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March 16, 2020

BY HAND and BY EMAIL

Mr. John Daghlian
Associate City Engineer
Engineering Division
Newton City Hall
1000 Commonwealth Avenue
Newton, MA 02459-1449

Re: Residences on the Charles 40B/15 Riverdale Avenue

Dear John,

I am enclosing herewith a revised drainage report dated March 13, 2020 together with the related existing and proposed watershed plans relative to the above project prepared by Allen and Major Associates, Inc. Also enclosed is a revised plan set entitled "Site Development Plans for Residences on the Charles, 15 Riverdale Avenue, Newton, MA" by Allen & Major Associates, Inc. dated March 13, 2020 consisting of 21 sheets.

Please feel free to contact me if you have any questions respecting the foregoing.

Sincerely,

Stephen J. Buchbinder

SJB/mer
Enclosures

cc: (By Email, w/out enclosures)
Ms. Katie Whewell
Ms. Adrianna Henriquez Olmstead
Mr. Jack Englert

ALLEN & MAJOR
ASSOCIATES, INC.

SITE LOCUS: N.T.S.

PROPOSED RESIDENCES ON THE CHARLES

NEWTON, MASSACHUSETTS

DRAINAGE REPORT

DATE PREPARED: DECEMBER 11, 2019
DATE REVISED: FEBRUARY 13, 2020
DATE REVISED: MARCH 13, 2020

3/13/20

COMMONWEALTH OF MASSACHUSETTS
TIMOTHY J. WILLIAMS
CIVIL
No. 43110
REGISTERED PROFESSIONAL ENGINEER

APPLICANT:
CPC LAND ACQUISITION COMPANY, LLC
1601 TRAPELO ROAD
SUITE 174
WALTHAM, MA 02451

PREPARED BY:
ALLEN & MAJOR ASSOCIATES, INC.
100 COMMERCE WAY, SUITE 5
WOBURN, MASSACHUSETTS 01801

A&M PROJECT NO. : 1374-23

DRAINAGE REPORT

PROPOSED RESIDENCES ON THE CHARLES

NEWTON, MA

PROPONENT:

CPC LAND ACQUISITION COMPANY, LLC
1601 TRAPELO ROAD
WALTHAM, MA 02451

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
100 COMMERCE WAY
WOBURN, MA 01888-0118

DATE ISSUED: DECEMBER 11, 2019
DATE REVISED: FEBRUARY 13, 2020
DATE REVISED: MARCH 13, 2020

A&M PROJECT #1374-23

Table of Contents

6. WATERSHED PLANS

EWS	EXISTING WATERSHED PLAN
PWS	PROPOSED WATERSHED PLAN

7. PLAN SET (UNDER SEPARATE COVER)

Section 1.0 Drainage Report

Table of Contents

- **INTRODUCTION**

The purpose of this drainage report is to provide an overview of the proposed stormwater management system for the proposed site redevelopment at 15 Riverdale Avenue, Newton, MA. The report will show by means of narrative, calculations and exhibits that the project meets DEP and the City of Newton's Stormwater Management Regulations.

The proposed project consists of the development of two separate buildings located to the north and south of Midland Avenue. The larger building to north of Midland Avenue is proposed to have a footprint of approximately 57,819 square feet, and 5 stories with 166 apartment units. The smaller building the south of Midland Avenue is proposed to have a footprint of approximately 13,403 square feet, and 4 stories with 38 apartment units. The larger building will have a hardscaped concourse area open to the air which splits the building. There will be a porous pave fire access road and a landscaped flood mitigation area to the south of the larger building. The stormwater management onsite has been designed to meet the treatment requirements of the City of Newton and the Massachusetts Department of Environmental Protection, Stormwater Standards and Stormwater Handbook.

The proposed site preparations include the removal of the existing buildings and associated parking lots on 15 Riverdale Avenue. The existing pavement within Midland Avenue, and Riverdale Avenue will have full depth reclamation. Los Angeles Street will have full depth reclamation from Midland Avenue to California Street. Additional site preparations include removing or abandoning drainage lines with the exception of the 18" clay drainage line at the northeast corner of the site, see site preparation plan. This existing 18" clay pipe will be maintained as an outlet within the proposed design.

The proposed stormwater management system (SMS) incorporates structural and non-structural BMPs to provide stormwater quality treatment and conveyance. The SMS includes drainage piping and structures, water quality units (proprietary separators and Contech Jellyfish® stormwater filter), underground detention basin and porous pavement. The environmentally sensitive site design incorporates low impact development techniques within the buffer areas to improve the existing site condition. These techniques include the installation of porous pavement and a flood mitigation area, which will introduce more native plantings and provide water quality treatment.

The primary mechanisms to address the peak rate of runoff from the site redevelopment is from the proposed underground detention system and a reduction in the total impervious area. The proposed redevelopment plan will reduce the impervious area by approximately 10,218 square feet with the installation of new landscaped areas and porous pavement. The result is a reduction in the rate and volume of stormwater runoff to the Charles River.

- **SITE CATEGORIZATION FOR STORMWATER REGULATIONS**

Due to the reduction in impervious area the proposed project is considered a redevelopment under the Massachusetts Stormwater Handbook. A "redevelopment" project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice 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. See the discussion of Stormwater Management Standards that follows.

- **SITE LOCATION AND ACCESS**

The site is a single lot with frontage on Midland Ave and Los Angeles Street, entirely within the City of Newton and is located approximately 0.1 miles from the intersection of California Street and Los Angeles Street to the south. The site has two existing buildings and two proposed buildings. The proposed buildings are referred to as Building 1, north of Midland Avenue, and Building 2, south of Midland Avenue. The existing building north of Midland Avenue, which will be replaced by Building 1, currently has four points of access to Midland Avenue. Two of these points of access are for passenger cars and two are for a mix of passenger car parking and loading docks. This will be reduced to threes access driveways for Building 1 parking lot access. The existing building south of Midland Avenue, which will be replaced by Building 2, has two existing access driveways. One driveway exits onto Midland Avenue form an existing parking lot, the other exits onto Los Angeles Street from an existing staging yard. The general location of these access points will be maintained for access driveways to Building 2.

- **WATERSHED**

The site is located within the Charles River Watershed directly abutting the Charles River. The Charles River Watershed has an area of approximately 308 square miles, encompassing 35 City and cities south and west of Boston Massachusetts. There are 20 dams along the 80-mile long Charles River, which ultimately flows to Boston Harbor. Exhibit 1 shows the limits of the Charles River Watershed.

The existing site discharges untreated stormwater directly into the 18" clay drainage line, which discharges to the Charles River. The site being located within the Charles River Watershed requires a TDML goal of a 65% reduction in the total phosphorus load discharged from the proposed site. With the installation of porous pavement systems and a Contech Jellyfish® stormwater filter the drainage system reduction goal has been met. Please refer to the loading calculations located in the appendices of this report.

EXHIBIT 1: Charles River Watershed

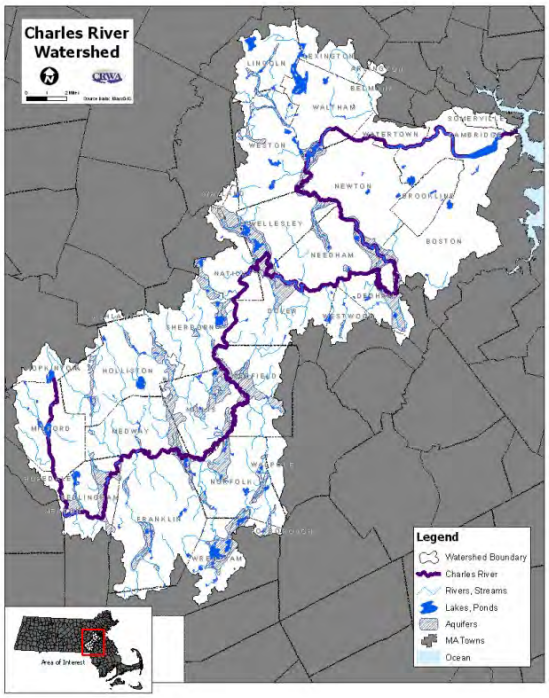


Image Source: Charles River Watershed Association

- **EXISTING SITE CONDITIONS**

The existing building north of Midland Avenue (approximately 52,033 square feet) sits in the center of the site. The existing building south of Midland Avenue (approximately 1,136 square feet) sits in the northeast corner of the parking lot. All surrounding topography generally slopes from south to north towards the Charles River. The majority of the site is comprised of impervious cover with some vegetation along the Charles River. The existing buildings have "flat" roofs. A majority of the site is connected to the underground drainage system through a series of catch basins and manholes that outlet into an 18" clay pipe that discharges directly to the Charles River.

The surface drainage flows have been analyzed at two (2) Study Points. Study Point #1 is the summation of onsite flows to the existing 18" clay pipe at the northeast corner of the site which discharges to the Charles River. Study Point #2 is the summation of all overland flows from the site to the Charles River.

- **EXISTING SOIL CONDITIONS**

The on-site soils have been identified utilizing the USDA Natural Resources Conservation Services (NRCS) Soil Survey for Middlesex County. The site is primarily soil type 602 – Urban Land. A copy of the soil map is included in the appendix of this report.

Further investigation on the underlying soils has been conducted by performing four (4) test pits throughout the site in locations identified for stormwater management. The test pit's show underlying soils to be primarily Loamy Sands. Loamy Sands have a Hydrologic Soil Group "A" designation which has been used throughout the design. The test pits showed groundwater elevations ranging from approximately elevation 15.8 at pit #4, to elevation 14.5 at pit #2&3. An exfiltration rate for the Loamy Sands has been determined to be 2.41 inches per hour based upon Table 2.3.3 1982 Rawls Rate, Volume 3: Documenting Compliance with the Massachusetts's Stormwater Handbook.

- **FEMA FLOODPLAIN**

Portions of the site are located within the FEMA *Zone "AE" Special Flood Hazard Area Subject to Inundation by the 1% Annual Chance Flood* (a.k.a. 100-year floodplain). The official Flood Insurance Rate Map (FIRM) on file with the City of Newton is dated June 4, 2010, community panel 25017C0552E. A copy of this map is provided in the appendix of this report.

- **DRAINAGE ANALYSIS METHODOLOGY**

A peak rate of runoff has been determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.

2. HydroCAD© Stormwater Modeling System by HydroCAD Software Solutions LLC, version 10.00, 2018. 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. Soil Survey of Middlesex County Massachusetts by United States Department of Agriculture, NRCS. Soil types and boundaries were obtained from this reference.

- **PEAK RATE OF RUNOFF**

A stormwater runoff analysis has been prepared for both the existing and proposed conditions and includes an estimate of the peak rate of runoff and total runoff volume from various rainfall events. Peak runoff rates have been developed using TR-55 Urban Hydrology for Small Watersheds, developed by the U.S. Department of Commerce, Engineering Division and the HydroCAD 10.00 computer program. Further, the analysis has been prepared in accordance with the City of Newton requirements and standard engineering practices including a design storm of 8.78 inches of precipitation in 24 hours for the 100-year storm event. The peak rate and volume of runoff will be estimated for each watershed during the 2, 10, 25 and 100-year storm events.

The stormwater runoff model indicates that the proposed site development reduces the rate and volume of runoff during all storm events at the identified points of analysis. The following tables provide a summary of the estimated peak rate, in Cubic Feet per Second (CFS) and total runoff volume, in cubic-feet (CF) at each of the two (2) Study Points for each of the design storm events. The HydroCAD worksheets are included in Section 3 and 4 of this report.

STUDY POINT #1 (Flow to Existing 18" Outlet Pipe to Charles River)

	2-Year	10-Year	25-Year	100-Year
Existing Runoff (CFS)	9.12	14.01	16.92	27.50
Redeveloped Runoff (CFS)	5.80	8.65	10.47	24.89
DECREASE	3.32	5.36	6.45	2.61
Existing Volume (CF)	31,164	48,856	59,549	98,722
Redeveloped Volume (CF)	26,548	42,073	51,620	87,460
DECREASE	4,616	6,783	7,929	11,262

STUDY POINT #2 (Overland Flow to Charles River)

	2-Year	10-Year	25-Year	100-Year
Existing Runoff (CFS)	0.04	0.18	0.28	1.55
Redeveloped Runoff (CFS)	0.00	0.00	0.01	0.11
DECREASE	0.04	0.18	0.27	1.44
Existing Volume (CF)	223	938	1,683	5,817
Redeveloped Volume (CF)	2	48	100	404
DECREASE	221	890	1,583	5,413

- **MA DEP STORMWATER PERFORMANCE STANDARDS**

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 meets the standards set forth by the Policy.

BMP's implemented in the design include:

Deep sump Catch Basins
Hydro-dynamic (Proprietary) Separators
Contech Jellyfish® Stormwater Filter
Underground Detention Basin
Porous Pavement

Stormwater Best Management Practices (BMP's) have been incorporated into the design of the project to mitigate the anticipated pollutant loading. The stormwater management system incorporates structural and non-structural BMP's to provide stormwater quality treatment and conveyance.

Temporary erosion and sedimentation controls will be incorporated into the construction phase of the project. These temporary controls may include straw bale 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 enumerated below as well as a description as to how the Project will comply with the Standards:

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 area or waters of the Commonwealth of Massachusetts. All discharges will be treated for water quality and the rate will not be increased over existing conditions.

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 so that the post-development peak discharge rates do not exceed the predevelopment peak discharge rates. A summary of the existing and proposed discharge rates is included within this document.

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 proposed site improvements are classified as a "redevelopment" under the MA DEP Stormwater Management Standards based upon a reduction in impervious area. Consequently, compliance with Standard #3 is required only to the maximum extent practicable. This reduction is achieved with the installation of porous pavement and landscape areas. However, the site has been designed to fully comply with Standard #3 as if the project was classified as a new development. This has been achieved with the design of porous pavement systems. See recharge calculations below;

Existing impervious area	= 140,728± square feet
Proposed impervious area	= 130,510± square feet
Change in impervious area	**= -10,218± square feet**

Total proposed impervious area (taken from HydroCAD model) = 130,510± square feet

Recharge Volume (Rv) = (F) x (Impervious Area)

Where:
Rv = Required Recharge Volume, expressed in cubic feet
F = Target Depth Factor associated with each Hydrologic Soil Group
Impervious Area = proposed impervious pavement, sidewalk, rooftop in square feet

Recharge Volume (Rv) = (F) x (impervious Area)
= (0.60 inches)*(1/12 inches/ft)* (130,510 square feet) [for Soil Group A]
= 6,526 ft^3

Recharge Provided; Porous Pavement Storage Volume = 6,526 ft^3 (See Appendix)

9,848 ft^3 > 6,526 ft^3 Required

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 site is classified as a "redevelopment" under the MA DEP Stormwater Management Standards. Consequently, compliance with Standard #4 is to the maximum extent practicable. Standard #4 is met when 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. The water quality volume for the site redevelopment is captured and treated using hydro-dynamic (proprietary) separators, stormwater filters, underground detention, and porous pavement.

The water quality volume (WQV) for runoff discharging to the existing 18" clay pipe is captured within the underground detention system with pretreatment from deep sump catch basins, proprietary separators and nitrogen and phosphorus removal from the Contech Jellyfish® stormwater filter. The Jellyfish unit is designed as an offline device with bypass flows routed through an outlet control structure and overflow weir. The weir elevation is set to capture 3,958 c.f. WQV before bypass. The required WQV for the portion of the site discharging to the 18" clay pipe is described below:

Contributing Treated Impervious Area = 52,357 s.f.

WQV = (52,357 s.f)(1in/12in/ft) = 4,363 c.f.

WQV Provided below weir = 4,368 c.f.

The TSS removal efficiencies for the proprietary separator are based on the values assigned under the Technology Acceptance and Reciprocity Partnership (TARP) testing protocol. The TARP is a workgroup of the Environmental Council of States that was originally comprised of California,

Illinois, Maryland, Massachusetts, New Jersey, New York, Pennsylvania and Virginia. TARP is recognized in the MA DEP Stormwater Management Handbook as a valid source for assigning TSS removal efficiencies for proprietary separators.

Other runoff (excluding roofs) from the site is captured and treated within the porous pavement subbase courses. Porous pavement will have 80% TSS removal credit if storage bed is sized to hold ½-inch or 1-inch water quality volume, and designed to drain within 72 hours. The required WQV for the portion of the site discharging to the porous pavement is described below:

Porous Pave #1

Impervious Area = 10,376 s.f.

WQV = (10,376 s.f)(1in/12in/ft) = 865 c.f.

WQV Provided = 7,753 c.f.

Porous Pave #2

Impervious Area = 658 s.f.

WQV = (658 s.f)(1in/12in/ft) = 55 c.f.

WQV Provided = 2,095 c.f.

FLOW TO EXISTING 18" OUTLET PIPE

TREATMENT TRAIN #1

BMP	TSS Removal Rate	Starting TSS Load	Amount Removed	Remaining Load
Deep Sump Catch Basin	0.25	1.00	0.25	0.75
Proprietary Separators	0.44	0.75	0.33	0.42
Contech Jellyfish® stormwater filter	0.80	0.42	0.34	0.08
TOTAL TSS REMOVAL	**0.92 or 92.00%**			

TREATMENT TRAIN #2

BMP	TSS Removal Rate	Starting TSS Load	Amount Removed	Remaining Load
Deep Sump Basin	0.25	1.00	0.25	0.75
Porous Pavement	0.80	0.75	0.60	0.15
TOTAL TSS REMOVAL	**0.85 or 85.00%**			

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

The site is considered a source of higher potential pollutant loads because it is anticipated that the project will generate greater than 1,000 vehicle trips per day. Pretreatment and Source reduction is provided to the maximum extent practicable. The drainage system will be designed to treat 1" water quality volume.

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 or Interim Wellhead Protection Area or near a critical area. Critical Areas are Outstanding Resource Waters as designated in 314 CMR 4.00, Special Resource Waters as designated in 314 CMR 4.00, recharge areas for public water supplies as defined in 310 CMR 22.02, bathing beaches as defined in 105 CMR 445.000, cold-water fisheries as defined in 314 CMR 9.02 and 310 CMR 10.04, and shellfish growing areas as defined in 314 CMR 9.02 and 310 CMR 10.04.

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 considered a redevelopment under the MA DEP Stormwater Management Standards as there is a decrease in the amount of total impervious area.

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

   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. The applicant will submit the Illicit Discharge Compliance Statement prior to the discharge of stormwater runoff to the post-construction stormwater best management practices and prior to the issuance of a Certificate of Compliance.

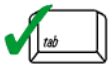
- **MA DEP CHECKLIST FOR STORMWATER REPORTS**
  See following pages.

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 8[2]
- Operation and Maintenance Plan required by Standard 9

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

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

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

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

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

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

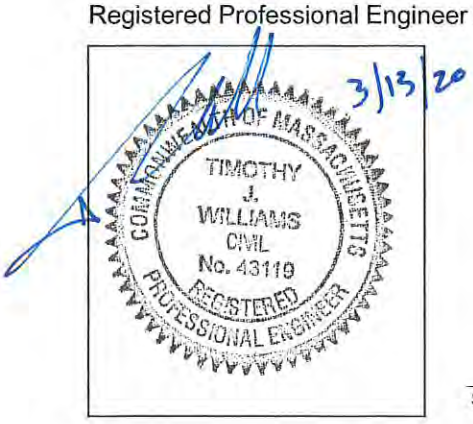
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☒ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☒ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☒ Other (describe): Porous Pave

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☒ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☒ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☒ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☒ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☒ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

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

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

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☒ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

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

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

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

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

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

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Section 2.0 Operation & Maintenance Plan

Table of Contents

- **INTRODUCTION**

In accordance with the standards set forth by the Stormwater Management Policy issued by the Department of Environmental Protection (DEP), Allen & Major Associates, Inc. has prepared the following Operation and Maintenance Plan for the new development of the Proposed Residences on the Charles development, 15 Riverdale Avenue, Newton, MA.

The plan is broken down 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 a post-construction operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long Term Maintenance Plan).

- **NOTIFICATION PROCEDURES FOR CHANGE OF RESPONSIBILITY FOR O&M**

The Stormwater Management System (SMS) for this project is owned by CPC Land Acquisition Company. (owner). The owner shall be legally responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance (O&M) Plan.

The project owner shall submit an annual summary report and the completed Operation & Maintenance Schedule & Checklist to the Conservation Commission (via email or print copy), highlighting inspection and maintenance activities including performances of BMPs. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner shall notify the Commission that the succeeding owner has assumed such responsibility. Upon subsequent transfers, the responsibility shall continue to be that of transferring owner until the transferee owner notifies the Commission of its assumption of responsibility.

In the event the SMS will serve multiple lots/owners, such as the subdivision of the existing parcel or creation of lease areas, the owner(s) shall establish an association on other legally enforceable arrangements under which the association or a single party shall have legal responsibility for the operation and maintenance of the entire SMS. The legal instrument creating such responsibility shall be recorded with the Registry of Deeds and promptly following its recording, a copy thereof shall be furnished to the Commission.

- **CONTACT INFORMATION**

Stormwater Management System Owner: CPC Land Acquisition Company, LLC
15 Riverdale Avenue
Newton, MA 02451
Phone: (781) 890-5600

Emergency Contact Information:

o CPC Land Acquisition Company, LLC (owner/operator)	Phone (781) 890-5600
o Allen & Major Associates, Inc. (Site Civil Engineer)	Phone (781) 935-6889
o Newton Public Works	Phone (617) 796-1000
o Newton Conservation Commission	Phone (617) 796-1134
o Newton Fire Department (non-emergency line)	Phone (617) 796-2200
o DEP Emergency Response (Mass DEP)	Phone (888) 304-1133
o Clean Harbors Inc (24-Hour Line)	Phone (800) 645-8265

- **CONSTRUCTION PERIOD**

1. Prior to the commencement of any site work, the Applicant and general contractor shall meet with the City Planner, Building Inspector, and the Board's Consulting Engineer in order to establish a construction phasing schedule and designated construction route.

2. Install Erosion Control measures as shown on the Erosion Control Plan prepared by A&M. The Newton Conservation agent shall approve the installation of hay bales and tubular barriers 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, hay bales, and tubular barriers at the locations shown on the 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 hay bales around each drain inlet prior to any demotion and or construction activities.

7. All erosion control measures shall be inspected weekly and after every rainfall event. Records of these inspections shall be kept on site for review by the City of Newton.

8. All erosion control measures shall be maintained, repaired or replaced as required or at the direction of the owner's engineer, the City Engineer, or the City Conservation Agent.

9. Sediment accumulation up-gradient of the hay 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. If it appears that sediment is exiting the site, 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.

11. Install stone check damns on site during construction as needed. 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.

o HOUSEKEEPING

The proposed site development will be designed to maintain a high level of water quality treatment for all stormwater discharge to the resource areas. 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 is a strict and complete manner.

o STORING OF MATERIALS AND WASTE PRODUCTS

There are proposed fenced-in exterior dumpster storage areas. The trash and waste program for the site includes exterior dumpsters. There will be a trash contractor used to pick up the waste material in the dumpsters. The stormwater drainage system has water quality inlets designed to capture trash and debris.

o VEHICLE WASHING

Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system. The proposed project does not include any designated vehicle washing areas, nor is it expected that any vehicle washing will take place on-site.

o 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.

- 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. No trees shall be planted over the drain lines or infiltration trenches, and that only shallow rooted plants and shrubs will be allowed.

- **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.

Only slow-release organic fertilizers should be used in the planting and mulch areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of the planting and mulch areas will be performed within manufacturers labeling instructions and shall not exceed an NPK ration of 1:1:1 (i.e. Triple 10 fertilizer mix), considered a low nitrogen mixture. Fertilizers approved for the use under this O&M Plan are as follows:

Type: LESCO® 28-0-12 (Lawn Fertilizer)
MERIT® 0.2 Plus Turf Fertilizer
MOMENTUM™ Force Weed & Feed

- **Suggested Aeration Program**

In-season aeration of lawn areas is good cultural practice, and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The depth of solid tine aeration is similar to core type, but should be performed when the soil is somewhat drier for a greater overall effect.

Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

The spring aeration should consist of two passes at opposite directions with 1/4" hollow core tines penetrating 3-5" into the soil profile. Aeration should occur when the soil is moist but not saturated. The soil cores should be shattered in place and dragged or swept back into the turf to control thatch. If desired the cores may also be removed and the area top-dressed with sand or sandy loam. If the area drains on average too slowly, the topdressing should contain a higher percentage of sand. If it is draining on average too quickly, the top dressing should contain a higher percentage of soil and organic matter.

- **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.
  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.

o 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 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 household or structural pests. 333 CMR 13.08.

Before beginning each application, the applicator must post a Department 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

Public Buildings - Applicators or their employers will provide pre-notification to any person upon their request. Pre-notification will include:

1. Name and phone number of the company making the application
2. Proposed date of application
3. Locations to be treated; and
4. Name, EPA Registration Number, and active ingredients of the products being used.

The applicator or their employers shall pre-notify the occupants of residential units between seven (7) days and forty-eight (48) hours prior to any application. The notification must include the following:

1. Name and phone number of company making the application
2. Proposed date and time of application
3. Locations to be treated
4. Product names, EPA Registration Numbers, and active ingredients for the pesticide products that may be used
5. Purpose of application
6. Preparation procedures required by the pesticide label to protect items such as food, utensils, and pests; and
7. Department approved Consumer Information Bulletin

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

- PET WASTE MANAGEMENT

The City of Newton has a dog control ordinance and anti-littering ordinance that requires all persons to remove waste material from within any way within the City. The owner's landscape crew (or designee) shall remove any obvious pet waste that has been left behind by pet owners within the project area. The pet waste shall be disposed of in accordance with local and state regulations.

- OPERATIONS AND MANAGEMENT OF SEPTIC SYSTEMS

There are no proposed septic systems within the limits of the project.

- MANAGEMENT OF DEICING CHEMICALS AND SNOW

Snow will be stockpiled on site until the accumulated snow becomes a hazard to the daily operations of the site. 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.

- **LONG TERM MAINTENANCE PLAN – FACILITIES DESCRIPTION**

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.

The following is a description of the stormwater management system for the project site.

Stormwater Collection System – On Site:

The stormwater collection system is a series of inlets located at low points within the limits of the paved area. An 18" pipe in the northern section of the site will remain undisturbed. All of the proposed on-site catch basins incorporate a deep sump and hooded outlet. The catch basins are connected by a closed gravity pipe network that pass through proprietary separators prior to entering the underground detention chamber or porous pavement.

Structural Pretreatment BMPs:

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.

Deep Sump Catch Basins:

Inspect catch basins 2 times per year (specifically after foliage and snow season) to ensure that the catch basins are working in their intended fashion and that they are free of debris. Structures will be skimmed of floatable debris at each inspection and sediment will be removed when or before sump is determined to be 50% full. If the basin outlet is designed with a hood to trap floatable materials (i.e. Snout), check to ensure watertight seal is working.

Proprietary Separators:
Proprietary Separators will be inspected and cleaned out 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.

Other BMPs and Accessories:

Porous Pavement:
Clean surface using vacuum sweeping machines monthly. Regularly monitor the paving surface to make sure it drains properly after storms. Inspect surface annually for deterioration or spalling. No winter sanding is allowed.

JellyFish Filter:
Sediment should be removed when accumulated to a depth of 12". Sediment and debris shall be removed by a vacuum truck. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations

Bioretention Area:
The bioretention area should be inspected each month for any trash accumulated during storm events. Mulch should be added annually along with the removal and replacement of any dead vegetation.

Underground Detention Chamber:
Sediment should be removed when accumulated to a depth of 3". Sediment and debris shall be removed by a vacuum truck. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations.

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.

Vegetated Areas:
Inspect slopes and embankments early in the growing season to identify active or potential erosion problems. Replant bare areas or areas with sparse growth. Where rill erosion is evident, armor the area with an appropriate lining or divert the erosive flows to on-site areas able to withstand the concentrated flows.

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, Rip-Rap:
These accessories will be inspected twice per year for erosion, debris accumulation, and unwanted vegetation. Erosion will be stabilized and sediment, debris, and woody vegetation will be removed.

Mosquito Control Plan:

MA Stormwater Handbook; Volume 2, Chapter 5 (Attached)
Both aboveground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance, and treatment with larvicides can minimize this potential.

The 2008 technical specifications for BMPs set forth in Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook also concur with this practice by requiring that all stormwater practices designed to drain do so within 72 hours.

- **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.

- **SUPPLEMENTAL INFORMATION**

  - Operation & Maintenance Plan Schedule
  - Massachusetts Stormwater Handbook, Chapter 5, Miscellaneous Stormwater Topics, Mosquito Control in Stormwater Management Practices.
  - CDS Inspection and Maintenance Guide
  - JellyFish Filter Maintenance Guide

OPERATION & MAINTENANCE PLAN SCHEDULE

Project: The Residences on the Charles
Address: 15 Riverdale Avenue
Newton, MA

Date: 2/13/2020
Party Responsible for O & M Plan: CPC Land Acquisition Company, LLC
Address: 1601 Trapelo Road
Waltham, MA 02451

Structure or Task	Maintenance Activity	Schedule/Notes	Maintenance Cost/Unit	Estimated Maintenance	Estimated Annual Maintenance Cost	Inspection Performed	
						Date:	By:
Street Sweeping	Sweep, power broom or vacuum paved areas.	Perform roadway sweeping following the spring thaw to remove any traction sand applied during the winter months. Perform roadway sweeping in the late fall to remove any leaf litter or debris.	$1,500/Sweeping	Semi-annually (Spring & Fall)			
		Maintain information that confirms that all street sweepings have been disposed in accordance with state and local requirements					
Porous Pavement	Vacuum sweep paved areas.	Clean surface using vacuum sweeping machines monthly. Regularly monitor the paving surface to make sure it drains properly after storms. Inspect surface annually for deterioration or spalling. No winter sanding is allowed.	$1,500/Sweeping	Semi-annually (Spring & Fall)			
		Maintain information that confirms that all street sweepings have been disposed in accordance with state and local requirements					
Deep Sump CB's	Inspect frames and grates. Empty sumps using a vacuum-truck.	Inspected annually, cleaned as needed when sediment reaches 50% of the sump depth.	$500/CB	Annually			
		Sediment and debris shall be removed by a vacuum truck. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations					
Jellylfish Filter	Inspect frames, rinse filters, vacuum structure	Inspect annually, repair, rinse, and clean as needed.	$4,000	Annually			
		Sediment should be removed when accumulated to a depth of 12”. Sediment and debris shall be removed by a vacuum truck. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations					

Hydrodynamic Separators (CDS)	Inspect frames and covers. Empty sediment storage chamber using a vacuum truck.	Inspected annually, clean as needed when sediment reaches a depth of 12”.	$4,000	Annually			
		Sediment should be removed when accumulated to a depth of 12”. Sediment and debris shall be removed by a vacuum truck. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations					
Underground Detention Chamber	Remove trash/debris	Twice a year	$500	Annually			
	Check for sediment and outlet clogging						
		Sediment should be removed when accumulated to a depth of 3”. Sediment and debris shall be removed by a vacuum truck. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations					
Bioretention Area	Inspect and remove trash	Monthly	$3,000	Annually			
	Mow Grass	2 to 12 times per year					
	Mulch, Fertilize, remove dead vegetation and prune	Annually					
Outfall locations	Inspect for sign of erosion or displaced stone. Replace outlet protection stone if needed. Inspect flap valves or Tideflex valves at outfall locations for proper operation.	Inspect twice a year for the first three years of construction and once per year thereafter	$500 allowance	Annually			
		Check sediment build-up on a yearly basis and clean as needed using hand methods					
Mosquito Control	CB management targeted larvicide treatment to CB's and all storm drains including proprietary separators to control mosquitoes in their aquatic stages.	Surveillance is a non chemical inspection method that involves classification of mosquito breeding sites, larval presence, and survey. Apply larvicide if larva growth is detected.	$500 allowance	CBs - quarterly			
Snow Storage	Debris from melted snow shall be cleared from the site and properly disposed of at the end of the snow season, but shall be cleared no later than May 15.	Avoid dumping snow removal over catch basins. Use areas designated on the approved layout plan for snow storage. Snow shall not be stockpiled within the Wet Water Quality Swale.	$500 allowance	Annually			
Parking Below Building	Cleaning of the parking below the building using a combination of sweeping and power scrubber	Vacuum sweep twice per year. Power scrub 1 time annually. Scrubbing would be completed with Tennant 7400 power scrubber or similar. Scrubber shall use a combination of cleaning solution, brushes, and vacuum pick-up to scrub surfaces. Waste water/solution is reclaimed and shall be disposed of by an licensed environmental waste company.	$6,500	Semi-annually (Spring & Fall)			

Chapter 5
Miscellaneous Stormwater Topics

Mosquito Control in Stormwater Management Practices

Both aboveground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance and treatment with larvicides can minimize this potential.

EPA recommends that stormwater treatment practices dewater within 3 days (72 hours) to reduce the number of mosquitoes that mature to adults, since the aquatic stage of many mosquito species is 7 to 10 days. Massachusetts has had a 72-hour dewatering rule in its Stormwater Management Standards since 1996. The 2008 technical specifications for BMPs set forth in Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook also concur with this practice by requiring that all stormwater practices designed to drain do so within 72 hours.

Some stormwater practices are designed to include permanent wet pools. These practices – if maintained properly – can limit mosquito breeding by providing habitat for mosquito predators. Additional measures that can be taken to reduce mosquito populations include increasing water circulation, attracting mosquito predators by adding suitable habitat, and applying larvicides.

The Massachusetts State Reclamation and Mosquito Control Board (SRMCB), through the Massachusetts Mosquito Control Districts, can undertake further mosquito control actions specifically for the purpose of mosquito control pursuant to Massachusetts General Law Chapter 252. The Mosquito Control Board, http://www.mass.gov/agr/mosquito/, describes mosquito control methods and is in the process of developing guidance documents that describe Best Management Practices for mosquito control projects.

The SRMCB and Mosquito Control Districts are not responsible for operating and maintaining stormwater BMPs to reduce mosquito populations. The owners of property that construct the stormwater BMPs or municipalities that "accept" them through local subdivision approval are responsible for their maintenance.[1] The SRMCB is composed of officials from MassDEP, Department of Agricultural Resources, and Department of Conservation and Recreation. The nine (9) Mosquito Control Districts overseen by the SRMCB are located throughout Massachusetts, covering 176 municipalities.

Construction Period Best Management Practices for Mosquito Control

To minimize mosquito breeding during construction, it is essential that the following actions be taken to minimize the creation of standing pools by taking the following actions:

- ***Minimize Land Disturbance:*** Minimizing land disturbance reduces the likelihood of mosquito breeding by reducing silt in runoff that will cause construction period controls to clog and retain standing pools of water for more than 72 hours.
- ***Catch Basin inlets:*** Inspect and refresh filter fabric, hay bales, filter socks or stone dams on a regular basis to ensure that any stormwater ponded at the inlet drains within 8 hours after precipitation stops. Shorter periods may be necessary to avoid hydroplaning in roads

[1] MassDEP and MassHighway understand that the numerous stormwater BMPs along state highways pose a unique challenge. To address this challenge, the 2004 MassHighway Stormwater Handbook will provide additional information on appropriate operation and maintenance practices for mosquito control when the Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards..

caused by water ponded at the catch basin inlet. Treat catch basin sumps with larvicides such as *Bacillus sphaericus* (*Bs*) using a licensed pesticide applicator.

- ***Check Dams:*** If temporary check dams are used during the construction period to lag peak rate of runoff or pond runoff for exfiltration, inspect and repair the check dams on a regular basis to ensure that any stormwater ponded behind the check dam drains within 72 hours.
- ***Design construction period sediment traps*** to dewater within 72 hours after precipitation. Because these traps are subject to high silt loads and tend to clog, treat them with the larvicide *Bs* after it rains from June through October, until the first frost occurs.
- ***Construction period open conveyances:*** When temporary manmade ditches are used for channelizing construction period runoff, inspect them on a regular basis to remove any accumulated sediment to restore flow capacity to the temporary ditch.
- ***Revegetating Disturbed Surfaces:*** Revegetating disturbed surfaces reduces sediment in runoff that will cause construction period controls to clog and retain standing pools of water for greater than 72 hours.
- ***Sediment fences/hay bale barriers:*** When inspections find standing pools of water beyond the 24-hour period after a storm, take action to restore barrier to its normal function.

Post-Construction Stormwater Treatment Practices

- Mosquito control begins with the environmentally sensitive site design. Environmentally sensitive site design that minimizes impervious surfaces reduces the amount of stormwater runoff. Disconnecting runoff using the LID Site Design credits outlined in the Massachusetts Stormwater Handbook reduces the amount of stormwater that must be conveyed to a treatment practice. Utilizing green roofs minimizes runoff from smaller storms. Storage media must be designed to dewater within 72 hours after precipitation.
- Mosquito control continues with the selection of structural stormwater BMPs that are unlikely to become breeding grounds for mosquitoes, such as:
    - ***Bioretention Areas/Rain Gardens/Sand Filter:*** These practices tend not to result in mosquito breeding. If any level spreaders, weirs or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
    - ***Infiltration Trenches:*** This practice tends not to result in mosquito breeding. If any level spreaders, weirs, or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
- Another mosquito control strategy is to select BMPs that can become habitats for mosquito predators, such as:
    - ***Constructed Stormwater Wetlands:*** Habitat features can be incorporated in constructed stormwater wetlands to attract dragonflies, amphibians, turtles, birds, bats, and other natural predators of mosquitoes.
    - ***Wet Basins:*** Wet basins can be designed to incorporate fish habitat features, such as deep pools. Introduce fish in consultation with Massachusetts Division of Fisheries and Wildlife. Vegetation within wet basins designed as fish habitat must be properly managed to ensure that vegetation does not overtake the habitat. Proper design to ensure that no low circulation or “dead” zones are created may reduce the potential for mosquito breeding. Introducing bubblers may increase water circulation in the wet basin.

Effective mosquito controls require proponents to design structural BMPs to prevent ponding and facilitate maintenance and, if necessary, the application of larvicides. Examples of such design practices include the following:

- ***Basins:*** Provide perimeter access around wet basins, extended dry detention basins and dry detention basins for both larviciding and routine maintenance. Control vegetation to ensure that access pathways stay open.
- ***BMPs without a permanent pool of water:*** All structural BMPs that do not rely on a permanent pool of water must drain and completely dewater within 72 hours after precipitation. This includes dry detention basins, extended dry detention basins, infiltration basins, and dry water quality swales. Use underdrains at extended dry detention basins to drain the small pools that form due to accumulation of silts. Wallace indicates that extended dry extended detention basins may breed more mosquitoes than wet basins. It is, therefore, imperative to design outlets from extended dry detention basins to completely dewater within the 72-hour period.
- ***Energy Dissipators and Flow Spreaders:*** Currier and Moeller, 2000 indicate that shallow recesses in energy dissipators and flow spreaders trap water where mosquitoes breed. Set the riprap in grout to reduce the shallow recesses and minimize mosquito breeding.
- ***Outlet control structures:*** Debris trapped in small orifices or on trash racks of outlet control structures such as multiple stage outlet risers may clog the orifices or the trash rack, causing a standing pool of water. Optimize the orifice size or trash rack mesh size to provide required peak rate attenuation/water quality detention/retention time while minimizing clogging.
- ***Rain Barrels and Cisterns:*** Seal lids to reduce the likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over inlets. The cistern system should be designed to ensure that all collected water is drained into it within 72 hours.
- ***Subsurface Structures, Deep Sump Catch Basins, Oil Grit Separators, and Leaching Catch Basins:*** Seal all manhole covers to reduce likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over the outlet (CALTRANS 2004).

The Operation and Maintenance Plan should provide for mosquito prevention and control.

- ***Check dams:*** Inspect permanent check dams on the schedule set forth in the O&M Plan. Inspect check dams 72 hours after storms for standing water ponding behind the dam. Take corrective action if standing water is found.
- ***Cisterns:*** Apply *Bs* larvicide in the cistern if any evidence of mosquitoes is found. The Operation and Maintenance Plan shall specify how often larvicides should be applied to waters in the cistern.
- ***Water quality swales:*** Remove and properly dispose of any accumulated sediment as scheduled in the Operation and Maintenance Plan.
- ***Larvicide Treatment:*** The Operation and Maintenance Plan must include measures to minimize mosquito breeding, including larviciding.
- The party identified in the Operation and Maintenance Plan as responsible for maintenance shall see that larvicides are applied as necessary to the following stormwater treatment practices: catch basins, oil/grit separators, wet basins, wet water quality swales, dry extended detention basins, infiltration basins, and constructed stormwater wetlands. The Operation and Maintenance Plan must ensure that all larvicides are applied by a licensed pesticide applicator and in compliance with all pesticide label requirements.
- The Operation and Maintenance Plan should identify the appropriate larvicide and the time and method of application. For example, *Bacillus sphaericus (Bs*), the preferred

larvicide for stormwater BMPs, should be hand-broadcast.[2] Alternatively, Altosid, a Methopren product, may be used. Because some practices are designed to dewater between storms, such as dry extended detention and infiltration basins, the Operation and Maintenance Plan should provide that larviciding must be conducted during or immediately after wet weather, when the detention or infiltration basin has a standing pool of water, unless a product is used that can withstand extended dry periods.

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[2] *Bacillus thuringienis israelensis* or *Bti* is usually applied by helicopter to wetlands and floodplains

Roads and Stormwater BMPs

In general, the stormwater BMPs used for land development projects can also be used for new roadways and roadway improvement projects. However, for improvement of existing roads, there are often constraints that limit the choice of BMP. These constraints derive from the linear configuration of the road, the limited area within the existing right-of-way, the structural and safety requirements attendant to good roadway design, and the long-term maintainability of the roadway drainage systems. The MassHighway Handbook provides strategies for dealing with the constraints associated with providing stormwater BMPs for roadway redevelopment projects.

Roadway design can minimize impacts caused by stormwater. Reducing roadway width reduces the total and peak volume of runoff. Designing a road with country drainage (no road shoulders or curbs) disconnects roadway runoff. Disconnection of roadway runoff is eligible for the Low Impact Site Design Credit provided the drainage is disconnected in accordance with specifications outlined in Volume 3.

Like other parties, municipalities that work within wetlands jurisdictional areas and adjacent buffer zones must design and implement structural stormwater best management practices in accordance with the Stormwater Management Standards and the Stormwater Management Handbook. In addition, in municipalities and areas where state agencies operate stormwater systems, the DPWs (or other town or state agencies) must meet the "good housekeeping" requirement of the municipality's or agency's MS4 permit.

MassHighway has taken stormwater management one step further by working with MassDEP to develop the MassHighway Storm Water Handbook for Highways and Bridges. The purpose of the MassHighway Handbook is to provide guidance for persons involved in the design, permitting, review and implementation of state highway projects, especially those involving existing roadways where physical constraints often limit the stormwater management options available. These constraints, like those common to redevelopment sites, may make it difficult to comply precisely with the requirements of the Stormwater Management Standards and the Massachusetts Stormwater Handbook.[3] In response to these constraints, MassDEP and MHD developed specific design, permitting, review and implementation practices that meet the unique challenges of providing environmental protection for existing state roads. The information in the MassHighway Handbook may also aid in the planning and design of projects to build new highways and to add lanes to existing highways, since they may face similar difficulties in meeting the requirements of the Stormwater Management Standards.

Although it is very useful, the MassHighway Handbook does not allow MassHighway projects to proceed without individual review and approval by the issuing authority when subject to the Wetlands Protection Act Regulations, 310 CMR 10.00, or the 401 Water Quality Certification Regulations, 314 CMR 9.00. For example, MassHighway must provide a Conservation Commission with a project-specific Operation and Maintenance Plan in accordance with Standard 9 that documents how the project's post-construction BMPs will be operated and maintained.[4]

[3] The 2004 MassHighway Handbook outlines standardized methods for dealing with these constraints as they apply to highway redevelopment projects. MassDEP and MassHighway intend to work together to provide guidance for add a lane projects when the 2004 Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards.

[4] The general permit for municipal separate storm sewer systems (the MS4 Permit) requires MassHighway to develop and implement procedures for the proper operation and maintenance of stormwater BMPs. To

Some municipalities have asked if the MassHighway Handbook governs municipal road projects. The answer is no.[5] The MassHighway Handbook was developed in response to the unique problems and challenges arising out of the management of the state highway system. Like other project proponents, cities and towns planning road or other projects in areas subject to jurisdiction under the Wetlands Protection Act must design and implement LID, non-structural and structural best management practices in accordance with the Stormwater Management Standards and the Massachusetts Stormwater Handbook.

avoid duplication of effort, MassHighway may be able rely on the same procedures to fulfill the operation and maintenance requirements of Standard 9 and the MS 4 Permit.

[5] Although the MassHighway Handbook does not govern municipal road projects, cities and towns may find some of the information presented in the Handbook useful.

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CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.5	0.4
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than eighteen inches the system should be cleaned out. **Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

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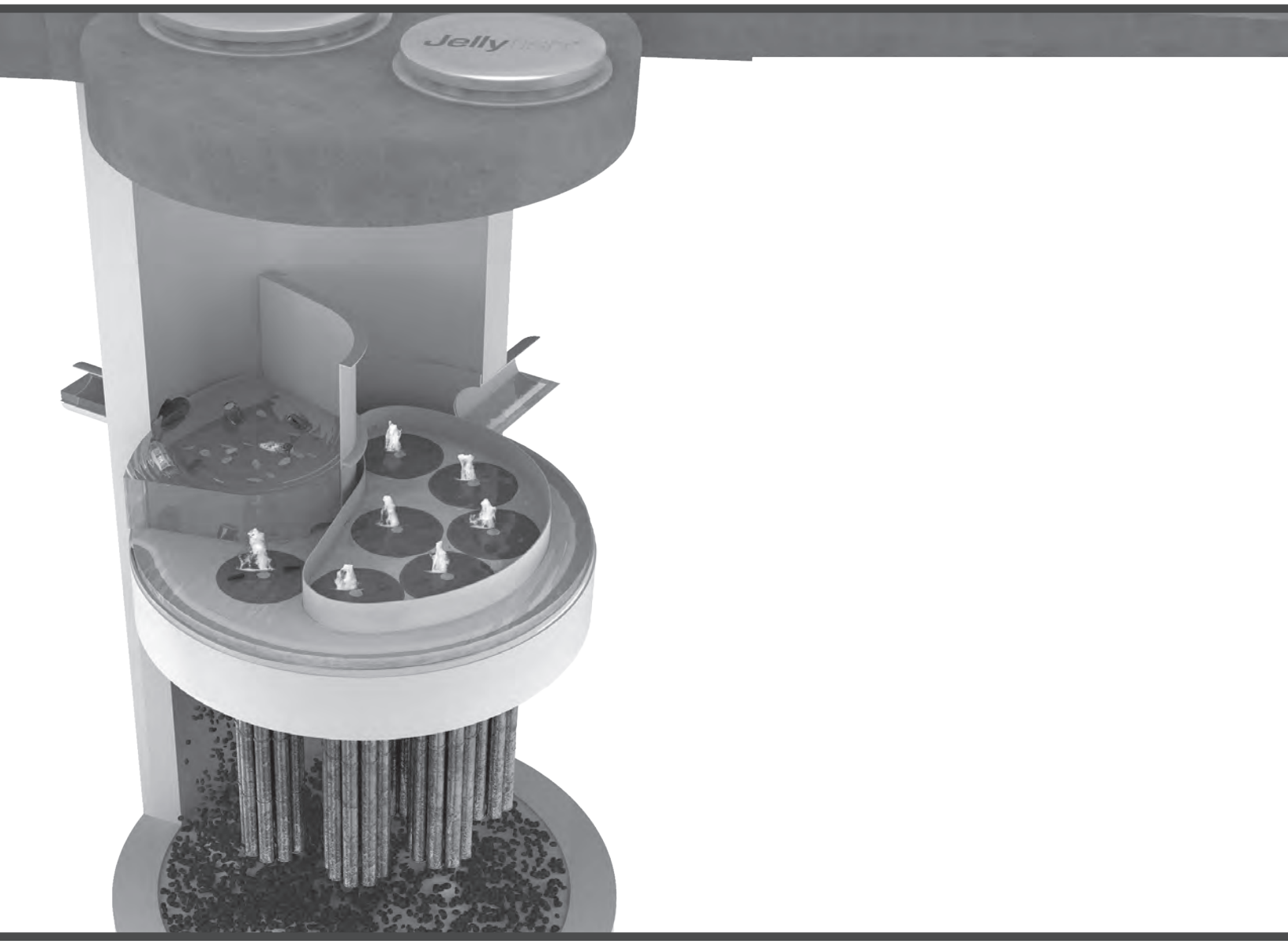
JellyFish® Filter Maintenance Guide



Jellyfish®

JELLYFISH® FILTER MANHOLE CONFIGURATIONS
INSPECTION & MAINTENANCE GUIDE

TABLE OF CONTENTS

1.0 Inspection and Maintenance Overview

The primary purpose of the Jellyfish® Filter is to capture and remove pollutants from stormwater runoff. As with any filtration system, these pollutants must be removed to maintain the filter's maximum treatment performance. Regular inspection and maintenance are required to insure proper functioning of the system.

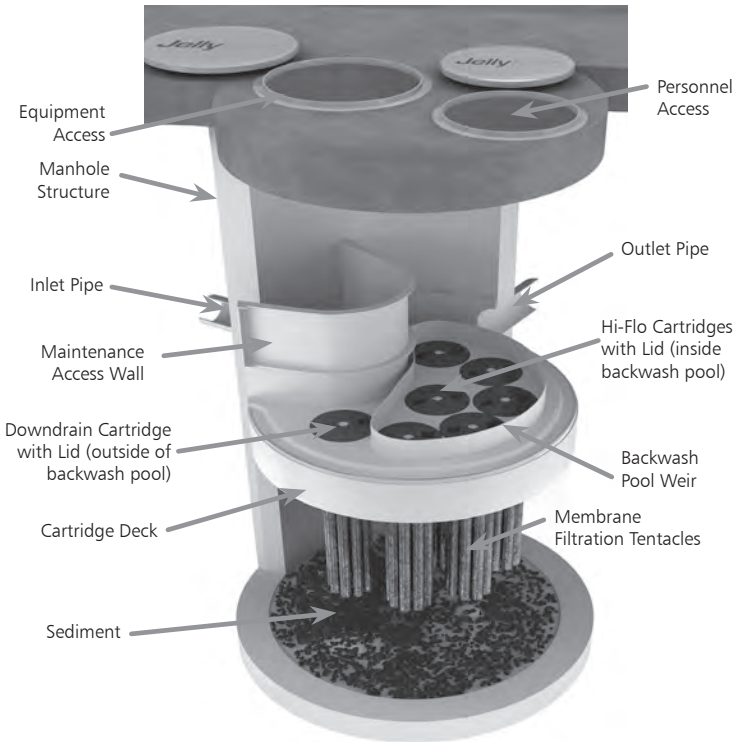
Maintenance frequencies and requirements are site specific and vary depending on pollutant loading. Additional maintenance activities may be required in the event of non-storm event runoff, such as base-flow or seasonal flow, an upstream chemical spill or due to excessive sediment loading from site erosion or extreme runoff events. It is a good practice to inspect the system after major storm events.

Inspection activities are typically conducted from surface observations and include:

- Observe if standing water is present
- Observe if there is any physical damage to the deck or cartridge lids
- Observe the amount of debris in the Maintenance Access Wall (MAW)

Maintenance activities typically include:

- Removal of oil, floatable trash and debris
- Removal of collected sediments
- Rinsing and re-installing the filter cartridges
- Replace filter cartridge tentacles, as needed



Note: Separator Skirt not shown

2.0 Inspection Timing

Inspection of the Jellyfish Filter is key in determining the maintenance requirements for, and to develop a history of the site's pollutant loading characteristics. In general, inspections should be performed at the times indicated below; *or per the approved project stormwater quality documents (if applicable), whichever is more frequent*.

1. Post-construction inspection is required prior to putting the Jellyfish Filter into service. All construction debris or construction-related sediment within the device must be removed, and any damage to system components repaired, before installing the filter cartridges.
2. A minimum of two inspections during the first year of operation to assess the sediment and floatable pollutant accumulation, and to ensure proper functioning of the system.
3. Inspection frequency in subsequent years is based on the inspection and maintenance plan developed in the first year of operation. Minimum frequency should be once per year.
4. Inspection is recommended after each major storm event.
5. Inspection is required immediately after an upstream oil, fuel or other chemical spill.

3.0 Inspection Procedure

The following procedure is recommended when performing inspections:

1. Provide traffic control measures as necessary.
2. Inspect the MAW for floatable pollutants such as trash, debris, and oil sheen.
3. Measure oil and sediment depth in several locations, by lowering a sediment probe through the MAW opening until contact is made with the floor of the structure. Record sediment depth, and presences of any oil layers.
4. Inspect cartridge lids. Missing or damaged cartridge lids to be replaced.
5. Inspect the MAW, cartridge deck, and backwash pool weir, for cracks or broken components. If damaged, repair is required.

3.1 Dry weather inspections

- Inspect the cartridge deck for standing water, and/or sediment on the deck.
- No standing water under normal operating conditions.
- Standing water inside the backwash pool, but not outside the backwash pool indicates that the filter cartridges need to be rinsed.

Inspection Utilitzing Sediment Probe

- Standing water outside the backwash pool may indicate a backwater condition caused by high water elevation in the receiving water body, or possibly a blockage in downstream infrastructure.
- Any appreciable sediment (≥1/16") accumulated on the deck surface should be removed.

3.2 Wet weather inspections

- Observe the rate and movement of water in the unit. Note the depth of water above deck elevation within the MAW.
- Less than 6 inches, flow should be exiting the cartridge lids of each of the draindown cartridges (i.e. cartridges located outside the backwash pool).
- Greater than 6 inches, flow should be exiting the cartridge lids of each of the draindown cartridges and each of the hi-flo cartridges (i.e. cartridges located inside the backwash pool), and water should be overflowing the backwash pool weir.
- 18 inches or greater and relatively little flow is exiting the cartridge lids and outlet pipe, this condition indicates that the filter cartridges are occluded with sediment and need to be rinsed

4.0 Maintenance Requirements

Required maintenance for the Jellyfish Filter is based upon results of the most recent inspection, historical maintenance records, or the site specific water quality management plan; whichever is more frequent. In general, maintenance requires some combination of the following:

1. Sediment removal for depths reaching 12 inches or greater, or within 3 years of the most recent sediment cleaning, whichever occurs sooner.
2. Floatable trash, debris, and oil removal.
3. Deck cleaned and free from sediment.
4. Filter cartridges rinsed and re-installed as required by the most recent inspection results, or within 12 months of the most recent filter rinsing, whichever occurs sooner.
5. Replace tentacles if rinsing does not restore adequate hydraulic capacity, remove accumulated sediment, or if damaged or missing. It is recommended that tentacles should remain in service no longer than 5 years before replacement.
6. Damaged or missing cartridge deck components must be repaired or replaced as indicated by results of the most recent inspection.
7. The unit must be cleaned out and filter cartridges inspected immediately after an upstream oil, fuel, or chemical spill. Filter cartridge tentacles should be replaced if damaged or compromised by the spill.

5.0 Maintenance Procedure

The following procedures are recommended when maintaining the Jellyfish Filter:

1. Provide traffic control measures as necessary.
2. Open all covers and hatches. Use ventilation equipment as required, according to confined space entry procedures.
3. Caution: Dropping objects onto the cartridge deck may cause damage.
4. Perform Inspection Procedure prior to maintenance activity.
5. To access the cartridge deck for filter cartridge service, descend the ladder and step directly onto the deck. Caution: Do not step onto the maintenance access wall (MAW) or backwash pool weir, as damage may result. Note that the cartridge deck may be slippery.
6. Maximum weight of maintenance crew and equipment on the cartridge deck not to exceed 450 lbs.

5.1 Filter Cartridge Removal

1. Remove a cartridge lid.
2. Remove cartridges from the deck using the lifting loops in the cartridge head plate. Rope or a lifting device (available from Contech) should be used. Caution: Should a snag occur, do not force the cartridge upward as damage to the tentacles may result. Wet cartridges typically weigh between 100 and 125 lbs.
3. Replace and secure the cartridge lid on the exposed empty receptacle as a safety precaution. Contech does not recommend exposing more than one empty cartridge receptacle at a time.

5.2 Filter Cartridge Rinsing

1. Remove all 11 tentacles from the cartridge head plate. Take care not to damage or break the plastic threaded nut or connector.
2. Position tentacles in a container (or over the MAW), with the

Cartridge Removal & Lifting Device

threaded connector (open end) facing down, so rinse water is flushed through the membrane and captured in the container.

3. Using the Jellyfish rinse tool (available from Contech) or a low-pressure garden hose sprayer, direct water spray onto the tentacle membrane, sweeping from top to bottom along the length of the tentacle. Rinse until all sediment is removed from the membrane. Caution: Do not use a high pressure sprayer or focused stream of water on the membrane. Excessive water pressure may damage the membrane.

4. Collected rinse water is typically removed by vacuum hose.
5. Reattach tentacles to cartridge head plate. Reuse O-rings and nuts, ensuring proper placement on each tentacle.

5.3 Cleaning Procedure

1. Perform vacuum cleaning of the Jellyfish Filter only after filter cartridges have been removed from the system. Access the lower chamber for vacuum cleaning only through the maintenance access wall (MAW) opening, being careful not to damage the flexible plastic separator skirt that is attached to the underside of the deck. The separator skirt surrounds the filter cartridge zone, and could be torn if contacted by the wand. Do not lower the vacuum wand through a cartridge receptacle, as damage to the receptacle will result.
2. Vacuum floatable trash, debris, and oil, from the MAW opening. Alternatively, floatable solids may be removed by a net or skimmer.

Tentacle Rinse Using Jellyfish Rinse Tool

3. Pressure wash cartridge deck and receptacles to remove all sediment and debris. Sediment should be rinsed into the sump area. Take care not to flush rinse water into the outlet pipe.
4. Remove water from the sump area. Vacuum or pump equipment should only be introduced through the MAW.
5. Remove the sediment from the bottom of the unit through the MAW opening.

Vacuuming Sump Through MAW

6. For larger diameter Jellyfish Filter manholes (≥8-ft) and vaults without an MAW opening, complete sediment removal may be facilitated by removing a cartridge lid from an empty receptacle and inserting a jetting wand (not a vacuum wand) through the receptacle. Use the sprayer to rinse loosened sediment toward the vacuum hose in the MAW opening, being careful not to damage the receptacle.
7. After the unit is clean, re-fill the lower chamber with water if required by the local jurisdiction, and re-install filter cartridges.
8. Dispose of sediment, floatable trash and debris, oil, spent tentacles, and water according to local regulatory requirements.

5.4 Filter Cartridge Replacement

1. Cartridges should be installed after the deck has been cleaned. It is important that the receptacle surfaces be free from grit and debris.
2. If rinsing is ineffective in removing sediment from the tentacles, or if tentacles are damaged, provisions must be made to replace the spent or damaged tentacles with new tentacles. Contact Contech to order replacement tentacles.
3. Lower filter cartridge to the cartridge deck. Remove cartridge lid from deck and carefully lower the filter cartridge into the receptacle until head plate gasket is seated squarely in receptacle. Caution: Should a snag occur when lowering the cartridge into the receptacle, do not force the cartridge downward; damage may occur.
4. Replace the cartridge lid and check fit before completing rotation to a firm hand-tight attachment.

5.5 Chemical Spills

Caution: If a chemical spill has been captured, do not attempt maintenance. Immediately contact the local hazard response agency and contact Contech.

6.0 Related Maintenance Activities

Jellyfish units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

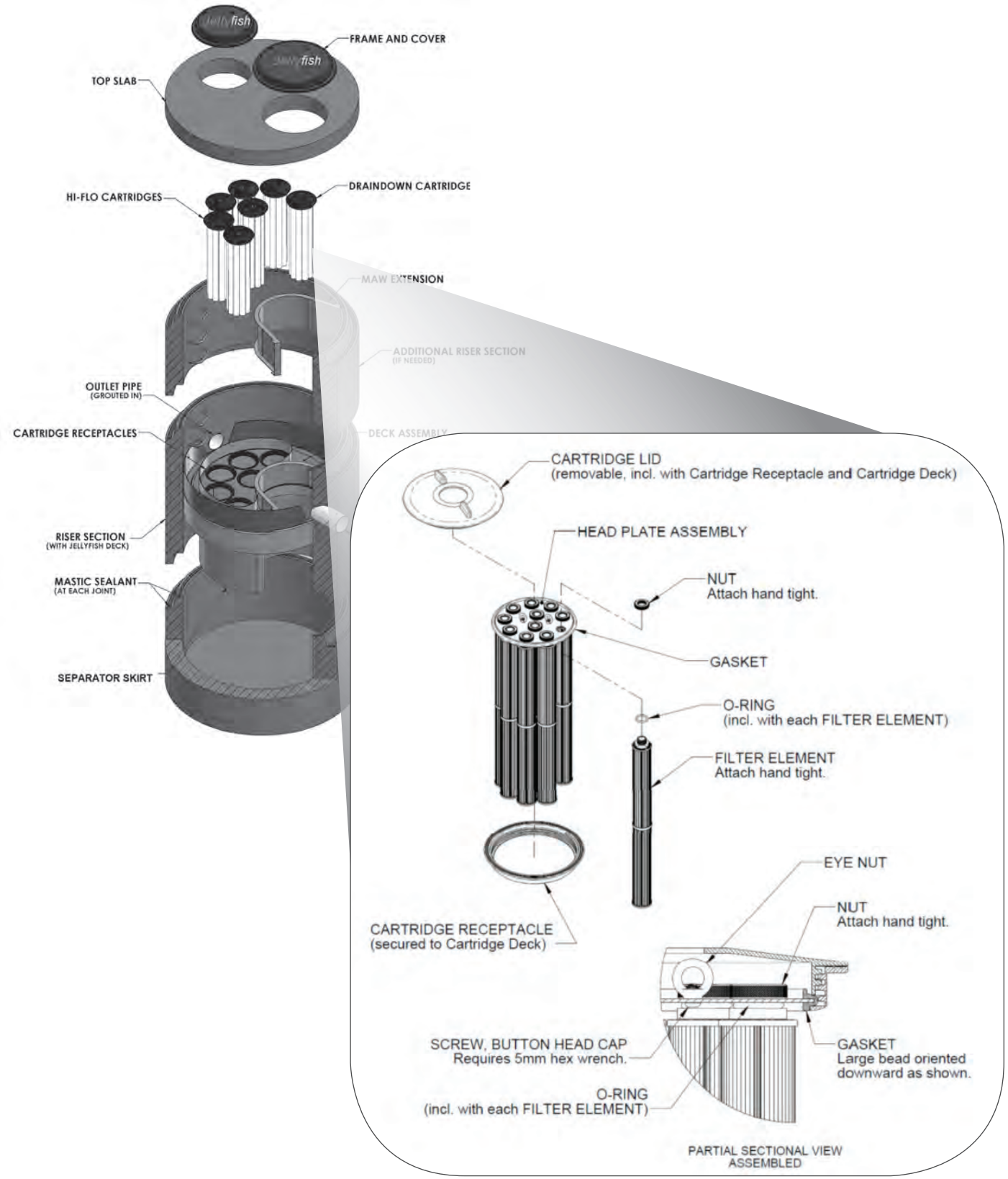
In order for maintenance of the Jellyfish filter to be successful, it is imperative that all other components be properly maintained. The maintenance and repair of upstream facilities should be carried out prior to Jellyfish maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

7.0 Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads. Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

Jellyfish Filter Components & Filter Cartridge



Jellyfish Filter Inspection and Maintenance Log

Owner:				Jellyfish Model No:		
Location:				GPS Coordinates:		
Lande Use:	Commercial:		Industrial:		Service Station:	
	Roadway/Highway:		Airport:		Residential:	

Date/Time:						
Inspector:						
Maintenance Contractor:						
Visible Oil Present: (Y/N)						
Oil Quantity Removed:						
Floatable Debris Present: (Y/N)						
Floatable Debris Removed: (Y/N)						
Water Depth in Backwash Pool						
Draindown Cartridges externally rinsed and recommissioned: (Y/N)						
New tentacles put on Cartridges: (Y/N)						
Hi-Flo Cartridges externally rinsed and recommissioned: (Y/N)						
New tentacles put on Hi-Flo Cartridges: (Y/N)						
Sediment Depth Measured: (Y/N)						
Sediment Depth (inches or mm):						
Sediment Removed: (Y/N)						
Cartridge Lids intact: (Y/N)						
Observed Damage:						
Comments:						

Jellyfish®

CONTECH ENGINEERED SOLUTIONS

Support

- Drawings and specifications are available at ContechES.com/jellyfish.
- Site-specific design support is available from Contech Engineered Solutions.

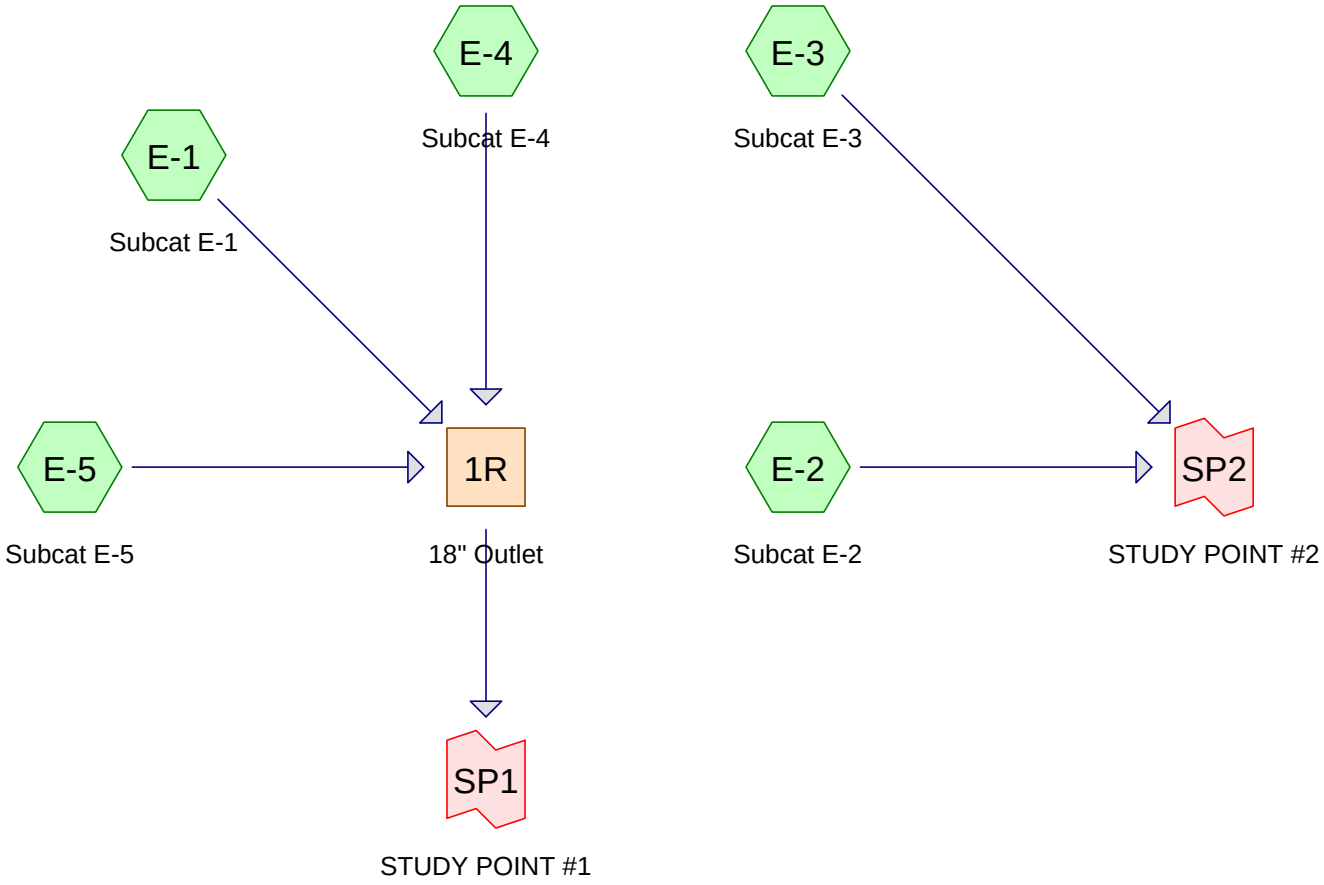
800.338.1122
www.ContechES.com

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, wastewater treatment and earth stabilization products. For information on other Contech segment offerings, visit ContechES.com or call 800.338.1122

The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; related foreign patents or other patents pending.

Section 3.0 HydroCAD Worksheets – Existing Conditions

EXISTING 2-YEAR STORM
EXISTING 10-YEAR STORM
EXSTING 100-YEAR STORM



Subcat Reach Pond Link

Routing Diagram for 1374-23 - Existing HydroCAD
Prepared by Allen & Major Associates Inc. , Printed 2/18/2020

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
38,394	39	>75% Grass cover, Good, HSG A (E-1, E-2, E-3, E-5)
140,728	98	Paved parking, HSG A (E-1, E-2, E-3, E-4, E-5)
179,122	**85**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
179,122	HSG A	E-1, E-2, E-3, E-4, E-5
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
179,122		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
38,394	0	0	0	0	38,394	>75% Grass cover, Good	E-1, E-2, E-3, E-5
140,728	0	0	0	0	140,728	Paved parking	E-1, E-2, E-3, E-4, E-5
179,122	**0**	**0**	**0**	**0**	**179,122**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1R	15.00	0.00	75.0	0.2000	0.011	18.0	0.0	0.0

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Subcat E-1 Runoff Area=80,560 sf 95.61% Impervious Runoff Depth=2.55"
Tc=6.0 min CN=95 Runoff=5.11 cfs 17,099 cf

Subcatchment E-2: Subcat E-2 Runoff Area=7,220 sf 35.05% Impervious Runoff Depth=0.37"
Tc=6.0 min CN=60 Runoff=0.04 cfs 223 cf

Subcatchment E-3: Subcat E-3 Runoff Area=27,620 sf 0.30% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment E-4: Subcat E-4 Runoff Area=52,033 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=3.51 cfs 12,435 cf

Subcatchment E-5: Subcat E-5 Runoff Area=11,689 sf 77.49% Impervious Runoff Depth=1.67"
Tc=6.0 min CN=85 Runoff=0.52 cfs 1,629 cf

Reach 1R: 18" Outlet Avg. Flow Depth=0.41' Max Vel=23.16 fps Inflow=9.14 cfs 31,164 cf
18.0" Round Pipe n=0.011 L=75.0' S=0.2000 '/' Capacity=55.52 cfs Outflow=9.12 cfs 31,164 cf

Link SP1: STUDY POINT #1 Inflow=9.12 cfs 31,164 cf
Primary=9.12 cfs 31,164 cf

Link SP2: STUDY POINT #2 Inflow=0.04 cfs 223 cf
Primary=0.04 cfs 223 cf

Total Runoff Area = 179,122 sf Runoff Volume = 31,387 cf Average Runoff Depth = 2.10"
21.43% Pervious = 38,394 sf 78.57% Impervious = 140,728 sf

Summary for Subcatchment E-1: Subcat E-1

Runoff = 5.11 cfs @ 12.09 hrs, Volume= 17,099 cf, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
3,535	39	>75% Grass cover, Good, HSG A
77,024	98	Paved parking, HSG A
80,560	95	Weighted Average
3,535		4.39% Pervious Area
77,024		95.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-2: Subcat E-2

Runoff = 0.04 cfs @ 12.15 hrs, Volume= 223 cf, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
4,689	39	>75% Grass cover, Good, HSG A
2,531	98	Paved parking, HSG A
7,220	60	Weighted Average
4,689		64.95% Pervious Area
2,531		35.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-3: Subcat E-3

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
27,538	39	>75% Grass cover, Good, HSG A
82	98	Paved parking, HSG A
27,620	39	Weighted Average
27,538		99.70% Pervious Area
82		0.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-4: Subcat E-4

Runoff = 3.51 cfs @ 12.09 hrs, Volume= 12,435 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
52,033	98	Paved parking, HSG A
52,033		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-5: Subcat E-5

Runoff = 0.52 cfs @ 12.09 hrs, Volume= 1,629 cf, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
2,632	39	>75% Grass cover, Good, HSG A
9,058	98	Paved parking, HSG A
11,689	85	Weighted Average
2,632		22.51% Pervious Area
9,058		77.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

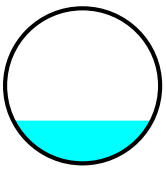
Summary for Reach 1R: 18" Outlet

Inflow Area = 144,282 sf, 95.73% Impervious, Inflow Depth = 2.59" for 2-year event
Inflow = 9.14 cfs @ 12.09 hrs, Volume= 31,164 cf
Outflow = 9.12 cfs @ 12.09 hrs, Volume= 31,164 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 23.16 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 7.37 fps, Avg. Travel Time= 0.2 min

Peak Storage= 30 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 55.52 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 75.0' Slope= 0.2000 '/'
Inlet Invert= 15.00', Outlet Invert= 0.00'



Summary for Link SP1: STUDY POINT #1

Inflow Area = 144,282 sf, 95.73% Impervious, Inflow Depth = 2.59" for 2-year event
Inflow = 9.12 cfs @ 12.09 hrs, Volume= 31,164 cf
Primary = 9.12 cfs @ 12.09 hrs, Volume= 31,164 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 34,840 sf, 7.50% Impervious, Inflow Depth = 0.08" for 2-year event
Inflow = 0.04 cfs @ 12.15 hrs, Volume= 223 cf
Primary = 0.04 cfs @ 12.15 hrs, Volume= 223 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Subcat E-1 Runoff Area=80,560 sf 95.61% Impervious Runoff Depth=4.02"
Tc=6.0 min CN=95 Runoff=7.87 cfs 27,012 cf

Subcatchment E-2: Subcat E-2 Runoff Area=7,220 sf 35.05% Impervious Runoff Depth=1.07"
Tc=6.0 min CN=60 Runoff=0.18 cfs 646 cf

Subcatchment E-3: Subcat E-3 Runoff Area=27,620 sf 0.30% Impervious Runoff Depth=0.13"
Tc=6.0 min CN=39 Runoff=0.01 cfs 291 cf

Subcatchment E-4: Subcat E-4 Runoff Area=52,033 sf 100.00% Impervious Runoff Depth=4.36"
Tc=6.0 min CN=98 Runoff=5.24 cfs 18,922 cf

Subcatchment E-5: Subcat E-5 Runoff Area=11,689 sf 77.49% Impervious Runoff Depth=3.00"
Tc=6.0 min CN=85 Runoff=0.92 cfs 2,923 cf

Reach 1R: 18" Outlet Avg. Flow Depth=0.51' Max Vel=26.14 fps Inflow=14.03 cfs 48,856 cf
18.0" Round Pipe n=0.011 L=75.0' S=0.2000 '/' Capacity=55.52 cfs Outflow=14.01 cfs 48,856 cf

Link SP1: STUDY POINT #1 Inflow=14.01 cfs 48,856 cf
Primary=14.01 cfs 48,856 cf

Link SP2: STUDY POINT #2 Inflow=0.18 cfs 938 cf
Primary=0.18 cfs 938 cf

Total Runoff Area = 179,122 sf Runoff Volume = 49,794 cf Average Runoff Depth = 3.34"
21.43% Pervious = 38,394 sf 78.57% Impervious = 140,728 sf

Summary for Subcatchment E-1: Subcat E-1

Runoff = 7.87 cfs @ 12.09 hrs, Volume= 27,012 cf, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
3,535	39	>75% Grass cover, Good, HSG A
77,024	98	Paved parking, HSG A
80,560	95	Weighted Average
3,535		4.39% Pervious Area
77,024		95.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-2: Subcat E-2

Runoff = 0.18 cfs @ 12.11 hrs, Volume= 646 cf, Depth= 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
4,689	39	>75% Grass cover, Good, HSG A
2,531	98	Paved parking, HSG A
7,220	60	Weighted Average
4,689		64.95% Pervious Area
2,531		35.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-3: Subcat E-3

Runoff = 0.01 cfs @ 14.58 hrs, Volume= 291 cf, Depth= 0.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
27,538	39	>75% Grass cover, Good, HSG A
82	98	Paved parking, HSG A
27,620	39	Weighted Average
27,538		99.70% Pervious Area
82		0.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-4: Subcat E-4

Runoff = 5.24 cfs @ 12.09 hrs, Volume= 18,922 cf, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
52,033	98	Paved parking, HSG A
52,033		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-5: Subcat E-5

Runoff = 0.92 cfs @ 12.09 hrs, Volume= 2,923 cf, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
2,632	39	>75% Grass cover, Good, HSG A
9,058	98	Paved parking, HSG A
11,689	85	Weighted Average
2,632		22.51% Pervious Area
9,058		77.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

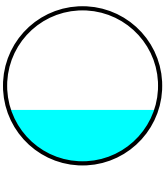
Summary for Reach 1R: 18" Outlet

Inflow Area = 144,282 sf, 95.73% Impervious, Inflow Depth = 4.06" for 10-year event
Inflow = 14.03 cfs @ 12.09 hrs, Volume= 48,856 cf
Outflow = 14.01 cfs @ 12.09 hrs, Volume= 48,856 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 26.14 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 8.44 fps, Avg. Travel Time= 0.1 min

Peak Storage= 40 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 55.52 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 75.0' Slope= 0.2000 '/'
Inlet Invert= 15.00', Outlet Invert= 0.00'



Summary for Link SP1: STUDY POINT #1

Inflow Area = 144,282 sf, 95.73% Impervious, Inflow Depth = 4.06" for 10-year event
Inflow = 14.01 cfs @ 12.09 hrs, Volume= 48,856 cf
Primary = 14.01 cfs @ 12.09 hrs, Volume= 48,856 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 34,840 sf, 7.50% Impervious, Inflow Depth = 0.32" for 10-year event
Inflow = 0.18 cfs @ 12.11 hrs, Volume= 938 cf
Primary = 0.18 cfs @ 12.11 hrs, Volume= 938 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Subcat E-1 Runoff Area=80,560 sf 95.61% Impervious Runoff Depth=8.18"
Tc=6.0 min CN=95 Runoff=15.42 cfs 54,905 cf

Subcatchment E-2: Subcat E-2 Runoff Area=7,220 sf 35.05% Impervious Runoff Depth=3.93"
Tc=6.0 min CN=60 Runoff=0.74 cfs 2,364 cf

Subcatchment E-3: Subcat E-3 Runoff Area=27,620 sf 0.30% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=39 Runoff=0.81 cfs 3,453 cf

Subcatchment E-4: Subcat E-4 Runoff Area=52,033 sf 100.00% Impervious Runoff Depth=8.54"
Tc=6.0 min CN=98 Runoff=10.06 cfs 37,029 cf

Subcatchment E-5: Subcat E-5 Runoff Area=11,689 sf 77.49% Impervious Runoff Depth=6.97"
Tc=6.0 min CN=85 Runoff=2.05 cfs 6,788 cf

Reach 1R: 18" Outlet Avg. Flow Depth=0.75' Max Vel=31.28 fps Inflow=27.53 cfs 98,722 cf
18.0" Round Pipe n=0.011 L=75.0' S=0.2000 '/' Capacity=55.52 cfs Outflow=27.50 cfs 98,722 cf

Link SP1: STUDY POINT #1 Inflow=27.50 cfs 98,722 cf
Primary=27.50 cfs 98,722 cf

Link SP2: STUDY POINT #2 Inflow=1.55 cfs 5,817 cf
Primary=1.55 cfs 5,817 cf

Total Runoff Area = 179,122 sf Runoff Volume = 104,538 cf Average Runoff Depth = 7.00"
21.43% Pervious = 38,394 sf 78.57% Impervious = 140,728 sf

Summary for Subcatchment E-1: Subcat E-1

Runoff = 15.42 cfs @ 12.09 hrs, Volume= 54,905 cf, Depth= 8.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
3,535	39	>75% Grass cover, Good, HSG A
77,024	98	Paved parking, HSG A
80,560	95	Weighted Average
3,535		4.39% Pervious Area
77,024		95.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-2: Subcat E-2

Runoff = 0.74 cfs @ 12.10 hrs, Volume= 2,364 cf, Depth= 3.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
4,689	39	>75% Grass cover, Good, HSG A
2,531	98	Paved parking, HSG A
7,220	60	Weighted Average
4,689		64.95% Pervious Area
2,531		35.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-3: Subcat E-3

Runoff = 0.81 cfs @ 12.12 hrs, Volume= 3,453 cf, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
27,538	39	>75% Grass cover, Good, HSG A
82	98	Paved parking, HSG A
27,620	39	Weighted Average
27,538		99.70% Pervious Area
82		0.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-4: Subcat E-4

Runoff = 10.06 cfs @ 12.09 hrs, Volume= 37,029 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
52,033	98	Paved parking, HSG A
52,033		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment E-5: Subcat E-5

Runoff = 2.05 cfs @ 12.09 hrs, Volume= 6,788 cf, Depth= 6.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
2,632	39	>75% Grass cover, Good, HSG A
9,058	98	Paved parking, HSG A
11,689	85	Weighted Average
2,632		22.51% Pervious Area
9,058		77.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

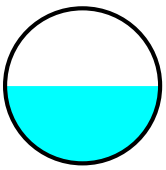
Summary for Reach 1R: 18" Outlet

Inflow Area = 144,282 sf, 95.73% Impervious, Inflow Depth = 8.21" for 100-year event
Inflow = 27.53 cfs @ 12.09 hrs, Volume= 98,722 cf
Outflow = 27.50 cfs @ 12.09 hrs, Volume= 98,722 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 31.28 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 10.49 fps, Avg. Travel Time= 0.1 min

Peak Storage= 66 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.75'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 55.52 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 75.0' Slope= 0.2000 '/'
Inlet Invert= 15.00', Outlet Invert= 0.00'



Summary for Link SP1: STUDY POINT #1

Inflow Area = 144,282 sf, 95.73% Impervious, Inflow Depth = 8.21" for 100-year event
Inflow = 27.50 cfs @ 12.09 hrs, Volume= 98,722 cf
Primary = 27.50 cfs @ 12.09 hrs, Volume= 98,722 cf, Atten= 0%, Lag= 0.0 min

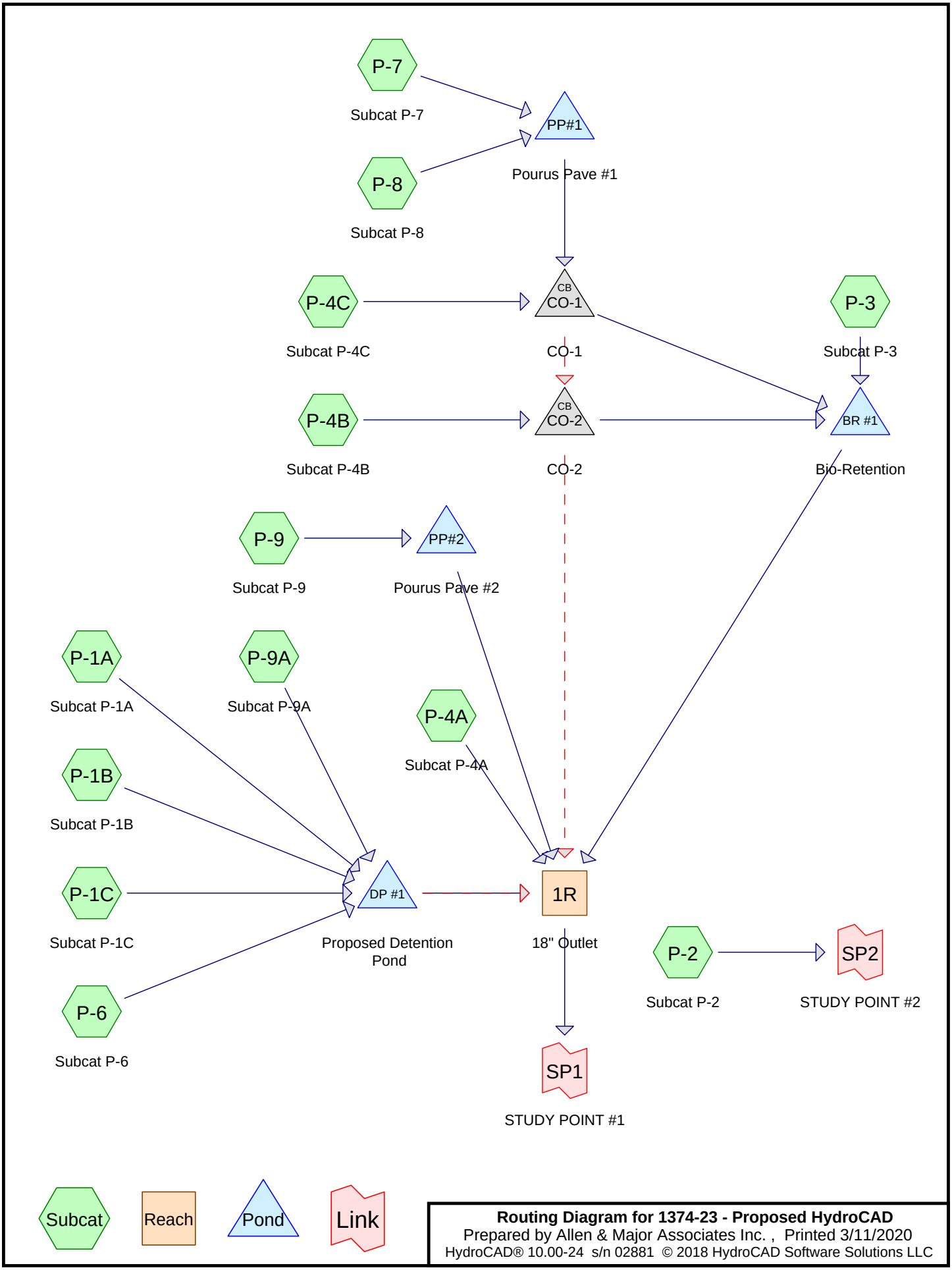
Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 34,840 sf, 7.50% Impervious, Inflow Depth = 2.00" for 100-year event
Inflow = 1.55 cfs @ 12.11 hrs, Volume= 5,817 cf
Primary = 1.55 cfs @ 12.11 hrs, Volume= 5,817 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Section 4.0 HydroCAD Worksheets – Proposed Conditions



Routing Diagram for 1374-23 - Proposed HydroCAD
Prepared by Allen & Major Associates Inc. , Printed 3/11/2020

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
35,534	39	>75% Grass cover, Good, HSG A (P-1A, P-1B, P-1C, P-2, P-3, P-6, P-7, P-8, P-9)
59,415	98	Paved parking, HSG A (P-1A, P-1B, P-1C, P-2, P-3, P-6, P-7, P-8, P-9, P-9A)
71,095	98	Roofs, HSG A (P-1B, P-4A, P-4B, P-4C)
13,078	98	Water Surface, 0% imp, HSG A (P-1C, P-3, P-4C, P-7, P-8, P-9)
179,122	**86**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
179,122	HSG A	P-1A, P-1B, P-1C, P-2, P-3, P-4A, P-4B, P-4C, P-6, P-7, P-8, P-9, P-9A
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
179,122		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
35,534	0	0	0	0	35,534	>75% Grass cover, Good	P-1A, P-1B, P-1C, P-2, P-3, P-6, P-7, P-8, P-9
59,415	0	0	0	0	59,415	Paved parking	P-1A, P-1B, P-1C, P-2, P-3, P-6, P-7, P-8, P-9, P-9A
71,095	0	0	0	0	71,095	Roofs	P-1B, P-4A, P-4B, P-4C
13,078	0	0	0	0	13,078	Water Surface, 0% imp	P-1C, P-3, P-4C, P-7, P-8, P-9
179,122	**0**	**0**	**0**	**0**	**179,122**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1R	15.00	0.00	75.0	0.2000	0.011	18.0	0.0	0.0
2	BR #1	16.00	15.43	114.0	0.0050	0.010	8.0	0.0	0.0
3	BR #1	16.00	16.00	160.0	0.0000	0.012	4.0	0.0	0.0
4	CO-1	17.46	17.07	78.0	0.0050	0.012	4.0	0.0	0.0
5	CO-1	18.23	17.92	62.0	0.0050	0.012	8.0	0.0	0.0
6	CO-2	17.51	17.07	88.0	0.0050	0.012	4.0	0.0	0.0
7	CO-2	17.92	17.36	48.0	0.0117	0.012	15.0	0.0	0.0
8	DP #1	15.40	15.16	49.0	0.0049	0.012	18.0	0.0	0.0
9	DP #1	16.42	16.25	17.0	0.0100	0.012	12.0	0.0	0.0

Notes Listing (all nodes)

Line#	Node Number	Notes
1	PP#1	Exfiltration Rate = 2.41 in./hr. (MA Stormwater Handbook Vol.3,Ch.1, PG.22, Rawls Rates)
2	PP#2	Exfiltration Rate = 2.41 in./hr. (MA Stormwater Handbook Vol.3,Ch.1, PG.22, Rawls Rates)

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1A: Subcat P-1A Runoff Area=19,270 sf 94.81% Impervious Runoff Depth=2.55"
Tc=6.0 min CN=95 Runoff=1.22 cfs 4,090 cf

Subcatchment P-1B: Subcat P-1B Runoff Area=25,482 sf 93.20% Impervious Runoff Depth=2.45"
Tc=6.0 min CN=94 Runoff=1.57 cfs 5,196 cf

Subcatchment P-1C: Subcat P-1C Runoff Area=8,741 sf 99.38% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.59 cfs 2,089 cf

Subcatchment P-2: Subcat P-2 Runoff Area=2,651 sf 5.21% Impervious Runoff Depth=0.01"
Tc=6.0 min CN=42 Runoff=0.00 cfs 2 cf

Subcatchment P-3: Subcat P-3 Runoff Area=20,411 sf 0.84% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment P-4A: Subcat P-4A Runoff Area=32,794 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=2.21 cfs 7,837 cf

Subcatchment P-4B: Subcat P-4B Runoff Area=13,050 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.88 cfs 3,119 cf

Subcatchment P-4C: Subcat P-4C Runoff Area=11,858 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.80 cfs 2,834 cf

Subcatchment P-6: Subcat P-6 Runoff Area=11,689 sf 77.49% Impervious Runoff Depth=1.67"
Tc=6.0 min CN=85 Runoff=0.52 cfs 1,629 cf

Subcatchment P-7: Subcat P-7 Runoff Area=14,139 sf 4.81% Impervious Runoff Depth=1.67"
Tc=6.0 min CN=85 Runoff=0.62 cfs 1,971 cf

Subcatchment P-8: Subcat P-8 Runoff Area=12,067 sf 80.35% Impervious Runoff Depth=1.75"
Tc=6.0 min CN=86 Runoff=0.56 cfs 1,758 cf

Subcatchment P-9: Subcat P-9 Runoff Area=5,268 sf 12.49% Impervious Runoff Depth=1.20"
Tc=6.0 min CN=78 Runoff=0.16 cfs 527 cf

Subcatchment P-9A: Subcat P-9A Runoff Area=1,702 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.11 cfs 407 cf

Reach 1R: 18" Outlet Avg. Flow Depth=0.33' Max Vel=20.36 fps Inflow=5.81 cfs 26,584 cf
18.0" Round Pipe n=0.011 L=75.0' S=0.2000 '/' Capacity=55.52 cfs Outflow=5.80 cfs 26,584 cf

Pond BR #1: Bio-Retention Peak Elev=17.10' Storage=951 cf Inflow=0.46 cfs 4,758 cf
Outflow=0.27 cfs 4,731 cf

Pond CO-1: CO-1 Peak Elev=18.76' Inflow=0.80 cfs 2,834 cf
Primary=0.25 cfs 2,345 cf Secondary=0.55 cfs 489 cf Outflow=0.80 cfs 2,834 cf

Pond CO-2: CO-2 Peak Elev=18.52' Inflow=1.43 cfs 3,608 cf
Primary=0.21 cfs 2,413 cf Secondary=1.22 cfs 1,195 cf Outflow=1.43 cfs 3,608 cf

Pond DP #1: Proposed Detention Pond Peak Elev=17.60' Storage=2,652 cf Inflow=4.02 cfs 13,411 cf
Primary=2.46 cfs 12,821 cf Secondary=0.00 cfs 0 cf Outflow=2.46 cfs 12,821 cf

Pond PP#1: Pourus Pave #1 Peak Elev=17.46' Storage=386 cf Inflow=1.18 cfs 3,729 cf
Discarded=0.58 cfs 3,729 cf Primary=0.00 cfs 0 cf Outflow=0.58 cfs 3,729 cf

Pond PP#2: Pourus Pave #2 Peak Elev=17.36' Storage=21 cf Inflow=0.16 cfs 527 cf
Discarded=0.15 cfs 527 cf Primary=0.00 cfs 0 cf Outflow=0.15 cfs 527 cf

Link SP1: STUDY POINT #1 Inflow=5.80 cfs 26,584 cf
Primary=5.80 cfs 26,584 cf

Link SP2: STUDY POINT #2

Inflow=0.00 cfs 2 cf
Primary=0.00 cfs 2 cf

Total Runoff Area = 179,122 sf Runoff Volume = 31,459 cf Average Runoff Depth = 2.11"
27.14% Pervious = 48,612 sf 72.86% Impervious = 130,510 sf

Summary for Subcatchment P-1A: Subcat P-1A

Runoff = 1.22 cfs @ 12.09 hrs, Volume= 4,090 cf, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
1,000	39	>75% Grass cover, Good, HSG A
18,270	98	Paved parking, HSG A
19,270	95	Weighted Average
1,000		5.19% Pervious Area
18,270		94.81% Impervious Area

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

Summary for Subcatchment P-1B: Subcat P-1B

Runoff = 1.57 cfs @ 12.09 hrs, Volume= 5,196 cf, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
1,734	39	>75% Grass cover, Good, HSG A
10,355	98	Paved parking, HSG A
13,393	98	Roofs, HSG A
25,482	94	Weighted Average
1,734		6.80% Pervious Area
23,748		93.20% Impervious Area

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

Summary for Subcatchment P-1C: Subcat P-1C

Runoff = 0.59 cfs @ 12.09 hrs, Volume= 2,089 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
54	39	>75% Grass cover, Good, HSG A
8,687	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
8,741	98	Weighted Average
54		0.62% Pervious Area
8,687		99.38% Impervious Area

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

Summary for Subcatchment P-2: Subcat P-2

Runoff = 0.00 cfs @ 22.40 hrs, Volume= 2 cf, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
2,513	39	>75% Grass cover, Good, HSG A
138	98	Paved parking, HSG A
2,651	42	Weighted Average
2,513		94.79% Pervious Area
138		5.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
20,239	39	>75% Grass cover, Good, HSG A
172	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
20,411	39	Weighted Average
20,239		99.16% Pervious Area
172		0.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-4A: Subcat P-4A

Runoff = 2.21 cfs @ 12.09 hrs, Volume= 7,837 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
32,794	98	Roofs, HSG A
32,794		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-4B: Subcat P-4B

Runoff = 0.88 cfs @ 12.09 hrs, Volume= 3,119 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
13,050	98	Roofs, HSG A
13,050		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-4C: Subcat P-4C

Runoff = 0.80 cfs @ 12.09 hrs, Volume= 2,834 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
11,858	98	Roofs, HSG A
0	98	Water Surface, 0% imp, HSG A
11,858	98	Weighted Average
0		0.00% Pervious Area
11,858		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-6: Subcat P-6

Runoff = 0.52 cfs @ 12.09 hrs, Volume= 1,629 cf, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
2,632	39	>75% Grass cover, Good, HSG A
9,058	98	Paved parking, HSG A
11,689	85	Weighted Average
2,632		22.51% Pervious Area
9,058		77.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-7: Subcat P-7

Runoff = 0.62 cfs @ 12.09 hrs, Volume= 1,971 cf, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
3,163	39	>75% Grass cover, Good, HSG A
680	98	Paved parking, HSG A
10,296	98	Water Surface, 0% imp, HSG A
14,139	85	Weighted Average
13,459		95.19% Pervious Area
680		4.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-8: Subcat P-8

Runoff = 0.56 cfs @ 12.09 hrs, Volume= 1,758 cf, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
2,371	39	>75% Grass cover, Good, HSG A
9,696	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
12,067	86	Weighted Average
2,371		19.65% Pervious Area
9,696		80.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-9: Subcat P-9

Runoff = 0.16 cfs @ 12.10 hrs, Volume= 527 cf, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
1,828	39	>75% Grass cover, Good, HSG A
658	98	Paved parking, HSG A
2,782	98	Water Surface, 0% imp, HSG A
5,268	78	Weighted Average
4,610		87.51% Pervious Area
658		12.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-9A: Subcat P-9A

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 407 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.10"

Area (sf)	CN	Description
1,702	98	Paved parking, HSG A
1,702		100.00% Impervious Area

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

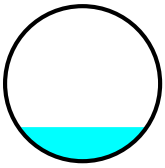
Summary for Reach 1R: 18" Outlet

Inflow Area = 176,471 sf, 73.88% Impervious, Inflow Depth > 1.81" for 2-year event
Inflow = 5.81 cfs @ 12.10 hrs, Volume= 26,584 cf
Outflow = 5.80 cfs @ 12.10 hrs, Volume= 26,584 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 20.36 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 5.58 fps, Avg. Travel Time= 0.2 min

Peak Storage= 21 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 55.52 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 75.0' Slope= 0.2000 '/'
Inlet Invert= 15.00', Outlet Invert= 0.00'



Summary for Pond BR #1: Bio-Retention

Inflow Area = 71,525 sf, 49.57% Impervious, Inflow Depth = 0.80" for 2-year event
Inflow = 0.46 cfs @ 12.09 hrs, Volume= 4,758 cf
Outflow = 0.27 cfs @ 12.56 hrs, Volume= 4,731 cf, Atten= 41%, Lag= 28.4 min
Primary = 0.27 cfs @ 12.56 hrs, Volume= 4,731 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 17.10' @ 12.56 hrs Surf.Area= 8,002 sf Storage= 951 cf
Flood Elev= 18.00' Surf.Area= 10,088 sf Storage= 5,541 cf

Plug-Flow detention time= 65.9 min calculated for 4,725 cf (99% of inflow)
Center-of-Mass det. time= 63.0 min (828.0 - 765.0)

Volume	Invert	Avail.Storage	Storage Description
#1	17.07'	4,691 cf	**Bio-Retention Ponding (Prismatic)** Listed below (Recalc)
#2	16.00'	850 cf	**Soil Media (Prismatic)** Listed below (Recalc) 4,250 cf Overall x 20.0% Voids
		5,541 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.07	3,972	0	0
18.00	6,116	4,691	4,691

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
16.00	3,972	0	0
17.07	3,972	4,250	4,250

Device	Routing	Invert	Outlet Devices
#1	Primary	16.00'	**8.0" Round Culvert** L= 114.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.00' / 15.43' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf
#2	Device 1	16.00'	**4.0" Round 4" UD X 2.00** L= 160.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.00' / 16.00' S= 0.0000 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.09 sf

Primary OutFlow Max=0.27 cfs @ 12.56 hrs HW=17.09' (Free Discharge)
└**1=Culvert** (Passes 0.27 cfs of 1.16 cfs potential flow)
└**2=4" UD** (Barrel Controls 0.27 cfs @ 1.55 fps)

Summary for Pond CO-1: CO-1

Inflow Area = 38,064 sf, 58.41% Impervious, Inflow Depth = 0.89" for 2-year event
Inflow = 0.80 cfs @ 12.09 hrs, Volume= 2,834 cf
Outflow = 0.80 cfs @ 12.09 hrs, Volume= 2,834 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.25 cfs @ 12.09 hrs, Volume= 2,345 cf
Secondary = 0.55 cfs @ 12.09 hrs, Volume= 489 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 18.76' @ 12.09 hrs
Flood Elev= 20.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	17.46'	**4.0" Round 4" to Bio-Ret** L= 78.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.46' / 17.07' S= 0.0050 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.09 sf
#2	Secondary	18.23'	**8.0" Round Roof Drain** L= 62.0' CMP, projecting, no headwall, Ke= 0.900

Inlet / Outlet Invert= 18.23' / 17.92' S= 0.0050 '/' Cc= 0.900
n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.25 cfs @ 12.09 hrs HW=18.75' (Free Discharge)
└**1=4" to Bio-Ret** (Barrel Controls 0.25 cfs @ 2.81 fps)

Secondary OutFlow Max=0.53 cfs @ 12.09 hrs HW=18.75' (Free Discharge)
└**2=Roof Drain** (Barrel Controls 0.53 cfs @ 2.53 fps)

Summary for Pond CO-2: CO-2

Inflow Area = 13,050 sf,100.00% Impervious, Inflow Depth = 3.32" for 2-year event
Inflow = 1.43 cfs @ 12.09 hrs, Volume= 3,608 cf
Outflow = 1.43 cfs @ 12.09 hrs, Volume= 3,608 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.21 cfs @ 12.09 hrs, Volume= 2,413 cf
Secondary = 1.22 cfs @ 12.09 hrs, Volume= 1,195 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 18.52' @ 12.09 hrs
Flood Elev= 20.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	17.51'	**4.0" Round 4" To Bio-Ret** L= 88.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.51' / 17.07' S= 0.0050 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.09 sf
#2	Secondary	17.92'	**15.0" Round Roof Drain** L= 48.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.92' / 17.36' S= 0.0117 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=0.21 cfs @ 12.09 hrs HW=18.51' (Free Discharge)
└**1=4" To Bio-Ret** (Barrel Controls 0.21 cfs @ 2.43 fps)

Secondary OutFlow Max=1.18 cfs @ 12.09 hrs HW=18.51' (Free Discharge)
└**2=Roof Drain** (Inlet Controls 1.18 cfs @ 2.06 fps)

Summary for Pond DP #1: Proposed Detention Pond

Inflow Area = 66,884 sf, 91.90% Impervious, Inflow Depth = 2.41" for 2-year event
Inflow = 4.02 cfs @ 12.09 hrs, Volume= 13,411 cf
Outflow = 2.46 cfs @ 12.20 hrs, Volume= 12,821 cf, Atten= 39%, Lag= 6.8 min
Primary = 2.46 cfs @ 12.20 hrs, Volume= 12,821 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 17.60' @ 12.20 hrs Surf.Area= 2,913 sf Storage= 2,652 cf
Flood Elev= 19.80' Surf.Area= 2,913 sf Storage= 4,694 cf

Plug-Flow detention time= 61.8 min calculated for 12,803 cf (95% of inflow)
Center-of-Mass det. time= 37.5 min (822.7 - 785.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	15.92'	2,917 cf	**17.96'W x 161.50'L x 3.25'H Field A** 9,429 cf Overall - 2,137 cf Embedded = 7,292 cf x 40.0% Voids
#2A	16.42'	1,728 cf	**ADS N-12 18"** x 48 Inside #1 Inside= 18.2"W x 18.2"H => 1.80 sf x 20.00'L = 36.0 cf Outside= 21.0"W x 21.0"H => 2.23 sf x 20.00'L = 44.5 cf 48 Chambers in 6 Rows
#3	15.92'	51 cf	**4.00'D x 4.08'H Vertical Cone/Cylinder**
		4,696 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	15.40'	**18.0" Round 18" HDPE** L= 49.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 15.40' / 15.16' S= 0.0049 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf

#2	Device 1	16.42'	**12.0" Round Culvert** L= 17.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.42' / 16.25' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#3	Secondary	18.90'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=2.46 cfs @ 12.20 hrs HW=17.60' (Free Discharge)
└**1=18" HDPE** (Passes 2.46 cfs of 8.09 cfs potential flow)
└**2=Culvert** (Inlet Controls 2.46 cfs @ 3.13 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=15.92' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond PP#1: Pourus Pave #1

Inflow Area = 26,206 sf, 39.59% Impervious, Inflow Depth = 1.71" for 2-year event
Inflow = 1.18 cfs @ 12.09 hrs, Volume= 3,729 cf
Outflow = 0.58 cfs @ 12.27 hrs, Volume= 3,729 cf, Atten= 51%, Lag= 10.6 min
Discarded = 0.58 cfs @ 12.27 hrs, Volume= 3,729 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 17.46' @ 12.27 hrs Surf.Area= 10,296 sf Storage= 386 cf
Flood Elev= 20.00' Surf.Area= 20,592 sf Storage= 7,897 cf

Plug-Flow detention time= 4.4 min calculated for 3,724 cf (100% of inflow)
Center-of-Mass det. time= 4.4 min (830.2 - 825.8)

Volume	Invert	Avail.Storage	Storage Description
#1	17.33'	7,197 cf	**Subbase (Conic)**Listed below (Recalc) 23,990 cf Overall x 30.0% Voids
#2	19.66'	700 cf	**Pourus Pave 4" (Conic)**Listed below (Recalc) 3,501 cf Overall x 20.0% Voids
		7,897 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
17.33	10,296	0	0	10,296
19.66	10,296	23,990	23,990	11,134

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
19.66	10,296	0	0	10,296
20.00	10,296	3,501	3,501	10,418

Device	Routing	Invert	Outlet Devices
#1	Discarded	17.33'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	19.60'	**115.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.58 cfs @ 12.27 hrs HW=17.45' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.58 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=17.33' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond PP#2: Pourus Pave #2

Inflow Area = 5,268 sf, 12.49% Impervious, Inflow Depth = 1.20" for 2-year event
Inflow = 0.16 cfs @ 12.10 hrs, Volume= 527 cf
Outflow = 0.15 cfs @ 12.14 hrs, Volume= 527 cf, Atten= 9%, Lag= 2.4 min
Discarded = 0.15 cfs @ 12.14 hrs, Volume= 527 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 17.36' @ 12.14 hrs Surf.Area= 2,782 sf Storage= 21 cf
Flood Elev= 20.00' Surf.Area= 5,564 sf Storage= 2,134 cf

Plug-Flow detention time= 2.4 min calculated for 526 cf (100% of inflow)
Center-of-Mass det. time= 2.4 min (853.3 - 850.9)

Volume	Invert	Avail.Storage	Storage Description
#1	17.33'	1,945 cf	**Subbase (Conic)**Listed below (Recalc) 6,482 cf Overall x 30.0% Voids
#2	19.66'	189 cf	**Pourus Pave 4" (Conic)**Listed below (Recalc) 946 cf Overall x 20.0% Voids
		2,134 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
17.33	2,782	0	0	2,782
19.66	2,782	6,482	6,482	3,218

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
19.66	2,782	0	0	2,782
20.00	2,782	946	946	2,846

Device	Routing	Invert	Outlet Devices
#1	Discarded	17.33'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	19.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.16 cfs @ 12.14 hrs HW=17.36' (Free Discharge)
↑└**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=17.33' (Free Discharge)
↑└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link SP1: STUDY POINT #1

Inflow Area = 176,471 sf, 73.88% Impervious, Inflow Depth > 1.81" for 2-year event
Inflow = 5.80 cfs @ 12.10 hrs, Volume= 26,584 cf
Primary = 5.80 cfs @ 12.10 hrs, Volume= 26,584 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 2,651 sf, 5.21% Impervious, Inflow Depth = 0.01" for 2-year event
Inflow = 0.00 cfs @ 22.40 hrs, Volume= 2 cf
Primary = 0.00 cfs @ 22.40 hrs, Volume= 2 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1A: Subcat P-1A Runoff Area=19,270 sf 94.81% Impervious Runoff Depth=4.02"
Tc=6.0 min CN=95 Runoff=1.88 cfs 6,461 cf

Subcatchment P-1B: Subcat P-1B Runoff Area=25,482 sf 93.20% Impervious Runoff Depth=3.91"
Tc=6.0 min CN=94 Runoff=2.45 cfs 8,311 cf

Subcatchment P-1C: Subcat P-1C Runoff Area=8,741 sf 99.38% Impervious Runoff Depth=4.36"
Tc=6.0 min CN=98 Runoff=0.88 cfs 3,179 cf

Subcatchment P-2: Subcat P-2 Runoff Area=2,651 sf 5.21% Impervious Runoff Depth=0.22"
Tc=6.0 min CN=42 Runoff=0.00 cfs 48 cf

Subcatchment P-3: Subcat P-3 Runoff Area=20,411 sf 0.84% Impervious Runoff Depth=0.13"
Tc=6.0 min CN=39 Runoff=0.01 cfs 215 cf

Subcatchment P-4A: Subcat P-4A Runoff Area=32,794 sf 100.00% Impervious Runoff Depth=4.36"
Tc=6.0 min CN=98 Runoff=3.30 cfs 11,926 cf

Subcatchment P-4B: Subcat P-4B Runoff Area=13,050 sf 100.00% Impervious Runoff Depth=4.36"
Tc=6.0 min CN=98 Runoff=1.32 cfs 4,746 cf

Subcatchment P-4C: Subcat P-4C Runoff Area=11,858 sf 100.00% Impervious Runoff Depth=4.36"
Tc=6.0 min CN=98 Runoff=1.20 cfs 4,312 cf

Subcatchment P-6: Subcat P-6 Runoff Area=11,689 sf 77.49% Impervious Runoff Depth=3.00"
Tc=6.0 min CN=85 Runoff=0.92 cfs 2,923 cf

Subcatchment P-7: Subcat P-7 Runoff Area=14,139 sf 4.81% Impervious Runoff Depth=3.00"
Tc=6.0 min CN=85 Runoff=1.11 cfs 3,535 cf

Subcatchment P-8: Subcat P-8 Runoff Area=12,067 sf 80.35% Impervious Runoff Depth=3.10"
Tc=6.0 min CN=86 Runoff=0.97 cfs 3,113 cf

Subcatchment P-9: Subcat P-9 Runoff Area=5,268 sf 12.49% Impervious Runoff Depth=2.38"
Tc=6.0 min CN=78 Runoff=0.33 cfs 1,043 cf

Subcatchment P-9A: Subcat P-9A Runoff Area=1,702 sf 100.00% Impervious Runoff Depth=4.36"
Tc=6.0 min CN=98 Runoff=0.17 cfs 619 cf

Reach 1R: 18" Outlet Avg. Flow Depth=0.40' Max Vel=22.85 fps Inflow=8.66 cfs 42,073 cf
18.0" Round Pipe n=0.011 L=75.0' S=0.2000 '/' Capacity=55.52 cfs Outflow=8.65 cfs 42,073 cf

Pond BR #1: Bio-Retention Peak Elev=17.15' Storage=1,176 cf Inflow=0.50 cfs 6,946 cf
Outflow=0.28 cfs 6,918 cf

Pond CO-1: CO-1 Peak Elev=19.04' Inflow=1.20 cfs 4,312 cf
Primary=0.27 cfs 3,306 cf Secondary=0.92 cfs 1,006 cf Outflow=1.20 cfs 4,312 cf

Pond CO-2: CO-2 Peak Elev=18.72' Inflow=2.24 cfs 5,752 cf
Primary=0.23 cfs 3,424 cf Secondary=2.01 cfs 2,328 cf Outflow=2.24 cfs 5,752 cf

Pond DP #1: Proposed Detention Pond Peak Elev=18.48' Storage=3,879 cf Inflow=6.30 cfs 21,492 cf
Primary=3.73 cfs 20,902 cf Secondary=0.00 cfs 0 cf Outflow=3.73 cfs 20,902 cf

Pond PP#1: Pourus Pave #1 Peak Elev=17.76' Storage=1,323 cf Inflow=2.08 cfs 6,648 cf
Discarded=0.58 cfs 6,648 cf Primary=0.00 cfs 0 cf Outflow=0.58 cfs 6,648 cf

Pond PP#2: Pourus Pave #2 Peak Elev=17.46' Storage=113 cf Inflow=0.33 cfs 1,043 cf
Discarded=0.16 cfs 1,043 cf Primary=0.00 cfs 0 cf Outflow=0.16 cfs 1,043 cf

Link SP1: STUDY POINT #1 Inflow=8.65 cfs 42,073 cf
Primary=8.65 cfs 42,073 cf

Link SP2: STUDY POINT #2

Inflow=0.00 cfs 48 cf
Primary=0.00 cfs 48 cf

Total Runoff Area = 179,122 sf Runoff Volume = 50,430 cf Average Runoff Depth = 3.38"
27.14% Pervious = 48,612 sf 72.86% Impervious = 130,510 sf

Summary for Subcatchment P-1A: Subcat P-1A

Runoff = 1.88 cfs @ 12.09 hrs, Volume= 6,461 cf, Depth= 4.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
1,000	39	>75% Grass cover, Good, HSG A
18,270	98	Paved parking, HSG A
19,270	95	Weighted Average
1,000		5.19% Pervious Area
18,270		94.81% Impervious Area

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

Summary for Subcatchment P-1B: Subcat P-1B

Runoff = 2.45 cfs @ 12.09 hrs, Volume= 8,311 cf, Depth= 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
1,734	39	>75% Grass cover, Good, HSG A
10,355	98	Paved parking, HSG A
13,393	98	Roofs, HSG A
25,482	94	Weighted Average
1,734		6.80% Pervious Area
23,748		93.20% Impervious Area

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

Summary for Subcatchment P-1C: Subcat P-1C

Runoff = 0.88 cfs @ 12.09 hrs, Volume= 3,179 cf, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
54	39	>75% Grass cover, Good, HSG A
8,687	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
8,741	98	Weighted Average
54		0.62% Pervious Area
8,687		99.38% Impervious Area

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

Summary for Subcatchment P-2: Subcat P-2

Runoff = 0.00 cfs @ 12.44 hrs, Volume= 48 cf, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
2,513	39	>75% Grass cover, Good, HSG A
138	98	Paved parking, HSG A
2,651	42	Weighted Average
2,513		94.79% Pervious Area
138		5.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.01 cfs @ 14.58 hrs, Volume= 215 cf, Depth= 0.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
20,239	39	>75% Grass cover, Good, HSG A
172	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
20,411	39	Weighted Average
20,239		99.16% Pervious Area
172		0.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-4A: Subcat P-4A

Runoff = 3.30 cfs @ 12.09 hrs, Volume= 11,926 cf, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
32,794	98	Roofs, HSG A
32,794		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-4B: Subcat P-4B

Runoff = 1.32 cfs @ 12.09 hrs, Volume= 4,746 cf, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
13,050	98	Roofs, HSG A
13,050		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-4C: Subcat P-4C

Runoff = 1.20 cfs @ 12.09 hrs, Volume= 4,312 cf, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
11,858	98	Roofs, HSG A
0	98	Water Surface, 0% imp, HSG A
11,858	98	Weighted Average
0		0.00% Pervious Area
11,858		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-6: Subcat P-6

Runoff = 0.92 cfs @ 12.09 hrs, Volume= 2,923 cf, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
2,632	39	>75% Grass cover, Good, HSG A
9,058	98	Paved parking, HSG A
11,689	85	Weighted Average
2,632		22.51% Pervious Area
9,058		77.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-7: Subcat P-7

Runoff = 1.11 cfs @ 12.09 hrs, Volume= 3,535 cf, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
3,163	39	>75% Grass cover, Good, HSG A
680	98	Paved parking, HSG A
10,296	98	Water Surface, 0% imp, HSG A
14,139	85	Weighted Average
13,459		95.19% Pervious Area
680		4.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-8: Subcat P-8

Runoff = 0.97 cfs @ 12.09 hrs, Volume= 3,113 cf, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
2,371	39	>75% Grass cover, Good, HSG A
9,696	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
12,067	86	Weighted Average
2,371		19.65% Pervious Area
9,696		80.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-9: Subcat P-9

Runoff = 0.33 cfs @ 12.09 hrs, Volume= 1,043 cf, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
1,828	39	>75% Grass cover, Good, HSG A
658	98	Paved parking, HSG A
2,782	98	Water Surface, 0% imp, HSG A
5,268	78	Weighted Average
4,610		87.51% Pervious Area
658		12.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-9A: Subcat P-9A

Runoff = 0.17 cfs @ 12.09 hrs, Volume= 619 cf, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.60"

Area (sf)	CN	Description
1,702	98	Paved parking, HSG A
1,702		100.00% Impervious Area

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

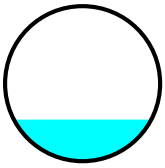
Summary for Reach 1R: 18" Outlet

Inflow Area = 176,471 sf, 73.88% Impervious, Inflow Depth = 2.86" for 10-year event
Inflow = 8.66 cfs @ 12.10 hrs, Volume= 42,073 cf
Outflow = 8.65 cfs @ 12.10 hrs, Volume= 42,073 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 22.85 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 6.32 fps, Avg. Travel Time= 0.2 min

Peak Storage= 28 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 55.52 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 75.0' Slope= 0.2000 '/'
Inlet Invert= 15.00', Outlet Invert= 0.00'



Summary for Pond BR #1: Bio-Retention

Inflow Area = 71,525 sf, 49.57% Impervious, Inflow Depth = 1.17" for 10-year event
Inflow = 0.50 cfs @ 12.09 hrs, Volume= 6,946 cf
Outflow = 0.28 cfs @ 12.76 hrs, Volume= 6,918 cf, Atten= 44%, Lag= 40.3 min
Primary = 0.28 cfs @ 12.76 hrs, Volume= 6,918 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 17.15' @ 12.76 hrs Surf.Area= 8,129 sf Storage= 1,176 cf
Flood Elev= 18.00' Surf.Area= 10,088 sf Storage= 5,541 cf

Plug-Flow detention time= 63.3 min calculated for 6,918 cf (100% of inflow)
Center-of-Mass det. time= 60.7 min (827.2 - 766.5)

Volume	Invert	Avail.Storage	Storage Description
#1	17.07'	4,691 cf	**Bio-Retention Ponding (Prismatic)** Listed below (Recalc)
#2	16.00'	850 cf	**Soil Media (Prismatic)** Listed below (Recalc) 4,250 cf Overall x 20.0% Voids
		5,541 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.07	3,972	0	0
18.00	6,116	4,691	4,691

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
16.00	3,972	0	0
17.07	3,972	4,250	4,250

Device	Routing	Invert	Outlet Devices
#1	Primary	16.00'	**8.0" Round Culvert** L= 114.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.00' / 15.43' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf
#2	Device 1	16.00'	**4.0" Round 4" UD X 2.00** L= 160.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.00' / 16.00' S= 0.0000 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.09 sf

Primary OutFlow Max=0.28 cfs @ 12.76 hrs HW=17.15' (Free Discharge)
└**1=Culvert** (Passes 0.28 cfs of 1.20 cfs potential flow)
└**2=4" UD** (Barrel Controls 0.28 cfs @ 1.61 fps)

Summary for Pond CO-1: CO-1

Inflow Area = 38,064 sf, 58.41% Impervious, Inflow Depth = 1.36" for 10-year event
Inflow = 1.20 cfs @ 12.09 hrs, Volume= 4,312 cf
Outflow = 1.20 cfs @ 12.09 hrs, Volume= 4,312 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.27 cfs @ 12.09 hrs, Volume= 3,306 cf
Secondary = 0.92 cfs @ 12.09 hrs, Volume= 1,006 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 19.04' @ 12.09 hrs
Flood Elev= 20.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	17.46'	**4.0" Round 4" to Bio-Ret** L= 78.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.46' / 17.07' S= 0.0050 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.09 sf
#2	Secondary	18.23'	**8.0" Round Roof Drain** L= 62.0' CMP, projecting, no headwall, Ke= 0.900

Inlet / Outlet Invert= 18.23' / 17.92' S= 0.0050 '/' Cc= 0.900
n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.27 cfs @ 12.09 hrs HW=19.02' (Free Discharge)
└**1=4" to Bio-Ret** (Barrel Controls 0.27 cfs @ 3.09 fps)

Secondary OutFlow Max=0.89 cfs @ 12.09 hrs HW=19.02' (Free Discharge)
└**2=Roof Drain** (Inlet Controls 0.89 cfs @ 2.56 fps)

Summary for Pond CO-2: CO-2

Inflow Area = 13,050 sf,100.00% Impervious, Inflow Depth = 5.29" for 10-year event
Inflow = 2.24 cfs @ 12.09 hrs, Volume= 5,752 cf
Outflow = 2.24 cfs @ 12.09 hrs, Volume= 5,752 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.23 cfs @ 12.09 hrs, Volume= 3,424 cf
Secondary = 2.01 cfs @ 12.09 hrs, Volume= 2,328 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 18.72' @ 12.09 hrs
Flood Elev= 20.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	17.51'	**4.0" Round 4" To Bio-Ret** L= 88.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.51' / 17.07' S= 0.0050 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.09 sf
#2	Secondary	17.92'	**15.0" Round Roof Drain** L= 48.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.92' / 17.36' S= 0.0117 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=0.23 cfs @ 12.09 hrs HW=18.71' (Free Discharge)
└**1=4" To Bio-Ret** (Barrel Controls 0.23 cfs @ 2.64 fps)

Secondary OutFlow Max=1.94 cfs @ 12.09 hrs HW=18.71' (Free Discharge)
└**2=Roof Drain** (Inlet Controls 1.94 cfs @ 2.39 fps)

Summary for Pond DP #1: Proposed Detention Pond

Inflow Area = 66,884 sf, 91.90% Impervious, Inflow Depth = 3.86" for 10-year event
Inflow = 6.30 cfs @ 12.09 hrs, Volume= 21,492 cf
Outflow = 3.73 cfs @ 12.21 hrs, Volume= 20,902 cf, Atten= 41%, Lag= 7.1 min
Primary = 3.73 cfs @ 12.21 hrs, Volume= 20,902 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 18.48' @ 12.21 hrs Surf.Area= 2,913 sf Storage= 3,879 cf
Flood Elev= 19.80' Surf.Area= 2,913 sf Storage= 4,694 cf

Plug-Flow detention time= 47.8 min calculated for 20,873 cf (97% of inflow)
Center-of-Mass det. time= 31.7 min (806.1 - 774.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	15.92'	2,917 cf	**17.96'W x 161.50'L x 3.25'H Field A** 9,429 cf Overall - 2,137 cf Embedded = 7,292 cf x 40.0% Voids
#2A	16.42'	1,728 cf	**ADS N-12 18"** x 48 Inside #1 Inside= 18.2"W x 18.2"H => 1.80 sf x 20.00'L = 36.0 cf Outside= 21.0"W x 21.0"H => 2.23 sf x 20.00'L = 44.5 cf 48 Chambers in 6 Rows
#3	15.92'	51 cf	**4.00'D x 4.08'H Vertical Cone/Cylinder**
		4,696 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	15.40'	**18.0" Round 18" HDPE** L= 49.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 15.40' / 15.16' S= 0.0049 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf

#2	Device 1	16.42'	**12.0" Round Culvert** L= 17.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.42' / 16.25' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#3	Secondary	18.90'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=3.72 cfs @ 12.21 hrs HW=18.47' (Free Discharge)
└**1=18" HDPE** (Passes 3.72 cfs of 10.24 cfs potential flow)
└**2=Culvert** (Inlet Controls 3.72 cfs @ 4.74 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=15.92' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond PP#1: Pourus Pave #1

Inflow Area = 26,206 sf, 39.59% Impervious, Inflow Depth = 3.04" for 10-year event
Inflow = 2.08 cfs @ 12.09 hrs, Volume= 6,648 cf
Outflow = 0.58 cfs @ 12.45 hrs, Volume= 6,648 cf, Atten= 72%, Lag= 21.6 min
Discarded = 0.58 cfs @ 12.45 hrs, Volume= 6,648 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 17.76' @ 12.45 hrs Surf.Area= 10,296 sf Storage= 1,323 cf
Flood Elev= 20.00' Surf.Area= 20,592 sf Storage= 7,897 cf

Plug-Flow detention time= 12.6 min calculated for 6,648 cf (100% of inflow)
Center-of-Mass det. time= 12.6 min (821.9 - 809.3)

Volume	Invert	Avail.Storage	Storage Description
#1	17.33'	7,197 cf	**Subbase (Conic)** Listed below (Recalc) 23,990 cf Overall x 30.0% Voids
#2	19.66'	700 cf	**Pourus Pave 4" (Conic)** Listed below (Recalc) 3,501 cf Overall x 20.0% Voids
		7,897 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
17.33	10,296	0	0	10,296
19.66	10,296	23,990	23,990	11,134

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
19.66	10,296	0	0	10,296
20.00	10,296	3,501	3,501	10,418

Device	Routing	Invert	Outlet Devices
#1	Discarded	17.33'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	19.60'	**115.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.58 cfs @ 12.45 hrs HW=17.76' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.58 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=17.33' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond PP#2: Pourus Pave #2

Inflow Area = 5,268 sf, 12.49% Impervious, Inflow Depth = 2.38" for 10-year event
Inflow = 0.33 cfs @ 12.09 hrs, Volume= 1,043 cf
Outflow = 0.16 cfs @ 12.28 hrs, Volume= 1,043 cf, Atten= 53%, Lag= 11.5 min
Discarded = 0.16 cfs @ 12.28 hrs, Volume= 1,043 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 17.46' @ 12.28 hrs Surf.Area= 2,782 sf Storage= 113 cf
Flood Elev= 20.00' Surf.Area= 5,564 sf Storage= 2,134 cf

Plug-Flow detention time= 4.6 min calculated for 1,042 cf (100% of inflow)
Center-of-Mass det. time= 4.6 min (835.6 - 830.9)

Volume	Invert	Avail.Storage	Storage Description
#1	17.33'	1,945 cf	**Subbase (Conic)**Listed below (Recalc) 6,482 cf Overall x 30.0% Voids
#2	19.66'	189 cf	**Pourus Pave 4" (Conic)**Listed below (Recalc) 946 cf Overall x 20.0% Voids
		2,134 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
17.33	2,782	0	0	2,782
19.66	2,782	6,482	6,482	3,218

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
19.66	2,782	0	0	2,782
20.00	2,782	946	946	2,846

Device	Routing	Invert	Outlet Devices
#1	Discarded	17.33'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	19.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.16 cfs @ 12.28 hrs HW=17.46' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=17.33' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Link SP1: STUDY POINT #1

Inflow Area = 176,471 sf, 73.88% Impervious, Inflow Depth = 2.86" for 10-year event
Inflow = 8.65 cfs @ 12.10 hrs, Volume= 42,073 cf
Primary = 8.65 cfs @ 12.10 hrs, Volume= 42,073 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 2,651 sf, 5.21% Impervious, Inflow Depth = 0.22" for 10-year event
Inflow = 0.00 cfs @ 12.44 hrs, Volume= 48 cf
Primary = 0.00 cfs @ 12.44 hrs, Volume= 48 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1A: Subcat P-1A Runoff Area=19,270 sf 94.81% Impervious Runoff Depth=8.18"
Tc=6.0 min CN=95 Runoff=3.69 cfs 13,133 cf

Subcatchment P-1B: Subcat P-1B Runoff Area=25,482 sf 93.20% Impervious Runoff Depth=8.06"
Tc=6.0 min CN=94 Runoff=4.85 cfs 17,111 cf

Subcatchment P-1C: Subcat P-1C Runoff Area=8,741 sf 99.38% Impervious Runoff Depth=8.54"
Tc=6.0 min CN=98 Runoff=1.69 cfs 6,220 cf

Subcatchment P-2: Subcat P-2 Runoff Area=2,651 sf 5.21% Impervious Runoff Depth=1.83"
Tc=6.0 min CN=42 Runoff=0.11 cfs 404 cf

Subcatchment P-3: Subcat P-3 Runoff Area=20,411 sf 0.84% Impervious Runoff Depth=1.50"
Tc=6.0 min CN=39 Runoff=0.60 cfs 2,552 cf

Subcatchment P-4A: Subcat P-4A Runoff Area=32,794 sf 100.00% Impervious Runoff Depth=8.54"
Tc=6.0 min CN=98 Runoff=6.34 cfs 23,338 cf

Subcatchment P-4B: Subcat P-4B Runoff Area=13,050 sf 100.00% Impervious Runoff Depth=8.54"
Tc=6.0 min CN=98 Runoff=2.52 cfs 9,287 cf

Subcatchment P-4C: Subcat P-4C Runoff Area=11,858 sf 100.00% Impervious Runoff Depth=8.54"
Tc=6.0 min CN=98 Runoff=2.29 cfs 8,439 cf

Subcatchment P-6: Subcat P-6 Runoff Area=11,689 sf 77.49% Impervious Runoff Depth=6.97"
Tc=6.0 min CN=85 Runoff=2.05 cfs 6,788 cf

Subcatchment P-7: Subcat P-7 Runoff Area=14,139 sf 4.81% Impervious Runoff Depth=6.97"
Tc=6.0 min CN=85 Runoff=2.48 cfs 8,210 cf

Subcatchment P-8: Subcat P-8 Runoff Area=12,067 sf 80.35% Impervious Runoff Depth=7.09"
Tc=6.0 min CN=86 Runoff=2.14 cfs 7,129 cf

Subcatchment P-9: Subcat P-9 Runoff Area=5,268 sf 12.49% Impervious Runoff Depth=6.12"
Tc=6.0 min CN=78 Runoff=0.84 cfs 2,685 cf

Subcatchment P-9A: Subcat P-9A Runoff Area=1,702 sf 100.00% Impervious Runoff Depth=8.54"
Tc=6.0 min CN=98 Runoff=0.33 cfs 1,211 cf

Reach 1R: 18" Outlet Avg. Flow Depth=0.71' Max Vel=30.56 fps Inflow=24.94 cfs 87,460 cf
18.0" Round Pipe n=0.011 L=75.0' S=0.2000 '/' Capacity=55.52 cfs Outflow=24.89 cfs 87,460 cf

Pond BR #1: Bio-Retention Peak Elev=17.54' Storage=2,973 cf Inflow=1.26 cfs 14,172 cf
Outflow=0.34 cfs 14,144 cf

Pond CO-1: CO-1 Peak Elev=20.77' Inflow=2.29 cfs 8,439 cf
Primary=0.39 cfs 5,791 cf Secondary=1.90 cfs 2,648 cf Outflow=2.29 cfs 8,439 cf

Pond CO-2: CO-2 Peak Elev=19.33' Inflow=4.43 cfs 11,935 cf
Primary=0.28 cfs 5,830 cf Secondary=4.15 cfs 6,105 cf Outflow=4.43 cfs 11,935 cf

Pond DP #1: Proposed Detention Pond Peak Elev=19.69' Storage=4,692 cf Inflow=12.61 cfs 44,463 cf
Primary=4.97 cfs 39,383 cf Secondary=9.23 cfs 4,490 cf Outflow=14.20 cfs 43,873 cf

Pond PP#1: Pourus Pave #1 Peak Elev=18.93' Storage=4,934 cf Inflow=4.63 cfs 15,339 cf
Discarded=0.61 cfs 15,339 cf Primary=0.00 cfs 0 cf Outflow=0.61 cfs 15,339 cf

Pond PP#2: Pourus Pave #2 Peak Elev=18.19' Storage=714 cf Inflow=0.84 cfs 2,685 cf
Discarded=0.16 cfs 2,685 cf Primary=0.00 cfs 0 cf Outflow=0.16 cfs 2,685 cf

Link SP1: STUDY POINT #1 Inflow=24.89 cfs 87,460 cf
Primary=24.89 cfs 87,460 cf

Link SP2: STUDY POINT #2

Inflow=0.11 cfs 404 cf
Primary=0.11 cfs 404 cf

Total Runoff Area = 179,122 sf Runoff Volume = 106,506 cf Average Runoff Depth = 7.14"
27.14% Pervious = 48,612 sf 72.86% Impervious = 130,510 sf

Summary for Subcatchment P-1A: Subcat P-1A

Runoff = 3.69 cfs @ 12.09 hrs, Volume= 13,133 cf, Depth= 8.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
1,000	39	>75% Grass cover, Good, HSG A
18,270	98	Paved parking, HSG A
19,270	95	Weighted Average
1,000		5.19% Pervious Area
18,270		94.81% Impervious Area

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

Summary for Subcatchment P-1B: Subcat P-1B

Runoff = 4.85 cfs @ 12.09 hrs, Volume= 17,111 cf, Depth= 8.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
1,734	39	>75% Grass cover, Good, HSG A
10,355	98	Paved parking, HSG A
13,393	98	Roofs, HSG A
25,482	94	Weighted Average
1,734		6.80% Pervious Area
23,748		93.20% Impervious Area

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

Summary for Subcatchment P-1C: Subcat P-1C

Runoff = 1.69 cfs @ 12.09 hrs, Volume= 6,220 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
54	39	>75% Grass cover, Good, HSG A
8,687	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
8,741	98	Weighted Average
54		0.62% Pervious Area
8,687		99.38% Impervious Area

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

Summary for Subcatchment P-2: Subcat P-2

Runoff = 0.11 cfs @ 12.11 hrs, Volume= 404 cf, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
2,513	39	>75% Grass cover, Good, HSG A
138	98	Paved parking, HSG A
2,651	42	Weighted Average
2,513		94.79% Pervious Area
138		5.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-3: Subcat P-3

Runoff = 0.60 cfs @ 12.12 hrs, Volume= 2,552 cf, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
20,239	39	>75% Grass cover, Good, HSG A
172	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
20,411	39	Weighted Average
20,239		99.16% Pervious Area
172		0.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-4A: Subcat P-4A

Runoff = 6.34 cfs @ 12.09 hrs, Volume= 23,338 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
32,794	98	Roofs, HSG A
32,794		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-4B: Subcat P-4B

Runoff = 2.52 cfs @ 12.09 hrs, Volume= 9,287 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
13,050	98	Roofs, HSG A
13,050		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-4C: Subcat P-4C

Runoff = 2.29 cfs @ 12.09 hrs, Volume= 8,439 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
11,858	98	Roofs, HSG A
0	98	Water Surface, 0% imp, HSG A
11,858	98	Weighted Average
0		0.00% Pervious Area
11,858		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-6: Subcat P-6

Runoff = 2.05 cfs @ 12.09 hrs, Volume= 6,788 cf, Depth= 6.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
2,632	39	>75% Grass cover, Good, HSG A
9,058	98	Paved parking, HSG A
11,689	85	Weighted Average
2,632		22.51% Pervious Area
9,058		77.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-7: Subcat P-7

Runoff = 2.48 cfs @ 12.09 hrs, Volume= 8,210 cf, Depth= 6.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
3,163	39	>75% Grass cover, Good, HSG A
680	98	Paved parking, HSG A
10,296	98	Water Surface, 0% imp, HSG A
14,139	85	Weighted Average
13,459		95.19% Pervious Area
680		4.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-8: Subcat P-8

Runoff = 2.14 cfs @ 12.09 hrs, Volume= 7,129 cf, Depth= 7.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
2,371	39	>75% Grass cover, Good, HSG A
9,696	98	Paved parking, HSG A
0	98	Water Surface, 0% imp, HSG A
12,067	86	Weighted Average
2,371		19.65% Pervious Area
9,696		80.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-9: Subcat P-9

Runoff = 0.84 cfs @ 12.09 hrs, Volume= 2,685 cf, Depth= 6.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
1,828	39	>75% Grass cover, Good, HSG A
658	98	Paved parking, HSG A
2,782	98	Water Surface, 0% imp, HSG A
5,268	78	Weighted Average
4,610		87.51% Pervious Area
658		12.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN. TC**

Summary for Subcatchment P-9A: Subcat P-9A

Runoff = 0.33 cfs @ 12.09 hrs, Volume= 1,211 cf, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
1,702	98	Paved parking, HSG A
1,702		100.00% Impervious Area

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

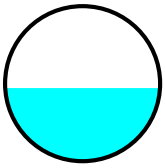
Summary for Reach 1R: 18" Outlet

Inflow Area = 176,471 sf, 73.88% Impervious, Inflow Depth = 5.95" for 100-year event
Inflow = 24.94 cfs @ 12.09 hrs, Volume= 87,460 cf
Outflow = 24.89 cfs @ 12.09 hrs, Volume= 87,460 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 30.56 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 7.80 fps, Avg. Travel Time= 0.2 min

Peak Storage= 61 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.71'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 55.52 cfs

18.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 75.0' Slope= 0.2000 '/'
Inlet Invert= 15.00', Outlet Invert= 0.00'



Summary for Pond BR #1: Bio-Retention

Inflow Area = 71,525 sf, 49.57% Impervious, Inflow Depth = 2.38" for 100-year event
Inflow = 1.26 cfs @ 12.11 hrs, Volume= 14,172 cf
Outflow = 0.34 cfs @ 13.97 hrs, Volume= 14,144 cf, Atten= 73%, Lag= 111.9 min
Primary = 0.34 cfs @ 13.97 hrs, Volume= 14,144 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 17.54' @ 13.97 hrs Surf.Area= 9,028 sf Storage= 2,973 cf
Flood Elev= 18.00' Surf.Area= 10,088 sf Storage= 5,541 cf

Plug-Flow detention time= 90.1 min calculated for 14,125 cf (100% of inflow)
Center-of-Mass det. time= 89.3 min (864.6 - 775.3)

Volume	Invert	Avail.Storage	Storage Description
#1	17.07'	4,691 cf	**Bio-Retention Ponding (Prismatic)** Listed below (Recalc)
#2	16.00'	850 cf	**Soil Media (Prismatic)** Listed below (Recalc) 4,250 cf Overall x 20.0% Voids
		5,541 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.07	3,972	0	0
18.00	6,116	4,691	4,691

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
16.00	3,972	0	0
17.07	3,972	4,250	4,250

Device	Routing	Invert	Outlet Devices
#1	Primary	16.00'	**8.0" Round Culvert** L= 114.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.00' / 15.43' S= 0.0050 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf
#2	Device 1	16.00'	**4.0" Round 4" UD X 2.00** L= 160.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.00' / 16.00' S= 0.0000 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.09 sf

Primary OutFlow Max=0.34 cfs @ 13.97 hrs HW=17.54' (Free Discharge)
└**1=Culvert** (Passes 0.34 cfs of 1.43 cfs potential flow)
└**2=4" UD** (Barrel Controls 0.34 cfs @ 1.95 fps)

Summary for Pond CO-1: CO-1

Inflow Area = 38,064 sf, 58.41% Impervious, Inflow Depth = 2.66" for 100-year event
Inflow = 2.29 cfs @ 12.09 hrs, Volume= 8,439 cf
Outflow = 2.29 cfs @ 12.09 hrs, Volume= 8,439 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.39 cfs @ 12.09 hrs, Volume= 5,791 cf
Secondary = 1.90 cfs @ 12.09 hrs, Volume= 2,648 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 20.77' @ 12.09 hrs
Flood Elev= 20.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	17.46'	**4.0" Round 4" to Bio-Ret** L= 78.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.46' / 17.07' S= 0.0050 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.09 sf
#2	Secondary	18.23'	**8.0" Round Roof Drain** L= 62.0' CMP, projecting, no headwall, Ke= 0.900

Inlet / Outlet Invert= 18.23' / 17.92' S= 0.0050 '/' Cc= 0.900
n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.38 cfs @ 12.09 hrs HW=20.66' (Free Discharge)
└**1=4" to Bio-Ret** (Barrel Controls 0.38 cfs @ 4.38 fps)

Secondary OutFlow Max=1.85 cfs @ 12.09 hrs HW=20.65' (Free Discharge)
└**2=Roof Drain** (Barrel Controls 1.85 cfs @ 5.30 fps)

Summary for Pond CO-2: CO-2

Inflow Area = 13,050 sf,100.00% Impervious, Inflow Depth = 10.97" for 100-year event
Inflow = 4.43 cfs @ 12.09 hrs, Volume= 11,935 cf
Outflow = 4.43 cfs @ 12.09 hrs, Volume= 11,935 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.28 cfs @ 12.09 hrs, Volume= 5,830 cf
Secondary = 4.15 cfs @ 12.09 hrs, Volume= 6,105 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 19.33' @ 12.09 hrs
Flood Elev= 20.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	17.51'	**4.0" Round 4" To Bio-Ret** L= 88.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.51' / 17.07' S= 0.0050 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.09 sf
#2	Secondary	17.92'	**15.0" Round Roof Drain** L= 48.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 17.92' / 17.36' S= 0.0117 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=0.28 cfs @ 12.09 hrs HW=19.29' (Free Discharge)
└**1=4" To Bio-Ret** (Barrel Controls 0.28 cfs @ 3.17 fps)

Secondary OutFlow Max=4.03 cfs @ 12.09 hrs HW=19.29' (Free Discharge)
└**2=Roof Drain** (Inlet Controls 4.03 cfs @ 3.28 fps)

Summary for Pond DP #1: Proposed Detention Pond

Inflow Area = 66,884 sf, 91.90% Impervious, Inflow Depth = 7.98" for 100-year event
Inflow = 12.61 cfs @ 12.09 hrs, Volume= 44,463 cf
Outflow = 14.20 cfs @ 12.10 hrs, Volume= 43,873 cf, Atten= 0%, Lag= 0.5 min
Primary = 4.97 cfs @ 12.09 hrs, Volume= 39,383 cf
Secondary = 9.23 cfs @ 12.10 hrs, Volume= 4,490 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 19.69' @ 12.09 hrs Surf.Area= 2,913 sf Storage= 4,692 cf
Flood Elev= 19.80' Surf.Area= 2,913 sf Storage= 4,694 cf

Plug-Flow detention time= 31.4 min calculated for 43,812 cf (99% of inflow)
Center-of-Mass det. time= 23.2 min (782.3 - 759.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	15.92'	2,917 cf	**17.96'W x 161.50'L x 3.25'H Field A** 9,429 cf Overall - 2,137 cf Embedded = 7,292 cf x 40.0% Voids
#2A	16.42'	1,728 cf	**ADS N-12 18"** x 48 Inside #1 Inside= 18.2"W x 18.2"H => 1.80 sf x 20.00'L = 36.0 cf Outside= 21.0"W x 21.0"H => 2.23 sf x 20.00'L = 44.5 cf 48 Chambers in 6 Rows
#3	15.92'	51 cf	**4.00'D x 4.08'H Vertical Cone/Cylinder**
		4,696 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	15.40'	**18.0" Round 18" HDPE** L= 49.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 15.40' / 15.16' S= 0.0049 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf

#2	Device 1	16.42'	**12.0" Round Culvert** L= 17.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.42' / 16.25' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#3	Secondary	18.90'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=4.95 cfs @ 12.09 hrs HW=19.66' (Free Discharge)
└**1=18" HDPE** (Passes 4.95 cfs of 12.59 cfs potential flow)
└**2=Culvert** (Inlet Controls 4.95 cfs @ 6.30 fps)

Secondary OutFlow Max=8.82 cfs @ 12.10 hrs HW=19.67' (Free Discharge)
└**3=Broad-Crested Rectangular Weir** (Weir Controls 8.82 cfs @ 2.87 fps)

Summary for Pond PP#1: Pourus Pave #1

Inflow Area = 26,206 sf, 39.59% Impervious, Inflow Depth = 7.02" for 100-year event
Inflow = 4.63 cfs @ 12.09 hrs, Volume= 15,339 cf
Outflow = 0.61 cfs @ 12.64 hrs, Volume= 15,339 cf, Atten= 87%, Lag= 33.3 min
Discarded = 0.61 cfs @ 12.64 hrs, Volume= 15,339 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 18.93' @ 12.64 hrs Surf.Area= 10,296 sf Storage= 4,934 cf
Flood Elev= 20.00' Surf.Area= 20,592 sf Storage= 7,897 cf

Plug-Flow detention time= 55.4 min calculated for 15,339 cf (100% of inflow)
Center-of-Mass det. time= 55.3 min (841.5 - 786.1)

Volume	Invert	Avail.Storage	Storage Description
#1	17.33'	7,197 cf	**Subbase (Conic)** Listed below (Recalc) 23,990 cf Overall x 30.0% Voids
#2	19.66'	700 cf	**Pourus Pave 4" (Conic)** Listed below (Recalc) 3,501 cf Overall x 20.0% Voids
		7,897 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
17.33	10,296	0	0	10,296
19.66	10,296	23,990	23,990	11,134

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
19.66	10,296	0	0	10,296
20.00	10,296	3,501	3,501	10,418

Device	Routing	Invert	Outlet Devices
#1	Discarded	17.33'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	19.60'	**115.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.61 cfs @ 12.64 hrs HW=18.93' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.61 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=17.33' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond PP#2: Pourus Pave #2

Inflow Area = 5,268 sf, 12.49% Impervious, Inflow Depth = 6.12" for 100-year event
Inflow = 0.84 cfs @ 12.09 hrs, Volume= 2,685 cf
Outflow = 0.16 cfs @ 12.53 hrs, Volume= 2,685 cf, Atten= 80%, Lag= 26.6 min
Discarded = 0.16 cfs @ 12.53 hrs, Volume= 2,685 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 18.19' @ 12.53 hrs Surf.Area= 2,782 sf Storage= 714 cf
Flood Elev= 20.00' Surf.Area= 5,564 sf Storage= 2,134 cf

Plug-Flow detention time= 26.5 min calculated for 2,685 cf (100% of inflow)
Center-of-Mass det. time= 26.5 min (830.4 - 803.9)

Volume	Invert	Avail.Storage	Storage Description
#1	17.33'	1,945 cf	**Subbase (Conic)**Listed below (Recalc) 6,482 cf Overall x 30.0% Voids
#2	19.66'	189 cf	**Pourus Pave 4" (Conic)**Listed below (Recalc) 946 cf Overall x 20.0% Voids
		2,134 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
17.33	2,782	0	0	2,782
19.66	2,782	6,482	6,482	3,218

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
19.66	2,782	0	0	2,782
20.00	2,782	946	946	2,846

Device	Routing	Invert	Outlet Devices
#1	Discarded	17.33'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	19.50'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.16 cfs @ 12.53 hrs HW=18.18' (Free Discharge)
↑└**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=17.33' (Free Discharge)
↑└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link SP1: STUDY POINT #1

Inflow Area = 176,471 sf, 73.88% Impervious, Inflow Depth = 5.95" for 100-year event
Inflow = 24.89 cfs @ 12.09 hrs, Volume= 87,460 cf
Primary = 24.89 cfs @ 12.09 hrs, Volume= 87,460 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 2,651 sf, 5.21% Impervious, Inflow Depth = 1.83" for 100-year event
Inflow = 0.11 cfs @ 12.11 hrs, Volume= 404 cf
Primary = 0.11 cfs @ 12.11 hrs, Volume= 404 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Section 5.0 Appendix

RAINFALL DATA

MANNING NUMBER TABLES

SOILS MAP

FORM 11 TEST PIT LOGS

CONTECH WATER QUALITY FLOW CALCULATION

CONTECH WQU SIZING SPREADSHEETS

STORMWATER PIPE SIZING CALCULATION

MADEP CALCULATIONS

RAINFALL DATA

Figure B-2.—Approximate geographic boundaries for SCS rainfall distributions.

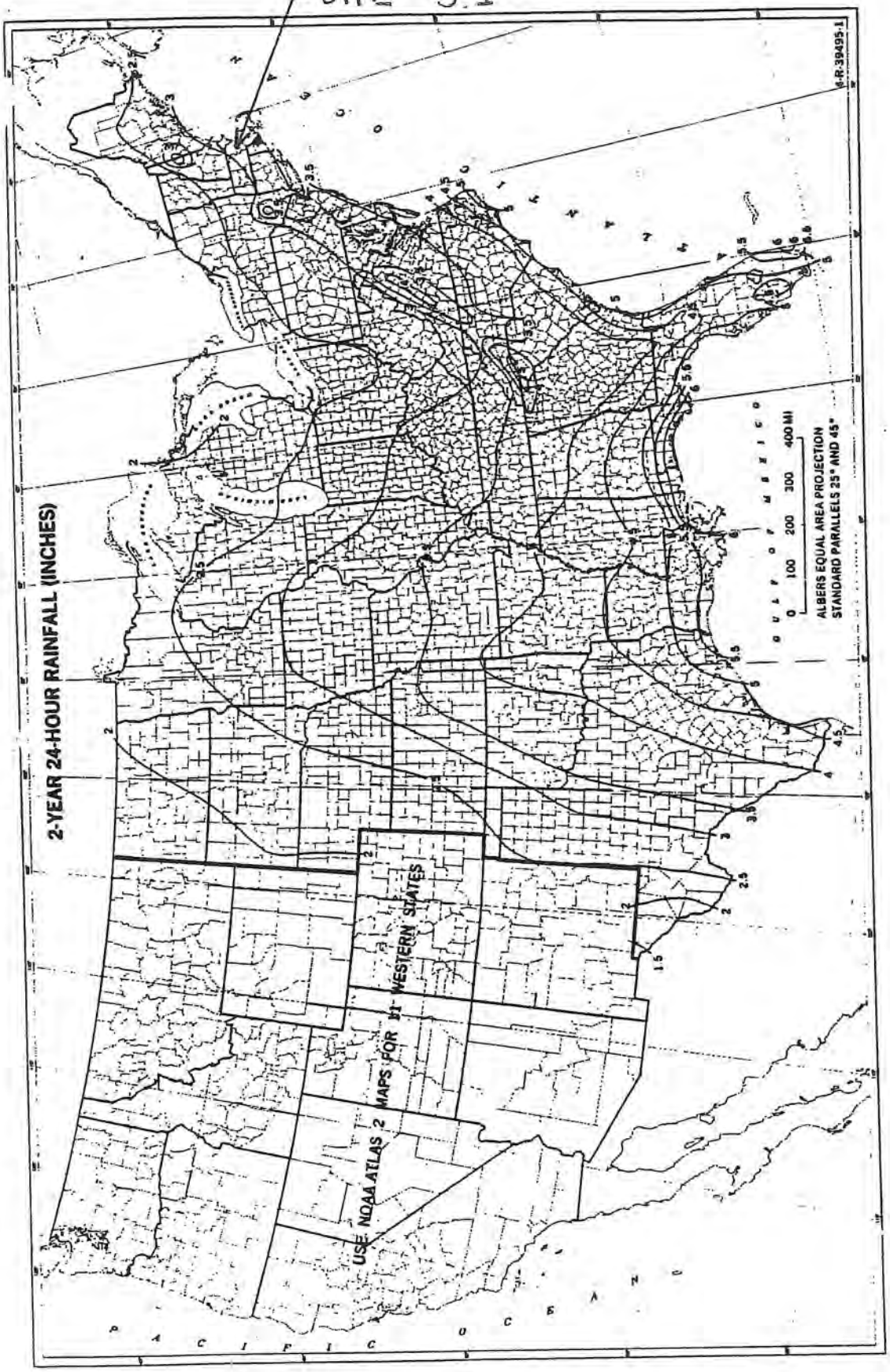


Figure B-3.—Two-year, 24-hour rainfall.

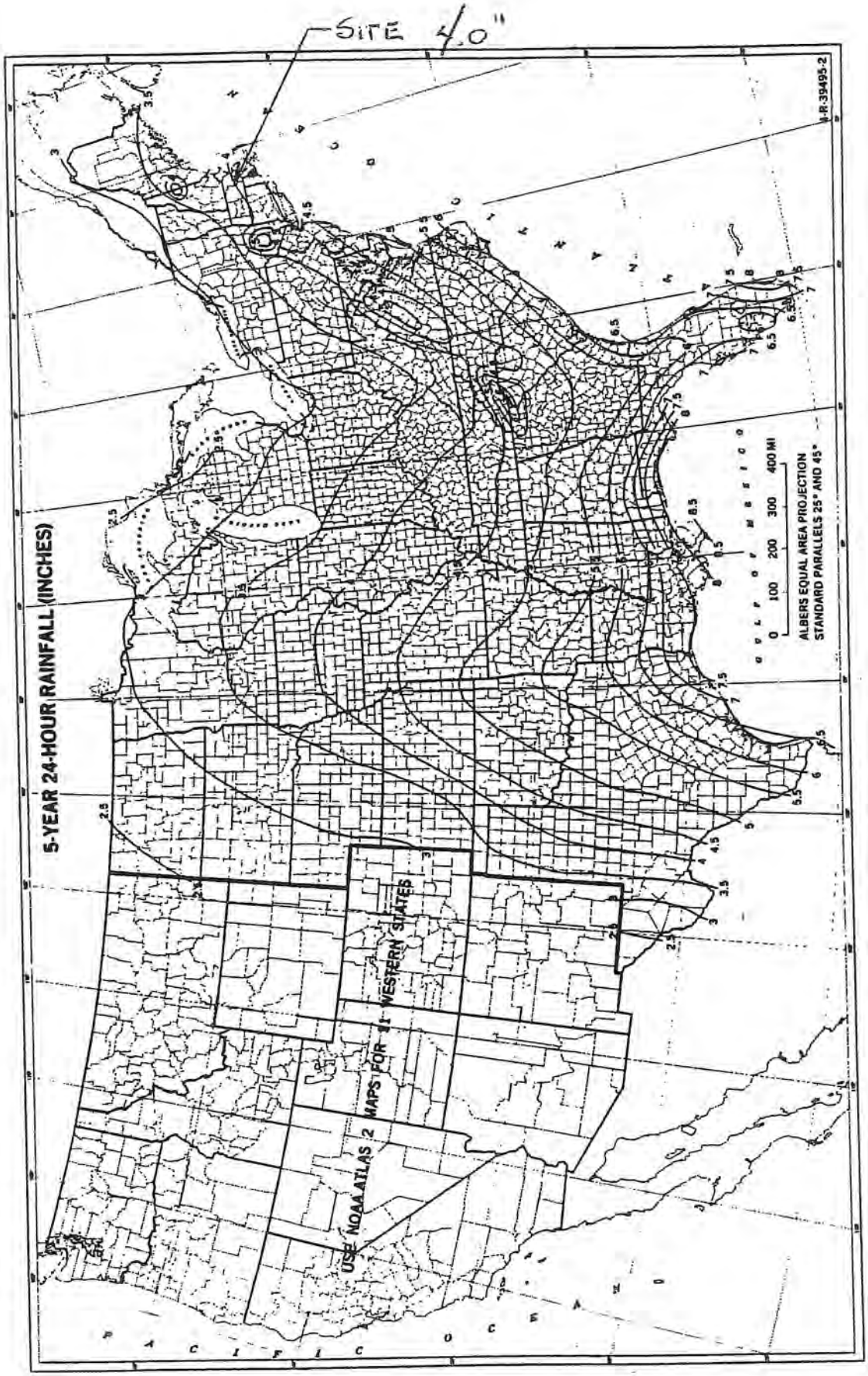


Figure B-4.—Five-yenr, 24-hour rainfall.

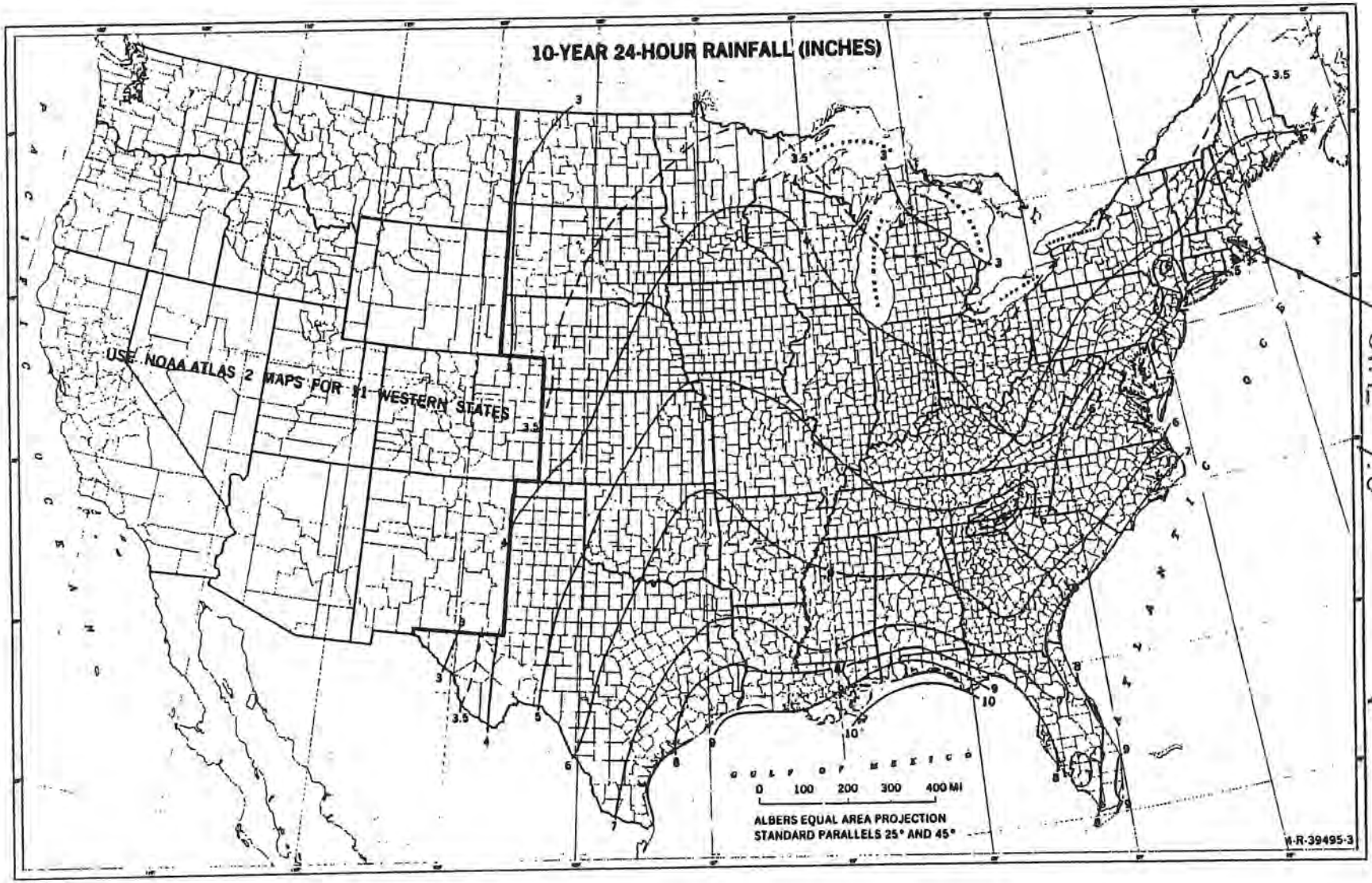


Figure B-5.—Ten-year, 24-hour rainfall.

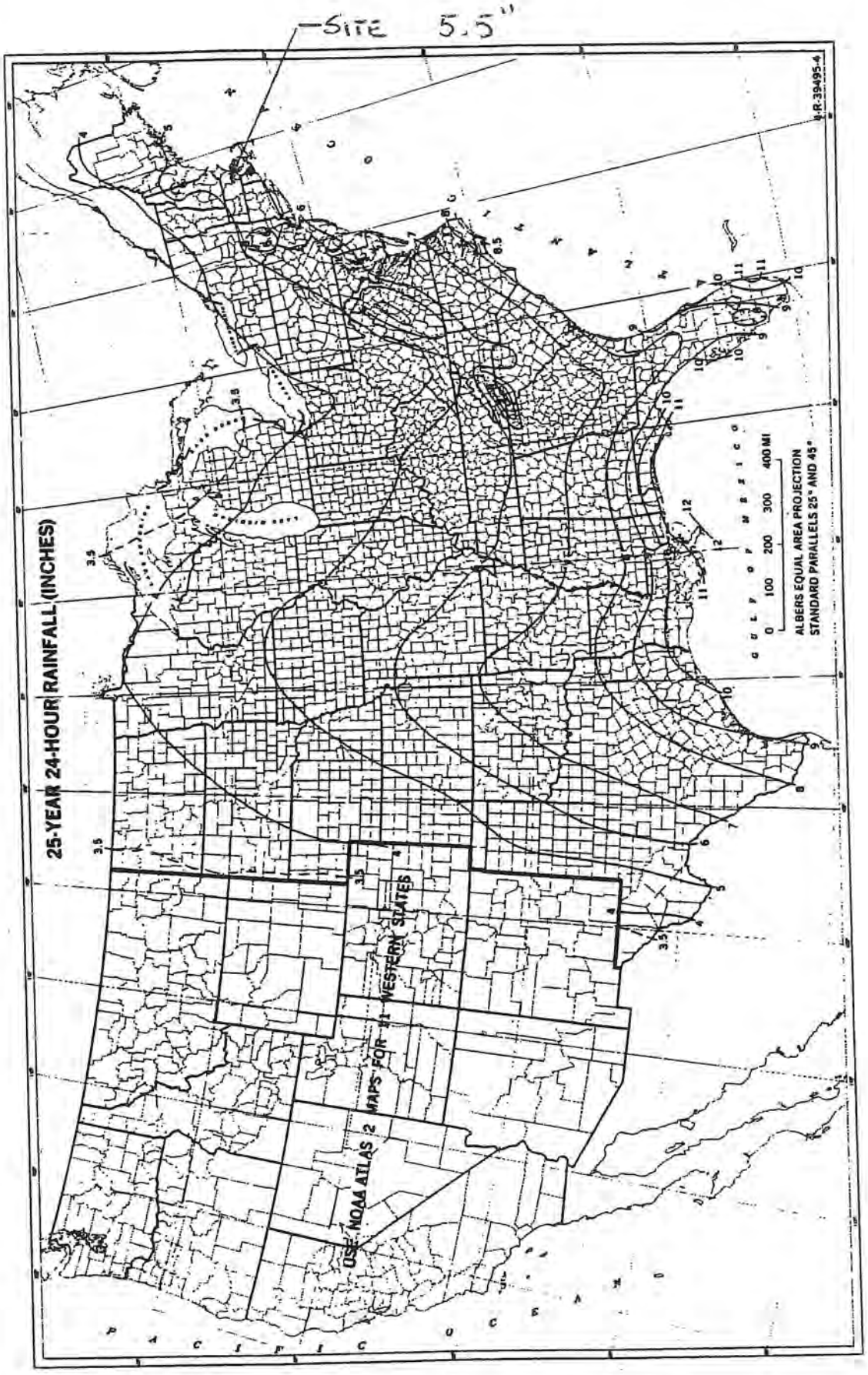


Figure B-6.—Twenty-five-year, 24-hour rainfall.

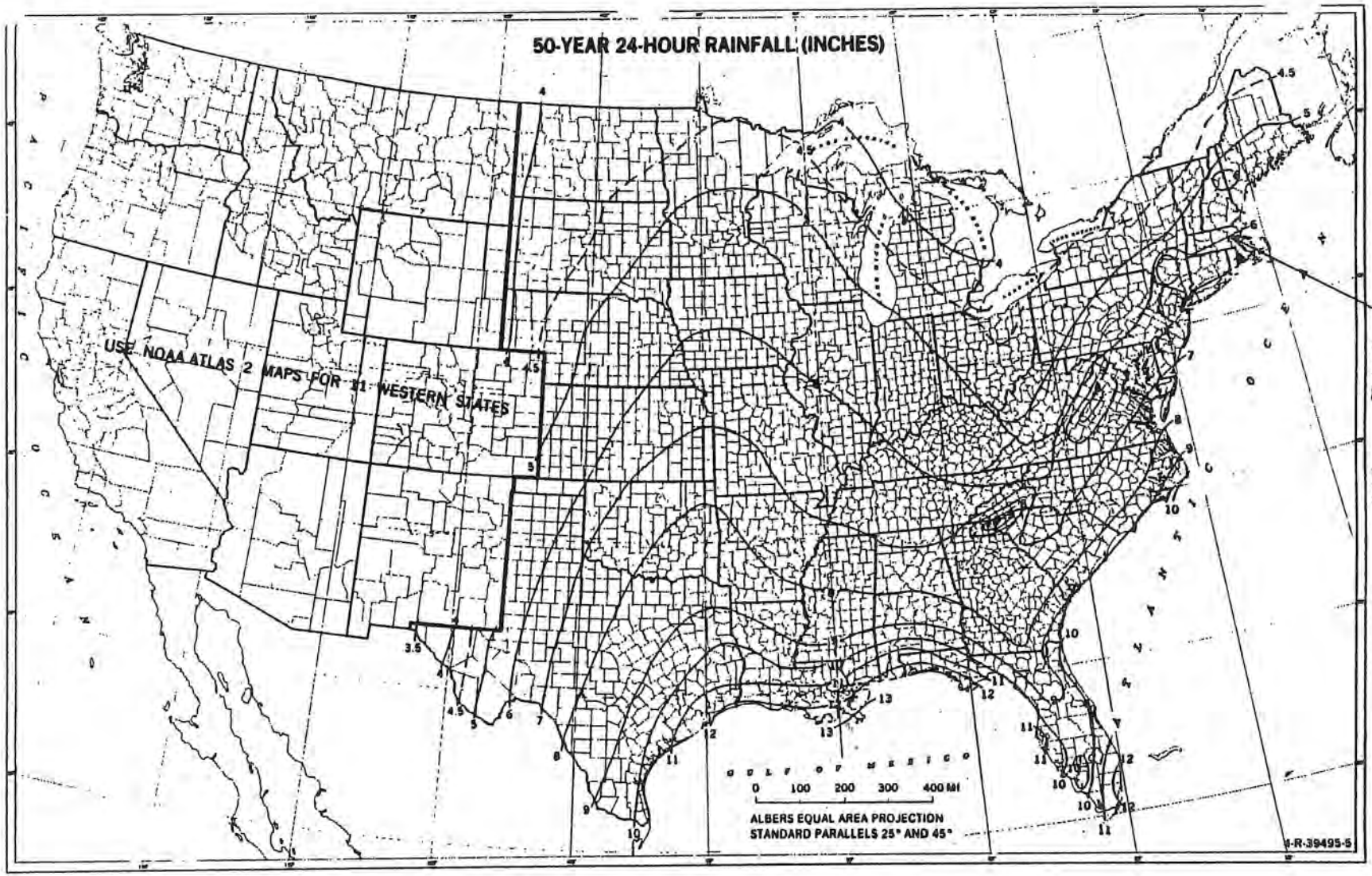


Figure B-7.—Fifty-year, 24-hour rainfall.

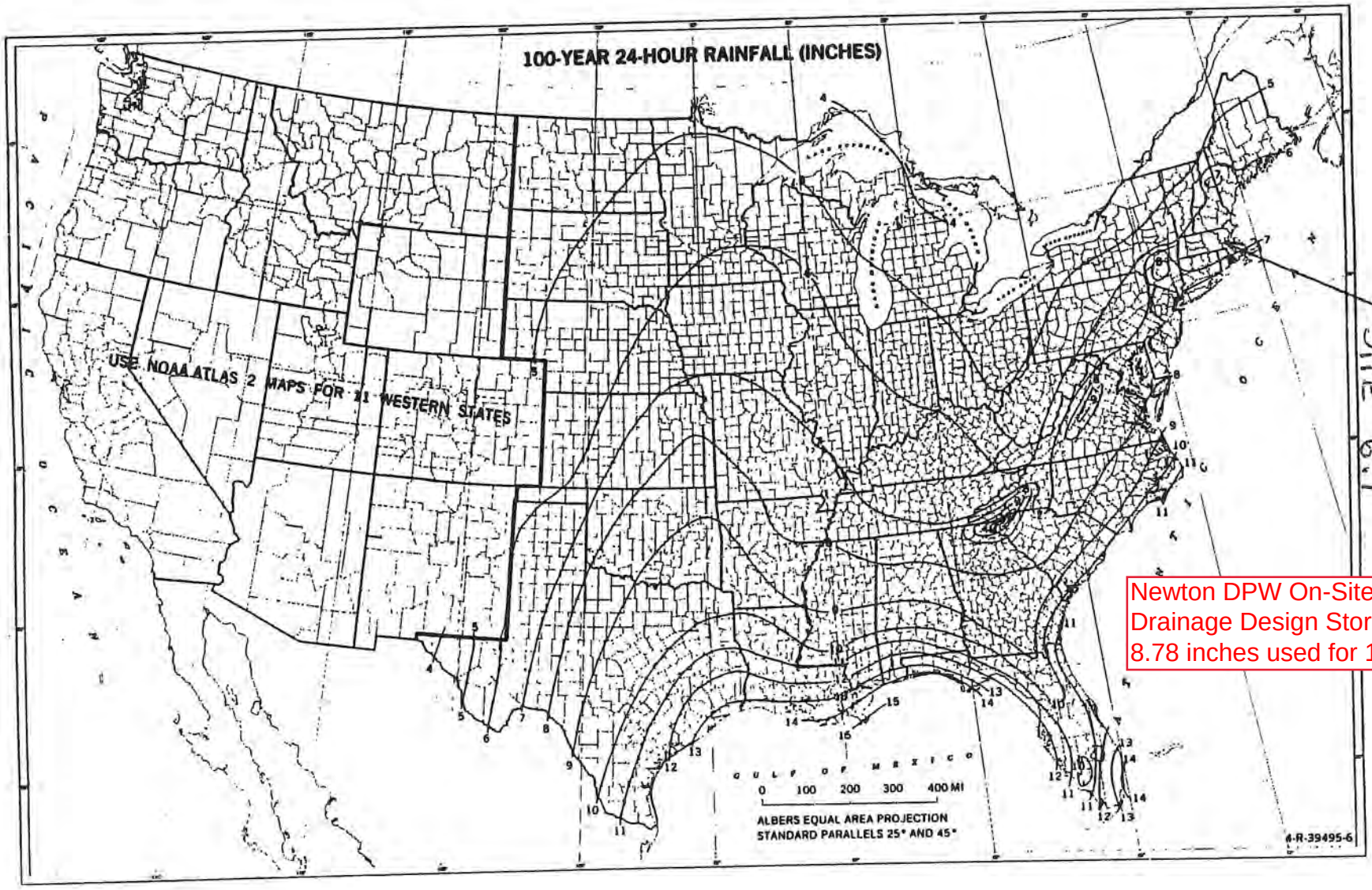


Figure B-8.—One-hundred-year, 24-hour rainfall.

MANNING NUMBER TABLES

Manning's Roughness Coefficients ("n")

Conduit	Manning's Coefficients
Closed Conduits	
Asbestos-Cement Pipe	0.011 to 0.015
Brick	0.013 to 0.017
Cast Iron Pipe	
Cement-lined and seal-coated	0.011 to 0.015
Concrete (Monolithic)	
Smooth forms	0.012 to 0.014
Rough forms	0.015 to 0.017
Concrete Pipe	0.011 to 0.015
Corrugated-Metal Pipe (1/2 - STUL 34470 2 1/2-inch corrgtn.)	
Plain	0.022 to 0.026
Paved invert	0.018 to 0.022
Spun asphalt-lined	0.011 to 0.015
Plastic Pipe (Smooth)	0.011 to 0.015
Vitrified Clay	
Pipes	0.011 to 0.015
Liner channels	0.013 to 0.017
Open Channels	
Lined Channels	
Asphalt	0.013 to 0.017
Brick	0.012 to 0.018
Concrete	0.011 to 0.020
Rubble or riprap	0.020 to 0.035
Vegetal	0.030 to 0.040
Excavated or Dredged	
Earth, straight and uniform	0.020 to 0.030
Earth, winding, fairly uniform	0.025 to 0.040
Rock	0.030 to 0.045
Unmaintained	0.050 to 0.140
Natural Channels (minor streams, top width at flood state < 100 feet)	
Fairly regular section	0.030 to 0.070
Irregular section with pools	0.040 to 0.100

Source: Design and Construction of Sanitary and Storm Sewers, American Society of Civil Engineers and the Water Pollution Control Federation, 1969.

SOILS MAP

Map Scale: 1:2,560 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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: Middlesex County, Massachusetts
Survey Area Data: Version 19, Sep 12, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 10, 2014—Aug 25, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	4.2	12.6%
602	Urban land	23.8	70.9%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	1.8	5.3%
655	Udorthents, wet substratum	3.8	11.2%
Totals for Area of Interest		**33.5**	**100.0%**

FORM 11 TEST PIT LOGS

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

CPC Land Acquisition Company, LLC
Owner Name

15 Riverdale Avenue
Street Address

Map 11002 Parcel 0007
Map/Lot #

Newton
City

MA
State

02458
Zip Code

B. Site Information

1. (Check one) ☐ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: NRCS Web Soil Survey (Source) 602 (Soil Map Unit)

Urban Land
Soil Name

Potential for high groundwater table
Soil Limitations

N/A
Soil Parent material

Outwash plains
Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018/ USGS (Year Published/Source) Coarse Deposits (Map Unit)

Coarse: gravel deposits, sand and gravel deposits, and sand deposits, not differentiated.
Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: _____ (Wetland Type)

7. Current Water Resource Conditions (USGS): November 26, 2019 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

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 Observation Hole Number: 1 (Hole #) | November 26, 2019 (Date) | 9:30 AM (Time) | Partly Cloudy/30s (Weather) | 42.36595 N (Latitude) | 71.19475 W (Longitude:)

1. Land Use: Developed lot, parking lot area (e.g., woodland, agricultural field, vacant lot, etc.) | N/A (Vegetation) | N/A (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 1-2% (Slope (%))

Description of Location: Southeast corner of parking lot

2. Soil Parent Material: gravel deposits, sand and gravel deposits, and sand deposits, not differentiated | Outwash plains (Landform) | Footslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body 205+/- feet | Drainage Way N/A feet | Wetlands 200+/- feet | Property Line 15+/- feet | Drinking Water Well N/A feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: _____ Depth Weeping from Pit | 72" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-9	Fill	-	-	-	-	-	-	-	-	-	
9-12	A	Sandy Loam	10YR 2/1	-	-	-	-	-	Granular	V.Friable	
12-48	B	Gravelly Coarse Loamy Sand	10YR 5/4	-	-	-	15-20%	10%	Massive	Friable	
48-72	C	Gravelly Coarse Sand	2.5Y 4/3	-	-	-	15-20%	-	S. Grain	Loose	

Additional Notes:

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 Observation Hole Number: 2 (Hole #) | 11/26/2019 (Date) | 10:30 AM (Time) | Partly cloudy/30s (Weather) | 42.36621 N (Latitude) | 71.19473 W (Longitude:)

1. Land Use: Developed lot, parking lot (e.g., woodland, agricultural field, vacant lot, etc.) | N/A (Vegetation) | N/A (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 1-2% (Slope (%))

Description of Location: Northeast corner of parking lot

2. Soil Parent Material: gravel deposits, sand and gravel deposits, and sand deposits, not differentiated | Outwash plains (Landform) | Footslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body 125+/- feet | Drainage Way N/A feet | Wetlands 120+/- feet
Property Line 15+/- feet | Drinking Water Well N/A feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: _____ Depth Weeping from Pit 68" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-14	Fill	-	-	-	-	-	-	-	-	-	
14-26	A	Gravelly Fine Sandy Loam	10YR 2/2	-	-	-	5-10%		Granular	V.Friable	
26-56	B	Gravelly Coarse Loamy Sand	10YR 5/4	-	-	-	15-20%	10-15%	Massive	Friable	
56-68	C	Gravelly Coarse Sand	2.5Y 4/4	-	-	-	15-20%	-	S. Grain	Loose	

Additional Notes:

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 Observation Hole Number: 3 (Hole #) | November 26, 2019 (Date) | 12:00 PM (Time) | Partly Cloudy/30s (Weather) | 42.36692 N (Latitude) | 71.19536 W (Longitude:)

1. Land Use: Developed lot, landscape area (e.g., woodland, agricultural field, vacant lot, etc.) | Grass (Vegetation) | N/A (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 1-2% (Slope (%))

Description of Location: Landscape area behind existing building

2. Soil Parent Material: gravel deposits, sand and gravel deposits, and sand deposits, not differentiated | Outwash plains (Landform) | Footslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body 65+/- feet | Drainage Way N/A feet | Wetlands 65+/- feet | Property Line 25+/- feet | Drinking Water Well N/A feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 48" Depth Weeping from Pit | 50" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-9	A	Fine Sandy Loam	10YR 2/1	-	-	-	-	-	Granular	Friable	
9-30	B	Coarse Loamy Sand	10YR 4/3	-	-	-	10-15%	-	Massive	V.Friable	
30-56	C	Gravelly Coarse Sand	2.5Y 3/3	30	10YR 6/1	5-10%	-	-	S. Grain	Loose	

Additional Notes:

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 Observation Hole Number: 4 (Hole #) | 11/26/2019 (Date) | 1:00 PM (Time) | Partly cloudy/30s (Weather) | 42.36691 N (Latitude) | 71.19568 W (Longitude:)

1. Land Use: Developed lot (e.g., woodland, agricultural field, vacant lot, etc.) | Grass (Vegetation) | N/A (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 1-2% (Slope (%))

Description of Location: Landscape area behind existing building

2. Soil Parent Material: gravel deposits, sand and gravel deposits, and sand deposits, not differentiated | Outwash plains (Landform) | Footslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body 145+/- feet | Drainage Way N/A feet | Wetlands 65+/- feet
Property Line 25+/- feet | Drinking Water Well N/A feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: 34" Depth Weeping from Pit | 36" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	A	Fine Sandy Loam	10YR 2/2	-	-	-	-	-	Granular	V.Friable	
12-36	B	Coarse Loamy Sand	10YR 4/4	30	10YR 6/1	5-10%	10-15%	-	Massive	Friable	
36-48	C	Coarse Sand	2.5Y 3/3	-	-	-	-	-	S.Grain	Loose	

Additional Notes:

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:	Obs. Hole # 1	Obs. Hole # 2	Obs.Hole#3	Obs.Hole#4
☒ Depth observed standing water in observation hole	72 inches	68 inches	50"	36"
☐ Depth weeping from side of observation hole	_____ inches	_____ inches		
☒ Depth to soil redoximorphic features (mottles)	- inches	- inches	30"	30"
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches		

_____ Index Well Number

_____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: 30 inches

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 (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. 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.

	11/26/2019
Signature of Soil Evaluator	Date
Bridget E. Souza / SE13867	07/01/2021
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License
Name of Approving Authority Witness	Approving Authority

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 Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

See site plans for test pit locations

CONTECH WATER QUALITY FLOW CALCULATION

Project: Residences on the Charles
Location: Newton, MA
Prepared For: Allen & Major

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
WQU 1	0.96	0.0014933	6.0	0.100	1.00	774.00	1.16
WQU 2	0.13	0.0002061	6.0	0.100	1.00	774.00	0.16
WQU 4	0.24	0.0003750	6.0	0.100	1.00	774.00	0.29
WQU 5	0.11	0.0001719	6.0	0.100	1.00	774.00	0.13

CONTECH WQU SIZING SPREADSHEETS

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

RESIDENCES ON THE CHARLES
NEWTON, MA

Area	**0.96 ac**	Unit Site Designation	**WQU 1**
Weighted C	**0.9**	Rainfall Station #	**69**
t_c	**6 min**		
CDS Model	**2015-4**	CDS Treatment Capacity	**1.4 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.02	0.02	9.8
0.04	9.6%	19.8%	0.03	0.03	9.2
0.06	9.4%	29.3%	0.05	0.05	8.9
0.08	7.7%	37.0%	0.07	0.07	7.3
0.10	8.6%	45.6%	0.09	0.09	8.0
0.12	6.3%	51.9%	0.10	0.10	5.8
0.14	4.7%	56.5%	0.12	0.12	4.3
0.16	4.6%	61.2%	0.14	0.14	4.2
0.18	3.5%	64.7%	0.15	0.15	3.2
0.20	4.3%	69.1%	0.17	0.17	3.9
0.25	8.0%	77.1%	0.22	0.22	6.9
0.30	5.6%	82.7%	0.26	0.26	4.7
0.35	4.4%	87.0%	0.30	0.30	3.6
0.40	2.5%	89.5%	0.34	0.34	2.0
0.45	2.5%	92.1%	0.39	0.39	2.0
0.50	1.4%	93.5%	0.43	0.43	1.1
0.75	5.0%	98.5%	0.65	0.65	3.3
1.00	1.0%	99.5%	0.86	0.86	0.6
1.50	0.0%	99.5%	1.29	1.29	0.0
2.00	0.0%	99.5%	1.72	1.40	0.0
3.00	0.5%	100.0%	2.58	1.40	0.1
					88.8
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**82.4%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Brief Stormceptor Sizing Report - WQU 2

Project Information & Location			
Project Name	Residences on the Charles	**Project Number**	633823
City	Newton	**State/ Province**	Massachusetts
Country	United States of America	**Date**	11/14/2019
Designer Information		**EOR Information (optional)**	
Name	David Adams	**Name**	
Company	Contech Engineered Solutions	**Company**	Allen & MAjor
Phone #	207-885-6191	**Phone #**	
Email	dadams@conteches.com	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	WQU 2
Target TSS Removal (%)	80
TSS Removal (%) Provided	95
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	95
STC 900	97
STC 1200	98
STC 1800	98
STC 2400	98
STC 3600	99
STC 4800	99
STC 6000	99
STC 7200	99
STC 11000	100
STC 13000	100
STC 16000	100
StormceptorMAX	Custom

Stormceptor®

CONTECH ENGINEERED SOLUTIONS
A QUIKRETE® COMPANY

Sizing Details

Drainage Area

Total Area (acres)	0.13
Imperviousness %	100.0

Rainfall

Station Name	BOSTON WSFO AP
State/Province	Massachusetts
Station ID #	0770
Years of Records	58
Latitude	42°21'38"N
Longitude	71°0'38"W

Water Quality Objective

TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	

Up Stream Storage

Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion

Max. Flow to Stormceptor (cfs)	0.00000

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

OK-110

Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	0.0	2.65
53.0	3.0	2.65
75.0	15.0	2.65
88.0	25.0	2.65
106.0	41.0	2.65
125.0	15.0	2.65
150.0	1.0	2.65
212.0	0.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Determining Jellyfish Size for Mass Based Loading

CONTECH Stormwater Solutions Inc. Engineer: DRA
Date Prepared: **11/14/2019**

Site Information

Project Name	**Residences on the Charles**
Project State	**Massachusetts**
Project City	**Newton**

Total Drainage Area, Ad	**1.25**	ac
Post Development Impervious Area, Ai	**1.09**	ac
Pervious Area, Ap	**0.17**	ac
% Impervious	**87%**	
Runoff Coefficient, Rc	**0.83**	

Upstream Detention System

Treatment release rate from detention, $Q_{release\ treat}$	**0.445**	cfs
Detention pretreatment credit (from removal efficiency calcs)	**50%**	

Mass Loading Calculations

Mean Annual Rainfall, P	**48**	in
Agency Required % Removal	**80%**	
Percent Runoff Capture	**90%**	
Mean Annual Runoff, Vt	**163226**	ft^3
Event Mean Concentration of Pollutant, EMC	**70**	mg/l
Annual Mass Load, M total	**712.87**	lbs

Filter System

Filtration Brand	**Jelly Fish**
Cartridge Length	**54** in

Jelly Fish Sizing

Mass removed by pretreatment system	**356.43**	lbs
Mass load to filters after pretreatment	**356.434**	
Mass to be Captured by System	**285.15**	lbs

Summary			
Mass	Treatment Mass	313.00	lbs
	Required Size	**JF4-2-1**	

STORMWATER PIPE SIZING CALCULATION

ALLEN & MAJOR ASSOCIATES, INC.

DRAINAGE PIPE DESIGN ANALYSIS

Manning's Formula

$V=1.486/n*R^{2/3}*S^{1/2}$
Q = V*A
(25-Year storm)

Where: V is the velocity in Ft/sec.
n is Mannings coefficient of friction
R is the Hydraulic Radius
S is the slope of the pipe

R=Area/Wetted Perimeter

Where: Area=Pi*(R/12)2
Wetted Perimeter=2*Pi*R/12

A&M Job No. 1374-23

Date: 3/13/2020

Project Location:
Residences on the Charles
15 Riverdale Ave
Neewton, MA

Prepared For:
CPC Land Acquisition Company, LLC

PIPE	Q_{design} (cfs)	n	Diameter (inches)	A (ft^2)	Wp (ft)	R (ft)	S (feet/foot)	Q_{full} (cfs)	$Q_{full} \geq Q_{design}$	V_{full} (ft/s)	Q_d/Q_f	Results Fig. 4-4A	V_{design} (ft/s)	$V_{design} \leq$ 10 ft/s
DMH2	1.16	0.013	12	0.79	3.14	0.25	0.0100	3.56	OK	4.54	0.33	0.87	3.95	OK
DMH3	5.25	0.013	18	1.77	4.71	0.38	0.0050	7.43	OK	4.20	0.71	1.08	4.54	OK
DMH4	5.25	0.013	18	1.77	4.71	0.38	0.0050	7.43	OK	4.20	0.71	1.08	4.54	OK
DMH5	2.27	0.013	15	1.23	3.93	0.31	0.0090	6.13	OK	4.99	0.37	0.89	4.44	OK
DMH6	10.47	0.013	18	1.77	4.71	0.38	0.0200	14.86	OK	8.41	0.70	1.08	9.08	OK
DMH8	6.69	0.013	18	1.77	4.71	0.38	0.0050	7.43	OK	4.20	0.90	1.13	4.75	OK
WQU1	5.25	0.013	18	1.77	4.71	0.38	0.0100	10.50	OK	5.94	0.50	0.99	5.88	OK
WQU2	0.65	0.013	12	0.79	3.14	0.25	0.0050	2.52	OK	3.21	0.26	0.82	2.63	OK
CO-1	1.43	0.013	12	0.79	3.14	0.25	0.0050	2.52	OK	3.21	0.57	1.03	3.30	OK
CO-2	2.71	0.013	15	1.23	3.93	0.31	0.0050	4.57	OK	3.72	0.59	1.04	3.87	OK
CO-3	6.67	0.013	18	1.77	4.71	0.38	0.0100	10.50	OK	5.94	0.63	1.05	6.24	OK
CO-4	6.67	0.013	18	1.77	4.71	0.38	0.0180	14.09	OK	7.98	0.47	0.97	7.74	OK
CO-5	0.54	0.013	8	0.35	2.09	0.17	0.0040	0.76	OK	2.19	0.71	1.08	2.36	OK

MADEP CALCULATIONS

ALLEN & MAJOR ASSOCIATES, INC.

Project No.	1374-23	**Sheet**	1 of 1
Project Description	Residences on the Charles		
	Newton, MA		
Calculated By	AM	**Date**	03/13/20
Checked By		**Date**	

Standard # 3: Groundwater Recharge

Proposed recharge system: Porous Pavement

In accordance with *MADEP – Volume 2, Technical Guide for Compliance with Massachusetts Stormwater Management Standards, dated January 2008*

A soils require a Volume to recharge of	0.60	inches
B soils require a Volume to recharge of	0.35	inches
C soils require a Volume to recharge of	0.25	inches
D soils require a Volume to recharge of	0.10	inches

Impervious area within: A-soils =	130,510	sf
Impervious area within: B-soils =	0	sf
Impervious area within: C-soils =	0	sf
Impervious area within: D-soils =	0	sf

Weighted Groundwater Recharge Depth = **0.60 in**

Total Site Volume required to be recharged =

130,510 sf x 1" / 12 x 0.60 in = 6,526 cf

Site volume recharge provided by = volume within porous pavement system

= 9,848 c.f. Total Volume Recharged > 6,526 cf (OK)

ALLEN & MAJOR ASSOCIATES, INC.

Project No.	1374-23	**Sheet**	1 of 1
Project Description	Residences on the Charles		
	Newton MA		
Calculated By	ARM	**Date**	03/13/20
Checked By		**Date**	

Drawdown within 72 hours Analysis for Static Method

Perforated Pipe System

Infiltration Rate: 2.41 inches/hour *(From table 2.3.3: Rawls, Brakensiek, Saxton, 1982)*

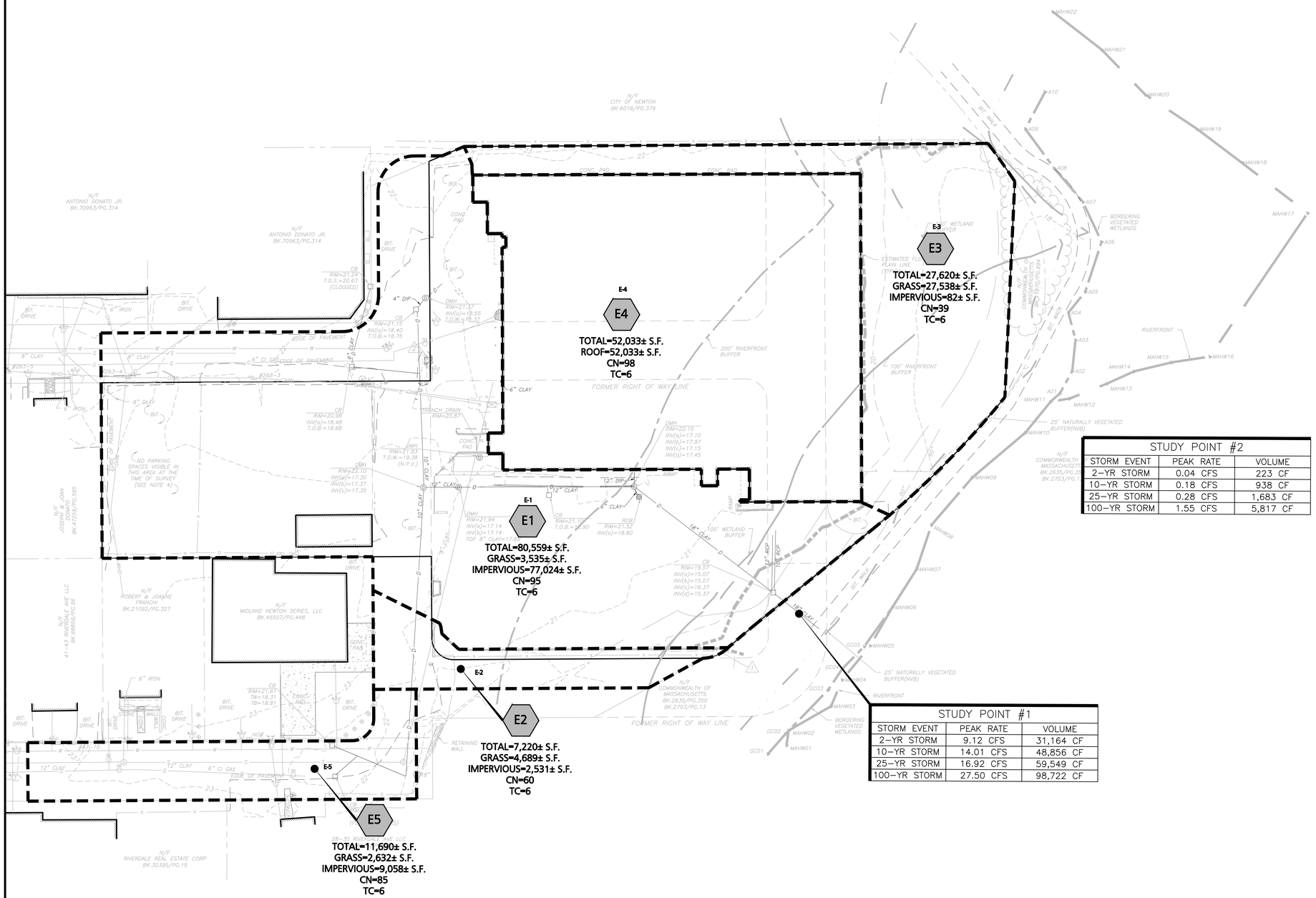
Volume Provide for Infiltration: 9,848 cf

Basin bottom area: 13,024 sf

Time $_{drawdown}$ = (Required Recharge Volume in cubic feet as determined by the Static Method)(1/Design Infiltration Rate in inches per hour)(conversion for inches to feet)(1/bottom area in feet)

Time $_{drawdown}$ = (9,848 cf) (1 / 2.41 in/hr) (1ft/12 in.) (1 / 13,024 sf)

= 3.77 hours



STUDY POINT #2		
STORM EVENT	PEAK RATE	VOLUME
2-YR STORM	0.04 CFS	223 CF
10-YR STORM	0.18 CFS	938 CF
25-YR STORM	0.28 CFS	1,683 CF
100-YR STORM	1.55 CFS	5,817 CF

STUDY POINT #1		
STORM EVENT	PEAK RATE	VOLUME
2-YR STORM	9.12 CFS	31,164 CF
10-YR STORM	14.01 CFS	48,856 CF
25-YR STORM	16.92 CFS	59,549 CF
100-YR STORM	27.50 CFS	98,722 CF

LEGEND

EXISTING WATERSHED

SUBCATCHMENT LABEL (E-1)

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GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

THE RESIDENCES ON THE CHARLES

15 RIVERDALE AVENUE
NEWTON, MA

CPC LAND ACQUISITION COMPANY, LLC

ARCHITECT

E-ICON ARCHITECTURE

101 SUMMER ST BOSTON MA 02110

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WOBURN, MA ■ EASTFIELD, MA ■ MANCHESTER, NH

STAMP

KEY PLAN

MARK	DATE	DESCRIPTION
2	02-13-2020	REV. COMP. PERMIT
1	12-11-2019	COMP. PERMIT

PROJECT NUMBER: 1374-23
DRAWN BY: AM/ND
CHECKED BY: TJW

SHEET TITLE

EXISTING WATERSHED PLAN

EWS

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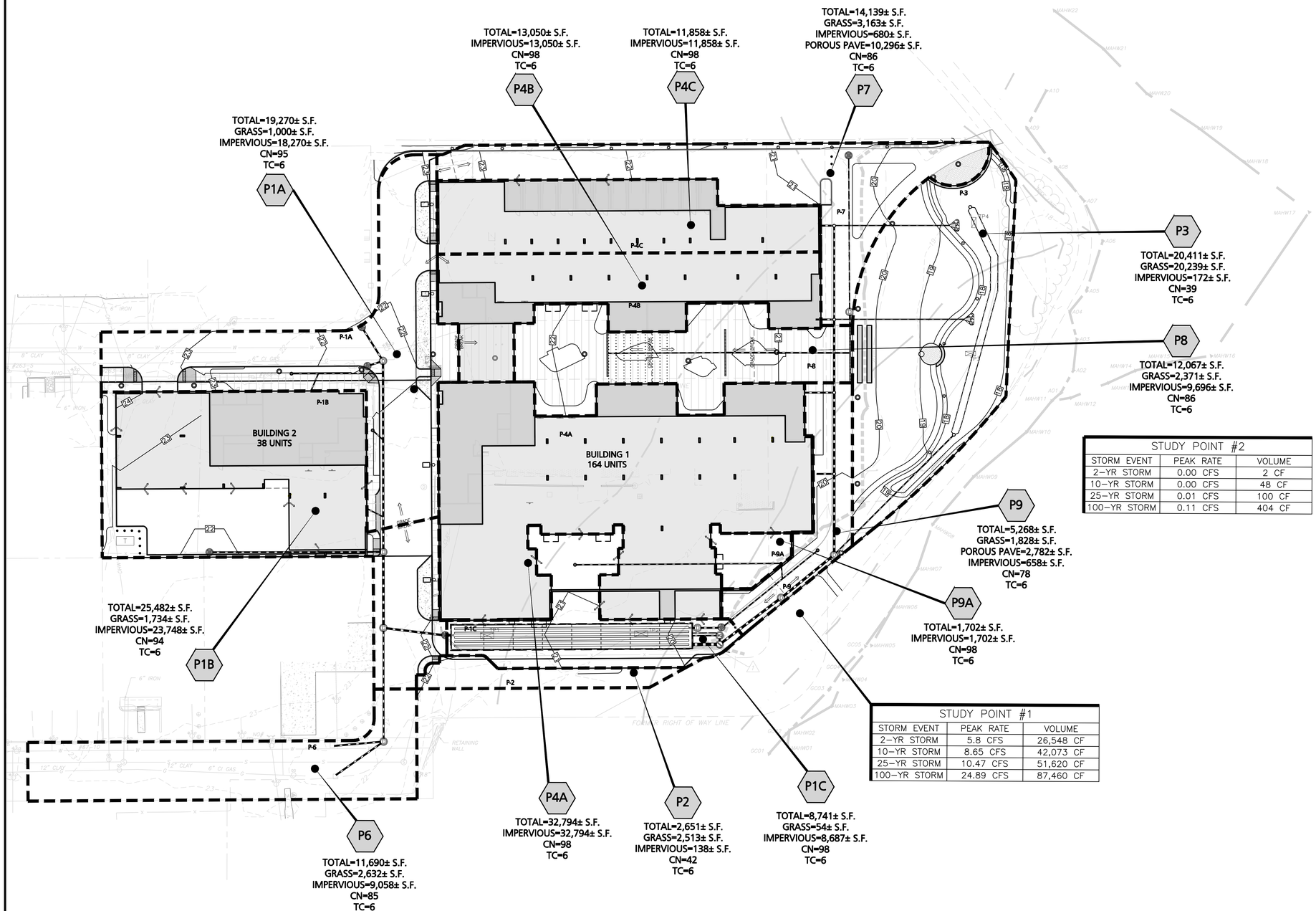

STUDY POINT #2		
STORM EVENT	PEAK RATE	VOLUME
2-YR STORM	0.00 CFS	2 CF
10-YR STORM	0.00 CFS	48 CF
25-YR STORM	0.01 CFS	100 CF
100-YR STORM	0.11 CFS	404 CF

STUDY POINT #1		
STORM EVENT	PEAK RATE	VOLUME
2-YR STORM	5.8 CFS	26,548 CF
10-YR STORM	8.65 CFS	42,073 CF
25-YR STORM	10.47 CFS	51,620 CF
100-YR STORM	24.89 CFS	87,460 CF

LEGEND

PROPOSED WATERSHED

SUBCATCHMENT LABEL P-1

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WOBURN, MA ● EASTHAM, MA ● MANCHESTER, NH

STAMP

KEY PLAN

PROJECT NUMBER: 1374-23
DRAWN BY: AM/ND
CHECKED BY: TJW

SHEET TITLE

PROPOSED WATERSHED

PWS