	Other
Depth (m.)			Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones	(Moist)	Other
0-18	А	10YR2/3				SL				
18-28	В	10YR5/6				LS	10%			
28-60	1C	10YR5/6				SL		2%		
60-156	2C	10YR5/6				SL		2%		

Additional Notes:

Water noted at 154", weeping at 150. ESHWT @ 150"

Cobbles and stones throughout B & C layers, no refusal,

layer fine sand at 60-70", no mottling noted.



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-10	Obs. Hole #	
		Depth observed standing v	water in observ	ation hole	154			
		Depth weeping from side of	of observation h	nole	inches 150		inches	
		Depth to soil redoximorphi	c features (mc	ottles)	inches		inches	
					inches		inches	
		Depth to adjusted seasona (USGS methodology)	al high groundw	vater (S _h)	inches		inches	
		Index Well Number		Reading Date				
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]					
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	156
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator Typed or Printed Name of Soil Evaluator /

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address						
	_ Topsfield			MA		Map/Lot # 01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



Commonwealth of Massachusetts City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C.	. On-Site Re	eview (minimum of t	wo holes requ	uired at every pro	oposed prim	ary and reserve dispos	sal area)
	Deep Observa	tion Hole Number:	TP-11	12/9/2016	8:00AM	Overcast, 35 deg	grees
	•			Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	69.0	Latit	ude/Longitude	42.664163 / -70.930328	<u>.</u>
	Description of L	_ocation:SouthW	est corner exis	sting garage			
2.	Land Use	Open field			N/A		0-3%
		(e.g., woodland, agricultural fie Grass	eld, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, boulders, e N/A	stc.) Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH,	BS, FS, TS)
3.	Distances from	: Open Water Body	N/A feet	_ Drainage Way	<u>N/A</u> feet	Wetlands	$\frac{120 + - feet}{feet}$
		Property Line	150'+/- feet	Drinking Water	Well <u>N/A</u>	Other	N/A feet
4.	Parent Material	: Sandy till		Unsuita	able Materials	Present: 🗌 Yes	X No
	If Yes:	Disturbed Soil	-ill Material] Impervious Layer(s)) 🗆 🛛	/eathered/Fractured Rock	Bedrock
5.	Groundwater O	bserved: x Yes	🗌 No	If yes:	156"	174"	
••						ping from Pit Depth Sta	anding Water in Hole
	Estimated Dept	th to High Groundwater:	156"	56.0			
			inches	elevation	1		



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-11

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Red	oximorphic Feat	ures	Soil Texture			Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
0-12	А	10YR2/3				SL					
12-36	B1	10YR5/4				LS					
36-66	B2	10YR5/6				Coarse sand	10-15%	Loose, SG			
66-120	1C	10YR5/8				Sand			Loose, SG		
120-180	2C	10YR5/8				LS					

Additional Notes:

Standing Water noted at 174", weeping at 156. ESHWT

@ 156", no refusal, no mottling noted.



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-11	Obs. Hole #	
		Depth observed standing	vater in observ	ation hole	174			
		Depth weeping from side of	of observation h	hole	inches 156		inches	
		Depth to soil redoximorphi	c features (mo	ottles)	inches		inches	
		Depth to adjusted seasona	al high groundw	vater (S _b)	inches		inches	
		(USGS methodology)	0 0		inches		inches	
		Index Well Number		Reading Date				
		$S_{h} = S_{c} - [S_{r} \times (OW_{c} - OW)]$	_{max})/OW _r]					
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	180
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

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Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address						
	_ Topsfield			MA		Map/Lot # 01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



Commonwealth of Massachusetts City/Town of

Estimated Depth to High Groundwater:

144''

inches

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

С	C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)										
	Deep Observation Hole Number:	TP-12	12/9/2016	8:30AM	Overcast, 35 degrees						
			Date	Time	Weather						
1.	Location										
		(0.0	_		C(41(2), 70, 020220)						

	Ground Elevation	on at Surface of	Hole:	68.0	Latitu	ide/Longitude	+42.664163 / -/0.9	30328	
	Description of L	ocation:	North w	vest corner pr	oposed UIS-2, alor	ng treeline			
2.	Land Use	Open field				N/A			0-3%
		(e.g., woodland, as Grass	gricultural field	, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, bou N/A	Ilders, etc.)	Slope (%)
		Vegetation			Landform		Position on Landscape (S	U, SH, BS, F	S, TS)
3.	Distances from	Open Wa	ater Body	N/A feet	Drainage Way	<u>N/A</u> feet	Wetlands		$\frac{100 + - feet}{feet}$
		Property	Line	300'+/-	Drinking Water \	Well <u>N/A</u>	Other		N/A feet
4.	Parent Material	: Sandy t	ill		Unsuita	ble Materials	Present: Y	′es	X No
	If Yes:	Disturbed Soil	🗌 Fil	I Material] Impervious Layer(s)	□ v	Veathered/Fractured Rc	ock	Bedrock
5.	Groundwater O	bserved: X	Yes	🗌 No	If yes:	144"		158"	
					•	Depth Wee	eping from Pit D	epth Standing	g Water in Hole

56.0

elevation



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-12

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Red	loximorphic Feat	ures	Soil Texture	Coarse F % by \	Fragments Volume	Soil Structure	Soil	Other	
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other	
0-6	A	10YR2/3				SL						
6-26	Bw	10YR5/4				LS	5-7%					
26786	1C	10YR5/6				Med. sand			Loose, SG		Boulder boundar	-
78-162	2C	10YR5/8				Sand					Angular	cobbles

Additional Notes:

Standing Water noted at 158", weeping at 144.

ESHWT @ 144", no refusal, very little/no mottling

noted. Some fractured ledge at 160", easily broken up.



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Metho	od Used:			Obs. Hole #	TP-12	Obs. Hole #		
	🗌 De	epth observed standing v	vater in observ	ation hole	158				
	🗌 De	epth weeping from side o	of observation h	nole	inches 144		inches		
	🗌 De	epth to soil redoximorphic	c features (mo	ttles)	inches		inches		
		epth to adjusted seasona	I high groundw	vater (S _h)	inches (S _h)				
	(U	ISGS methodology)		inches			inches		
		Index Well Number		Reading Date					
	S _h	$n = S_c - [S_r \times (OW_c - OW_c)]$	_{max})/OW _r]						
	Ot	Obs. Hole # S _c		S _r	OW _c	OW _{max}	OW _r	S _h	
	Ot	bs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	X Yes I No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	162
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

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Date

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Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

	Deep Observat	ion Hole Number:	TP-13	12/9/2016 Date	9:30AM Time	Overcast, 35 degree Weather	25
1.	Location						
	Ground Elevation	on at Surface of Hole:	72.5	Latit	ude/Longitude	e: 42.664163 / -70.930328	_
	Description of L	ocation: South	east corner (Se	e Test Pits Plan, T	PP-1)		
2.	Land Use	Open field			N/A		3-8%
		(e.g., woodland, agricultural fin	eld, vacant lot, etc.)	Morraine	Surface Stones	$(\mbox{e.g.},\mbox{ cobbles},\mbox{ stones},\mbox{ boulders},\mbox{ etc.})} N/A$	Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH, BS, I	FS, TS)
3.	Distances from:	Open Water Body	N/A feet	_ Drainage Way	<u>N/A</u> feet	Wetlands	$\frac{450 + - feet}{feet}$
		Property Line	100'+/	_ Drinking Water	Well <u>N/A</u>	Other	N/A feet
4.	Parent Material:	Sandy till		Unsuit	able Materials	Present: Yes	X No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s) 🗆 \	Neathered/Fractured Rock	Bedrock
5.	Groundwater Ol	bserved: X Yes	🗌 No	If yes:	100"	122"	
			_	,	Depth We	eping from Pit Depth Standir	ng Water in Hole
	Estimated Dept	h to High Groundwater:	122"	62.3			
			inches	elevation	ו		



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-13

Depth (in.)		Soil Matrix: Color-	Red	loximorphic Feat	ures	Soil Texture	Coarse F % by \	ragments /olume		Soil	e Other	
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones	Soil Structure	(Moist)	Other	
0-10	А	10YR2/3				FSL						
10-40	Bw	10YR5/4				FSL						
40-132	С	10YR5/6				FSL		2%	Massive, fri	able	Some frac	tured
											ledge	

Additional Notes:

Standing Water noted at 122", weeping at 100. ESHWT @ 100", no

refusal, very little/no mottling noted. Some fractured ledge in C

horizon, easily broken up.



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	/ Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features				Coarse Fragments % by Volume		Soil Structure	Soil	Other
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-13	Obs. Hole #		
		Depth observed standing	water in observ	ation hole	122				
		Depth weeping from side of	of observation I	nole	inches 100		inches inches inches		
		Depth to soil redoximorphi	c features (mo	ottles)	inches				
	_			(-)	inches				
		Depth to adjusted seasonal high groundwater (S _h) (USGS methodology)			inches		inches		
		Index Well Number		Reading Date					
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]						
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	132
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

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Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address						
	_ Topsfield			MA		Map/Lot # 01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Constru-	ction	Upgrade	Γ	Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil S	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitati			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? [If Yes, continue to #5.	x Yes	🗌 No		e 100-year flood boundary A Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{\mathrm{W}}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (USGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal 🛛 Belo	w Normal
8.	Other references reviewed: N/	А					



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

	Deep Observat	tion Hole Number:	TP-14	12/9/2016 Date	10:30AM Time	Overcast, 35 degree Weather	S
1.	Location						
	Ground Elevation	on at Surface of Hole:	72.5	Latit	ude/Longitude	e: 42.664163 / -70.930328	_
	Description of L	ocation: South	ern corner (Se	e Test Pits Plan, TH	PP-1)		
2.	Land Use	Open field			N/A		3-8%
		(e.g., woodland, agricultural fine Grass	eld, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, boulders, etc.)	Slope (%)
~		Vegetation	N/A	Landform		Position on Landscape (SU, SH, BS, F	
3.	Distances from:	Open Water Body	feet	_ Drainage Way	<u>N/A</u> feet	Wetlands	$\frac{430+-\text{feet}}{\text{feet}}$
		Property Line	125'+/	- Drinking Water	Well <u>N/A</u>	Other	N/A
4.	Parent Material	Sandy till		Unsuita	able Materials	Present: Yes	X No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer(s) 🗆 '	Neathered/Fractured Rock	Bedrock
5.	Groundwater O	bserved: <u>x</u> Yes	🗌 No	If yes:	118"	122"	
	Estimated Dept	h to High Groundwater:	122" inches	62.7 elevation	•	eping from Pit Depth Standin	g Water in Hole



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-14

Depth (in.)	Soil Horizon/ Layer	/ Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil	Other
Depth (m.)			Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
0-12	A	10YR2/3				LS					
12-36	Bw	10YR5/4				LS					
36-132	С	10YR5/6				FSL		2%	Massive, fri	able	

Additional Notes:

Standing Water noted at 122", weeping at 118. ESHWT @ 118",

no refusal, very little/no mottling noted.



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observation	n Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
	(e.	g., woodland, agricultural fi	eld, vacant lot, etc.)		Surface Stones (e.g., cobl	bles, stones, boulders,	etc.) Slope (%)
	Ve	getation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet	_ • •	feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:			Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes: 🗌 Dis	sturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater Obse	erved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Depth to	b High Groundwater:					
			inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	/ Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features				Coarse Fragments % by Volume		Soil Structure	Soil	Other
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-14	Obs. Hole #		
		Depth observed standing	water in observ	ation hole	122				
		Depth weeping from side of	of observation h	nole	inches 118		inches inches inches		
		Depth to soil redoximorphi	c features (mo	ottles)	inches				
		Dopth to adjusted seasons	high groundw	vator(S)	inches				
		Depth to adjusted seasonal high groundwater (S _h) (USGS methodology)			inches		inches		
		Index Well Number		Reading Date					
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$							
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	132
			inches		inches
C.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator Typed or Printed Name of Soil Evaluator /

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal at	rea)
--	------

	Deep Observa	tion Hole Number:	TP-15	12/9/2016 Date	11:00AM Time	Overcast, 35 degr Weather	ees
1.	Location						
	Ground Elevation	on at Surface of Hole:	72.2	Lat	itude/Longitud	e: 42.664163 / -70.930328	
	Description of L	ocation: South	ern corner (See	e Test Pits Plan, T	'PP-1)		
2.	Land Use	Open field			N/A		3-8%
		(e.g., woodland, agricultural fie Grass	eld, vacant lot, etc.)	Morraine	Surface Stones	s (e.g., cobbles, stones, boulders, etc. N/A) Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH, BS	S, FS, TS)
3.	Distances from	Open Water Body	N/A feet	_ Drainage Way	<u>N/A</u> feet	A Wetlands	<u>300+/- feet</u>
		Property Line	125'+/	- Drinking Wate	r Well <u>N/A</u>	A Other	N/A feet
4.	Parent Material	: Sandy till		Unsui	itable Materials	s Present: 🗌 Yes	X No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer((s)	Weathered/Fractured Rock	Bedrock
5.	Groundwater O	bserved: x Yes	🗌 No	If yes:	: 120"	136"	
-				, , , , , , , , , , , , , , , , , , ,		eeping from Pit Depth Stan	ding Water in Hole
	Estimated Dept	h to High Groundwater:	120	62.2			-
		-	inches	elevatio	on	_	



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-15

Depth (in.)	Soil Horizon/ Layer	Soil Horizon/ S Layer		Soil Matrix: Color- Moist (Munsell)	Rec	loximorphic Feat	ures	Soil Texture		ragments /olume			Other	
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other			
0-12	А	10YR2/3				FSL								
12-40	Bw	10YR5/4				FSL								
40-140	С	10YR5/6				SL		5%	Massive, fri	able	Angular	cobbles		

Additional Notes:

Standing Water noted at 136", weeping at 120. ESHWT @ 120", partial refusal west

side of pit @116", mottling noted below weep line. Some fine materials in C layer.

Some angular cobbles in C layer (~5%)



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Horizon/ Soil Matrix: Color- ayer Moist (Munsell)	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-15	Obs. Hole #	
		Depth observed standing	water in observ	ation hole	136			
		Depth weeping from side of	of observation I	nole	inches 120		inches	
		Depth to soil redoximorphi	c features (mo	ottles)	inches		inches	
		Depth to adjusted seasona	al high groundv	vater (S _h)	inches		inches	
		(USGS methodology)			inches		inches	
		Index Well Number		Reading Date				
		$S_{h} = S_{c} - [S_{r} \times (OW_{c} - OW_{c})]$	/oWr]					
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	140
			inches		inches
C.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator Typed or Printed Name of Soil Evaluator /

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

	Deep Observat	tion Hole Number:	TP-16	12/9/2016 Date	11:30AM Time	Overcast, 35 degree	S
1.	Location						
	Ground Elevation	on at Surface of Hole:	68.0	Latit	ude/Longitude	e: 42.664163 / -70.930328	_
	Description of L	ocation: Cente	r of site (See T	est Pits Plan, TPP-	1)		
2.	Land Use	Open field			N/A		0-3%
		(e.g., woodland, agricultural fi Grass	eld, vacant lot, etc.)	Morraine	Surface Stones	s (e.g., cobbles, stones, boulders, etc.) N/A	Slope (%)
3.	Distances from:	Vegetation Open Water Body	N/A feet	Landform _ Drainage Way	<u>N/A</u> feet	Position on Landscape (SU, SH, BS, F Wetlands	⁻ S, TS) <u>200+/- feet</u> feet
		Property Line	$\frac{180'+/}{\text{feet}}$	Drinking Water	Well <u>N/A</u> feet	Conter	N/A feet
4.	Parent Material	Sandy till		Unsuit	able Materials	s Present: 🗌 Yes	X No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer(s	s) 🗌 V	Weathered/Fractured Rock	Bedrock
5.	Groundwater O	bserved: <u>x</u> Yes	🗌 No	If yes:	120"	128"	
	Estimated Dept	h to High Groundwater:	120 inches	58.0 elevatio		eeping from Pit Depth Standin	g Water in Hole



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-16	
-------	--

Depth (in.)	Soil Horizon/	/Soil Matrix: Color- Moist (Munsell)	Rec	loximorphic Feat	ures	Soil Texture	Coarse F % by \	ragments /olume	Soil Structure	Soil Consistence	Other	
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other	
0-18	A	10YR2/3				FSL						
18-24	Bw	10YR5/4				FSL						_
24-60	1C	10YR5/6				Sand						_
60-138	2C	10YR5/6				SL		5%			Angular	cobbles

Additional Notes:

Standing Water noted at 128", weeping at 120. ESHWT @ 120", refusal @

138" (bedrock), Some angular cobbles in C layer (~5%)



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-16	Obs. Hole #	
		Depth observed standing	water in observ	ation hole	128			
		Depth weeping from side of	of observation h	hole	inches 120		inches	
		Depth to soil redoximorphi	c features (mo	ottles)	inches		inches	
		Depth to adjusted seasona	al high groundw	vater (S⊾)	inches		inches	
		(USGS methodology)		inches		inches		
		Index Well Number		Reading Date				
		$S_{h} = S_{c} - [S_{r} \times (OW_{c} - OW)]$	/oW _r]					
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	138
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator Typed or Printed Name of Soil Evaluator /

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



Commonwealth of Massachusetts City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area*) TP-17 12/9/2016 12:30AM Overcast, 35 degrees

	Deen Observation Hale Number	1P-1/	12/9/2010	12.30/111	Overease, 55 degre	
	Deep Observation Hole Number:		Date	Time	Weather	
1.	Location					
	Ground Elevation at Surface of Hole:	69.5	Latitu	ide/Longitude: 42.	664163 / -70.930328	
	Description of Location: Southe	ern corner of e	xisting garage (See	Test Pits Plan, T	'PP-1)	
2.	Land Use Open field			N/A		0-3%
	(e.g., woodland, agricultural fie Grass	ld, vacant lot, etc.)	Morraine		cobbles, stones, boulders, etc.) $/A$	Slope (%)
	Vegetation		Landform	Posi	tion on Landscape (SU, SH, BS	, FS, TS)
3.	Distances from: Open Water Body	N/A feet	Drainage Way	N/A feet	Wetlands	$\frac{150+-feet}{feet}$
	Property Line	<u>160'+/-</u> feet	Drinking Water V	Nell <u>N/A</u>	Other	N/A feet
4.	Parent Material: Sandy till		Unsuita	ble Materials Pres	sent: 🗌 Yes	X No
	If Yes: Disturbed Soil IF	Fill Material] Impervious Layer(s)	🗌 Weath	nered/Fractured Rock	Bedrock
5.	Groundwater Observed: X Yes	🗌 No	If yes:	156"	166"	
				Depth Weeping	from Pit Depth Stand	ling Water in Hole
	Estimated Depth to High Groundwater:	156 inches	55.5 elevation			
			cicvation			



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-17

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Feat	ures	Soil Texture		Fragments Volume	Soil Structure	Soil	Other	
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other	
0-20	A	10YR2/1				LS					Heavily p	lowed
20-36	Bw	10YR5/8				SL						
36-60	1C	10YR5/6				Med. Sand		5%			Some coa	rse sand
60-168	2C	10YR5/6				SL					Angular	cobbles
											manganes	e deposits

Additional Notes:

Standing Water noted at 166", weeping at 156. ESHWT @ 156", refusal

@ 168" (bedrock), Some angular cobbles in 1C layer (~5%)



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-17	Obs. Hole #		
		Depth observed standing	water in observ	ation hole	166				
		Depth weeping from side of	of observation h	nole	inches 156		inches		
		Depth to soil redoximorphi	c features (mo	ottles)	inches		inches		
	_			(-)	inches		inches		
		Depth to adjusted seasona (USGS methodology)	al high groundw	vater (S _h)	inches		inches		
		Index Well Number		Reading Date					
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]						
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

E. Depth of Pervious Material

- 1. Depth of Naturally Occurring Pervious Material
 - a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	166
			inches		inches
C.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

ature of Soil Evaluator Typed or Printed Name of Soil Evaluator /

Date

Expiration Date of License

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"

		ites, Inc.

Title	MA DEP Standard Calculations	By DMR
Project	Rolling Green Elderly Housing Development, Topsfield, MA	Chk'd <u>SRC</u>
Date	October 13, 2016	Apprv'd SRC
Revised	January 17, 2017	
Date	October 13, 2016	

Computation Sheet

Stormwater Recharge/Water Quality Volume Table

Required Recharge Equation: Rv = F * Impervious Area

Rv = Required Recharge Volume, expressed in ft³, cubic yards or acre-feet F = Target Depth Factor associated with each Hydraulic Soil Group Impervious Area = pavement & rooftop area on site

Required Water Quality Treatment Volume Equation: V wq = (D wq/12 inches/foot) * (A IMP * 43,560 square feet/acre)

 V_{WQ} = Required Water Quality Treatment Volume, expressed in ft³

 $D_{WQ} = Water Quality Depth$

 $A_{IMP} = Impervious Area (excluding non-metal roofs)$

						1	Recharge Required		Water Quality Ve	olume Required	
				Imperviou	us Area (Feet)			Impervious Area		D (Inch)	V
W'SHED	Area (Feet)	Pervious	HSG A (F=0.6)*	HSG B (F=0.35)*	HSG C (F=0.25)*	HSG D (F=0.1)*	F Avg. (Inches)	(Feet)	$\mathbf{R}\mathbf{v}$ (ft ³)	D_{WQ} (Inch)	V_{WQ}
P-1	81,522	81,522	0	0	0	0	0.000	0	0	0.5	0
P-2	23,114	7,946	8,319	3,632	3,217	0	0.466	15,168	589	0.5	632
P-3	27,582	24,037	3,545	0	0	0	0.600	3,545	177	0.5	148
P-3A	4,950	1,557	3,393	0	0	0	0.600	3,393	170	0.5	141
P-4	21,573	9,507	12,066	0	0	0	0.600	12,066	603	0.5	503
P-5	39,272	19,021	19,655	0	596	0	0.590	20,251	995	0.5	844
P-6	19,137	7,682	11,455	0	0	0	0.600	11,455	573	0.5	477
P-7	15,670	8,687	6,983	0	0	0	0.600	6,983	349	0.5	291
P-8	15,307	14,235	1,072	0	0	0	0.600	1,072	54	0.5	45
P-9	102,567	98,195	4,372	0	0	0	0.600	4,372	219	0.5	182
P-10	31,595	29,291	0	0	2,304	0	0.250	2,304	48	0.5	96
R-1	3,185	0	850	0	2,335	0	0.343	3,185	91	0.5	133
R-2	3,195	0	0	0	3,195	0	0.250	3,195	67	0.5	133
R-3	3,625	0	0	0	3,625	0	0.250	3,625	76	0.5	151
R-4	3,625	0	0	0	3,625	0	0.250	3,625	76	0.5	151
R-5	3,195	0	0	0	3,195	0	0.250	3,195	67	0.5	133
R-6	3,625	0	630	0	2,995	0	0.311	3,625	94	0.5	151
R-7	3,895	0	3,895	0	0	0	0.600	3,895	195	0.5	162
R-8	3,625	0	3,625	0	0	0	0.600	3,625	181	0.5	151
R-9	3,625	0	3,625	0	0	0	0.600	3,625	181	0.5	151
R-10	3,895	0	3,895	0	0	0	0.600	3,895	195	0.5	162
R-11	3,625	0	3,625	0	0	0	0.600	3,625	181	0.5	151
R-12	3,895	0	3,895	0	0	0	0.600	3,895	195	0.5	162
R-13	3,895	0	3,895	0	0	0	0.600	3,895	195	0.5	162
R-14	3,625	0	3,625	0	0	0	0.600	3,625	181	0.5	151
R-15	1,705	0	1,705	0	0	0	0.600	1,705	85	0.5	71
R-16	1,490	0	1,490	0	0	0	0.600	1,490	75	0.5	62
R-17	120	0	120	0	0	0	0.600	120	6	1.5	15
Total	436,014	0			0	0			5,909		5,597

Allen & Major	Associates, Inc.	Computation Sheet	U
Title	MA DEP Standard Calculations	Ву	DMR
Project	Rolling Green Elderly Housing Development, Topsfield, MA	Chk'd	SRC
Date	October 13, 2016	Apprv'd	SRC
Revised	January 17, 2017		
Equations prov	vided above		
Rv = F * Imper	vious Area		

Underground Infiltration System #1 - #9 and Surface Detention Basins #1-3

Water Quality Volume

 $D_{WQ} = Water Quality Depth$

 $A_{WQ} =$

 $A_{WQ} =$

 $A_{WQ} = Required Water Quality Treatment Volume, expressed in ft³$ $<math>D_{WQ} = Water Quality Depth$ $A_{IMP} = Impervious Area (excluding non-metal roofs)$

Rv = Required Recharge Volume, expressed in fi³, cubic yards or acre-feet F = Target Depth Factor associated with each Hydraulic Soil Group

Provided (cf) 34,716

34,716

 A_{WQ} = Required Water Quality Treatment Volume, expressed in ft³

Impervious Area = pavement & rooftop area on site

A IMP = Impervious Area (excluding non-metal roofs)

Required (cf)

5,909 5,909

[Required (cf)	Provided (cf)]	
	$A_{WQ} =$	5,597	34,716		Underground Infiltration System #1 - #9 and Surface Detention Basins #1-3
[$A_{WQ} =$	5,597	34,716		Total

4

Total

Draindown Within 72 Hours

Timedrawdown=(Rv) (1/Design Infiltration Rate in inches per hour) (Conversion for inches to feet) (1/bottom area in feet)

Underground Infiltration System #1 (Assumed Sand)	
Infiltration Rate (in/Hr)=	1.02
Bottom Area $(ft^2) =$	3,396
Infiltration Volume $(ft^3) =$	965
Time _{drawdown} (Hours)=	3.34

Underground Infiltration System #2 (Sand)					
Infiltration Rate (in/Hr)=	8.27				
Bottom Area $(ft^2) =$	1,176				
Infiltration Volume $(ft^3) =$	837				
Time _{drawdown} (Hours)=	1.03				

Underground Infiltration Systems #3-9 (Sandy Loam)					
Infiltration Rate (in/Hr)=	1.02				
Bottom Area $(ft^2) =$	104				
Infiltration Volume $(ft^3) =$	195				
Time _{drawdown} (Hours)=	22.03				

Surface Infiltration System (Sandy Loam & Sand)	
Infiltration Rate (in/Hr)=	1.02	
Bottom Area $(ft^2) =$	4,743	
Infiltration Volume $(ft^3) =$	2,959	
Time _{drawdown} (Hours)=	7.34	Page 2

Allen & Major Associates, Inc.

Title	MA DEP Standard Calculations
Project	Rolling Green Elderly Housing Development, Topsfield, MA
Date	October 13, 2016
Revised	January 17, 2017

TSS Removal Worksheet

Α	B BMP'	C TSS Removal Rate'		D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)	
ulation 祥1	Deep Sump and Hooded Catch Basin	0.25		1.00	0.25	0.75	(25% has been removed prior to infiltration)
TSS Removal Calculation Worksheet - UIS#1	Proprietary Treatment Practice WQU- 1	0.77		0.75	0.58	0.17	
TSS Rer Work	Subsurface Infiltration Basin #1 with Filter Fabric	0.80		0.17	0.14	0.03	
			Total ⁻	TSS Removal =	97%		
Α	В	С		D	E	F	
	BMP'	TSS Removal Rate		Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)	
S oval ation #2	Deep Sump Catch Basins	0.25		1.00	0.25	0.75	(25% has been removed prior to infiltration)
TSS Removal Calculation Worksheet - UIS #2	Subsurface Infiltration Basin #1	0.80		0.75	0.60	0.15	
			Total	TSS Removal =	85%		_

Computation Sheet

By DMR Chk'd SRC Apprv'd SRC

Allen & Major Associates, Inc.

Allen & Major Ass	sociates, Inc.	Computation Sh	Computation Sheet		
Title	MA DEP Standard Calculations	Ву	DMR		
Project	Rolling Green Elderly Housing Development, Topsfield, MA	Chk'd	SRC		
Date Revised	October 13, 2016 January 17, 2017	Apprv'd	SRC		

Α	В	C TSS Removal		D Starting TSS	E Amount	F Remaining	
	BMP ¹	Rate ¹		Load*	Removed (C*D)	Load (D-E)	_
ioval tion 3	Deep Sump Catch Basins	0.25		1.00	0.25	0.75	(25% has been removed prior to infiltration)
TSS Rem Calculat orksheet #2 & 3	Proprietary Treatment Practice	0.80		0.75	0.60	0.15	
TS 0 Wor	Infiltration Basin	0.80		0.15	0.12	0.03	

Total TSS Removal =

Mounding Analysis

Infiltration System	Water Table		System Bottom	Vertical Separation	Attenuated System	Mounding Analysis Required
1	56.50		60.00	3.5	YES	YES
2	59.50		61.50	2.0	YES	YES

97%

Allen & Major Associates, Inc.

TitlePipe Sizing TableProjectTopsfield Elderly Housing DevelopmentDateOctober 13, 2016RevisedJanuary 17, 2017A&M Project Number: 2165-01A

Minimum Slope:	0.0047	_	By	DMR	
Minimum Pipe Size:	6		Chk'd	SRC	
Rainfall Intensity (in/hr):	5.40	(25 year storm)	Apprv'd	TJW	
Manning's n:	0.011	HDPE/PVC			
Manning's n:	0.013	RCP			
Minimum Pipe Cover:	1.84'	_			

Elderly Housing Development - Topsfield, MA

Line						Req'd. Capac.	Pipe Size	Slope	Design	Capacity	Drop	Invert Elev	ation	Rim Elev.	
From	То	Length	Area	wgt. C	CA	Qd	D	S	Q _{full}	V _{full}		Upper	Lower	Upper	Cover
Upper	Lower	(feet)	(acres)			(cfs)	(in)	(%)	(cfs)	(fps)	(feet)	(ft)	(ft)	(ft)	(ft)
CB1	DMH-1	32	0.402	0.57	0.228	1.23	10	1.00%	2.6	4.75	0.32	64.66	64.34	69.10	3.48
CB2	DMH-1	40	0.060	0.91	0.054	0.29	10	0.70%	2.2	3.97	0.28	64.62	64.34	68.50	2.92
DMH-1	WQU-1	19				1.52	12	1.53%	5.2	6.62	0.29	64.34	64.05	68.00	2.54
REAR OF UNITS	CLEANOUT	100	0.046	0.95	0.044	0.24	6	1.00%	0.7	3.38	1.00	100.00	99.00	102.00	VARIES
LARGEST UNIT (AA)	CLEANOUT	100	0.087	0.95	0.083	0.45	6	1.00%	0.7	3.38	1.00	100.00	99.00	102.00	VARIES
WQU1	UIS1	7.5	1.047	0.69	0.719	2.21	12	2.00%	6.0	7.58	0.15	63.80	63.65	68.40	3.48
CB3	DMH5	12	0.130	0.79	0.103	0.55	10	1.00%	2.6	4.75	0.12	72.45	72.33	75.30	1.89
CB4	DMH5	12	0.130	0.79	0.103	0.55	10	1.00%	2.6	4.75	0.12	72.35	72.23	75.20	1.89
CB5	DMH4	17	0.207	0.75	0.155	0.84	10	1.00%	2.6	4.75	0.17	71.84	71.67	75.05	2.25
CB6	DMH4	17	0.207	0.75	0.155	0.84	10	1.00%	2.6	4.75	0.17	71.84	71.67	75.10	2.30
WQU2	DMH9	21	0.673	3.08	0.515	2.78	12	0.95%	4.1	5.23	0.20	70.75	70.55	76.90	5.03
UIS 3	DMH9	30	0.083	0.95	0.079	0.43	6	9.00%	2.0	10.13	2.70	73.40	70.70	76.75	2.72
UIS 4	6" TEE	30	0.073	0.95	0.070	0.38	6	0.47%	0.5	2.31	0.14	74.20	74.06	77.50	2.68
UIS 5	CO-7	22	0.083	0.95	0.079	0.43	6	0.91%	0.6	3.22	0.20	74.80	74.60	78.30	2.88
CO-7	6" TEE	54	0.083	0.95	0.079	0.43	6	1.00%	0.7	3.38	0.54	74.60	74.06	78.00	2.78
6" TEE	DMH 9	63	0.083	0.95	0.079	0.43	8	5.57%	3.4	9.66	3.51	74.06	70.55	78.00	3.15
DMH9	FES1	62				3.58	15	0.48%	5.3	4.33	0.30	70.45	70.15	76.90	5.08
DMH5	DMH4	46	0.402	0.57	0.228	1.23	10	1.00%	2.6	4.75	0.46	72.13	71.67	75.30	2.21
CB7	WQU3	5	0.281	0.80	0.226	1.22	10	3.00%	4.5	8.22	0.15	72.00	71.85	74.80	1.84
CB8	WQU3	15	0.281	0.80	0.226	1.22	10	1.00%	2.6	4.75	0.15	72.00	71.85	74.80	1.84
WQU3	DMH6	31	0.562	1.61	0.452	2.44	12	0.97%	4.2	5.27	0.30	71.60	71.30	74.90	2.18
DMH-6	FES-2	36	0.888	0.70	0.619	3.34	12	0.56%	3.1	4.00	0.20	71.20	71.00	75.10	2.77
OCS-1	DMH-10	155				9.45	15	1.80%	10.3	8.35	2.79	70.00	67.21	74.00	2.63
DMH-10	FES-3	97				9.45	15	1.76%	10.2	8.26	1.71	67.11	65.40	71.80	3.32
DCB-9	CB-2	82	0.725	0.39	0.286	1.54	10	0.50%	1.8	3.36	0.41	65.13	64.72	70.70	4.61

Computation Sheet

Illicit Discharge Compliance Statement

Responsibility:

The Owner is responsible for ultimate compliance with all provisions of the Massachusetts Stormwater Management Policy, the USEPA NPDES Construction General Permit and responsible for identifying and eliminating illicit discharges (as defined by the USEPA).

OWNER NAME:	Sarkis Development Company
ADDRESS:	2 Elm Square
	Andover, MA 01810
TEL. NUMBER:	(978) 475-4055

Engineer's Compliance Statement:

To the best of my knowledge, the attached plans, computations and specifications meet the requirements of Standard 10 of the Massachusetts Stormwater Handbook regarding illicit discharges to the stormwater management system and that no detectable illicit discharges exist on the site. All documents and attachments were prepared under my direction and qualified personnel properly gathered and evaluated the information submitted, to the best of my knowledge.

Included with this statement are site plans, drawn to scale, that identify the location of systems for conveying stormwater on the site and show that these systems do not allow the entry of any illicit discharges into the stormwater management system. The plans also show any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater systems.

For a redevelopment project (if applicable), all actions taken to identify and remove illicit discharges, including without limitation, visual screening, dye or smoke testing, and the removal of any sources of illicit discharges to the stormwater management system are documented and included with this statement.