STORMWATER REPORT

FOR

THE ENGINE YARD
40 ALPINE ROW
(AM 279 PARCEL 181)
FRANKLIN, MASSACHUSETTS

DANIEL R. CAMPBELL
CIVIL
No. 46245
COMMONWEALTH OF MASSACHUSETTS
REGISTERED PROFESSIONAL ENGINEER

JUNE 21, 2021

Prepared By:
Level Design Group, L.L.C.
249 South Street, Unit 1
Plainville, MA 02762

Prepared For:
Walker Development & Construction, Inc.
Attn: Mr. Jeffrey Walker
5 Mt. Royal Ave, Suite 40
Marlborough, MA 01752

LDG Project No.:
1880.00

LEVEL
DESIGN GROUP

TABLE OF CONTENTS

HYDROLOGIC SUMMARY

METHODOLOGY

The HydroCAD computer program (HydroCAD) was used to model the existing and proposed hydrology of the site and design a stormwater management system. HydroCAD generates flood hydrographs dependent upon the type of land use, vegetation, soil types, land slope, watershed areas and rainfall data. HydroCAD also takes into account the antecedent moisture condition of the soil. The peak rate of runoff and volume of runoff are projected for the input storm frequency events (design storms).

Rainfall data was obtained from the United States Weather Bureau Technical Paper 40. Rainfall amounts for storm frequencies of 2-, 10-, 25- and 100-year return periods for Bristol County, Massachusetts were input into HydroCAD. A 24-hour type III rainfall distribution was used in the HydroCAD analysis as prescribed for New England by the USDA Soil Conservation Service (SCS).

PRE-DEVELOPMENT CONDITIONS

The project site is located at 40 Alpine Row, Franklin, MA. Assessor's Parcel ID: 279-181 is a 1.32 Acre Downtown Commercial zoned property with an existing office/warehouse building, several garages, and associated parking facilities, utilities, and drainage. The project is bordered to the south by Alpine Row, Alpine Place and residential lots, to the north by a Massachusetts Bay Transportation Railroad, and residential homes to the east and west.

The existing site drains principally to the northeast, with approximately 1.3 acres draining northeast through the existing parking lot and discharging through either the existing catch basin drywell in the center of the property or the existing catch basin on the east side of the property to the abutting railroad to the north. The existing drainage system provides minimal treatment, infiltration, or detention of stormwater runoff. The pre-development drainage area is modeled as a single hydrologic area. This hydrologic area is identified on the Pre-Development Watershed Plan attached to this report and is denoted as 1S. Hydrologic area 1S contains approximately 1.3 acres of contributing area and drains north and northeast to the abutting Massachusetts Bay Transportation Railroad. The model includes flow from Alpine as a separate subcatchment to detail flow conditions within the pipe network, influenced by the Town.

Ground cover of the site is primarily paved with some vegetation interior to areas where there have been previous items removed from the property. The current impervious coverage on-site is 53,360 s.f., which includes the "grassed" areas within the containment walls. This grass is growing through the gravel containment areas within the walls, it is not a grassed area as detailed in previous studies. On-site test pits were dug in the areas of the proposed stormwater management facilities to verify existing soil conditions and determine the estimated seasonal high groundwater elevation (ESHGWE). Soils documented in the soil test pits are gravelly sand with no evidence of ESHWE visible within the test pit holes

The on-site soils within the area of the limits of the development are classified by the Soil Survey for Bristol County Massachusetts, Northern Part:

602 -Urban Land, HSG based upon geotechnical

See the SCS soils documentation and test pit logs attached herein for additional on-site soil details.

Based on current MAGIS Mapping the site is NOT located in any of the following environmentally sensitive areas:

- Areas of Critical Environmental Concern
- Natural Heritage and Endangered Species Program – Priority Habitats of Rare Species
- Natural Heritage and Endangered Species Program – Estimated Habitats of Rare Wildlife
- Natural Heritage and Endangered Species Program – Natural Communities
- Natural Heritage and Endangered Species Program – Certified Vernal Pools
- MADEP Wellhead Protection Areas – Zone 1 & Zone 2
- Surface Water Supply Protection Areas – Zone A, Zone B, & Zone C
- MADEP Surface Water Supply Watersheds
- MA DFW Coldwater Fisheries Resource Area.

POST-DEVELOPMENT CONDITIONS

The Applicant is proposing the demolition of all but on on-site structure and the associated pavement due to regrading. The 6,061 s.f. structure to the west side of the property will remain and redevelopment will occur around the property. The applicant proposes the construction of a 12,230± s.f. Footprint structure with commercial, multi-family and underlevel parking, associated utilities and parking.

A new site drainage system is developed to capture and infiltrate the roof area of the proposed structure, and provide treatment of the entire parking area, with the exception of approximately 2,100 s.f. of the new parking lot between the proposed building and existing building. The existing building will not be captured in the drainage planning, however with the removal of pavement at the front of the building will be utilized and partially infiltrated prior to discharge to the roadway.

Runoff from all paved areas will be collected in deep-sump and hooded catch basins and treated by a CDS or VortSentry Stormwater Treatment Unit prior to discharge to the existing municipal system which crosses the property. This provides a required minimum 44% TSS removal required prior to discharging to an infiltration practice in the event the municipal system is modified at a later date. The infiltration pit configuration has been designed to fully infiltrate stormwater flows for the 2-, 10-, & 25- year design storms. With an overflow discharge after the final basin through a catch basin grate, which will flow to the on-site Double catch basin and through the CDS unit for the side of the parking lot.

The total proposed site impervious coverage is 45,146± sf . This is a total impervious lot coverage of 78.5% over the parcel the Building lot coverage is far less with a total coverage of 31.8%.

A fully compliant stormwater management system for the entire site addressing compliance with the 10 MADEP Stormwater Standards will be part of the site redevelopment. Site improvements have been made to the maximum extent practicable in accordance with MADEP Stormwater Regulations.

STANDARD 1: Untreated Discharges

Stormwater Management Standard 1 requires that, "No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth".

This standard is met by the proposed redevelopment not creating any new non-treated stormwater discharges. All surface runoff from the proposed impervious areas is collected and treated for suspended solids removal and directed to the existing on-site drainage line. The treatment of the site drainage prior to discharge mimic existing drainage flow patterns while maintaining a cleaner site flow.

STANDARD 2: Peak Rate Control and Flood Prevention

Stormwater Management Standard 2 requires that, "Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for land subject to coastal storm flowage."

This standard is met by the proposed development mitigating the post-development peak discharge rates at the designated control point for all design storm events. This is accomplished by directing stormwater flow from the proposed building roof area to multiple infiltration systems located on the site. Below is a description of the control point used in the hydrologic analysis and a summary of pre- and post- development discharge rates. The proposed development will reduce the peak rate of runoff at all the design control points and provide ample groundwater recharge.

SUMMARY OF PEAK STORMWATER RUNOFF (CFS)

One singular control point was used in the analysis. This point was chosen as it is the outfall of the existing drain system from the property and Town drainage systems at the north side of the site, adjacent to the Railroad.

Control Point – R1				
Storm	Pre-Dev. Flow (CFS)	Post-Dev. Flow (CFS	Pre-Dev .,Volume (af)	Post-Dev. Volume (af)
1-yr	4.04	2.76	0.294	0.176
2-yr	4.93	3.72	0.363	0.230
10-yr	7.67	6.40	0.575	0.410
25-yr	9.79	8.36	0.742	0.560
100-yr	14.14	12.48	1.084	0.881

The roadway included in the calculations is a constant, but the roadway area (estimated) contributes approximately ¼ of the flow to each the pre and post development scenarios. The net peak discharge is controlled and does not increase at the control points for any of the evaluated design storms.

STANDARD 3: Recharge to Groundwater

Stormwater Management Standard 3 requires that, "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, 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 the 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."

This standard is fulfilled through the infiltration of the proposed building roof area. This 12,230 s.f. is controlled through proposed infiltration pits, which overflow to eachother until the final basin which has a catch basin grate, which will flow to the low point double catch basin, flow through the on-site CDS prior to discharge. There is very little infiltration which occurs through the on-site 4,000 s.f. of pervious area. All stormwater discharged to the proposed infiltration practices is roof drainage and is considered "clean" by stormwater standards and the remainder of the site discharge is treated in excess of 44% TSS removal prior to discharge to the municipal system. Below is a detailed calculation demonstrating full compliance with the recharge to groundwater requirements.

<u>GROUND WATER RECHARGE</u>

The on-site soils as classified by the Soil Survey for Bristol County Massachusetts, Northern Part are Hinckley loamy sand, 8 to 15 percent slopes, Hydrologic Soil Group (HSG) B. Based on test pits by Level Design Group, LLC, on-site parent soils are identified as sand and/or gravelly sand within the area of the proposed infiltration basins and an infiltration rate of 2.41 inches per hour was used based on the Rawls Rates. The required infiltration for a HSG B soil is 0.35 inches of runoff times the total impervious area.

The post-development increase in impervious area must be utilized for the recharge calculations as a redevelopment project. However, there is an overall decrease in impervious area on-site through the development. As such the evaluation which took place incorporates the final site impervious area for the analysis. The required recharge volume is calculated as follows:

Required Recharge Volume for the Development = (45,146± sf of impervious area) x (0.35 in of runoff for HSG B) x (1 ft./12 in.) = <u>1,317± cu. ft.</u>

Water used to satisfy the recharge to groundwater standard is from pretreated surface runoff from the parking area and driveway and from the proposed building rooftops. The Simple Dynamic Method of Recharge Volume was utilized to calculate recharged groundwater.

Simple Dynamic Method Calculations for all proposed infiltration practices:

Required Recharge Volume:

Rv = F x impervious area created
Rv = (HSG "B") x (impervious area created)

Recharge Volume Provided:

A=Rv÷(d+Kt), where d=depth below outlet, Kt=Rawls Rate=2.41 inches per hour
t=time (2 hours – Stormwater Handbook Recommendation)

Minimum Required Volume of Infiltration Practice = V (cf) =A x d (or n x d where n is the void space % of the system) where n =Overall Storage Efficiency of the Infiltration pits, d = depth below lowest outlet

The calculations for each of the infiltration systems are detailed in the table below.

System	*Impervious Area (sf.)*	*Rv (cf)*	**n x d (ft)*	*Kt in/hr*	*t (hr)*	*Min Req. Area (sf).*	*Minimum Volume Required (cf)*	*Volume Provided Below Outlet (cf.)*
IP Row	45,146	0	*n=0.72 d=6 nd=4.32	*2.41*	*2*	0	0	*1,353*

**overall storage system efficiency values (n) for the Infiltration Pits is taken from HydroCAD Chamber Wizard for each basin.*

The total minimum recharge volume requirement 1,350± cu. ft. for the entire site is far exceeded with a total provided recharge volume of 1,353± cu.ft. of storage provided below the lowest outlet of each subsurface infiltration system. All proposed systems far exceed the required design volumes as detailed in the above table.

STANDARD 4: 80% TSS Removal

Stormwater Management Standard 4 requires that, "Stormwater management systems must be designed to remove 80% of the average annual post-construction 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. Stormwater BMPs 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"

This standard is met by collecting all surface runoff form all paved areas with deep sump and hooded catch basins. This flow is then treated by a CDS or VortSentry Stormwater Treatment Unit prior to discharge to an infiltration basin providing greater than the required 80% TSS removal as detailed in the attached MADEP TSS Removal Calculation Sheets.

Water Quality Calculations:

The volume of stormwater runoff to be treated for water quality is calculated as one-half inches times the total post-development impervious area of the site based on current MADEP Stormwater Management Standards. With the understanding that the proposed development partially located within the 200' riparian zone and there are sensitive resources within 100' of the development water water quality calculations detail compliance with a wat1/er quality volume equal to one inch times the total post-development impervious The water quality volume calculation is detailed below.

Total Site Imperious Area= 45,146± ± s.f.
1.0 inch x 1 foot/12 inches= 0.0833 feet
0.0833 feet x 45,146± s.f.= 3,760± cu.ft.

Total Volume to be treated for Water Quality= 3,760± cu.ft.

As detailed above, the two proposed infiltration systems provide 1,353± cu.ft. of volume below their lowest outlets. This volume satisfies the required 3,760± cu.ft of water quality volume to be treated for the proposed development. To achieve the required 44% TSS removal prior to flow being infiltrated a variety of structural practices are utilized. All impervious areas, not including roof top runoff directly piped to an infiltration practice, will be collected in deep sump and hooded catch basins and treated by a CDS Stormwater Treatment Unit to achieve the minimum 44% TSS removal required for each system prior to flows being infiltrated. Sizing calculation for the two Stormwater Treatment Units is detailed below.

CDS Stormwater Treatment Unit Sizing

The CDS Units are sized using the *Massachusetts Department of Environmental Protection Wetlands Program – Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices*.

Flow to DBLE CB

$Q_{1.0}$=(qu)(A)(WQV)
qu=774 csm/in for a Tc of 0.1 hours (taken from Figure 2 of the Massachusetts Department of Environmental Protection Wetlands program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate
A=0.587 Acres
WQV=1.0 inches

$Q_{1.0}$ =(774 csm/in) (0.587 acres - impervious coverage) (0.0015625 sq. mi / acre) (1.0 inch)

$Q_{1.0}$ = 0.059 cfs < CDS Model 2015 with a Treatment Capacity =1.4 cfs

Flow to CB

$Q_{1.0}$=(qu)(A)(WQV)
qu=774 csm/in for a Tc of 0.1 hours (taken from Figure 2 of the Massachusetts Department of Environmental Protection Wetlands program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate
A=0.179 acres
WQV=1.0 inches
$Q_{1.0}$ =(774 csm/in) (0.179 acres) (0.0015625 sq. mi / acre) (1.0 inch)

$Q_{1.0}$ = 0.018 cfs < VortSentryit with a Treatment Capacity = 1.2 cfs

STANDARD 5: Higher Potential Pollutant Loads

Stormwater Management Standard 5 requires that, "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 stormwater BMPs determined by the Department to be suitable for such use 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. 2,§26-53, and the regulations promulgated thereunder at 314 CMF 3.00, 314 CMR 4.00 and 314 CMR 5.00."

The proposed use in not considered a use that would generate Higher Potential Pollutant Loads.

STANDARD 6: Critical Areas

Stormwater Management Standard 6 requires that Stormwater discharge to a Zone II Interim Wellhead Protection Area of a public water supply and stormwater discharges near any other critical area require the use of specific source control and pollution prevention measures and the specific stormwater best management practices determined by the Department to be suitable for managing discharges to such area, as provided in the Massachusetts Stormwater Handbook. A discharge 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 or Special Resource Waters shall be set back from the receiving water and receive the highest and best practical method of treatment. A "stormwater discharge," as defined in 314 CMR 3.04(2)(a)1. or (b), to an Outstanding Resource Waters or Special Resource Waters shall comply with 314 CMF 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A area prohibited unless essential to the operation of the public water supply."

The development site is not located within a Critical Area as defined by the Massachusetts Stormwater Handbook.

STANDARD 7: Redevelopment and Other Projects Subject to the Standards only to the Maximum Extent Practicable

The definition of a Redevelopment Project under the definition provided in the MADEP Stormwater Handbook for Standard 7 is listed below:

> "Development rehabilitation, expansion and phased projected on previously developed sites, provided that redevelopment results in no next increase in impervious area."

The proposed development is considered a Redevelopment Project however, it fully complies with the requirements of the MADEP Stormwater Management Standards.

STANDARD 8: Erosion and Sediment Control

Stormwater Management Standard 8 requires that, "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), must be developed and implemented."

This standard is met by including erosion and sediment controls within the design plans. A gravel construction entrance is proposed at the access point to the site once the pavement is removed from that area of the site. A 9" diameter Filtrexx Silt Sox is proposed at the limits of all site related construction activities. Silt sacks are also proposed to be installed in all of the existing catch basins within the area of the proposed site disturbance and within proposed structures until the site has been stabilized and the stormwater management system is brought on-line. A draft Stormwater Pollution Prevention Plan (SWPPP) has been prepared and is included as part of the Stormwater Report. The SWPPP will be finalized prior to construction as required when a NPDES General Construction Permit is applied for.

STANDARD 9: Operation and Maintenance

Stormwater Management Standard 9 requires that, "A long-term operation and maintenance plan must be developed and implemented to ensure that stormwater management systems function as designed".

This standard is fully met with development and implementation of an Operation and Maintenance Plan, which is included in Stormwater Management Report.

STANDARD 10: Illicit Discharges

Stormwater Management Standard 10 requires that, "All illicit discharges to the stormwater management system are prohibited".

LEVEL
DESIGN GROUP

This standard is fully met with development and implementation of a Long Term Pollution Prevention which is included in the Stormwater Management Report. An Illicit Discharge statement has been prepared and is included herein.

CONCLUSION

The proposed development of this parcel will be a significant improvement to the area and to the on-site resource areas. The proposed development meets or exceeds the current MADEP Stormwater Management Standards and Guidelines and provides a stormwater management system that will maintain water quality while attenuating peak rates of runoff at the control points which providing maximum on-site groundwater recharge. This was achieved by using pretreatment BMPs and directing the stormwater runoff to multiple infiltration basins which attenuate peak flows while maximizing groundwater recharge and providing high a level of TSS removal. An Operation and Maintenance Plan for post-construction maintenance of the Stormwater Management System has been developed and is included with this report.

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL508 695 2221 FAX508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM

MADEP Stormwater Report Checklist

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

Checklist for Stormwater Report

A. Introduction

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

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

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

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

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

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

---

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

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

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 (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:

- [x] No disturbance to any Wetland Resource Areas
- [ ] Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- [x] 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): ______________________

Standard 1: No New Untreated Discharges

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

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 (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 (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 (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.

To be completed at the end of permitting for review by the Town selected review Engineer

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.

DESIGN GROUP

USGS Topographic Map (MAGIS)

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL508 695 2221 FAX508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM

Name: FRANKLIN
Date: 06/21/21
Scale: 1 inch = 2,000 ft.

Location: 042° 04' 50.57" N 071° 23' 09.88" W

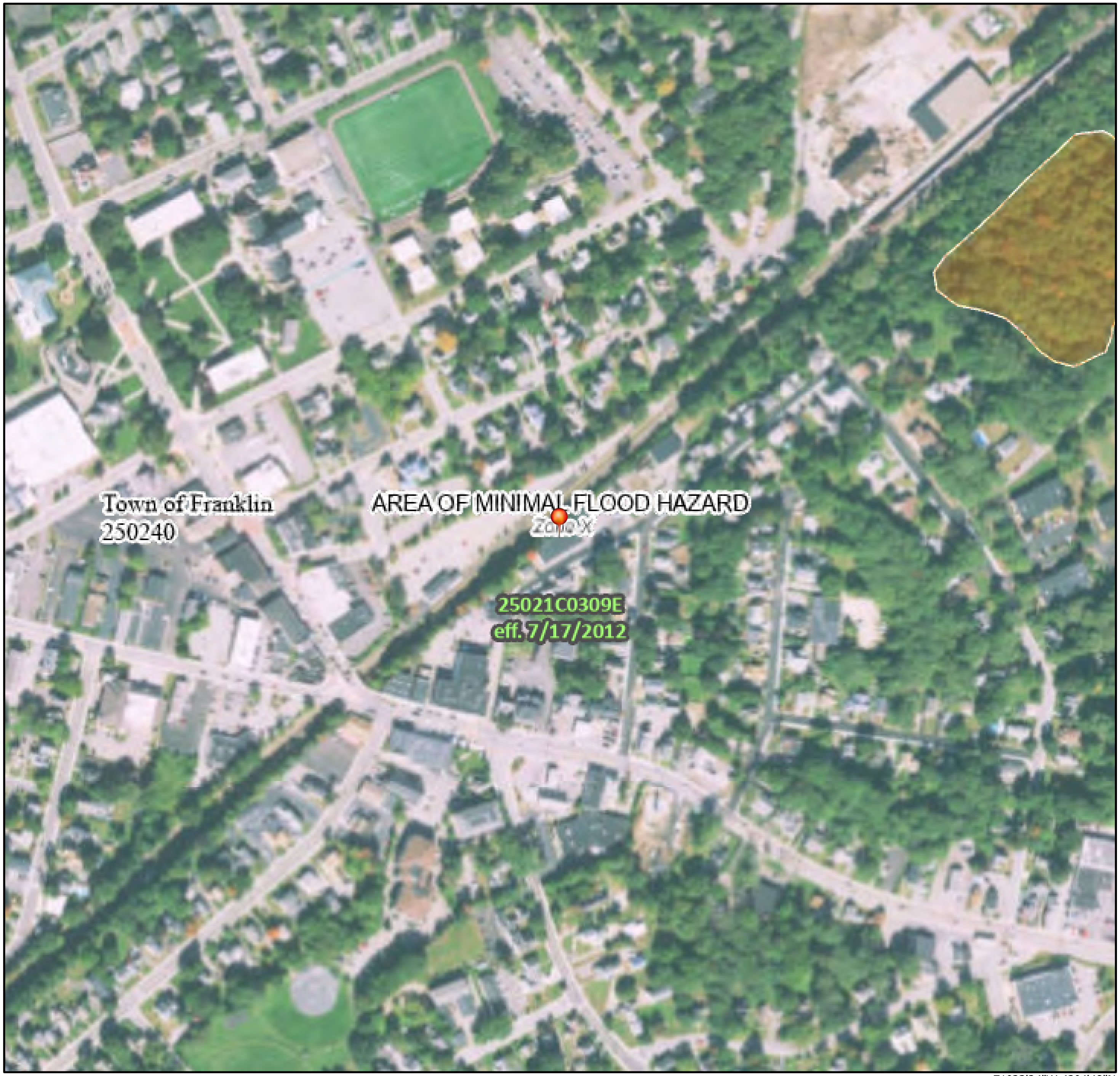
FEMA FIRM Map

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL508 695 2221 FAX508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM

National Flood Hazard Layer FIRMette

FEMA

71°24'1"W 42°5'14"N



71°23'24"W 42°4'48"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard *Zone X*
	Effective LOMRs
	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
	8 Coastal Transect
	513 Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
MAP PANELS	Digital Data Available
	No Digital Data Available
	Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/21/2021 at 8:32 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

On-Site Soils Documentation

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL 508 695 2221 FAX 508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM

Soil Map—Norfolk and Suffolk Counties, Massachusetts
(THE ENGINE YARD)

Map Scale: 1:1,190 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

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: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 5, 2019—Jul 8, 2019

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
602	Urban land, 0 to 15 percent slopes	1.7	100.0%
Totals for Area of Interest		**1.7**	**100.0%**

LEVEL
DESIGN GROUP

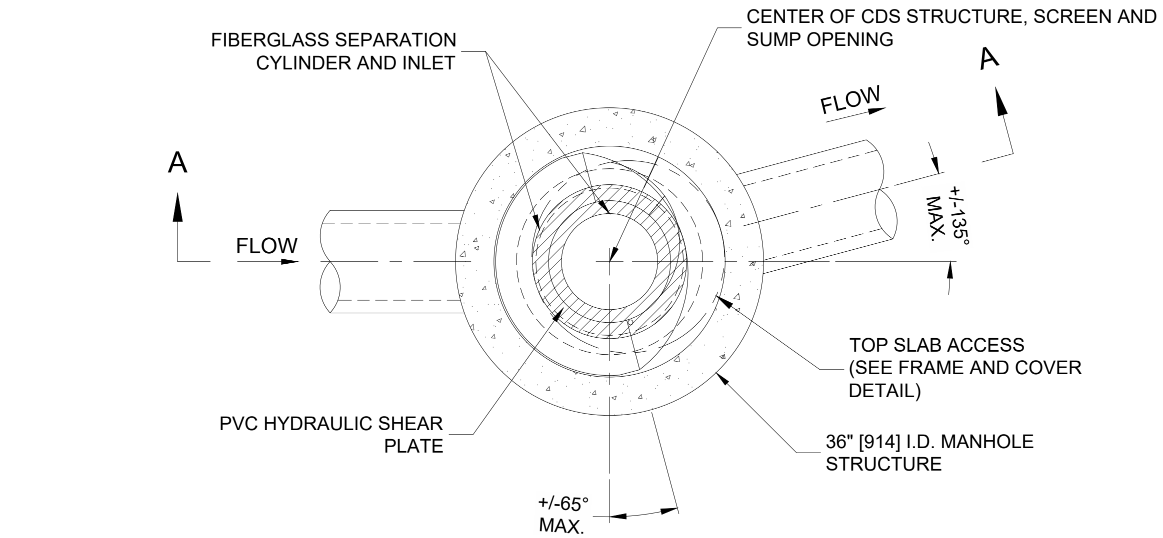
Stormwater Treatment Unit Documentation

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL 508 695 2221 FAX 508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM

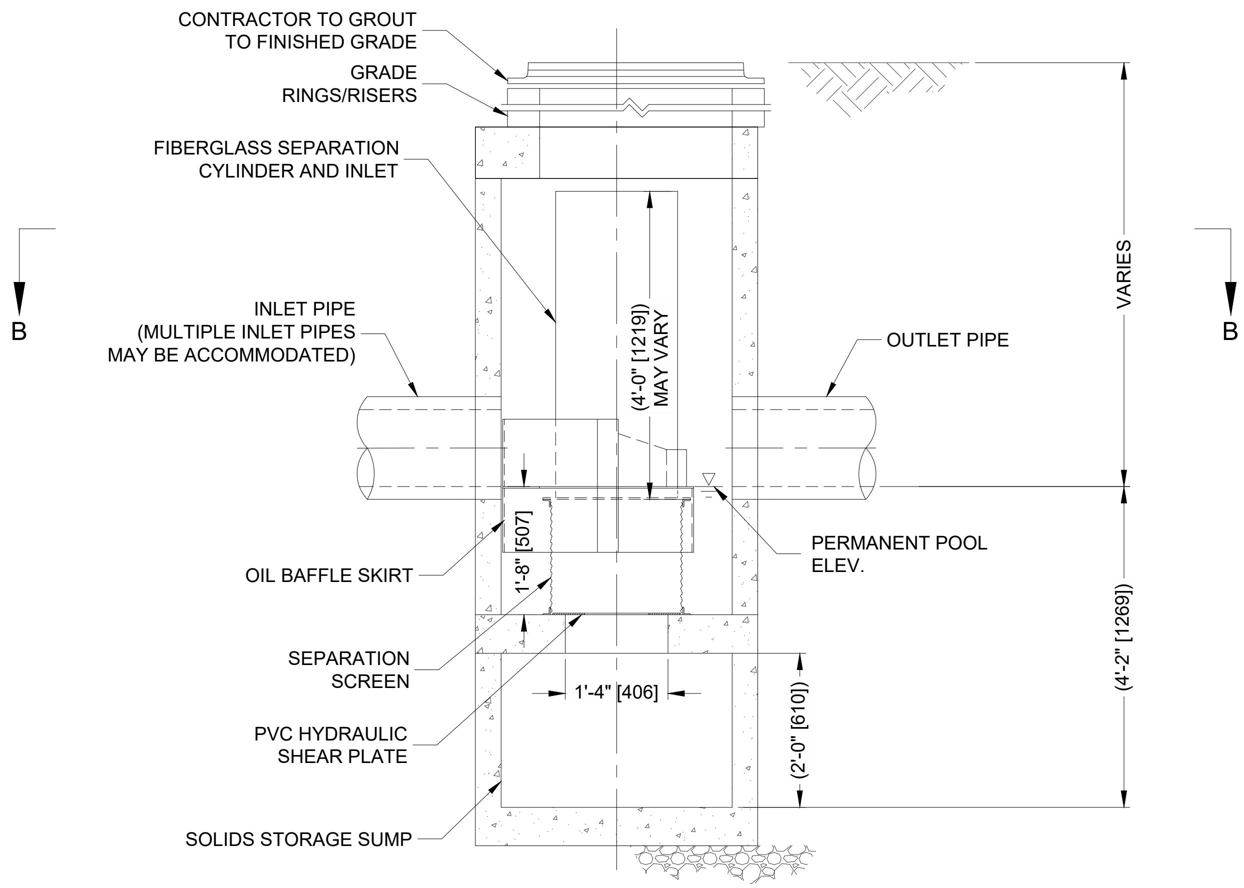
CDS1515-3-C DESIGN NOTES

CDS1515-3-C RATED TREATMENT CAPACITY IS 1.0 CFS, OR PER LOCAL REGULATIONS.

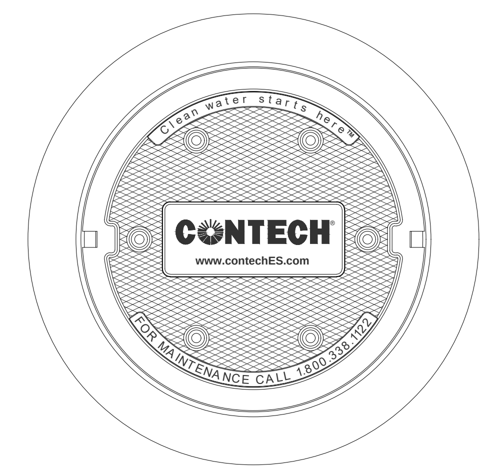
THE STANDARD CDS1515-3-C CONFIGURATION IS SHOWN.



PLAN VIEW B-B
N.T.S.



ELEVATION A-A
N.T.S.



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			

* PER ENGINEER OF RECORD

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO..
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS1515-3-C
ONLINE CDS
STANDARD DETAIL

Project: **The Engine Yard**
Location: **Franklin, MA**
Prepared For: **Level Design / Dan Campbell**

CONTECH ENGINEERED SOLUTIONS

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	0.75	0.0011719	5.0	0.083	1.00	795.00	0.93
WQI	0.11	0.0001719	5.0	0.083	1.00	795.00	0.14

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

THE ENGINE YARD
FRANKLIN, MA

Area	0.11 ac	Unit Site Designation	WQI
Weighted C	0.9	Rainfall Station #	68
t_c	5 min		
CDS Model	1515-3	CDS Treatment Capacity	1.0 cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.00	0.00	9.3
0.04	9.5%	18.8%	0.00	0.00	9.5
0.06	8.7%	27.5%	0.01	0.01	8.7
0.08	10.1%	37.6%	0.01	0.01	10.1
0.10	7.2%	44.8%	0.01	0.01	7.2
0.12	6.0%	50.8%	0.01	0.01	6.0
0.14	6.3%	57.1%	0.01	0.01	6.3
0.16	5.6%	62.7%	0.02	0.02	5.6
0.18	4.7%	67.4%	0.02	0.02	4.7
0.20	3.6%	71.0%	0.02	0.02	3.6
0.25	8.2%	79.1%	0.02	0.02	8.2
0.50	14.9%	94.0%	0.05	0.05	14.8
0.75	3.2%	97.3%	0.07	0.07	3.2
1.00	1.2%	98.5%	0.10	0.10	1.2
1.50	0.7%	99.2%	0.15	0.15	0.7
2.00	0.8%	100.0%	0.20	0.20	0.7
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					99.6
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**93.2%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

THE ENGINE YARD
FRANKLIN, MA

Area	0.75 ac	Unit Site Designation	WQU #1
Weighted C	0.9	Rainfall Station #	68
t_c	5 min		
CDS Model	1515-3	CDS Treatment Capacity	1.0 cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.01	0.01	9.3
0.04	9.5%	18.8%	0.03	0.03	9.5
0.06	8.7%	27.5%	0.04	0.04	8.7
0.08	10.1%	37.6%	0.05	0.05	10.0
0.10	7.2%	44.8%	0.07	0.07	7.0
0.12	6.0%	50.8%	0.08	0.08	5.9
0.14	6.3%	57.1%	0.09	0.09	6.1
0.16	5.6%	62.7%	0.11	0.11	5.4
0.18	4.7%	67.4%	0.12	0.12	4.5
0.20	3.6%	71.0%	0.14	0.14	3.4
0.25	8.2%	79.1%	0.17	0.17	7.6
0.50	14.9%	94.0%	0.34	0.34	12.7
0.75	3.2%	97.3%	0.51	0.51	2.5
1.00	1.2%	98.5%	0.68	0.68	0.9
1.50	0.7%	99.2%	1.01	1.00	0.4
2.00	0.8%	100.0%	1.35	1.00	0.3
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					94.1
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**87.7%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

STORM WATER TREATMENT DEVICE

1.0 GENERAL

1.1 This item shall govern the furnishing and installation of the CDS® by Contech Engineered Solutions LLC, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.

1.2 The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

1.3 The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a CDS® device manufactured by:

Contech Engineered Solutions LLC
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

1.4 Related Sections

1.4.1 Section 02240: Dewatering
1.4.2 Section 02260: Excavation Support and Protection
1.4.3 Section 02315: Excavation and Fill
1.4.4 Section 02340: Soil Stabilization

1.5 All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.

1.6 The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

1.7 The SWTD manufacturer shall submit to the Engineer of Record a “Manufacturer’s Performance Certification” certifying that each SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research

1.8 No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

2.0 MATERIALS

2.1 Housing unit of stormwater treatment device shall be constructed of pre-cast or cast-in-place concrete, no exceptions. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

- 2.1.1 Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
- 2.1.2 Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
- 2.1.3 Cement shall be Type III Portland Cement conforming to ASTM C 150;
- 2.1.4 Aggregates shall conform to ASTM C 33;
- 2.1.5 Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
- 2.1.6 Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
- 2.1.7 Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

2.2 Internal Components and appurtenances shall conform to the following:

- 2.2.1 Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
- 2.2.2 Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
- 2.2.3 Fiberglass components shall conform to the ASTM D-4097
- 2.2.4 Access system(s) conform to the following:
- 2.2.5 Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

3.0 PERFORMANCE

3.1 The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using a particle size distribution having a mean particle size (d_{50}) of 125 microns unless otherwise stated.

3.2 The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to 2.4 millimeters (mm) regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The SWTD shall be designed to retain all previously captured pollutants addressed by this subsection under all flow conditions. The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of storm water runoff (20 ± 5 mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.

3.3 The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine particle re-suspension. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.

3.4 The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.

3.5 The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

3.6 The SWTD shall have completed field tested following TARP Tier II protocol requirements

4.0 EXECUTION

4.1 The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.

4.2 The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.

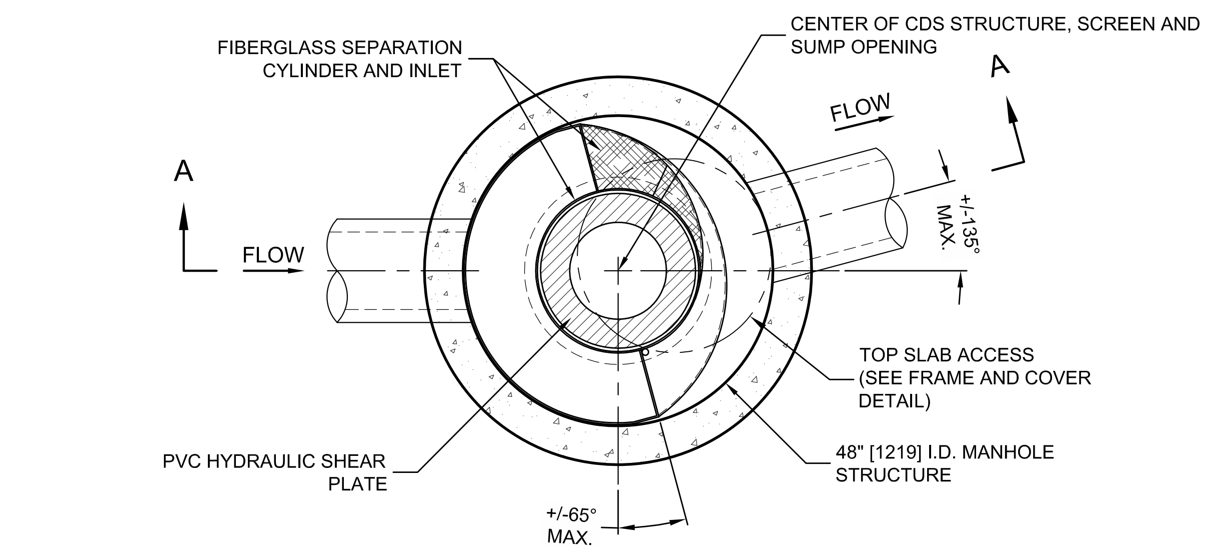
4.3 The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.

4.4 The contractor shall removal all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Owner.

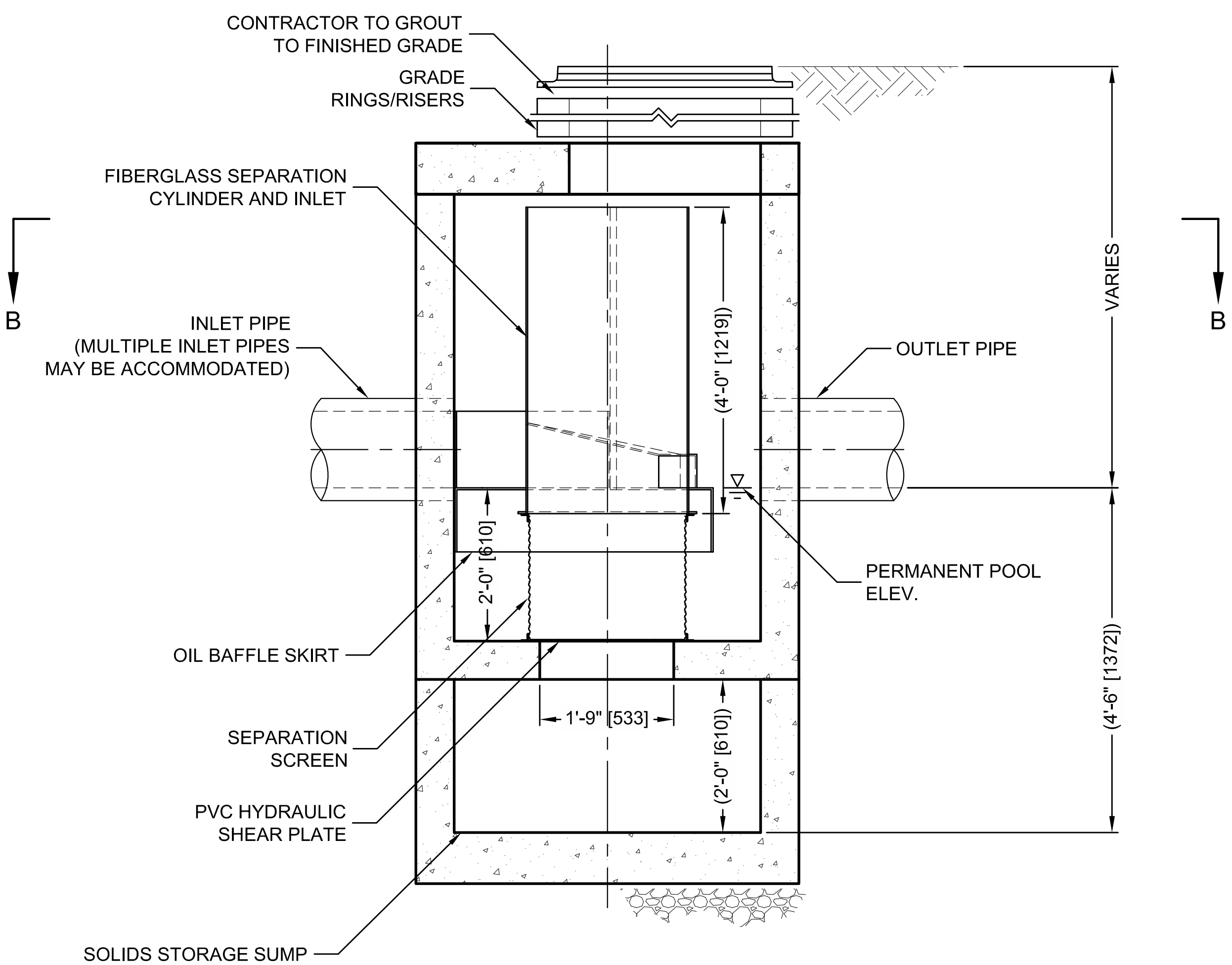
TABLE 1
Storm Water Treatment Device
Storage Capacities

CDS Model	Minimum Sump Storage Capacity $(yd^3)/(m^3)$	Minimum Oil Storage Capacity (gal)/(L)
CDS2015-4	0.9(0.7)	61(232)
CDS2015-5	1.5(1.1)	83(313)
CDS2020-5	1.5(1.1)	99(376)
CDS2025-5	1.5(1.1)	116(439)
CDS3020-6	2.1 (1.6)	184(696)
CDS3025-6	2.1(1.6)	210(795)
CDS3030-6	2.1 (1.6)	236(895)
CDS3035-6	2.1 (1.6)	263(994)
CDS3535-7	2.9(2.2)	377(1426)
CDS4030-8	5.6(4.3)	426(1612)
CDS4040-8	5.6 (4.3)	520(1970)
CDS4045-8	5.6 (4.3)	568(2149)
CDS5640-10	8.7(6.7)	758(2869)
CDS5653-10	8.7(6.7)	965(3652)
CDS5668-10	8.7(6.7)	1172(4435)
CDS5678-10	8.7(6.7)	1309(4956)
CDS7070-DV	3.6(2.8)	914 (3459)
CDS10060-DV	5.0 (3.8)	792 (2997)
CDS10080-DV	5.0 (3.8)	1057 (4000)
CDS100100-DV	5.0 (3.8)	1320 (4996)

END OF SECTION



PLAN VIEW B-B
N.T.S.



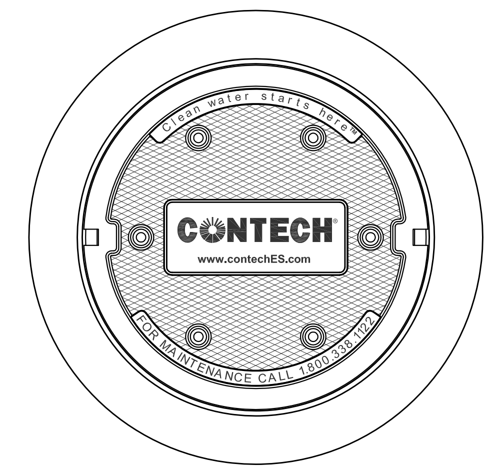
ELEVATION A-A
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CDS2015-4-C DESIGN NOTES

THE STANDARD CDS2015-4-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION)
SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH® ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS2015-4-C
INLINE CDS
STANDARD DETAIL

CONTECH®
ENGINEERED SOLUTIONS

CDS®
Hydrodynamic Separator

The experts you need to solve your stormwater management challenges

Your Contech Team

Contech is the leader in stormwater management solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

STORMWATER CONSULTANT

It's my job to recommend the best solution to meet permitting requirements.

STORMWATER DESIGN ENGINEER

I work with consultants to design the best approved solution to meet your project's needs.

REGULATORY MANAGER

I understand the local stormwater regulations and what solutions will be approved.

SALES ENGINEER

I make sure our solutions meet the needs of the contractor during construction.

Contech is your partner in stormwater management solutions

Unique screening technology for stormwater runoff – CDS®

The CDS hydrodynamic separator uses swirl concentration and continuous deflective separation to screen, separate and trap trash, debris, sediment, and hydrocarbons from stormwater runoff.

At the heart of the CDS system is a unique screening technology used to capture and retain trash and debris. The screen face is louvered so that it is smooth in the downstream direction. The effect created is called "Continuous Deflective Separation." The power of the incoming flow is harnessed to continually shear debris off the screen and to direct trash and sediment toward the center of the separation cylinder. This results in a screen that is self-cleaning and provides 100% removal of floatables and neutrally buoyant material debris 4.7 mm or larger, without blinding.

CDS is used to meet trash Total Maximum Daily Load (TMDL) requirements, for stormwater quality control, inlet and outlet pollution control, and as pretreatment for filtration, detention/infiltration, bioretention, rainwater harvesting systems, and a variety of green infrastructure practices.

CDS® Features and Benefits

FEATURE	BENEFIT
Captures and retains 100% of floatables and neutrally buoyant debris 4.7mm or larger	Superior pollutant removal
Self-cleaning screen	Ease of maintenance
Isolated storage sump eliminates scour potential	Excellent pollutant retention
Internal bypass	Eliminates the need for additional structures
Multiple pipe inlets and 90-180º angles	Design flexibility
Clear access to sump and stored pollutants	Fast, easy maintenance

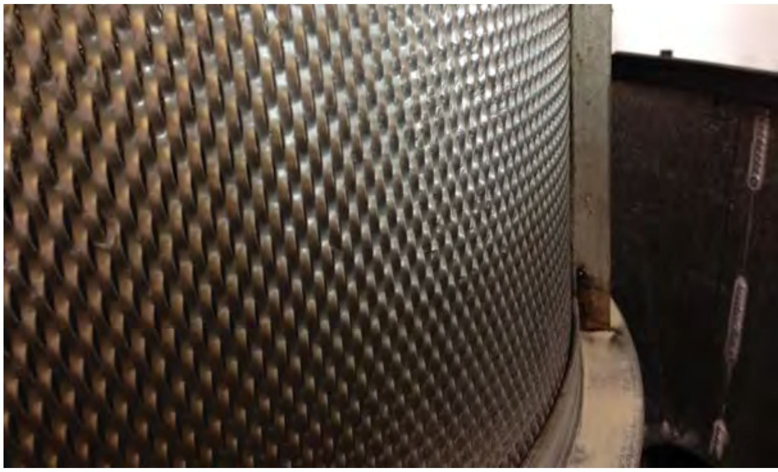
APPLICATION TIPS

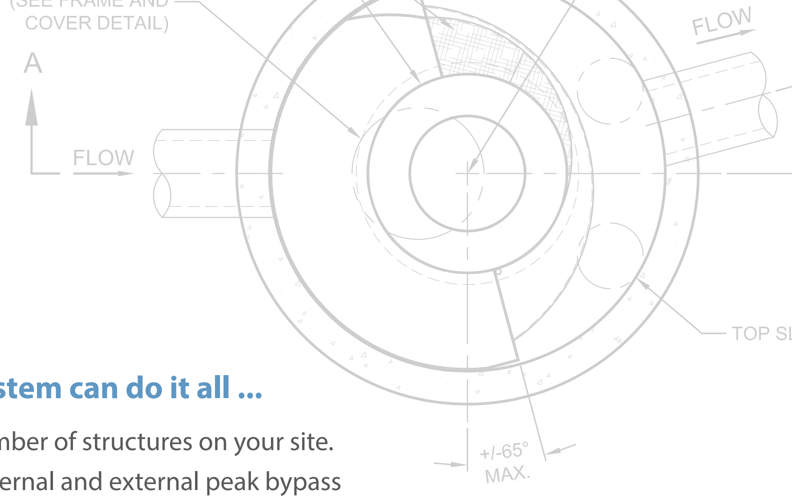
- Because of its internal peak bypass weirs, CDS systems can provide cost savings by eliminating the need for additional structures.
- Pretreating detention, infiltration, and green infrastructure practices with CDS can protect downstream structures and provide for easy maintenance.
- The CDS an ideal solution for retrofit applications due to its compact footprint and configuration flexibility.

The CDS® Screen

A fundamentally different approach to trash control ...

Traditional approaches to trash control typically involve "direct screening" that can easily become clogged, as trash is pinned to the screen as water passes through. Clogged screens can lead to flooding as water backs up. The design of the CDS screen is fundamentally different. Flow is introduced to the screen face which is louvered so that it is smooth in the downstream direction. The effect created is called "Continuous Deflective Separation." The power of the incoming flow is harnessed to continually shear debris off the screen and to direct trash and sediment toward the center of the separation cylinder.

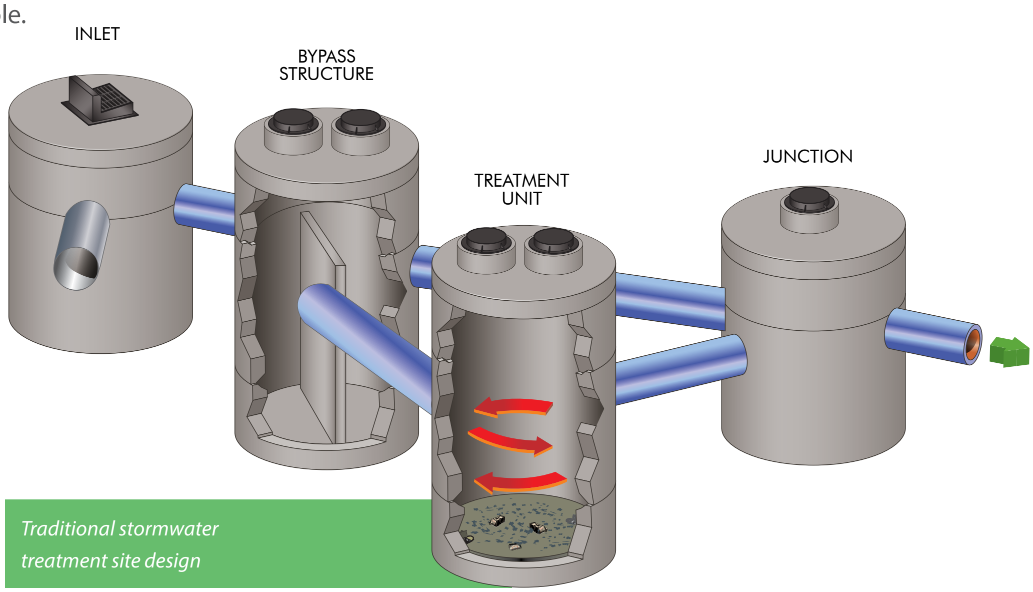




CDS® Design Configuration

Why use traditional stormwater design when ONE system can do it all ...

The CDS effectively treats stormwater runoff while reducing the number of structures on your site. Inline, offline, grate inlet, and drop inlet configurations available. Internal and external peak bypass options also available.

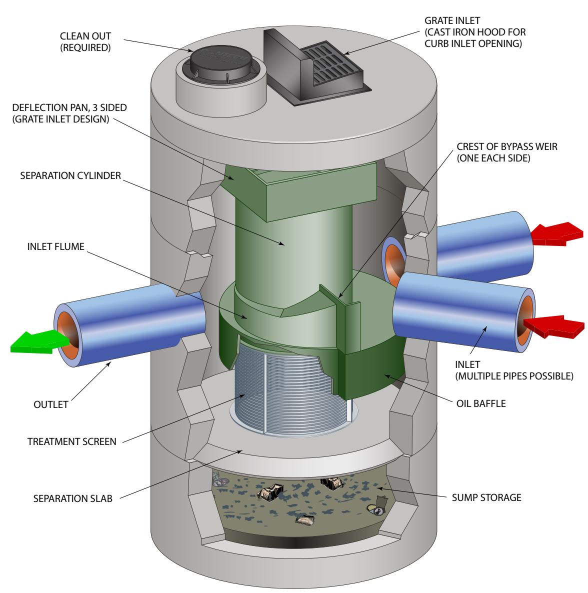


Traditional stormwater treatment site design

A Traditional Stormwater Treatment Site Design would require several structures on your site. With CDS, one system can do it all!

CDS® Advantages

- Grate inlet option available
- Internal bypass weir
- Accepts multiple inlets at a variety of angles
- Advanced hydrodynamic separator
- Captures and retains 100% of floatables and neutrally buoyant debris 4.7 mm or larger
- Indirect screening capability keeps screen from clogging
- Retention of all captured pollutants, even at high flows
- Performance verified by NJCAT, WA Ecology, and ETV Canada



Learn More:
www.ContechES.com/cds

CDS® Applications

CDS is commonly used in the following stormwater applications:

- Stormwater quality control – trash, debris, sediment, and hydrocarbon removal
- Urban retrofit and redevelopment
- Inlet and outlet protection
- Pretreatment for filtration, detention/infiltration, bioretention, rainwater harvesting systems, and Low Impact Development designs

CDS® provides trash control

CDS® pretreats a bioswale

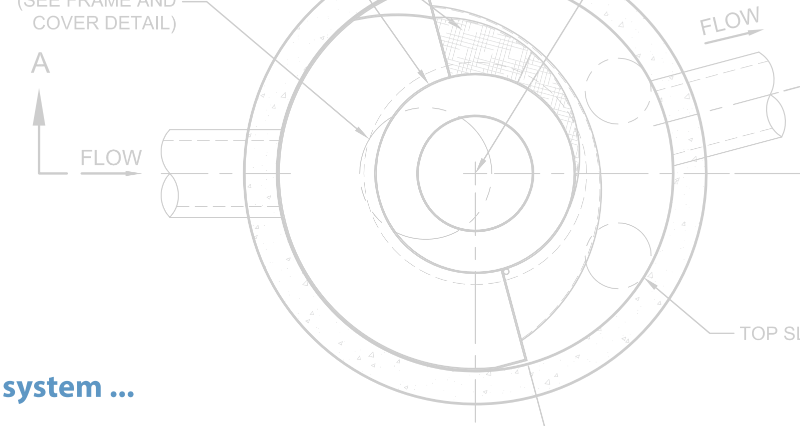
Select CDS® Certifications and Verifications

CDS has been verified by some of the most stringent stormwater technology evaluation organizations in North America, including:

- Washington State Department of Ecology (GULD) - Pretreatment
- New Jersey Department of Environmental Protection (NJDEP)
- Canadian Environmental Technology Verification (ETV)
- California Statewide Trash Amendments Full Capture System Certified*

**The CDS System has been certified by the California State Water Resources Control Board as a Full Capture System provided that it is sized to treat the peak flow rate from the region specific 1-year, 1-hour design storm, or the peak flow capacity of the corresponding storm drain, whichever is less.*

Save time, space and money with CDS



CDS® Maintenance

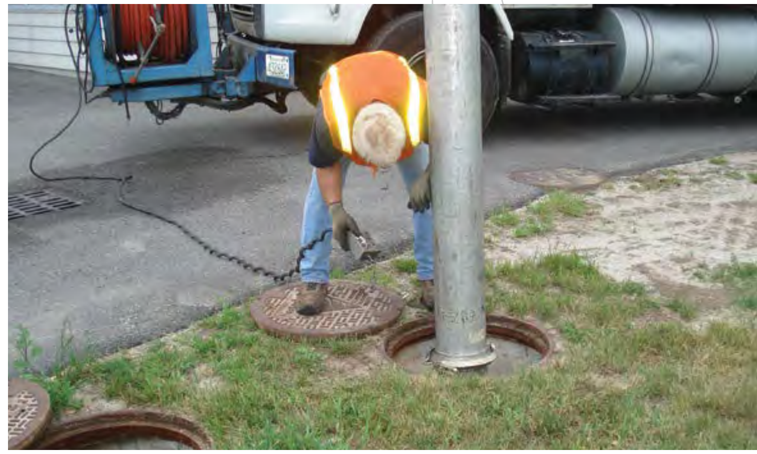
Select a cost-effective and easy-to-access treatment system ...

Systems vary in their maintenance needs, and the selection of a cost-effective and easy-to-access treatment system can mean a huge difference in maintenance expenses for years to come.

A CDS unit is designed to minimize maintenance and make it as easy and inexpensive as possible to keep our systems working properly.

INSPECTION

Inspection is the key to effective maintenance. Pollutant deposition and transport may vary from year to year and site to site. Semi-annual inspections will help ensure that the system is cleaned out at the appropriate time. Inspections should be performed more frequently where site conditions may cause rapid accumulation of pollutants.



Most CDS® units can easily be cleaned within thirty minutes.

RECOMMENDATIONS FOR CDS MAINTENANCE

The recommended cleanout of solids within the CDS unit's sump should occur at 75% of the sump capacity. Access to the CDS unit is typically achieved through two manhole access covers – one allows inspection and cleanout of the separation chamber and sump, and another allows inspection and cleanout of sediment captured and retained behind the screen. A vacuum truck is recommended for cleanout of the CDS unit and can be easily accomplished in less than 30 minutes for most installations.

Design Your Own Hydrodynamic Separator (DYOHDS™)

Quickly prepare designs for estimates and project meetings ...

- Multiple sizing methods available.
- Site-specific questions ensure the selected unit will comply with site constraints.
- Multiple treatment options may be available based on regulations and site parameters.
- Follow up reports contain a site-specific design, sizing summary, standard detail, and specification.

Learn More:
www.ContechES.com/dyohds

A partner you can rely on

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

Few companies offer the wide range of high-quality stormwater resources you can find with us — state-of-the-art products, decades of expertise, and all the maintenance support you need to operate your system cost-effectively.

THE CONTECH WAY

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors, and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

TAKE THE NEXT STEP

For more information: www.ContechES.com

CONTECH® ENGINEERED SOLUTIONS

Get social with us:

800-338-1122 | www.ContechES.com

CDS Guide

Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

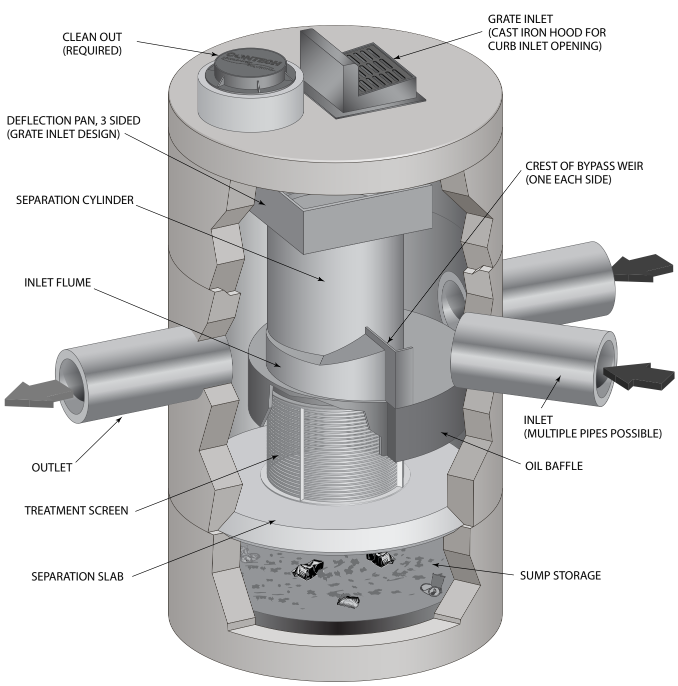
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

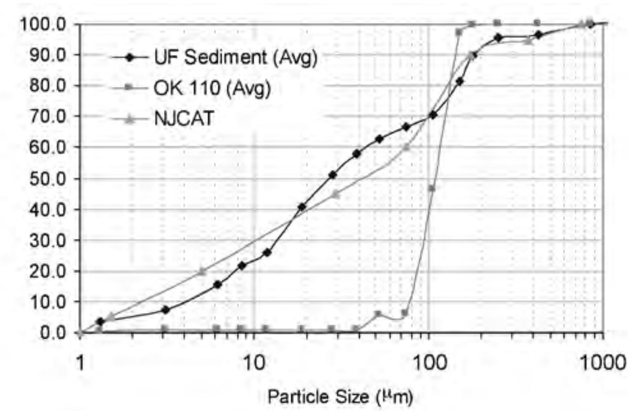


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

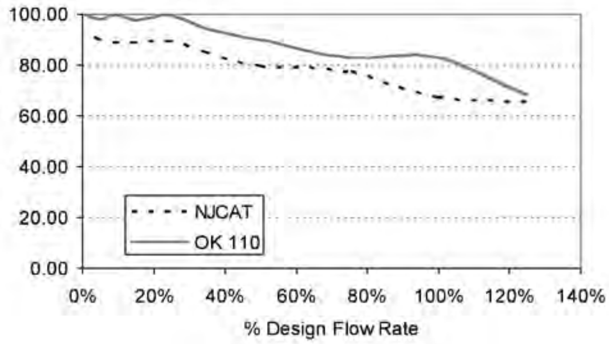


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

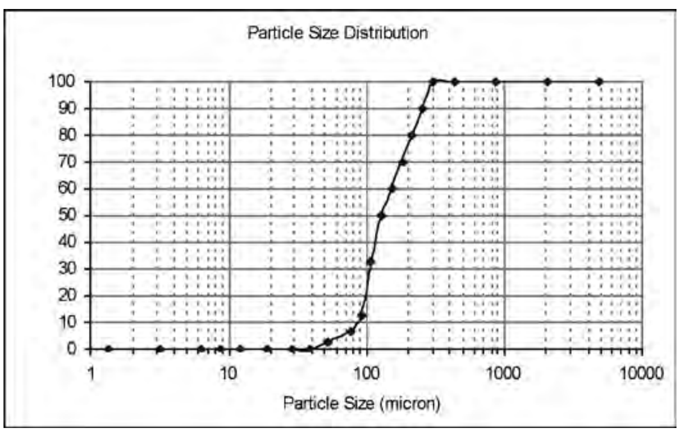


Figure 3. WASDOE PSD

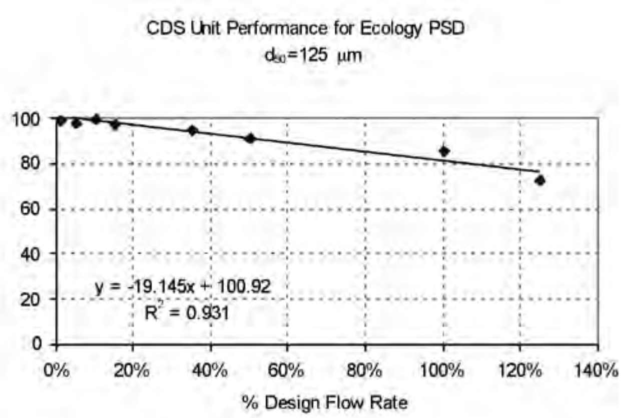


Figure 4. Modeled performance for WASDOE PSD.

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.

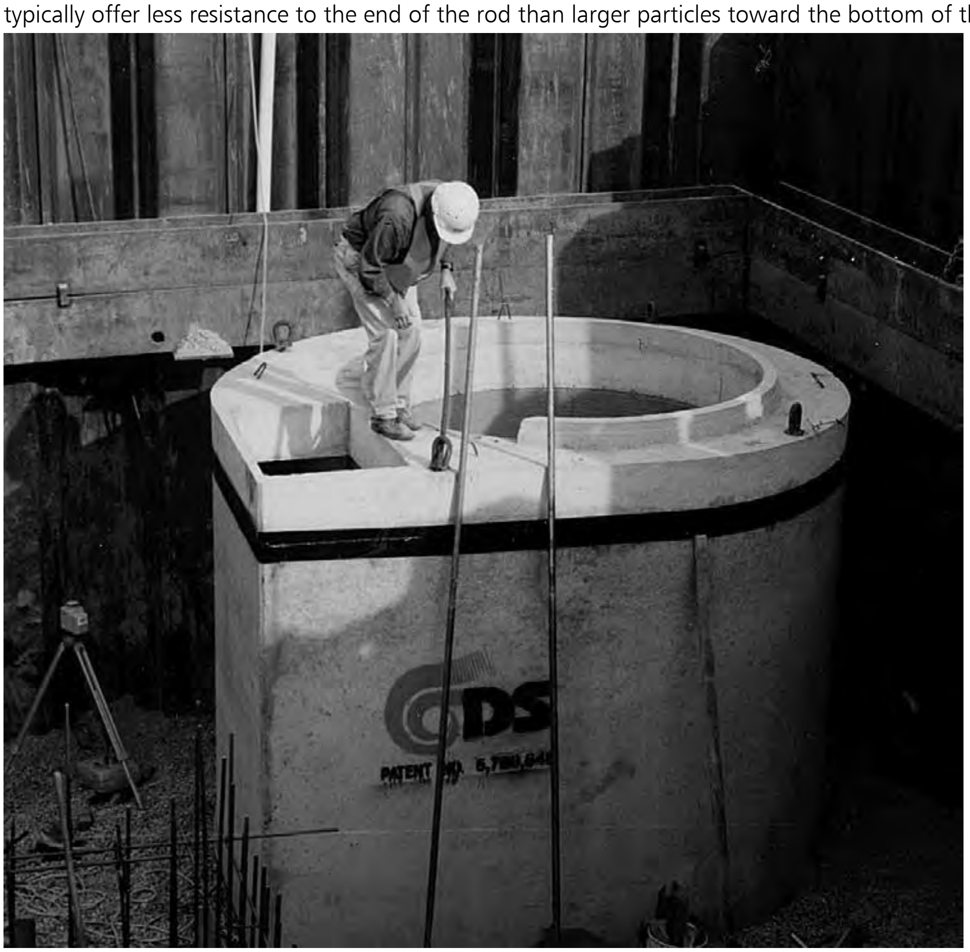
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should 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 cleaned 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. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
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
CDS3025	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
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



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 the values listed in table 1 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.

SUPPORT

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

CONTECH®
ENGINEERED SOLUTIONS
800-338-1122
www.ContechES.com

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

cds_manual 3/17 PDF

Rational Method Pipe-to-Pipe Calculations

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL 508 695 2221 FAX 508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM

STORM SEWER SYSTEM DESIGN (25 yr. Design Storm)
THE ENGINE YARD
40 ALPINE ROW
FRANKLIN, MA
LDG PROJ. # 1880.00

EGMEN TYPE	TIME TO INLET	TIME IN PIPE	ACCUMUL TIME	RUNOFF COEFF "C"	AREA (acres)	SUM OF AxC	ACCUMUL AxC	RAINFALL I	SYSTEM Q (cfs)	PIPE SIZE (in)	PIPE (ft) LENGTH	SLOPE (ft/ft)	Vfull (fps)	Qfull (cfs)	ROUGH. COEFF. "n"	CAPACITY CHECK
I	5.00	0.02	5.00	0.90	0.46											
				0.30	0.00											
				0.20	0.17											
						0.45	0.45	6.00	2.69	18	18	0.0400	14.05	24.83	0.0110	WITHIN CAPACITY
I	5.00	0.25	5.00	0.90	0.12											
				0.30	0.00											
				0.20	0.05											
						0.12	0.12	6.00	0.71	8	62	0.0100	4.09	1.43	0.0110	WITHIN CAPACITY
C	5.00	0.05	5.25	0.90	0.58											
				0.30	0.00											
				0.20	0.23											
						0.57	1.13	6.00	6.81	18	40	0.0400	14.05	24.83	0.0110	WITHIN CAPACITY

LEVEL DESIGN GROUP, LLC
249 South Street, Unit 1
Plainville, MA 02762
Phone # (508) 695-2221

Existing Conditions – Subcatchments

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL508 695 2221 FAX508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM

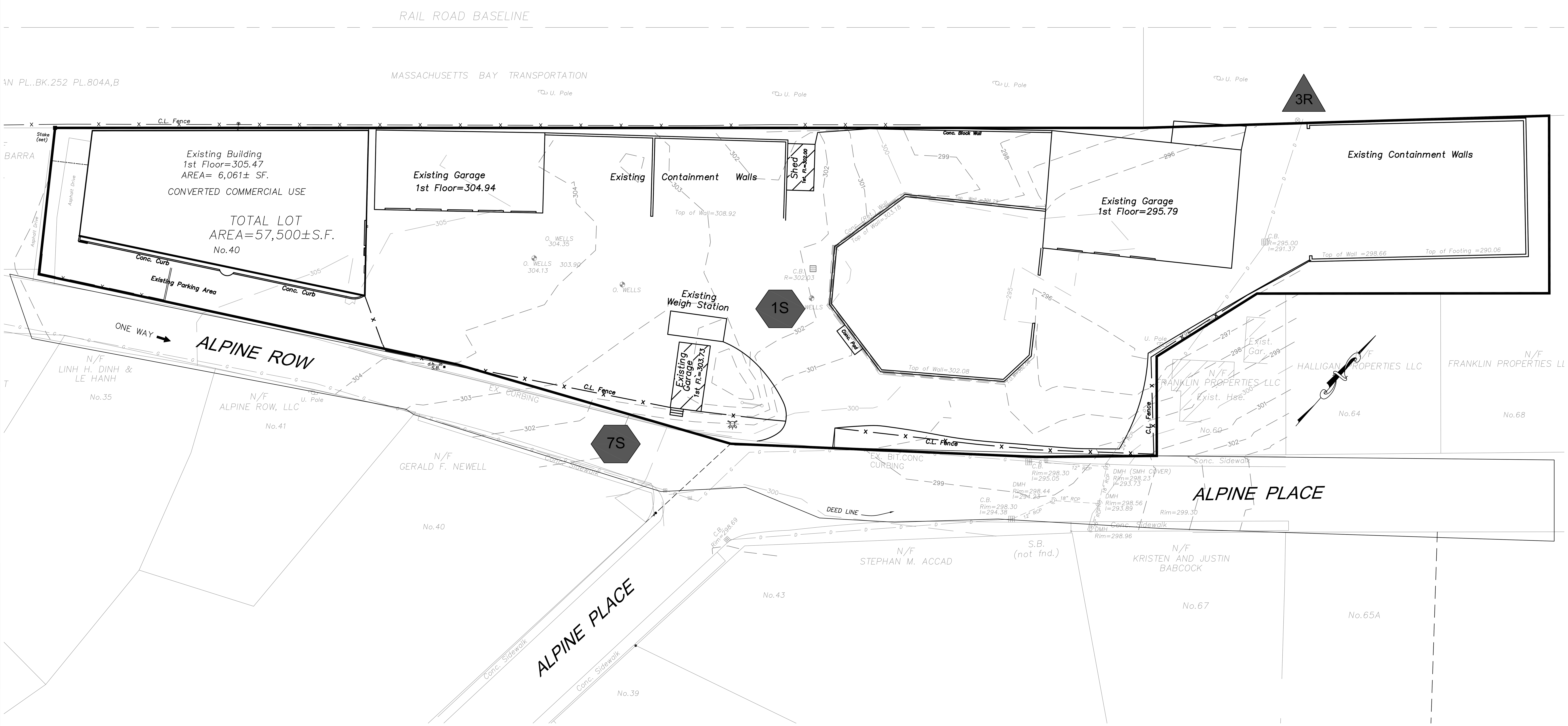
LEGEND

EXISTING		PROPOSED
100	CONTOUR	100
D	STORM DRAIN	
W	WATER	
	ELECTRIC MANHOLE	
E	ELECTRICAL	
G	GAS	
S	SANITARY SEWER	
	HYDRANT	
	SEWER MANHOLE	
	DRAIN MANHOLE	
	VALVE	
	CATCH BASIN	
	CURB	
429x5	SPOT GRADE	429.5
	HP RAMP	
	SEDIMENTATION CONTROL BARRIER	
	LIGHT POLE	
	TREE	
	UTILITY POLE	
	POST INDICATOR VALVE	PIV
	TRAFFIC DIRECTION	

NOTES:

1. EXISTING CONDITIONS WERE OBTAINED FROM PLANS PREPARED BY GUERRIERE & HALNON, INC. FRANKLIN, MA, ENTITLED "SITE PLAN AND SPECIAL PERMIT, AS-BUILT BREWING, 40 ALPINE ROW, FRANKLIN, MASSACHUSETTS" DATED MAY 6, 2019, AS AMENDED JULY 12, 2019. LDG UTILIZED TOWN GIS AND PERFORMED LIMITED INSTRUMENT SURVEY ON THE DRAIN SYSTEM IN ALPINE PRIOR TO CROSSING THE PROPERTY. THE EXISTING CB'S WE UTILIZED AS A "KNOWN" FOR PURPOSES OF THIS INVESTIGATION.

2. THE LOCATION OF EXISTING UTILITIES IS APPROXIMATE, THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL UTILITIES IN THE FIELD PRIOR TO THE START OF CONSTRUCTION. NOTIFY "DIG-SAFE" AT 1-888-344-7233 AT LEAST 72 HOURS PRIOR TO ANY SITE DEMOLITION OR EXCAVATION.



NO	DATE	REVISIONS
1	06/21/2021	PERMIT SUBMISSION

SEAL

DATE :	JUNE 21, 2021
DRAWN :	DRC
SCALE :	1" = 20'

THE ENGINE YARD

COMMERCIAL/RESIDENTIAL REUSE
PARCEL ID 279-181-000-000
40 ALPINE ROW
FRANKLIN, MASSACHUSETTS

LEVEL DESIGN GROUP
CIVIL ENGINEERING / LAND SURVEYING
249 SOUTH STREET
UNIT 1
PLAINVILLE, MA 02762
TEL. (508) 695-2221 FAX. (508) 695-2219

EXISTING DRAINAGE

D-1.0

0' 10' 20' 40'

1880.00

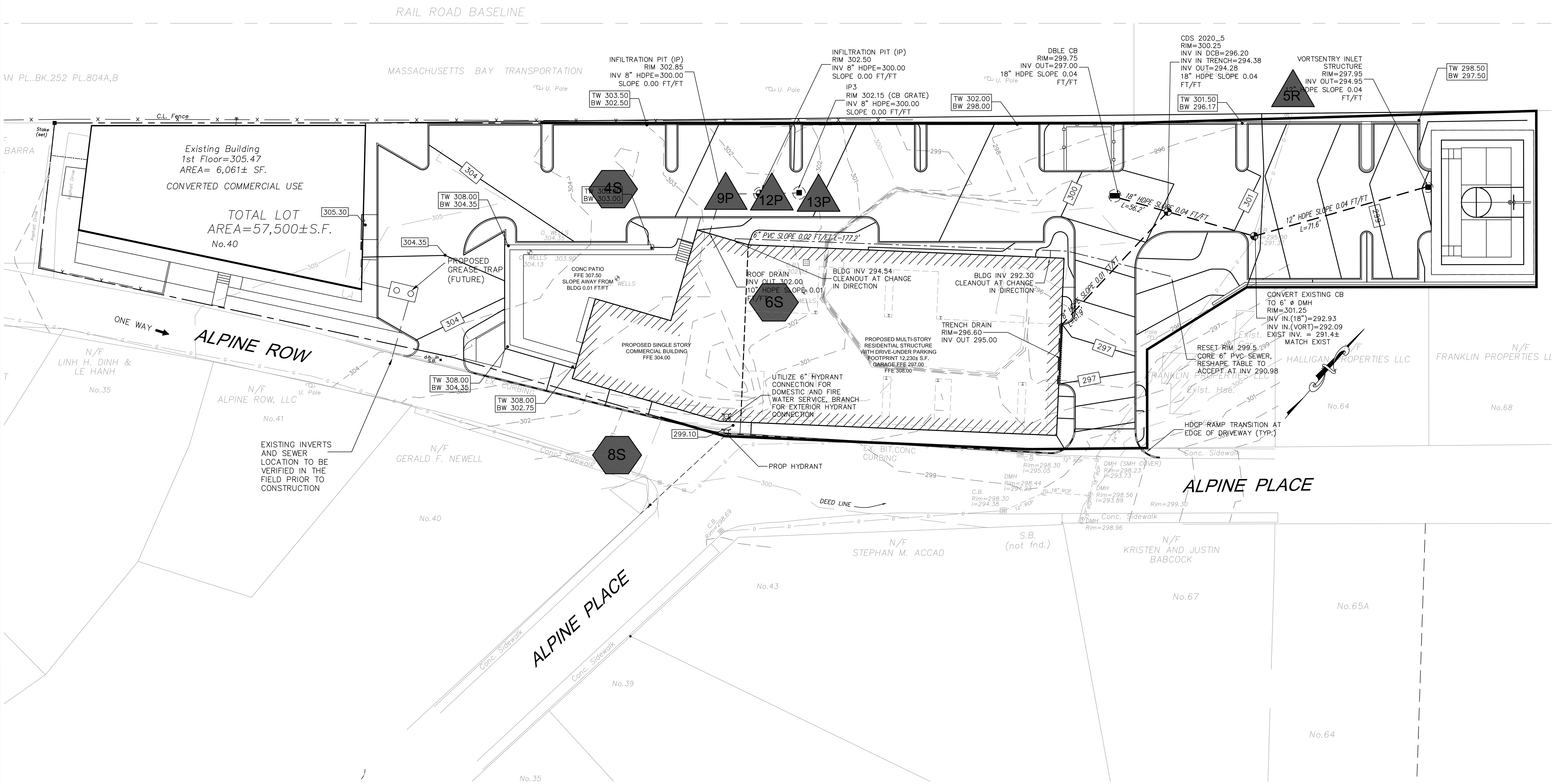
Proposed Conditions – Subcatchments

LEGEND

EXISTING		PROPOSED
100	CONTOUR	100
D	STORM DRAIN	
W	WATER	
	ELECTRIC MANHOLE	
E	ELECTRICAL	E
G	GAS	G
S	SANITARY SEWER	
	HYDRANT	
	SEWER MANHOLE	
	DRAIN MANHOLE	
	VALVE	
	CATCH BASIN	
	CURB	
429x5	SPOT GRADE	429.5
	HP RAMP	
	SEDIMENTATION CONTROL BARRIER	
	LIGHT POLE	
	TREE	
	UTILITY POLE	
	POST INDICATOR VALVE	PIV
	TRAFFIC DIRECTION	

NOTES:

1. EXISTING CONDITIONS WERE OBTAINED FROM PLANS PREPARED BY GUERRIERE & HALNON, INC. FRANKLIN, MA, ENTITLED "SITE PLAN AND SPECIAL PERMIT, AS-BUILT BREWING, 40 ALPINE ROW, FRANKLIN, MASSACHUSETTS" DATED MAY 6, 2019, AS AMENDED JULY 12, 2019. LDG UTILIZED TOWN GIS AND PERFORMED LIMITED INSTRUMENT SURVEY ON THE DRAIN SYSTEM IN ALPINE PRIOR TO CROSSING THE PROPERTY. THE EXISTING CB'S WE UTILIZED AS A "KNOWN" FOR PURPOSES OF THIS INVESTIGATION.
2. THE LOCATION OF EXISTING UTILITIES IS APPROXIMATE, THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL UTILITIES IN THE FIELD PRIOR TO THE START OF CONSTRUCTION. NOTIFY "DIG-SAFE" AT 1-888-344-7233 AT LEAST 72 HOURS PRIOR TO ANY SITE DEMOLITION OR EXCAVATION.
3. CONTRACTOR SHALL NOTIFY ENGINEER OF ANY DISCREPANCIES IN THE DESIGN PLANS PRIOR TO THE START OF CONSTRUCTION.
4. ALL EXISTING PAVEMENT SHALL BE SAWCUT PRIOR TO REMOVAL.
5. ALL EXISTING PAVEMENT, CURB, WALKS, UTILITIES, LIGHT POLES, TREES, SHRUBS, ETC., SHALL BE REMOVED FROM THE AREAS TO BE DEVELOPED. ALL SUCH ITEMS NOT WITHIN THE WORK AREA SHALL BE PROTECTED AND UNDISTURBED.
6. ALL DISTURBED AREAS NOT RECEIVING IMPROVEMENTS SHALL BE LOAMED AND SEEDED.
7. ALL CONSTRUCTION AND CONSTRUCTION ACTIVITIES SHALL CONFORM TO STATE AND LOCAL REQUIREMENTS. INCLUDING BUT NOT LIMITED TO THE TOWN OF FRANKLIN, THE COMMONWEALTH OF MASSACHUSETTS AND ANY OTHER AGENCIES HAVING JURISDICTION.



NO	DATE	REVISIONS
1	06/21/2021	PERMIT SUBMISSION

SEAL

DATE : JUNE 21, 2021
DRAWN : DRC
SCALE : 1" = 20'

THE ENGINE YARD

COMMERCIAL/RESIDENTIAL REUSE
PARCEL ID 279-181-000-000
40 ALPINE ROW
FRANKLIN, MASSACHUSETTS

LEVEL DESIGN GROUP
CIVIL ENGINEERING / LAND SURVEYING
249 SOUTH STREET
UNIT 1
PLAINVILLE, MA 02762
TEL. (508) 695-2221 FAX. (508) 695-2219

PROPOSED DRAINAGE

D-2.0

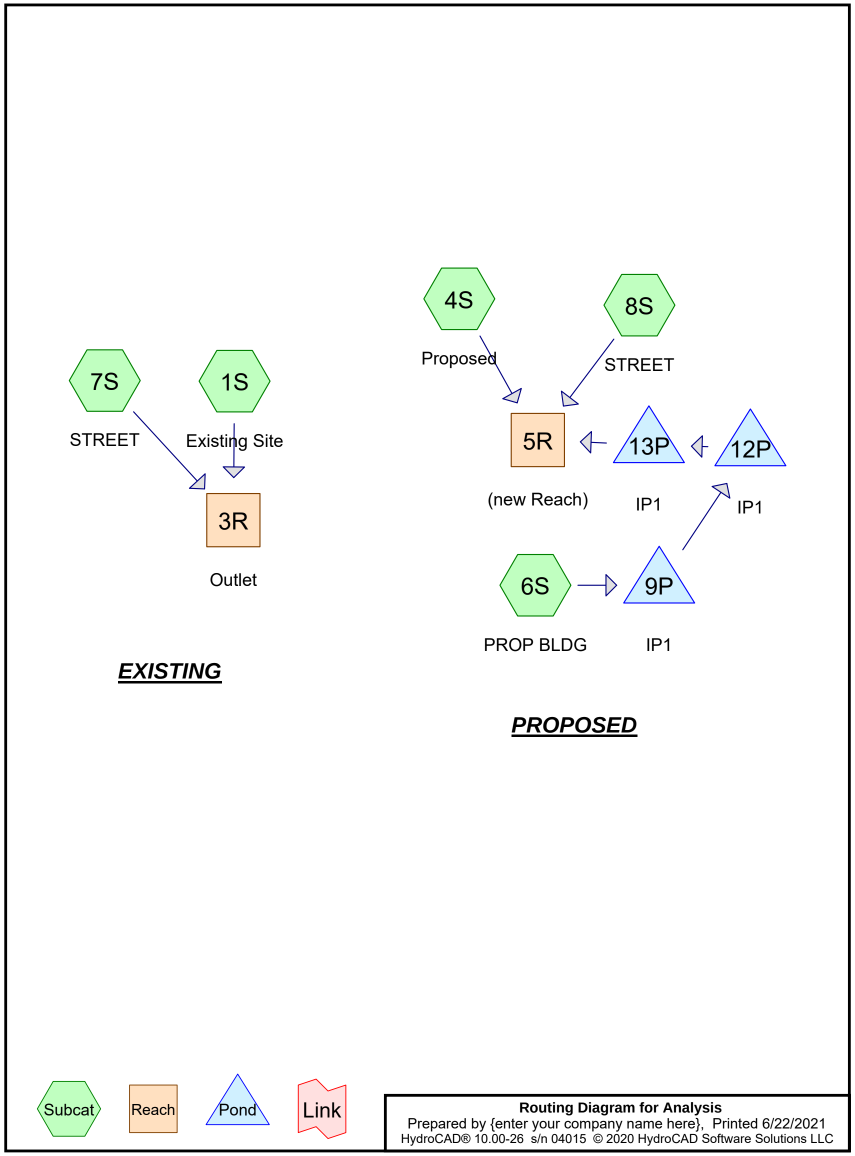
0' 10' 20' 40'

1880.00

LEVEL
DESIGN GROUP

HydroCAD Analysis

Existing & Proposed Conditions – 2 Year Storm



Project Notes

Rainfall events imported from "Analysis 12-6-2017.hcp"

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.284	39	>75% Grass cover, Good, HSG A (4S)
0.095	61	>75% Grass cover, Good, HSG B (1S)
0.497	98	Paved parking, HSG A (4S)
0.943	98	Paved parking, Roof, HSG B (1S)
0.738	98	Paved roads w/curbs & sewers, HSG A (7S, 8S)
0.421	98	Roofs, HSG A (1S, 4S)
0.119	98	Unconnected pavement, HSG A (4S)
0.281	98	Unconnected roofs, HSG A (6S)
3.378	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.340	HSG A	1S, 4S, 6S, 7S, 8S
1.038	HSG B	1S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
3.378		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.284	0.095	0.000	0.000	0.000	0.379	>75% Grass cover, Good	1S, 4S
0.497	0.000	0.000	0.000	0.000	0.497	Paved parking	4S
0.000	0.943	0.000	0.000	0.000	0.943	Paved parking, Roof	1S
0.738	0.000	0.000	0.000	0.000	0.738	Paved roads w/curbs & sewers	7S, 8S
0.421	0.000	0.000	0.000	0.000	0.421	Roofs	1S, 4S
0.119	0.000	0.000	0.000	0.000	0.119	Unconnected pavement	4S
0.281	0.000	0.000	0.000	0.000	0.281	Unconnected roofs	6S
2.340	**1.038**	**0.000**	**0.000**	**0.000**	**3.378**	**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	9P	300.00	300.00	10.0	0.0000	0.013	8.0	0.0	0.0
2	12P	300.00	300.00	10.0	0.0000	0.013	8.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Site Runoff Area=57,500 sf 92.80% Impervious Runoff Depth>2.52"
Tc=6.0 min CN=95 Runoff=3.81 cfs 0.277 af

Subcatchment 4S: Proposed Runoff Area=45,270 sf 72.71% Impervious Runoff Depth>1.44"
Tc=6.0 min CN=82 Runoff=1.85 cfs 0.125 af

Subcatchment 6S: PROP BLDG Runoff Area=12,230 sf 100.00% Impervious Runoff Depth>2.79"
Tc=6.0 min CN=98 Runoff=0.86 cfs 0.065 af

Subcatchment 7S: STREET Runoff Area=16,070 sf 100.00% Impervious Runoff Depth>2.79"
Tc=6.0 min CN=98 Runoff=1.13 cfs 0.086 af

Subcatchment 8S: STREET Runoff Area=16,070 sf 100.00% Impervious Runoff Depth>2.79"
Tc=6.0 min CN=98 Runoff=1.13 cfs 0.086 af

Reach 3R: Outlet Inflow=4.93 cfs 0.363 af
Outflow=4.93 cfs 0.363 af

Reach 5R: (new Reach) Inflow=3.72 cfs 0.230 af
Outflow=3.72 cfs 0.230 af

Pond 9P: IP1 Peak Elev=300.84' Storage=53 cf Inflow=0.86 cfs 0.065 af
Discarded=0.03 cfs 0.026 af Primary=0.81 cfs 0.039 af Outflow=0.84 cfs 0.065 af

Pond 12P: IP1 Peak Elev=300.79' Storage=59 cf Inflow=0.81 cfs 0.039 af
Discarded=0.03 cfs 0.011 af Primary=0.77 cfs 0.028 af Outflow=0.80 cfs 0.039 af

Pond 13P: IP1 Peak Elev=302.09' Storage=157 cf Inflow=0.77 cfs 0.028 af
Discarded=0.03 cfs 0.009 af Primary=0.76 cfs 0.020 af Outflow=0.79 cfs 0.028 af

Total Runoff Area = 3.378 ac Runoff Volume = 0.639 af Average Runoff Depth = 2.27"
11.21% Pervious = 0.379 ac 88.79% Impervious = 2.999 ac

Summary for Subcatchment 1S: Existing Site

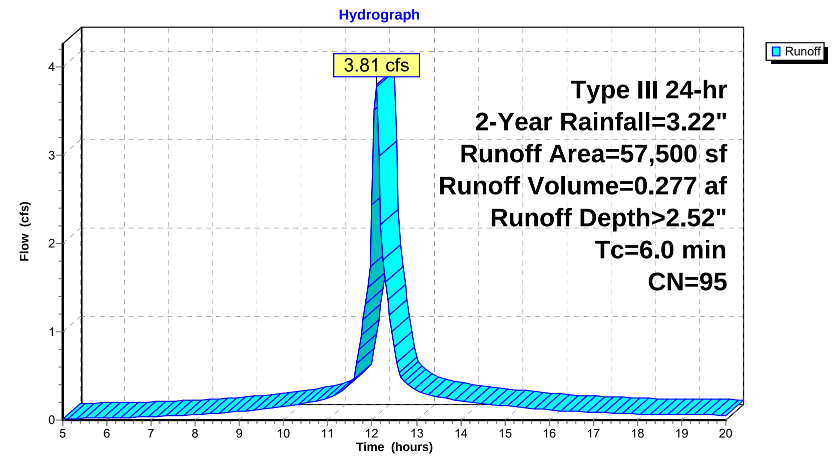
Runoff = 3.81 cfs @ 12.09 hrs, Volume= 0.277 af, Depth> 2.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.22"

	Area (sf)	CN	Description
	4,140	61	>75% Grass cover, Good, HSG B
*	41,070	98	Paved parking, Roof, HSG B
	12,290	98	Roofs, HSG A
	57,500	95	Weighted Average
	4,140		7.20% Pervious Area
	53,360		92.80% Impervious Area

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

Subcatchment 1S: Existing Site



Summary for Subcatchment 4S: Proposed

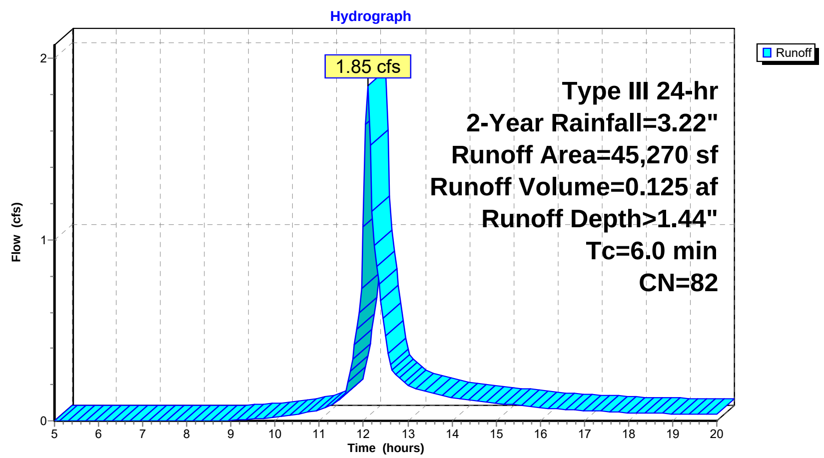
Runoff = 1.85 cfs @ 12.09 hrs, Volume= 0.125 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.22"

Area (sf)	CN	Description
12,354	39	>75% Grass cover, Good, HSG A
21,655	98	Paved parking, HSG A
5,200	98	Unconnected pavement, HSG A
6,061	98	Roofs, HSG A
45,270	82	Weighted Average
12,354		27.29% Pervious Area
32,916		72.71% Impervious Area
5,200		15.80% Unconnected

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

Subcatchment 4S: Proposed



Summary for Subcatchment 6S: PROP BLDG

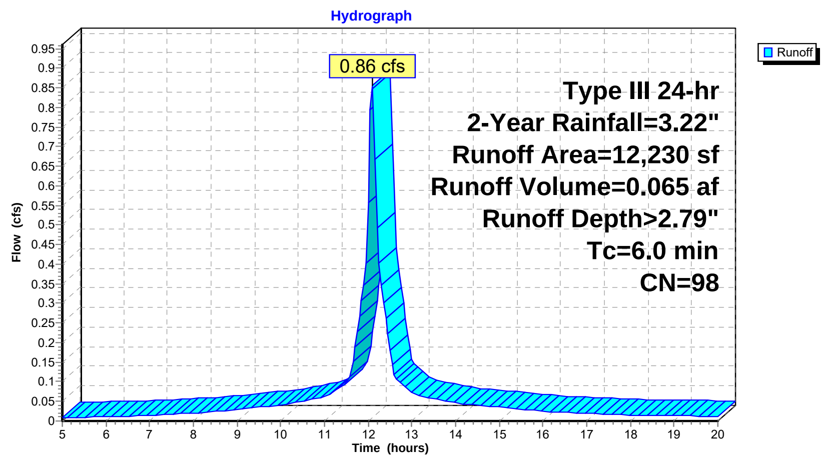
Runoff = 0.86 cfs @ 12.09 hrs, Volume= 0.065 af, Depth> 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.22"

Area (sf)	CN	Description
12,230	98	Unconnected roofs, HSG A
12,230		100.00% Impervious Area
12,230		100.00% Unconnected

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

Subcatchment 6S: PROP BLDG



Summary for Subcatchment 7S: STREET

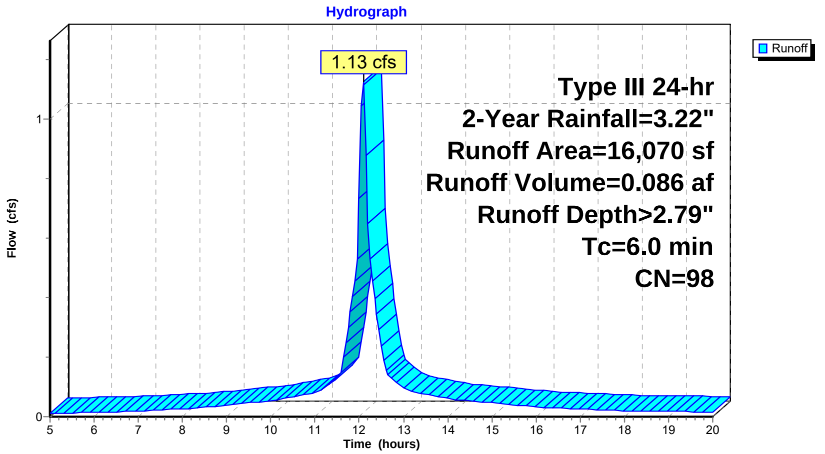
Runoff = 1.13 cfs @ 12.09 hrs, Volume= 0.086 af, Depth> 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.22"

Area (sf)	CN	Description
16,070	98	Paved roads w/curbs & sewers, HSG A
16,070		100.00% Impervious Area

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

Subcatchment 7S: STREET



Summary for Subcatchment 8S: STREET

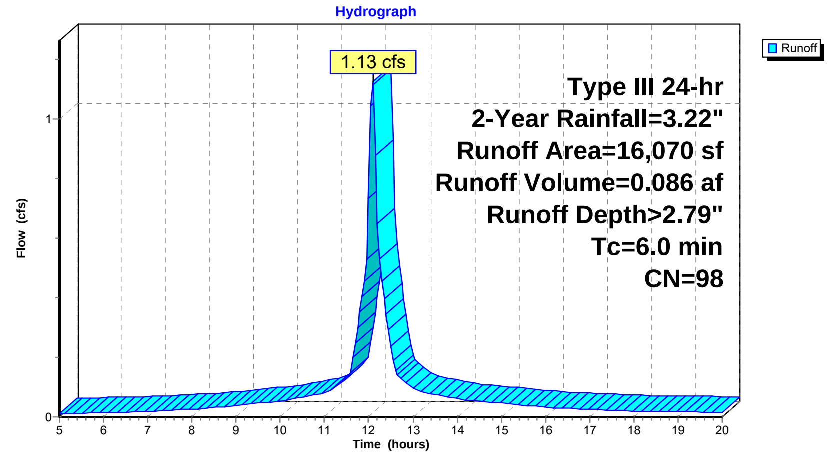
Runoff = 1.13 cfs @ 12.09 hrs, Volume= 0.086 af, Depth> 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.22"

Area (sf)	CN	Description
16,070	98	Paved roads w/curbs & sewers, HSG A
16,070		100.00% Impervious Area

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

Subcatchment 8S: STREET

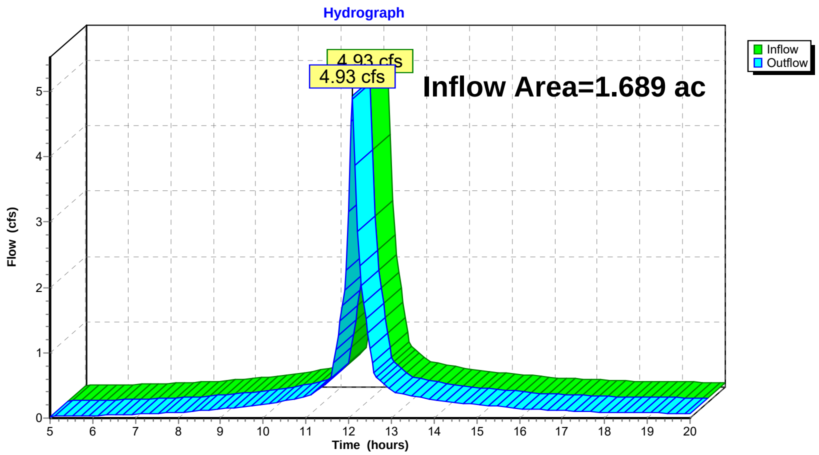


Summary for Reach 3R: Outlet

Inflow Area = 1.689 ac, 94.37% Impervious, Inflow Depth > 2.58" for 2-Year event
Inflow = 4.93 cfs @ 12.09 hrs, Volume= 0.363 af
Outflow = 4.93 cfs @ 12.09 hrs, Volume= 0.363 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 3R: Outlet

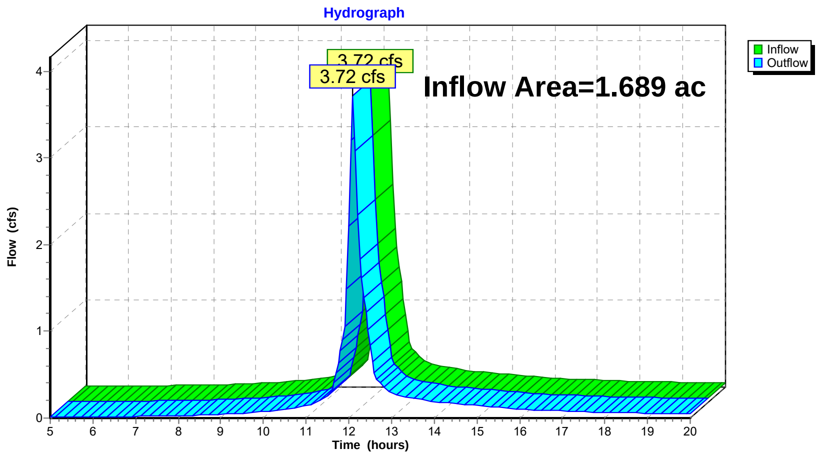


Summary for Reach 5R: (new Reach)

Inflow Area = 1.689 ac, 83.21% Impervious, Inflow Depth > 1.64" for 2-Year event
Inflow = 3.72 cfs @ 12.10 hrs, Volume= 0.230 af
Outflow = 3.72 cfs @ 12.10 hrs, Volume= 0.230 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 5R: (new Reach)



Summary for Pond 9P: IP1

Inflow Area = 0.281 ac,100.00% Impervious, Inflow Depth > 2.79" for 2-Year event
Inflow = 0.86 cfs @ 12.09 hrs, Volume= 0.065 af
Outflow = 0.84 cfs @ 12.10 hrs, Volume= 0.065 af, Atten= 2%, Lag= 0.9 min
Discarded = 0.03 cfs @ 12.10 hrs, Volume= 0.026 af
Primary = 0.81 cfs @ 12.10 hrs, Volume= 0.039 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 300.84' @ 12.10 hrs Surf.Area= 154 sf Storage= 53 cf

Plug-Flow detention time= 2.0 min calculated for 0.065 af (100% of inflow)
Center-of-Mass det. time= 1.6 min (740.1 - 738.5)

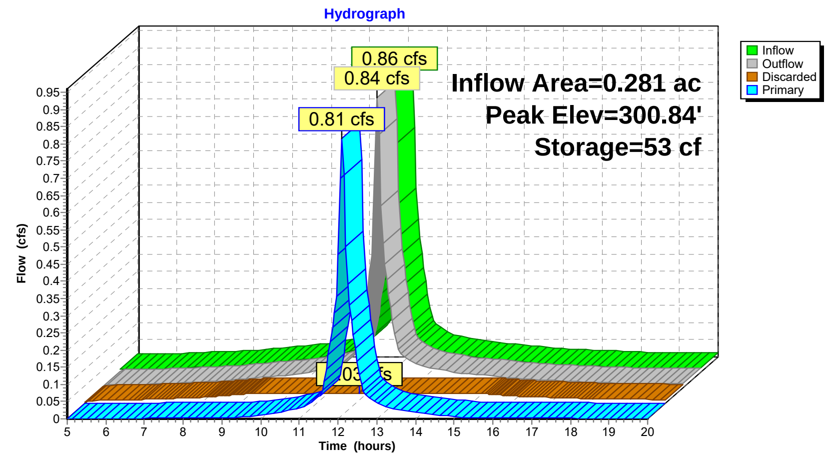
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	342 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder** 924 cf Overall - 69 cf Embedded = 854 cf x 40.0% Voids
#2	300.00'	42 cf	**3.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1 69 cf Overall - 5.0" Wall Thickness = 42 cf
		384 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	300.00'	**8.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 300.00' / 300.00' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 220.00'

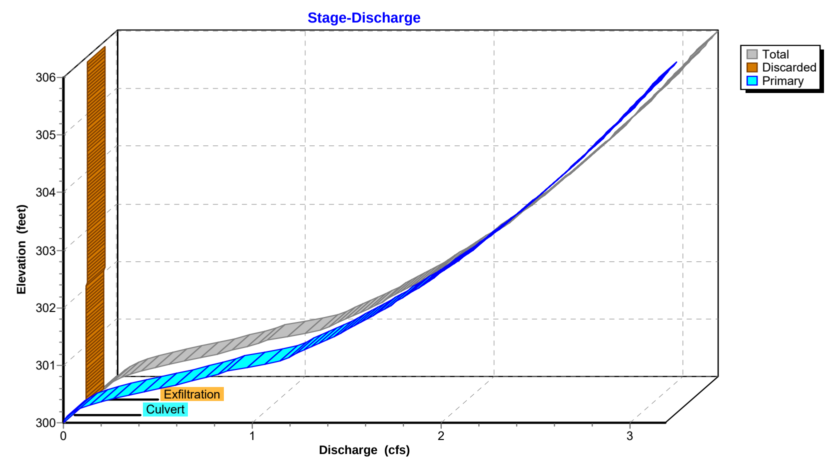
Discarded OutFlow Max=0.03 cfs @ 12.10 hrs HW=300.83' (Free Discharge)
└─**2=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=0.81 cfs @ 12.10 hrs HW=300.83' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.81 cfs @ 2.39 fps)

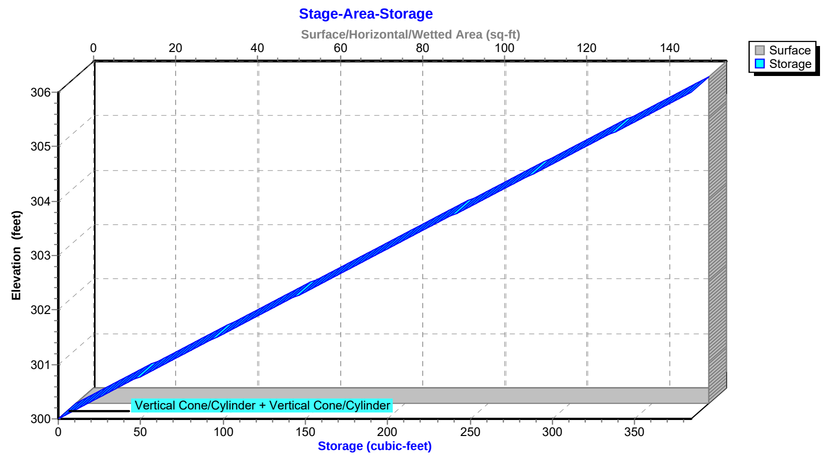
Pond 9P: IP1



Pond 9P: IP1



Pond 9P: IP1



Summary for Pond 12P: IP1

Inflow Area = 0.281 ac,100.00% Impervious, Inflow Depth > 1.67" for 2-Year event
Inflow = 0.81 cfs @ 12.10 hrs, Volume= 0.039 af
Outflow = 0.80 cfs @ 12.12 hrs, Volume= 0.039 af, Atten= 2%, Lag= 1.0 min
Discarded = 0.03 cfs @ 12.12 hrs, Volume= 0.011 af
Primary = 0.77 cfs @ 12.12 hrs, Volume= 0.028 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 300.79' @ 12.12 hrs Surf.Area= 154 sf Storage= 59 cf

Plug-Flow detention time= 1.9 min calculated for 0.039 af (100% of inflow)
Center-of-Mass det. time= 1.9 min (733.0 - 731.2)

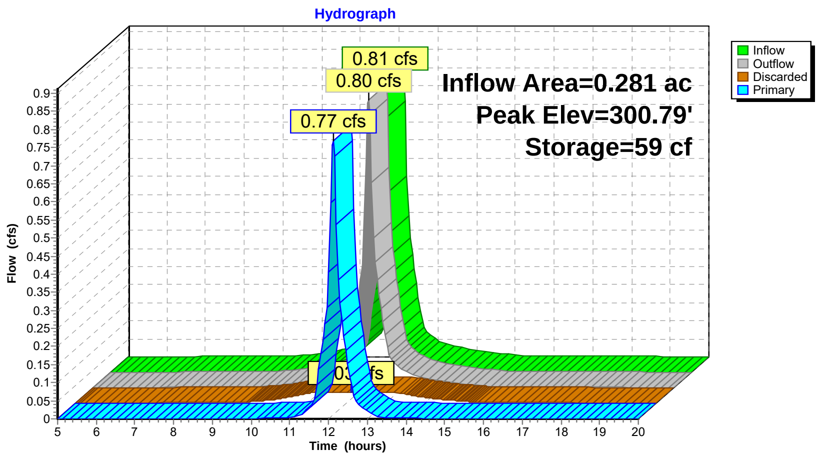
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	281 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder** 924 cf Overall - 220 cf Embedded = 704 cf x 40.0% Voids
#2	300.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1 220 cf Overall - 5.0" Wall Thickness = 170 cf
		451 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	300.00'	**8.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 300.00' / 300.00' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 220.00'

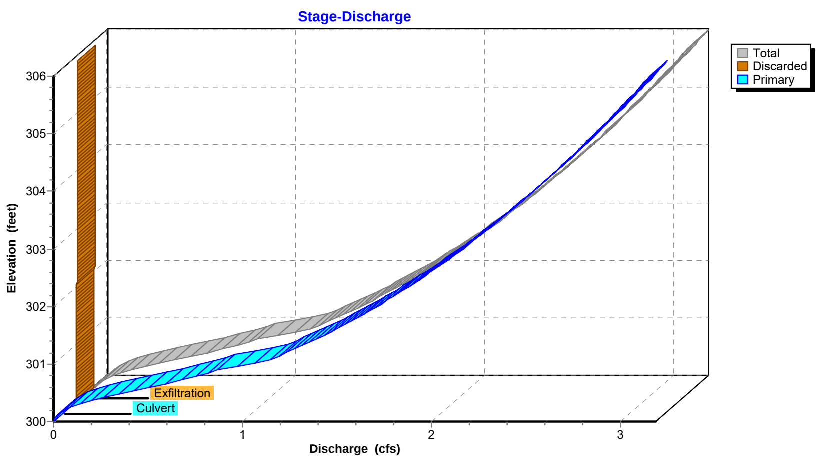
Discarded OutFlow Max=0.03 cfs @ 12.12 hrs HW=300.77' (Free Discharge)
└─**2=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=0.75 cfs @ 12.12 hrs HW=300.77' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.75 cfs @ 2.32 fps)

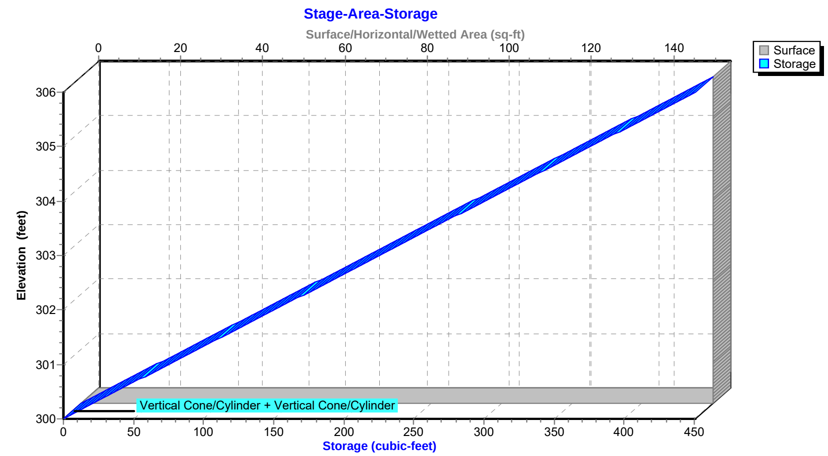
Pond 12P: IP1



Pond 12P: IP1



Pond 12P: IP1



Summary for Pond 13P: IP1

Inflow Area = 0.281 ac,100.00% Impervious, Inflow Depth > 1.20" for 2-Year event
Inflow = 0.77 cfs @ 12.12 hrs, Volume= 0.028 af
Outflow = 0.79 cfs @ 12.11 hrs, Volume= 0.028 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.03 cfs @ 12.11 hrs, Volume= 0.009 af
Primary = 0.76 cfs @ 12.11 hrs, Volume= 0.020 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 302.09' @ 12.11 hrs Surf.Area= 154 sf Storage= 157 cf

Plug-Flow detention time= 15.4 min calculated for 0.028 af (100% of inflow)
Center-of-Mass det. time= 15.4 min (744.9 - 729.5)

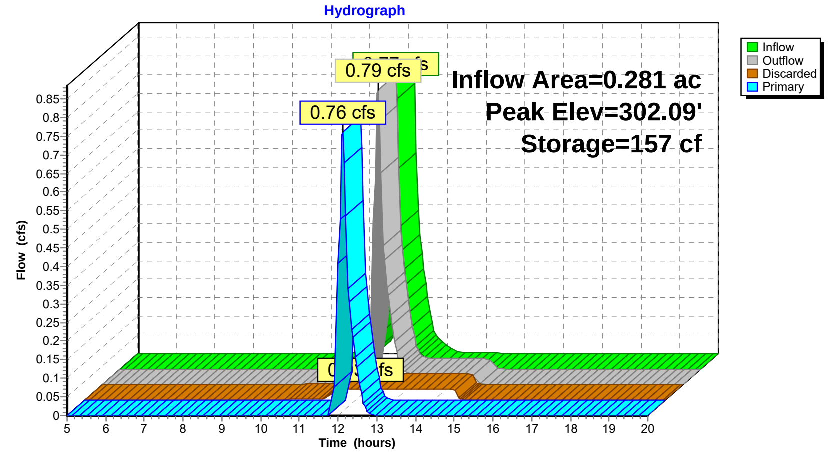
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	281 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder** 924 cf Overall - 220 cf Embedded = 704 cf x 40.0% Voids
#2	300.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1 220 cf Overall - 5.0" Wall Thickness = 170 cf
		451 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 220.00'
#2	Primary	302.00'	**2.0" x 2.0" Horiz. Orifice/Grate X 5.00 columns** X 5 rows C= 0.600 in 24.0" x 24.0" Grate (17% open area) Limited to weir flow at low heads

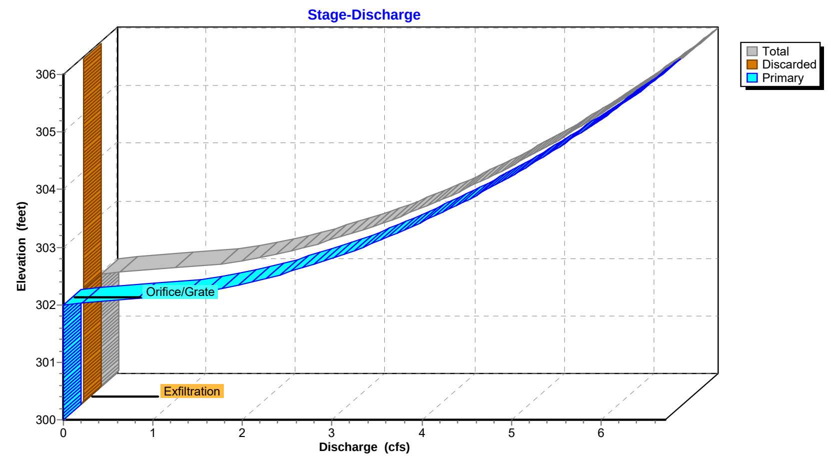
Discarded OutFlow Max=0.03 cfs @ 12.11 hrs HW=302.09' (Free Discharge)
└─**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=0.72 cfs @ 12.11 hrs HW=302.09' (Free Discharge)
└─**2=Orifice/Grate** (Weir Controls 0.72 cfs @ 0.99 fps)

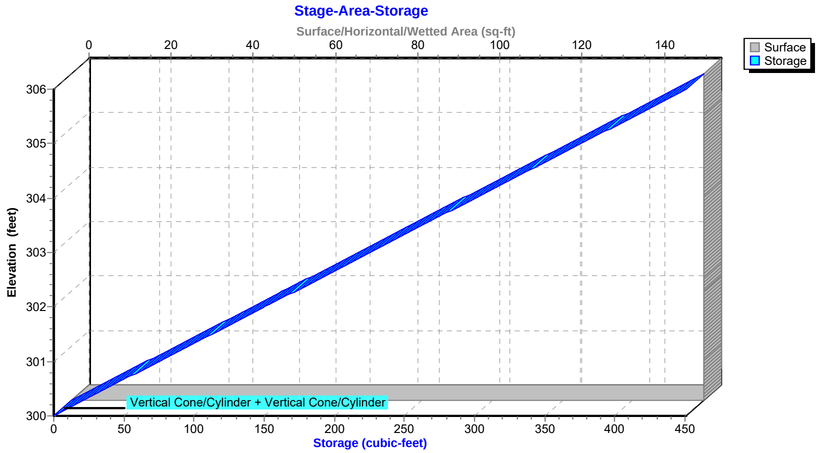
Pond 13P: IP1



Pond 13P: IP1



Pond 13P: IP1

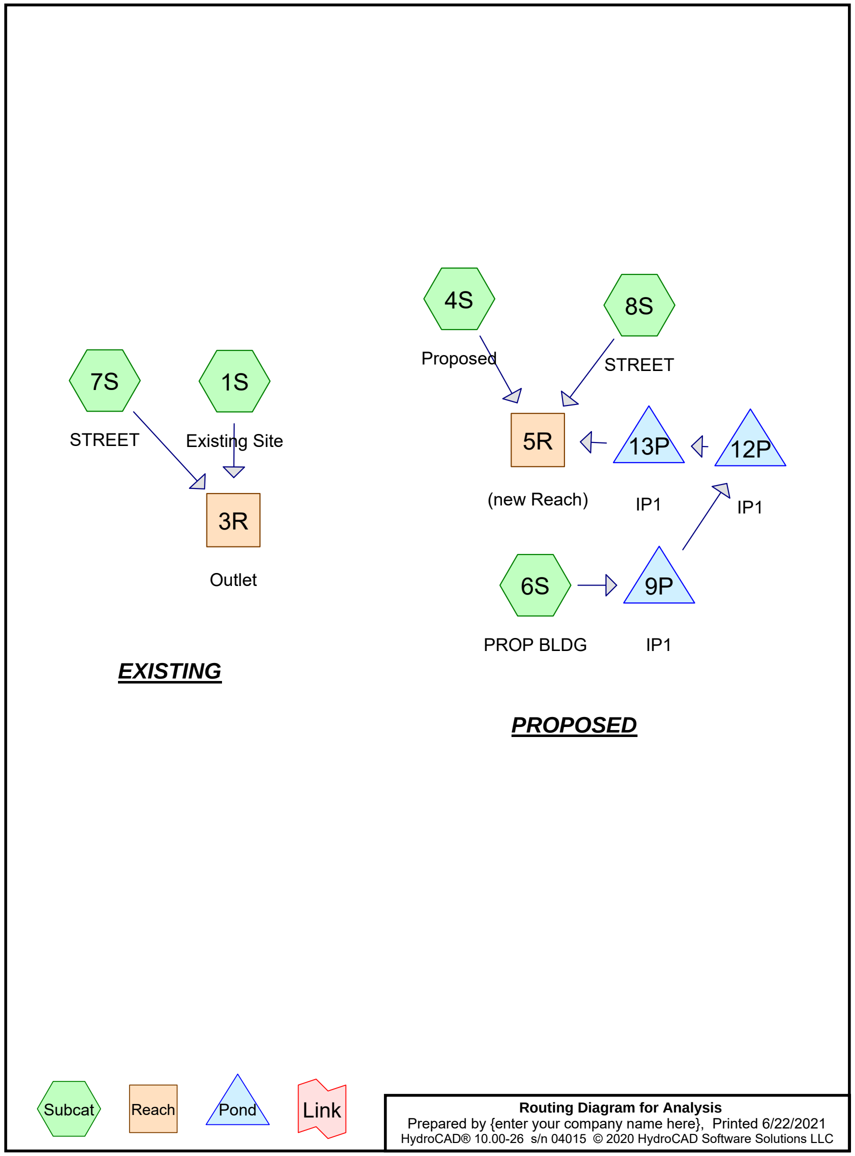

Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0 20 40 60 80 100 120 140
Surface
Storage
Elevation (feet)
306 305 304 303 302 301 300
Vertical Cone/Cylinder + Vertical Cone/Cylinder
0 50 100 150 200 250 300 350 400 450
Storage (cubic-feet)

LEVEL
DESIGN GROUP

HydroCAD Analysis

Existing & Proposed Conditions – 10 Year Storm

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL 508 695 2221 FAX 508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM



Project Notes

Rainfall events imported from "Analysis 12-6-2017.hcp"

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.284	39	>75% Grass cover, Good, HSG A (4S)
0.095	61	>75% Grass cover, Good, HSG B (1S)
0.497	98	Paved parking, HSG A (4S)
0.943	98	Paved parking, Roof, HSG B (1S)
0.738	98	Paved roads w/curbs & sewers, HSG A (7S, 8S)
0.421	98	Roofs, HSG A (1S, 4S)
0.119	98	Unconnected pavement, HSG A (4S)
0.281	98	Unconnected roofs, HSG A (6S)
3.378	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.340	HSG A	1S, 4S, 6S, 7S, 8S
1.038	HSG B	1S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
3.378		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.284	0.095	0.000	0.000	0.000	0.379	>75% Grass cover, Good	1S, 4S
0.497	0.000	0.000	0.000	0.000	0.497	Paved parking	4S
0.000	0.943	0.000	0.000	0.000	0.943	Paved parking, Roof	1S
0.738	0.000	0.000	0.000	0.000	0.738	Paved roads w/curbs & sewers	7S, 8S
0.421	0.000	0.000	0.000	0.000	0.421	Roofs	1S, 4S
0.119	0.000	0.000	0.000	0.000	0.119	Unconnected pavement	4S
0.281	0.000	0.000	0.000	0.000	0.281	Unconnected roofs	6S
2.340	**1.038**	**0.000**	**0.000**	**0.000**	**3.378**	**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	9P	300.00	300.00	10.0	0.0000	0.013	8.0	0.0	0.0
2	12P	300.00	300.00	10.0	0.0000	0.013	8.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Site	Runoff Area=57,500 sf 92.80% Impervious Runoff Depth>4.03" Tc=6.0 min CN=95 Runoff=5.95 cfs 0.443 af
Subcatchment 4S: Proposed	Runoff Area=45,270 sf 72.71% Impervious Runoff Depth>2.77" Tc=6.0 min CN=82 Runoff=3.52 cfs 0.239 af
Subcatchment 6S: PROP BLDG	Runoff Area=12,230 sf 100.00% Impervious Runoff Depth>4.29" Tc=6.0 min CN=98 Runoff=1.30 cfs 0.100 af
Subcatchment 7S: STREET	Runoff Area=16,070 sf 100.00% Impervious Runoff Depth>4.29" Tc=6.0 min CN=98 Runoff=1.71 cfs 0.132 af
Subcatchment 8S: STREET	Runoff Area=16,070 sf 100.00% Impervious Runoff Depth>4.29" Tc=6.0 min CN=98 Runoff=1.71 cfs 0.132 af
Reach 3R: Outlet	Inflow=7.67 cfs 0.575 af Outflow=7.67 cfs 0.575 af
Reach 5R: (new Reach)	Inflow=6.40 cfs 0.410 af Outflow=6.40 cfs 0.410 af
Pond 9P: IP1	Peak Elev=301.21' Storage=77 cf Inflow=1.30 cfs 0.100 af Discarded=0.03 cfs 0.032 af Primary=1.24 cfs 0.069 af Outflow=1.27 cfs 0.100 af
Pond 12P: IP1	Peak Elev=301.13' Storage=85 cf Inflow=1.24 cfs 0.069 af Discarded=0.03 cfs 0.017 af Primary=1.20 cfs 0.052 af Outflow=1.23 cfs 0.069 af
Pond 13P: IP1	Peak Elev=302.14' Storage=161 cf Inflow=1.20 cfs 0.052 af Discarded=0.03 cfs 0.013 af Primary=1.21 cfs 0.039 af Outflow=1.24 cfs 0.052 af

Total Runoff Area = 3.378 ac Runoff Volume = 1.047 af Average Runoff Depth = 3.72"
11.21% Pervious = 0.379 ac 88.79% Impervious = 2.999 ac

Summary for Subcatchment 1S: Existing Site

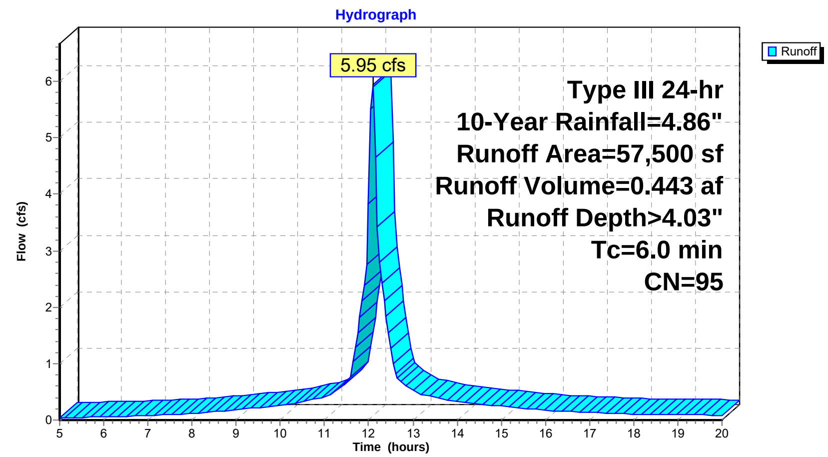
Runoff = 5.95 cfs @ 12.09 hrs, Volume= 0.443 af, Depth> 4.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

	Area (sf)	CN	Description
	4,140	61	>75% Grass cover, Good, HSG B
*	41,070	98	Paved parking, Roof, HSG B
	12,290	98	Roofs, HSG A
	57,500	95	Weighted Average
	4,140		7.20% Pervious Area
	53,360		92.80% Impervious Area

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

Subcatchment 1S: Existing Site



Summary for Subcatchment 4S: Proposed

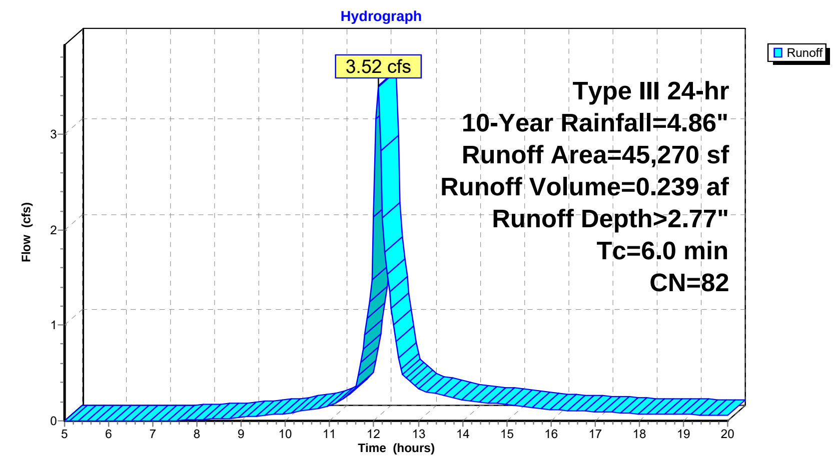
Runoff = 3.52 cfs @ 12.09 hrs, Volume= 0.239 af, Depth> 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

Area (sf)	CN	Description
12,354	39	>75% Grass cover, Good, HSG A
21,655	98	Paved parking, HSG A
5,200	98	Unconnected pavement, HSG A
6,061	98	Roofs, HSG A
45,270	82	Weighted Average
12,354		27.29% Pervious Area
32,916		72.71% Impervious Area
5,200		15.80% Unconnected

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

Subcatchment 4S: Proposed



Summary for Subcatchment 6S: PROP BLDG

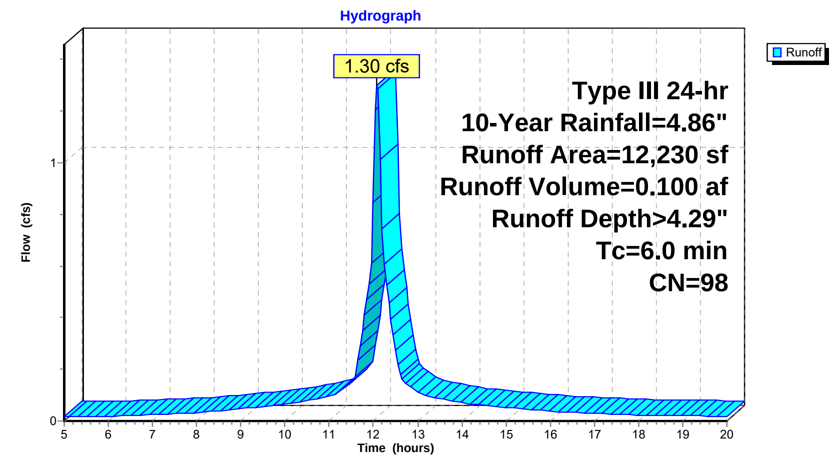
Runoff = 1.30 cfs @ 12.09 hrs, Volume= 0.100 af, Depth> 4.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

Area (sf)	CN	Description
12,230	98	Unconnected roofs, HSG A
12,230		100.00% Impervious Area
12,230		100.00% Unconnected

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

Subcatchment 6S: PROP BLDG



Summary for Subcatchment 7S: STREET

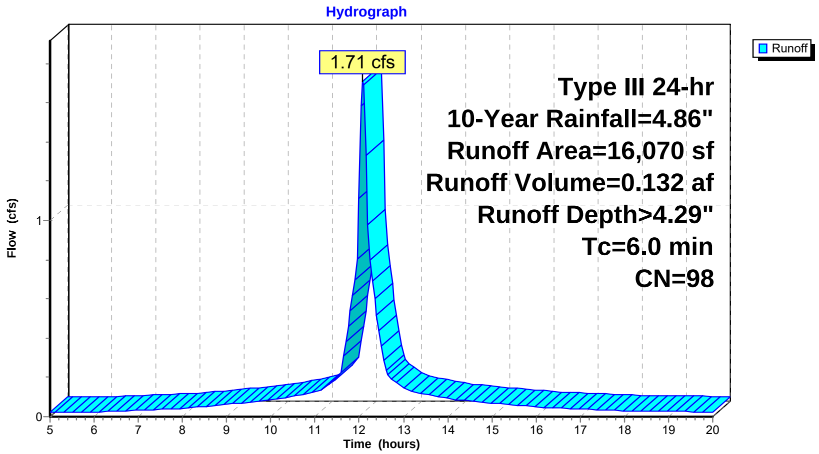
Runoff = 1.71 cfs @ 12.09 hrs, Volume= 0.132 af, Depth> 4.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

Area (sf)	CN	Description
16,070	98	Paved roads w/curbs & sewers, HSG A
16,070		100.00% Impervious Area

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

Subcatchment 7S: STREET



Summary for Subcatchment 8S: STREET

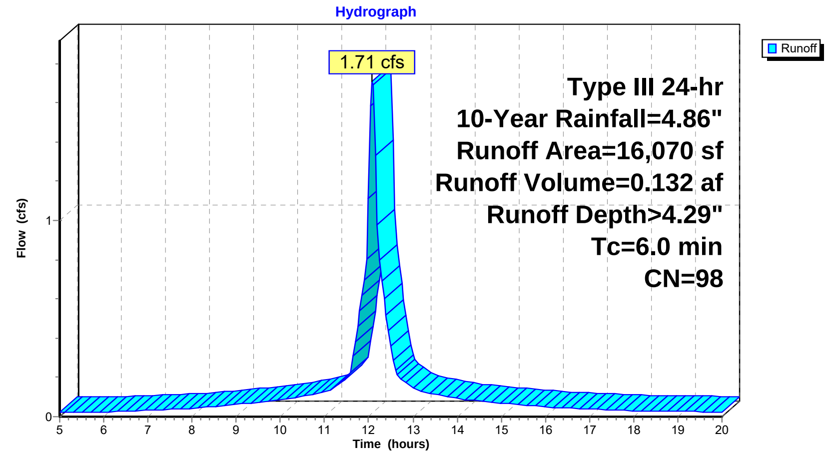
Runoff = 1.71 cfs @ 12.09 hrs, Volume= 0.132 af, Depth> 4.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

Area (sf)	CN	Description
16,070	98	Paved roads w/curbs & sewers, HSG A
16,070		100.00% Impervious Area

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

Subcatchment 8S: STREET

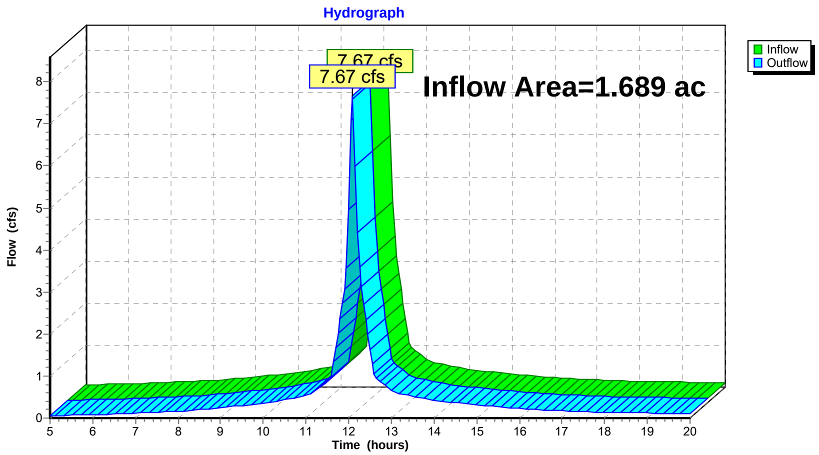


Summary for Reach 3R: Outlet

Inflow Area = 1.689 ac, 94.37% Impervious, Inflow Depth > 4.09" for 10-Year event
Inflow = 7.67 cfs @ 12.09 hrs, Volume= 0.575 af
Outflow = 7.67 cfs @ 12.09 hrs, Volume= 0.575 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 3R: Outlet

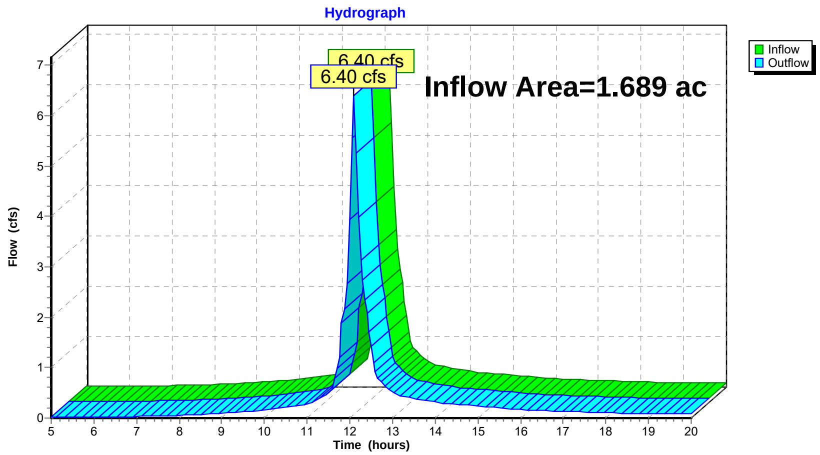


Summary for Reach 5R: (new Reach)

Inflow Area = 1.689 ac, 83.21% Impervious, Inflow Depth > 2.91" for 10-Year event
Inflow = 6.40 cfs @ 12.10 hrs, Volume= 0.410 af
Outflow = 6.40 cfs @ 12.10 hrs, Volume= 0.410 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 5R: (new Reach)



Summary for Pond 9P: IP1

Inflow Area = 0.281 ac,100.00% Impervious, Inflow Depth > 4.29" for 10-Year event
Inflow = 1.30 cfs @ 12.09 hrs, Volume= 0.100 af
Outflow = 1.27 cfs @ 12.10 hrs, Volume= 0.100 af, Atten= 3%, Lag= 1.0 min
Discarded = 0.03 cfs @ 12.10 hrs, Volume= 0.032 af
Primary = 1.24 cfs @ 12.10 hrs, Volume= 0.069 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 301.21' @ 12.10 hrs Surf.Area= 154 sf Storage= 77 cf

Plug-Flow detention time= 1.9 min calculated for 0.100 af (100% of inflow)
Center-of-Mass det. time= 1.5 min (736.8 - 735.3)

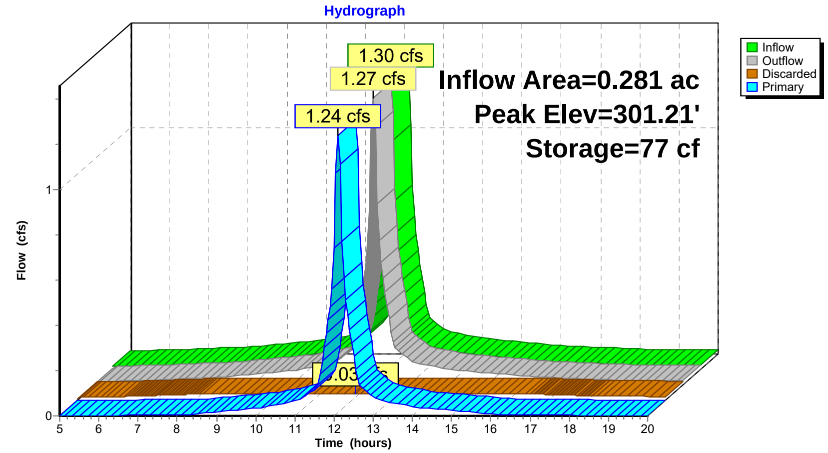
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	342 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder** 924 cf Overall - 69 cf Embedded = 854 cf x 40.0% Voids
#2	300.00'	42 cf	**3.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1 69 cf Overall - 5.0" Wall Thickness = 42 cf
		384 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	300.00'	**8.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 300.00' / 300.00' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 220.00'

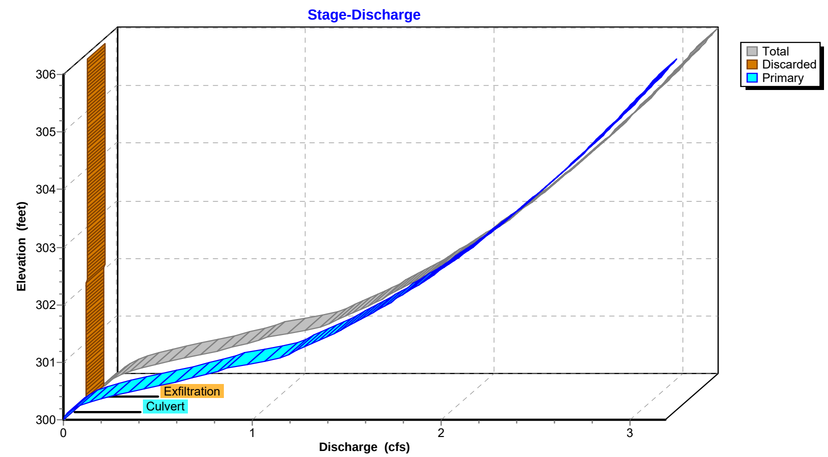
Discarded OutFlow Max=0.03 cfs @ 12.10 hrs HW=301.20' (Free Discharge)
└─**2=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=1.23 cfs @ 12.10 hrs HW=301.19' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.23 cfs @ 3.53 fps)

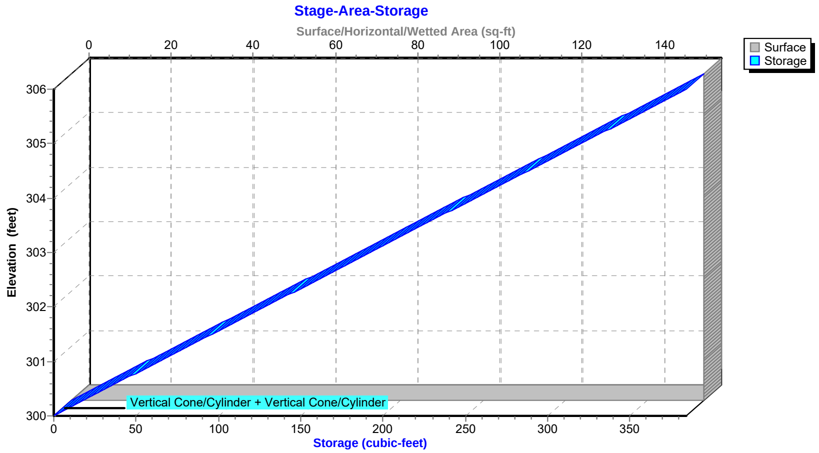
Pond 9P: IP1



Pond 9P: IP1



Pond 9P: IP1



Summary for Pond 12P: IP1

Inflow Area = 0.281 ac,100.00% Impervious, Inflow Depth > 2.94" for 10-Year event
Inflow = 1.24 cfs @ 12.10 hrs, Volume= 0.069 af
Outflow = 1.23 cfs @ 12.12 hrs, Volume= 0.069 af, Atten= 1%, Lag= 1.0 min
Discarded = 0.03 cfs @ 12.12 hrs, Volume= 0.017 af
Primary = 1.20 cfs @ 12.12 hrs, Volume= 0.052 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 301.13' @ 12.12 hrs Surf.Area= 154 sf Storage= 85 cf

Plug-Flow detention time= 1.9 min calculated for 0.069 af (100% of inflow)
Center-of-Mass det. time= 1.8 min (732.1 - 730.3)

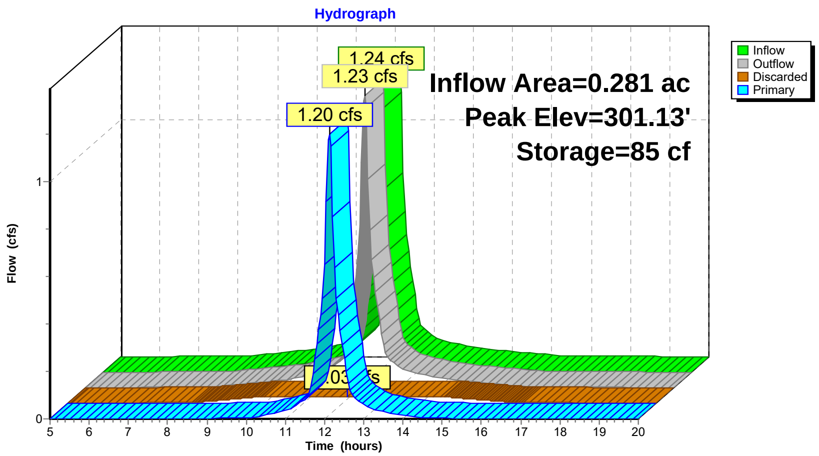
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	281 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder** 924 cf Overall - 220 cf Embedded = 704 cf x 40.0% Voids
#2	300.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1 220 cf Overall - 5.0" Wall Thickness = 170 cf
		451 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	300.00'	**8.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 300.00' / 300.00' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 220.00'

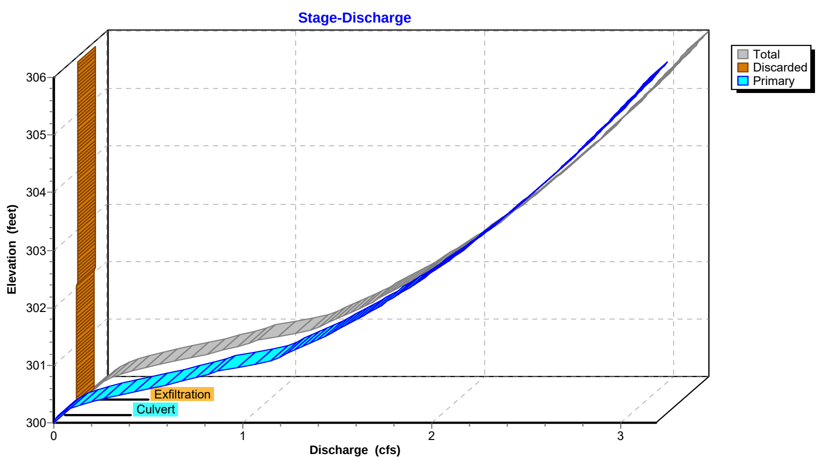
Discarded OutFlow Max=0.03 cfs @ 12.12 hrs HW=301.11' (Free Discharge)
└─**2=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=1.17 cfs @ 12.12 hrs HW=301.10' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.17 cfs @ 3.34 fps)

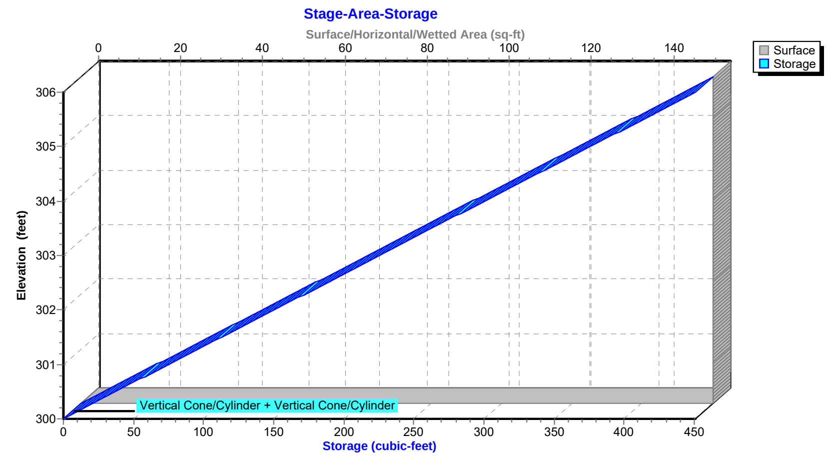
Pond 12P: IP1



Pond 12P: IP1



Pond 12P: IP1



Summary for Pond 13P: IP1

Inflow Area =	0.281 ac,100.00% Impervious,	Inflow Depth > 2.21"		for 10-Year event
Inflow =	1.20 cfs @	12.12 hrs, Volume=	0.052 af	
Outflow =	1.24 cfs @	12.11 hrs, Volume=	0.052 af,	Atten= 0%, Lag= 0.0 min
Discarded =	0.03 cfs @	12.11 hrs, Volume=	0.013 af	
Primary =	1.21 cfs @	12.11 hrs, Volume=	0.039 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 302.14' @ 12.11 hrs Surf.Area= 154 sf Storage= 161 cf

Plug-Flow detention time= 13.0 min calculated for 0.051 af (100% of inflow)
Center-of-Mass det. time= 13.0 min (742.4 - 729.4)

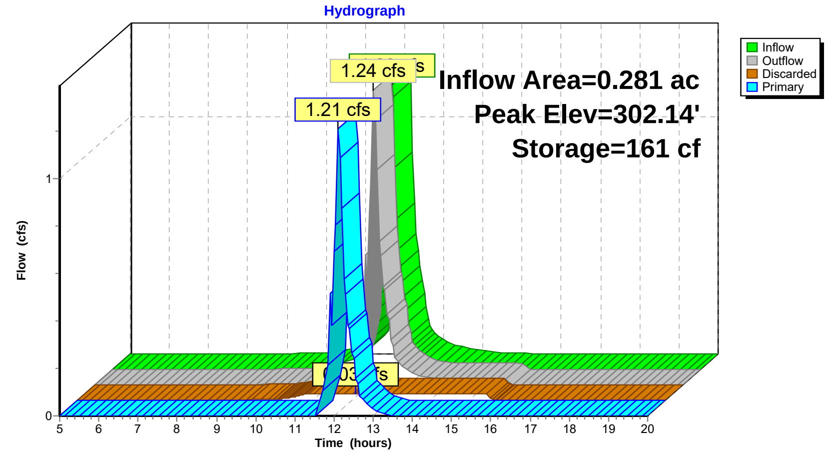
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	281 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder** 924 cf Overall - 220 cf Embedded = 704 cf x 40.0% Voids
#2	300.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1 220 cf Overall - 5.0" Wall Thickness = 170 cf
		451 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 220.00'
#2	Primary	302.00'	**2.0" x 2.0" Horiz. Orifice/Grate X 5.00 columns** X 5 rows C= 0.600 in 24.0" x 24.0" Grate (17% open area) Limited to weir flow at low heads

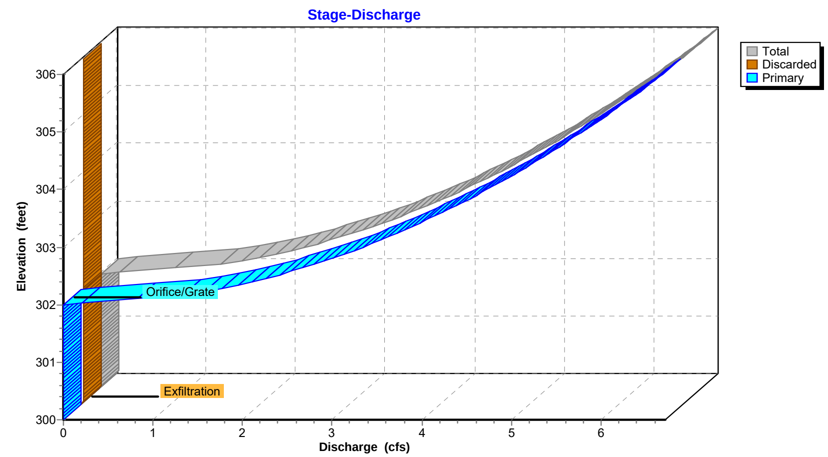
Discarded OutFlow Max=0.03 cfs @ 12.11 hrs HW=302.14' (Free Discharge)
└─**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=1.25 cfs @ 12.11 hrs HW=302.14' (Free Discharge)
└─**2=Orifice/Grate** (Orifice Controls 1.25 cfs @ 1.80 fps)

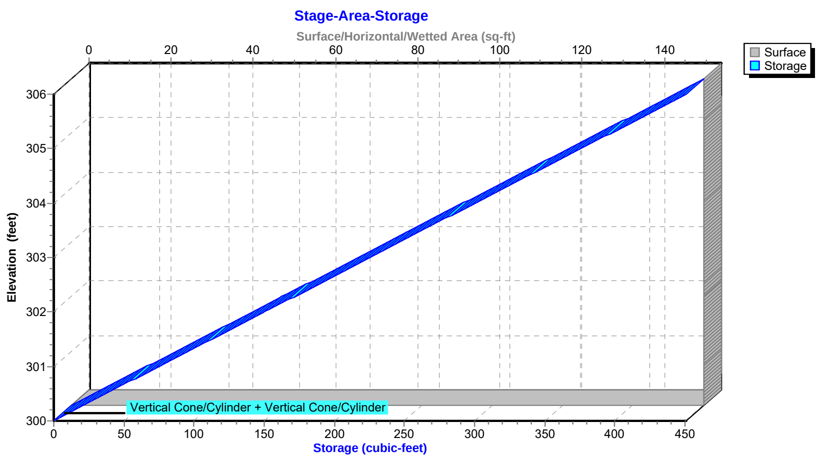
Pond 13P: IP1



Pond 13P: IP1



Pond 13P: IP1

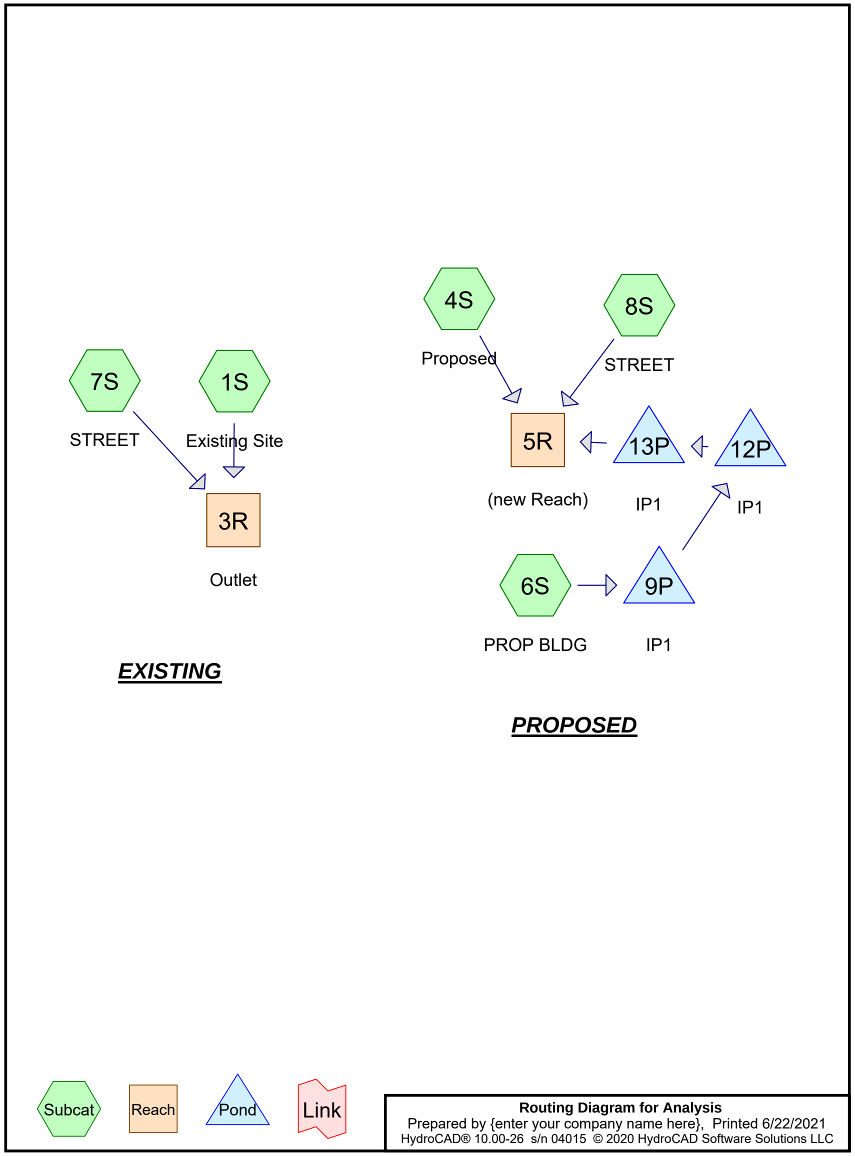

Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0
20
40
60
80
100
120
140
Surface
Storage
306
305
304
303
302
301
300
Elevation (feet)
Vertical Cone/Cylinder + Vertical Cone/Cylinder
0
50
100
150
200
250
300
350
400
450
Storage (cubic-feet)

LEVEL
DESIGN GROUP

HydroCAD Analysis

Existing & Proposed Conditions - 25 Year Storm

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL508 695 2221 FAX508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM



Project Notes

Rainfall events imported from "Analysis 12-6-2017.hcp"

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.284	39	>75% Grass cover, Good, HSG A (4S)
0.095	61	>75% Grass cover, Good, HSG B (1S)
0.497	98	Paved parking, HSG A (4S)
0.943	98	Paved parking, Roof, HSG B (1S)
0.738	98	Paved roads w/curbs & sewers, HSG A (7S, 8S)
0.421	98	Roofs, HSG A (1S, 4S)
0.119	98	Unconnected pavement, HSG A (4S)
0.281	98	Unconnected roofs, HSG A (6S)
3.378	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.340	HSG A	1S, 4S, 6S, 7S, 8S
1.038	HSG B	1S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
3.378		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.284	0.095	0.000	0.000	0.000	0.379	>75% Grass cover, Good	1S, 4S
0.497	0.000	0.000	0.000	0.000	0.497	Paved parking	4S
0.000	0.943	0.000	0.000	0.000	0.943	Paved parking, Roof	1S
0.738	0.000	0.000	0.000	0.000	0.738	Paved roads w/curbs & sewers	7S, 8S
0.421	0.000	0.000	0.000	0.000	0.421	Roofs	1S, 4S
0.119	0.000	0.000	0.000	0.000	0.119	Unconnected pavement	4S
0.281	0.000	0.000	0.000	0.000	0.281	Unconnected roofs	6S
2.340	**1.038**	**0.000**	**0.000**	**0.000**	**3.378**	**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	9P	300.00	300.00	10.0	0.0000	0.013	8.0	0.0	0.0
2	12P	300.00	300.00	10.0	0.0000	0.013	8.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Site Runoff Area=57,500 sf 92.80% Impervious Runoff Depth>5.22"
Tc=6.0 min CN=95 Runoff=7.62 cfs 0.574 af

Subcatchment 4S: Proposed Runoff Area=45,270 sf 72.71% Impervious Runoff Depth>3.88"
Tc=6.0 min CN=82 Runoff=4.87 cfs 0.336 af

Subcatchment 6S: PROP BLDG Runoff Area=12,230 sf 100.00% Impervious Runoff Depth>5.47"
Tc=6.0 min CN=98 Runoff=1.65 cfs 0.128 af

Subcatchment 7S: STREET Runoff Area=16,070 sf 100.00% Impervious Runoff Depth>5.47"
Tc=6.0 min CN=98 Runoff=2.17 cfs 0.168 af

Subcatchment 8S: STREET Runoff Area=16,070 sf 100.00% Impervious Runoff Depth>5.47"
Tc=6.0 min CN=98 Runoff=2.17 cfs 0.168 af

Reach 3R: Outlet Inflow=9.79 cfs 0.742 af
Outflow=9.79 cfs 0.742 af

Reach 5R: (new Reach) Inflow=8.36 cfs 0.560 af
Outflow=8.36 cfs 0.560 af

Pond 9P: IP1 Peak Elev=301.69' Storage=108 cf Inflow=1.65 cfs 0.128 af
Discarded=0.03 cfs 0.034 af Primary=1.54 cfs 0.094 af Outflow=1.57 cfs 0.128 af

Pond 12P: IP1 Peak Elev=301.54' Storage=115 cf Inflow=1.54 cfs 0.094 af
Discarded=0.03 cfs 0.021 af Primary=1.46 cfs 0.073 af Outflow=1.49 cfs 0.094 af

Pond 13P: IP1 Peak Elev=302.18' Storage=164 cf Inflow=1.46 cfs 0.073 af
Discarded=0.03 cfs 0.017 af Primary=1.41 cfs 0.056 af Outflow=1.44 cfs 0.073 af

Total Runoff Area = 3.378 ac Runoff Volume = 1.374 af Average Runoff Depth = 4.88"
11.21% Pervious = 0.379 ac 88.79% Impervious = 2.999 ac

Summary for Subcatchment 1S: Existing Site

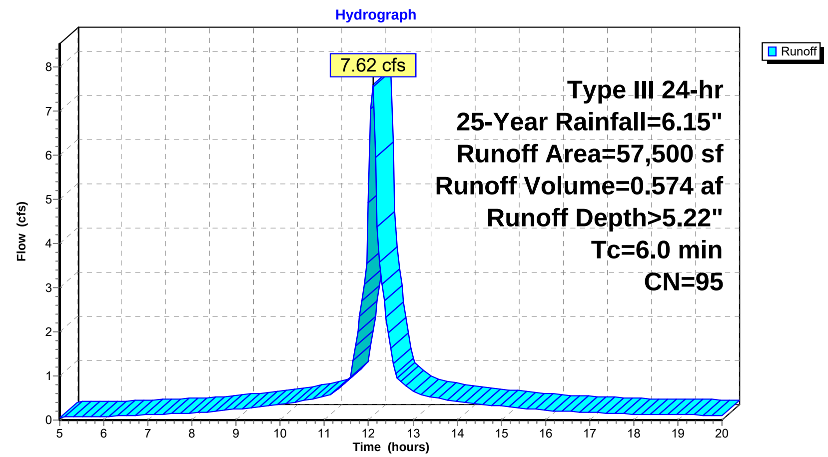
Runoff = 7.62 cfs @ 12.09 hrs, Volume= 0.574 af, Depth> 5.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.15"

	Area (sf)	CN	Description
	4,140	61	>75% Grass cover, Good, HSG B
*	41,070	98	Paved parking, Roof, HSG B
	12,290	98	Roofs, HSG A
	57,500	95	Weighted Average
	4,140		7.20% Pervious Area
	53,360		92.80% Impervious Area

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

Subcatchment 1S: Existing Site



Summary for Subcatchment 4S: Proposed

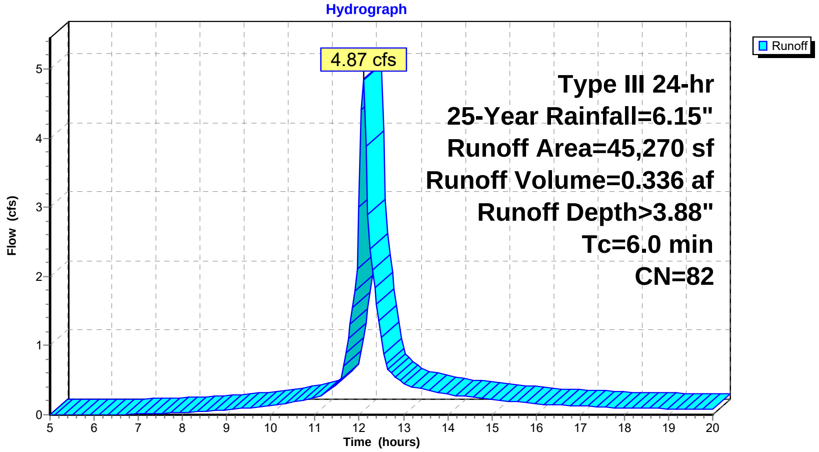
Runoff = 4.87 cfs @ 12.09 hrs, Volume= 0.336 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.15"

Area (sf)	CN	Description
12,354	39	>75% Grass cover, Good, HSG A
21,655	98	Paved parking, HSG A
5,200	98	Unconnected pavement, HSG A
6,061	98	Roofs, HSG A
45,270	82	Weighted Average
12,354		27.29% Pervious Area
32,916		72.71% Impervious Area
5,200		15.80% Unconnected

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

Subcatchment 4S: Proposed



Summary for Subcatchment 6S: PROP BLDG

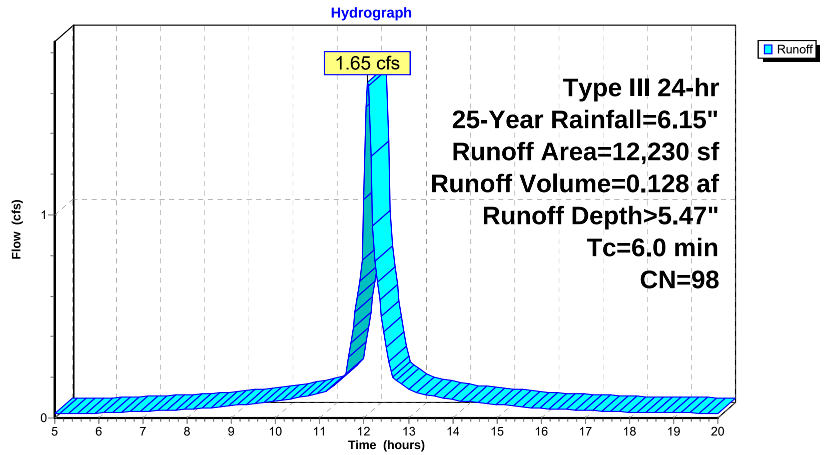
Runoff = 1.65 cfs @ 12.09 hrs, Volume= 0.128 af, Depth> 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.15"

Area (sf)	CN	Description
12,230	98	Unconnected roofs, HSG A
12,230		100.00% Impervious Area
12,230		100.00% Unconnected

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

Subcatchment 6S: PROP BLDG



Summary for Subcatchment 7S: STREET

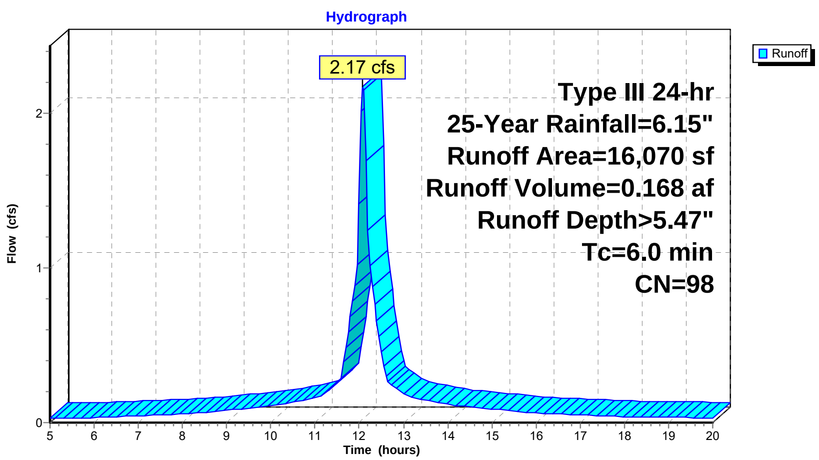
Runoff = 2.17 cfs @ 12.09 hrs, Volume= 0.168 af, Depth> 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.15"

Area (sf)	CN	Description
16,070	98	Paved roads w/curbs & sewers, HSG A
16,070		100.00% Impervious Area

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

Subcatchment 7S: STREET



Summary for Subcatchment 8S: STREET

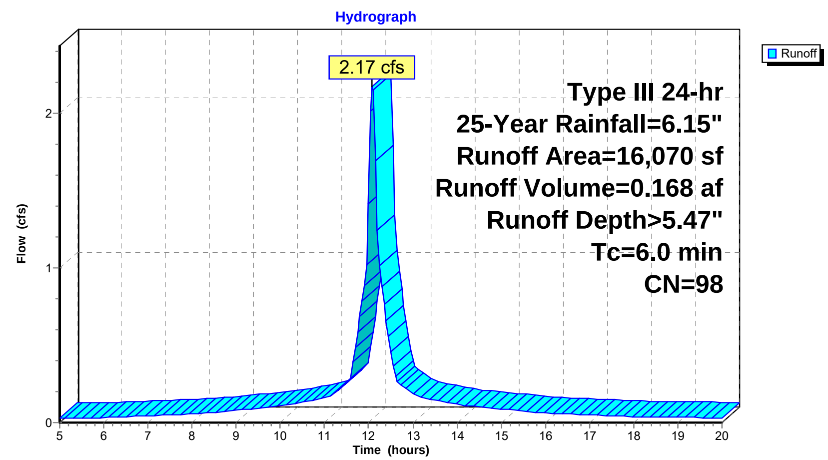
Runoff = 2.17 cfs @ 12.09 hrs, Volume= 0.168 af, Depth> 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.15"

Area (sf)	CN	Description
16,070	98	Paved roads w/curbs & sewers, HSG A
16,070		100.00% Impervious Area

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

Subcatchment 8S: STREET

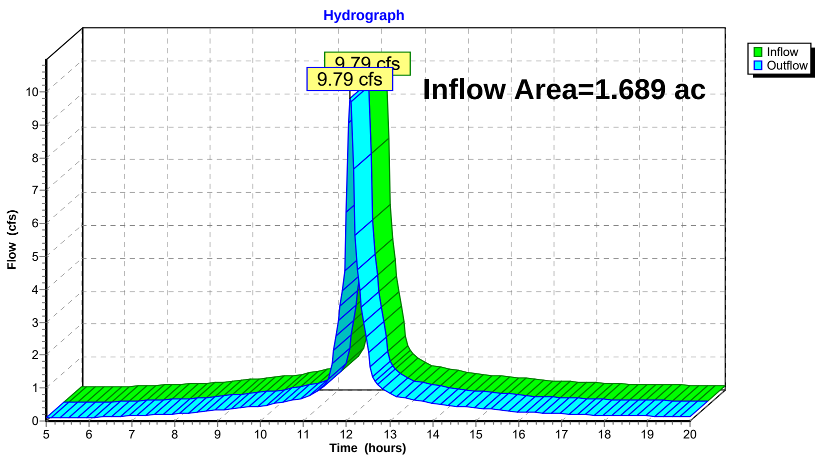


Summary for Reach 3R: Outlet

Inflow Area = 1.689 ac, 94.37% Impervious, Inflow Depth > 5.27" for 25-Year event
Inflow = 9.79 cfs @ 12.09 hrs, Volume= 0.742 af
Outflow = 9.79 cfs @ 12.09 hrs, Volume= 0.742 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 3R: Outlet

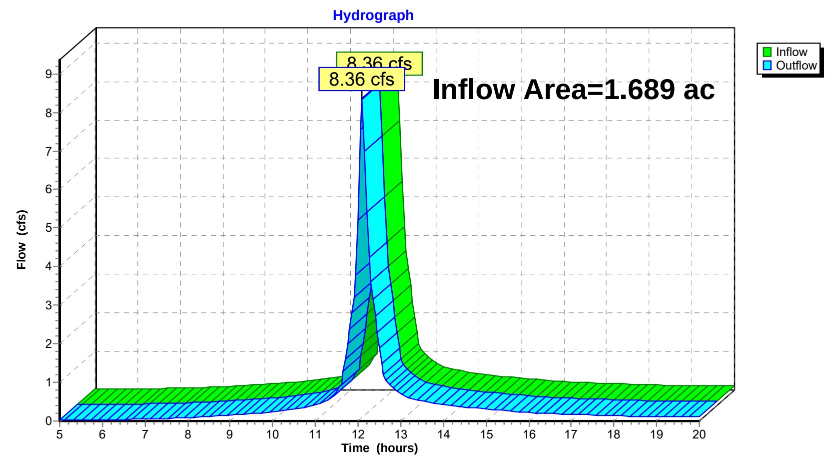


Summary for Reach 5R: (new Reach)

Inflow Area = 1.689 ac, 83.21% Impervious, Inflow Depth > 3.98" for 25-Year event
Inflow = 8.36 cfs @ 12.09 hrs, Volume= 0.560 af
Outflow = 8.36 cfs @ 12.09 hrs, Volume= 0.560 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 5R: (new Reach)



Summary for Pond 9P: IP1

Inflow Area = 0.281 ac,100.00% Impervious, Inflow Depth > 5.47" for 25-Year event
Inflow = 1.65 cfs @ 12.09 hrs, Volume= 0.128 af
Outflow = 1.57 cfs @ 12.11 hrs, Volume= 0.128 af, Atten= 5%, Lag= 1.4 min
Discarded = 0.03 cfs @ 12.11 hrs, Volume= 0.034 af
Primary = 1.54 cfs @ 12.11 hrs, Volume= 0.094 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 301.69' @ 12.11 hrs Surf.Area= 154 sf Storage= 108 cf

Plug-Flow detention time= 1.9 min calculated for 0.127 af (100% of inflow)
Center-of-Mass det. time= 1.5 min (735.6 - 734.0)

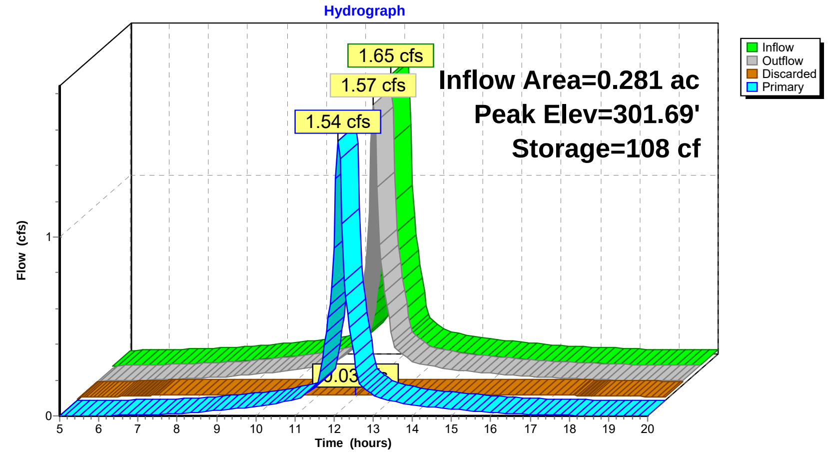
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	342 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder** 924 cf Overall - 69 cf Embedded = 854 cf x 40.0% Voids
#2	300.00'	42 cf	**3.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1 69 cf Overall - 5.0" Wall Thickness = 42 cf
		384 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	300.00'	**8.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 300.00' / 300.00' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 220.00'

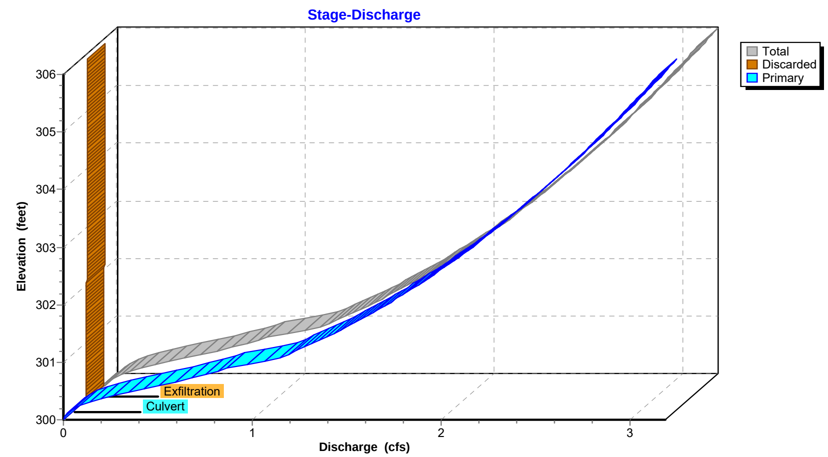
Discarded OutFlow Max=0.03 cfs @ 12.11 hrs HW=301.65' (Free Discharge)
└─**2=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=1.52 cfs @ 12.11 hrs HW=301.65' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.52 cfs @ 4.36 fps)

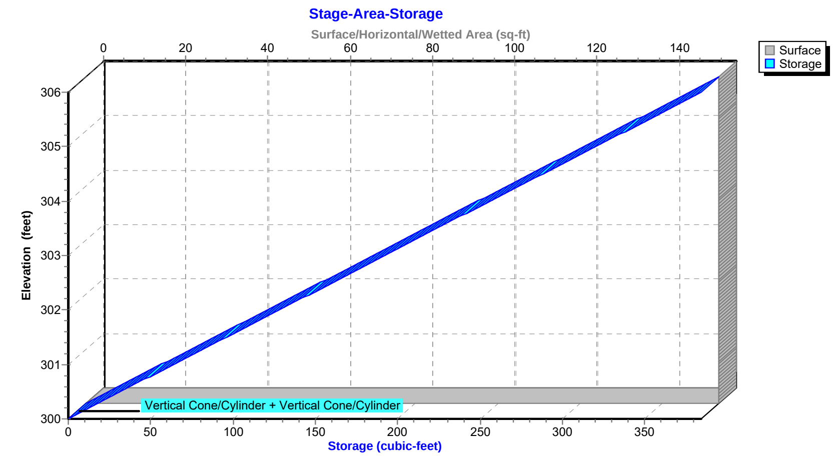
Pond 9P: IP1



Pond 9P: IP1



Pond 9P: IP1



Summary for Pond 12P: IP1

Inflow Area =	0.281 ac,100.00% Impervious,	Inflow Depth > 4.01"	for 25-Year event	
Inflow =	1.54 cfs @	12.11 hrs, Volume=	0.094 af	
Outflow =	1.49 cfs @	12.14 hrs, Volume=	0.094 af,	Atten= 4%, Lag= 1.7 min
Discarded =	0.03 cfs @	12.14 hrs, Volume=	0.021 af	
Primary =	1.46 cfs @	12.14 hrs, Volume=	0.073 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 301.54' @ 12.14 hrs Surf.Area= 154 sf Storage= 115 cf

Plug-Flow detention time= 1.9 min calculated for 0.094 af (100% of inflow)
Center-of-Mass det. time= 1.8 min (731.9 - 730.0)

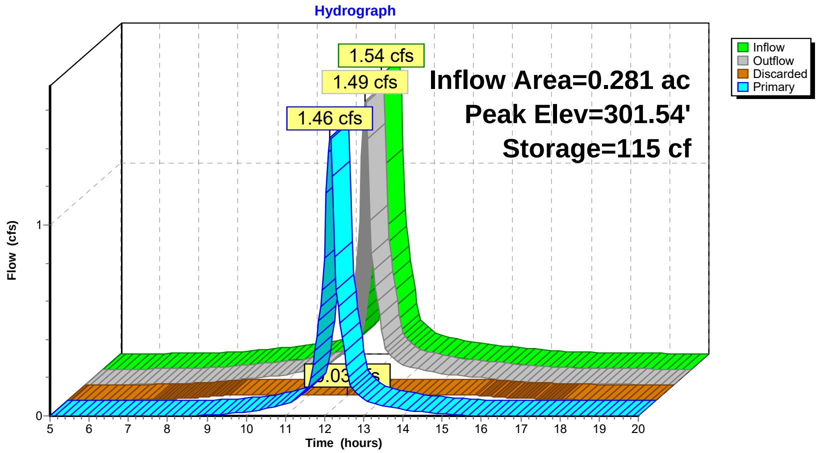
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	281 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder** 924 cf Overall - 220 cf Embedded = 704 cf x 40.0% Voids
#2	300.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1 220 cf Overall - 5.0" Wall Thickness = 170 cf
		451 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	300.00'	**8.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 300.00' / 300.00' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 220.00'

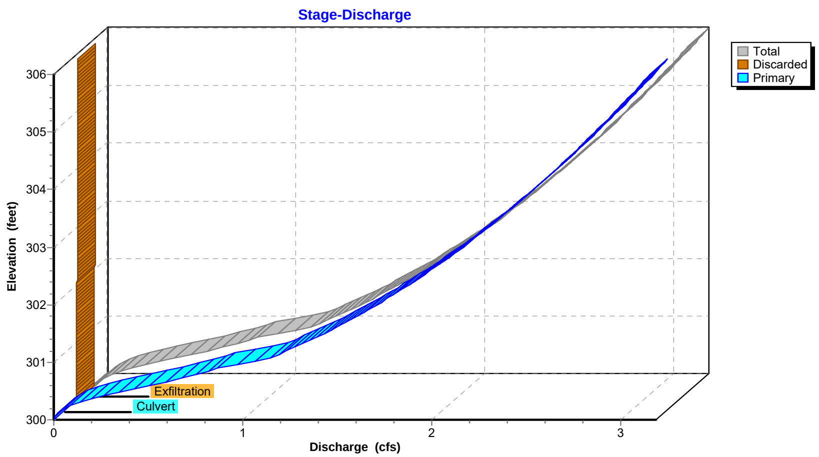
Discarded OutFlow Max=0.03 cfs @ 12.14 hrs HW=301.50' (Free Discharge)
└─**2=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=1.43 cfs @ 12.14 hrs HW=301.50' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.43 cfs @ 4.10 fps)

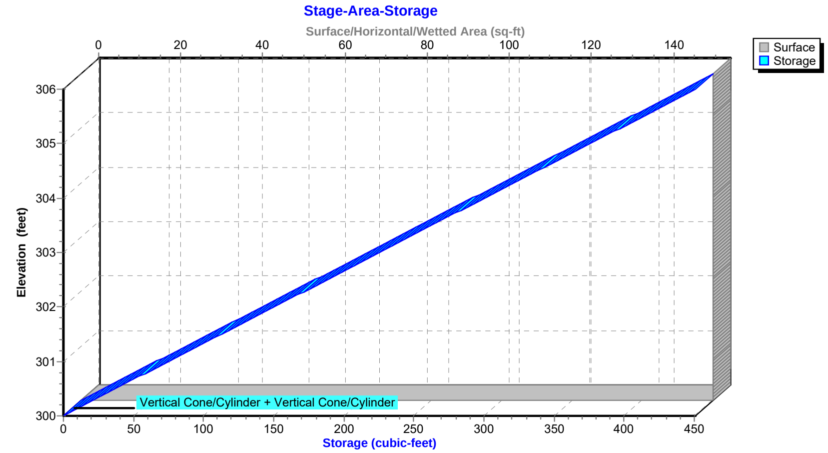
Pond 12P: IP1



Pond 12P: IP1



Pond 12P: IP1



Summary for Pond 13P: IP1

Inflow Area = 0.281 ac,100.00% Impervious, Inflow Depth > 3.12" for 25-Year event
Inflow = 1.46 cfs @ 12.14 hrs, Volume= 0.073 af
Outflow = 1.44 cfs @ 12.14 hrs, Volume= 0.073 af, Atten= 1%, Lag= 0.1 min
Discarded = 0.03 cfs @ 12.14 hrs, Volume= 0.017 af
Primary = 1.41 cfs @ 12.14 hrs, Volume= 0.056 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 302.18' @ 12.14 hrs Surf.Area= 154 sf Storage= 164 cf

Plug-Flow detention time= 12.4 min calculated for 0.073 af (100% of inflow)
Center-of-Mass det. time= 12.4 min (742.0 - 729.5)

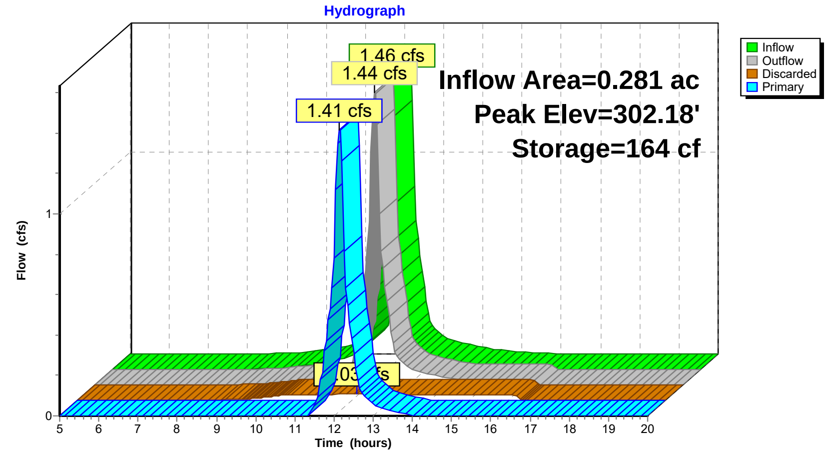
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	281 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder** 924 cf Overall - 220 cf Embedded = 704 cf x 40.0% Voids
#2	300.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1 220 cf Overall - 5.0" Wall Thickness = 170 cf
		451 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 220.00'
#2	Primary	302.00'	**2.0" x 2.0" Horiz. Orifice/Grate X 5.00 columns** X 5 rows C= 0.600 in 24.0" x 24.0" Grate (17% open area) Limited to weir flow at low heads

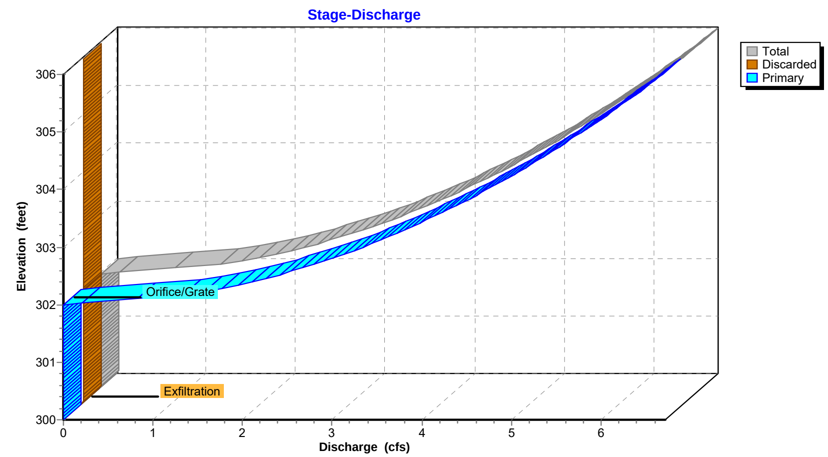
Discarded OutFlow Max=0.03 cfs @ 12.14 hrs HW=302.18' (Free Discharge)
└─**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=1.40 cfs @ 12.14 hrs HW=302.18' (Free Discharge)
└─**2=Orifice/Grate** (Orifice Controls 1.40 cfs @ 2.02 fps)

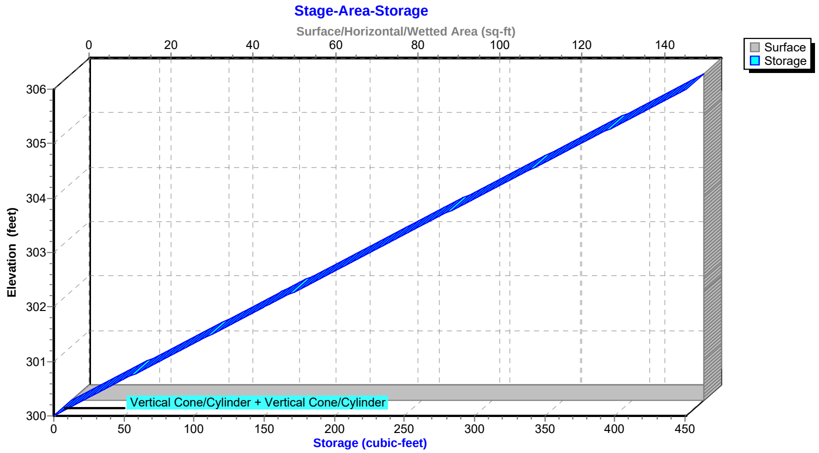
Pond 13P: IP1



Pond 13P: IP1



Pond 13P: IP1

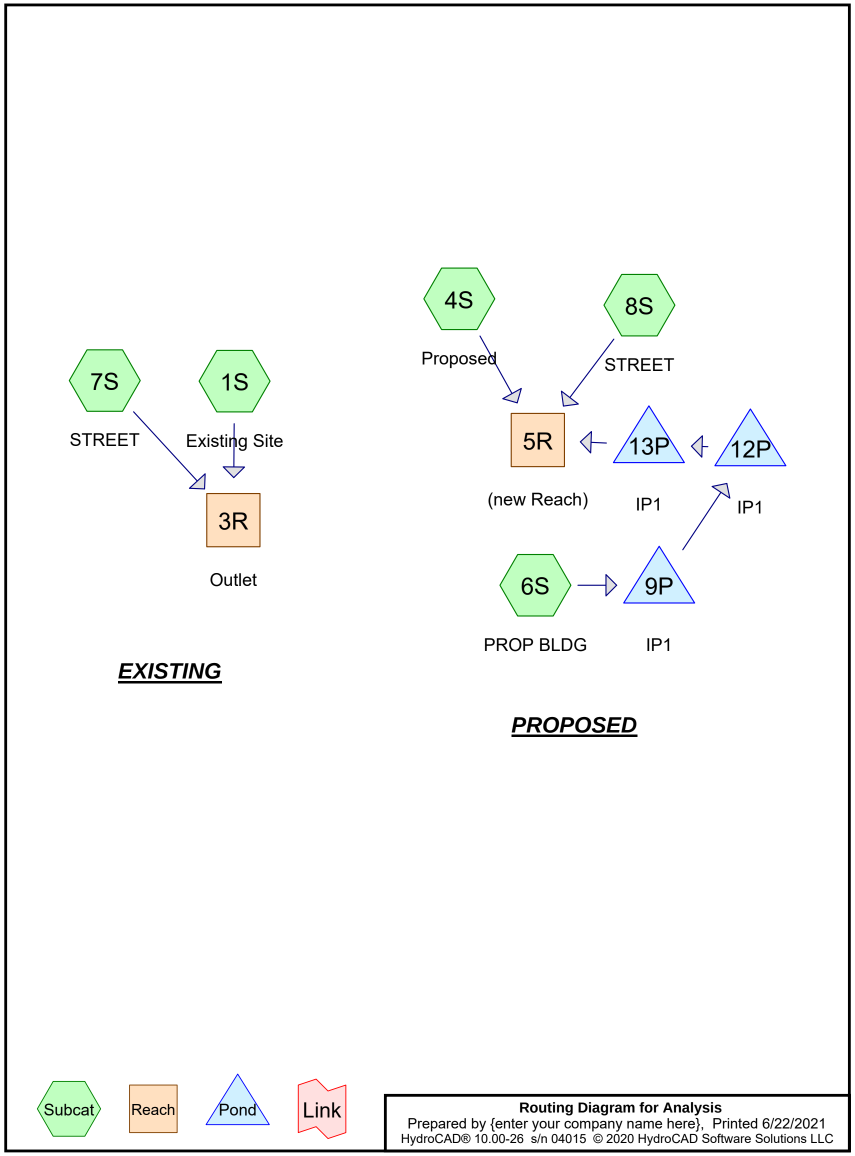

Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0 20 40 60 80 100 120 140
Surface
Storage
306 305 304 303 302 301 300
Elevation (feet)
Vertical Cone/Cylinder + Vertical Cone/Cylinder
0 50 100 150 200 250 300 350 400 450
Storage (cubic-feet)

LEVEL
DESIGN GROUP

HydroCAD Analysis

Existing & Proposed Conditions - 100 Year Storm

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL508 695 2221 FAX508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM



Project Notes

Rainfall events imported from "Analysis 12-6-2017.hcp"

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.284	39	>75% Grass cover, Good, HSG A (4S)
0.095	61	>75% Grass cover, Good, HSG B (1S)
0.497	98	Paved parking, HSG A (4S)
0.943	98	Paved parking, Roof, HSG B (1S)
0.738	98	Paved roads w/curbs & sewers, HSG A (7S, 8S)
0.421	98	Roofs, HSG A (1S, 4S)
0.119	98	Unconnected pavement, HSG A (4S)
0.281	98	Unconnected roofs, HSG A (6S)
3.378	**92**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
2.340	HSG A	1S, 4S, 6S, 7S, 8S
1.038	HSG B	1S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
3.378		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.284	0.095	0.000	0.000	0.000	0.379	>75% Grass cover, Good	1S, 4S
0.497	0.000	0.000	0.000	0.000	0.497	Paved parking	4S
0.000	0.943	0.000	0.000	0.000	0.943	Paved parking, Roof	1S
0.738	0.000	0.000	0.000	0.000	0.738	Paved roads w/curbs & sewers	7S, 8S
0.421	0.000	0.000	0.000	0.000	0.421	Roofs	1S, 4S
0.119	0.000	0.000	0.000	0.000	0.119	Unconnected pavement	4S
0.281	0.000	0.000	0.000	0.000	0.281	Unconnected roofs	6S
2.340	**1.038**	**0.000**	**0.000**	**0.000**	**3.378**	**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	9P	300.00	300.00	10.0	0.0000	0.013	8.0	0.0	0.0
2	12P	300.00	300.00	10.0	0.0000	0.013	8.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Site Runoff Area=57,500 sf 92.80% Impervious Runoff Depth>7.65"
Tc=6.0 min CN=95 Runoff=11.03 cfs 0.842 af

Subcatchment 4S: Proposed Runoff Area=45,270 sf 72.71% Impervious Runoff Depth>6.25"
Tc=6.0 min CN=82 Runoff=7.67 cfs 0.541 af

Subcatchment 6S: PROP BLDG Runoff Area=12,230 sf 100.00% Impervious Runoff Depth>7.87"
Tc=6.0 min CN=98 Runoff=2.37 cfs 0.184 af

Subcatchment 7S: STREET Runoff Area=16,070 sf 100.00% Impervious Runoff Depth>7.87"
Tc=6.0 min CN=98 Runoff=3.11 cfs 0.242 af

Subcatchment 8S: STREET Runoff Area=16,070 sf 100.00% Impervious Runoff Depth>7.87"
Tc=6.0 min CN=98 Runoff=3.11 cfs 0.242 af

Reach 3R: Outlet Inflow=14.14 cfs 1.084 af
Outflow=14.14 cfs 1.084 af

Reach 5R: (new Reach) Inflow=12.48 cfs 0.881 af
Outflow=12.48 cfs 0.881 af

Pond 9P: IP1 Peak Elev=302.99' Storage=191 cf Inflow=2.37 cfs 0.184 af
Discarded=0.03 cfs 0.036 af Primary=2.17 cfs 0.148 af Outflow=2.20 cfs 0.184 af

Pond 12P: IP1 Peak Elev=302.63' Storage=198 cf Inflow=2.17 cfs 0.148 af
Discarded=0.03 cfs 0.027 af Primary=2.01 cfs 0.120 af Outflow=2.04 cfs 0.148 af

Pond 13P: IP1 Peak Elev=302.35' Storage=177 cf Inflow=2.01 cfs 0.120 af
Discarded=0.03 cfs 0.022 af Primary=1.98 cfs 0.098 af Outflow=2.01 cfs 0.120 af

Total Runoff Area = 3.378 ac Runoff Volume = 2.052 af Average Runoff Depth = 7.29"
11.21% Pervious = 0.379 ac 88.79% Impervious = 2.999 ac

Summary for Subcatchment 1S: Existing Site

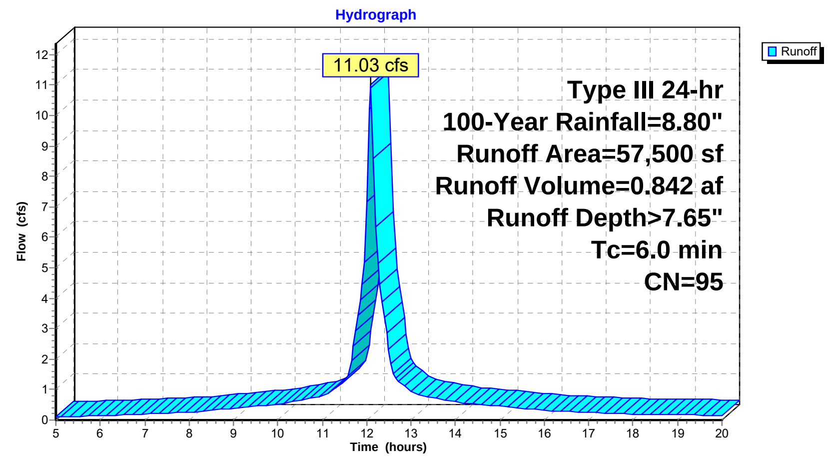
Runoff = 11.03 cfs @ 12.09 hrs, Volume= 0.842 af, Depth> 7.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.80"

	Area (sf)	CN	Description
	4,140	61	>75% Grass cover, Good, HSG B
*	41,070	98	Paved parking, Roof, HSG B
	12,290	98	Roofs, HSG A
	57,500	95	Weighted Average
	4,140		7.20% Pervious Area
	53,360		92.80% Impervious Area

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

Subcatchment 1S: Existing Site



Summary for Subcatchment 4S: Proposed

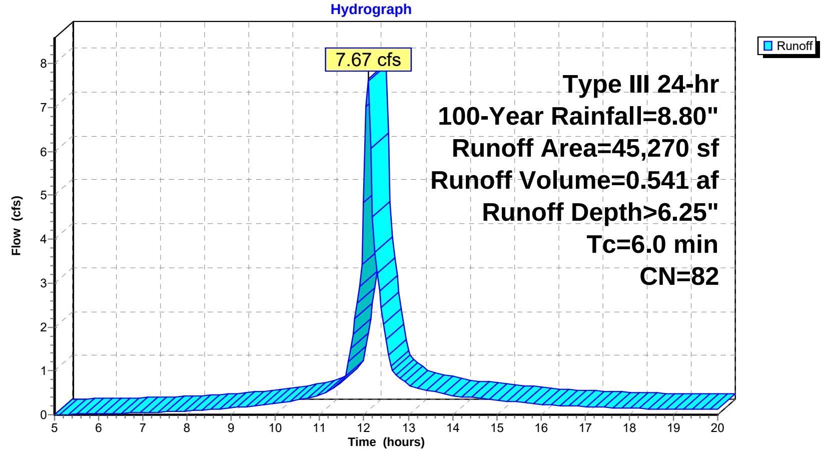
Runoff = 7.67 cfs @ 12.09 hrs, Volume= 0.541 af, Depth> 6.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.80"

Area (sf)	CN	Description
12,354	39	>75% Grass cover, Good, HSG A
21,655	98	Paved parking, HSG A
5,200	98	Unconnected pavement, HSG A
6,061	98	Roofs, HSG A
45,270	82	Weighted Average
12,354		27.29% Pervious Area
32,916		72.71% Impervious Area
5,200		15.80% Unconnected

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

Subcatchment 4S: Proposed



Summary for Subcatchment 6S: PROP BLDG

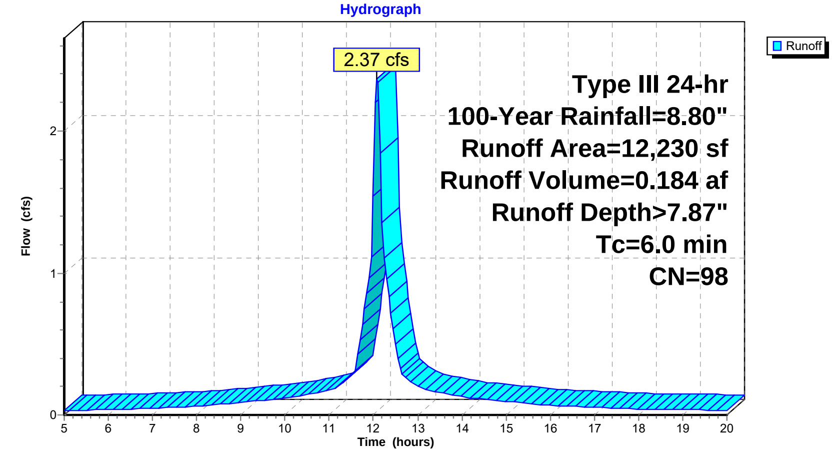
Runoff = 2.37 cfs @ 12.09 hrs, Volume= 0.184 af, Depth> 7.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.80"

Area (sf)	CN	Description
12,230	98	Unconnected roofs, HSG A
12,230		100.00% Impervious Area
12,230		100.00% Unconnected

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

Subcatchment 6S: PROP BLDG



Summary for Subcatchment 7S: STREET

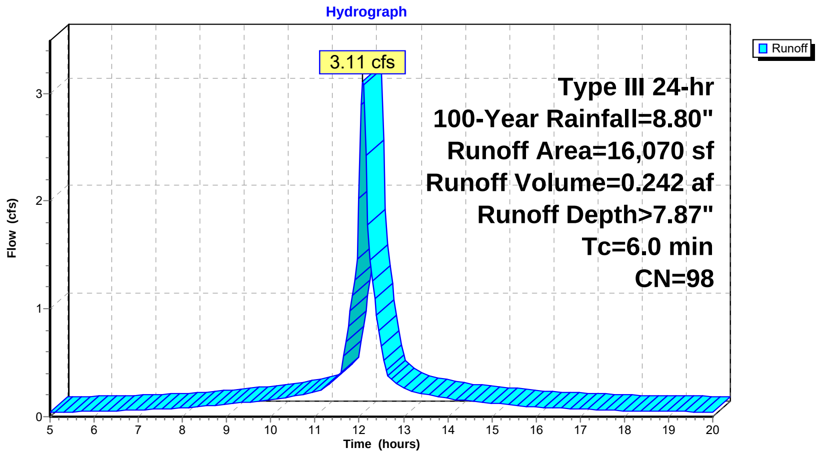
Runoff = 3.11 cfs @ 12.09 hrs, Volume= 0.242 af, Depth> 7.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.80"

Area (sf)	CN	Description
16,070	98	Paved roads w/curbs & sewers, HSG A
16,070		100.00% Impervious Area

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

Subcatchment 7S: STREET



Summary for Subcatchment 8S: STREET

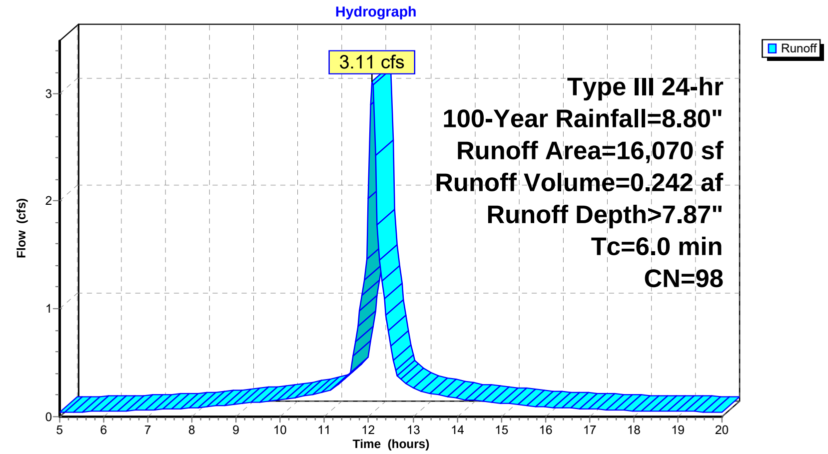
Runoff = 3.11 cfs @ 12.09 hrs, Volume= 0.242 af, Depth> 7.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.80"

Area (sf)	CN	Description
16,070	98	Paved roads w/curbs & sewers, HSG A
16,070		100.00% Impervious Area

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

Subcatchment 8S: STREET

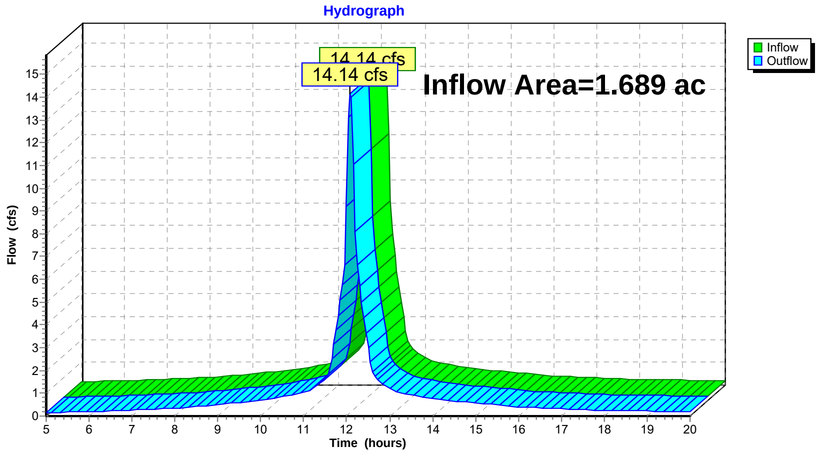


Summary for Reach 3R: Outlet

Inflow Area = 1.689 ac, 94.37% Impervious, Inflow Depth > 7.70" for 100-Year event
Inflow = 14.14 cfs @ 12.09 hrs, Volume= 1.084 af
Outflow = 14.14 cfs @ 12.09 hrs, Volume= 1.084 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 3R: Outlet

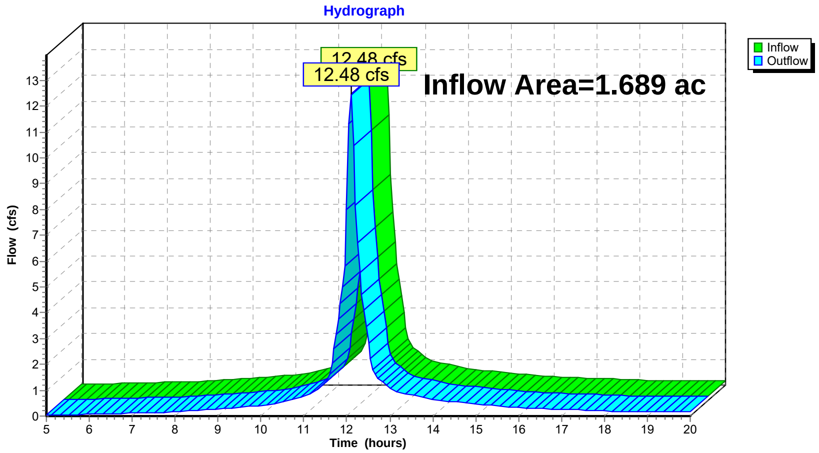


Summary for Reach 5R: (new Reach)

Inflow Area = 1.689 ac, 83.21% Impervious, Inflow Depth > 6.26" for 100-Year event
Inflow = 12.48 cfs @ 12.09 hrs, Volume= 0.881 af
Outflow = 12.48 cfs @ 12.09 hrs, Volume= 0.881 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 5R: (new Reach)



Summary for Pond 9P: IP1

Inflow Area = 0.281 ac,100.00% Impervious, Inflow Depth > 7.87" for 100-Year event
Inflow = 2.37 cfs @ 12.09 hrs, Volume= 0.184 af
Outflow = 2.20 cfs @ 12.12 hrs, Volume= 0.184 af, Atten= 7%, Lag= 1.9 min
Discarded = 0.03 cfs @ 12.12 hrs, Volume= 0.036 af
Primary = 2.17 cfs @ 12.12 hrs, Volume= 0.148 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 302.99' @ 12.12 hrs Surf.Area= 154 sf Storage= 191 cf

Plug-Flow detention time= 1.9 min calculated for 0.183 af (100% of inflow)
Center-of-Mass det. time= 1.5 min (734.3 - 732.8)

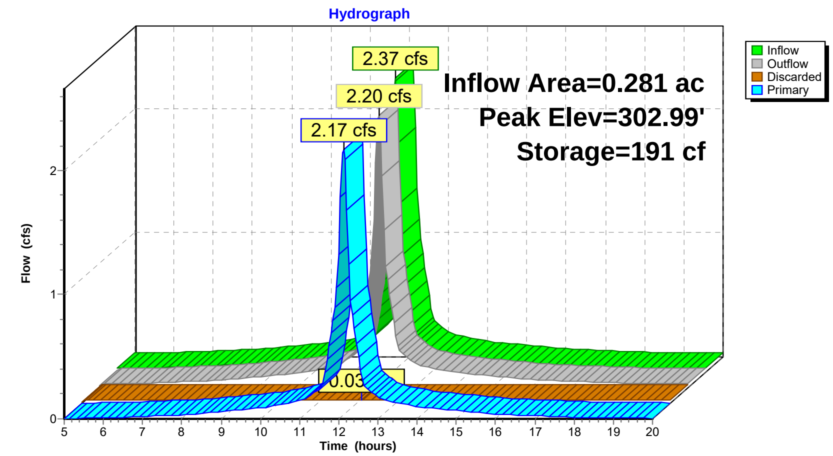
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	342 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder**
			924 cf Overall - 69 cf Embedded = 854 cf x 40.0% Voids
#2	300.00'	42 cf	**3.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1
			69 cf Overall - 5.0" Wall Thickness = 42 cf
		384 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	300.00'	**8.0" Round Culvert**
			L= 10.0' CPP, projecting, no headwall, Ke= 0.900
			Inlet / Outlet Invert= 300.00' / 300.00' S= 0.0000 '/' Cc= 0.900
			n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area**
			Conductivity to Groundwater Elevation = 220.00'

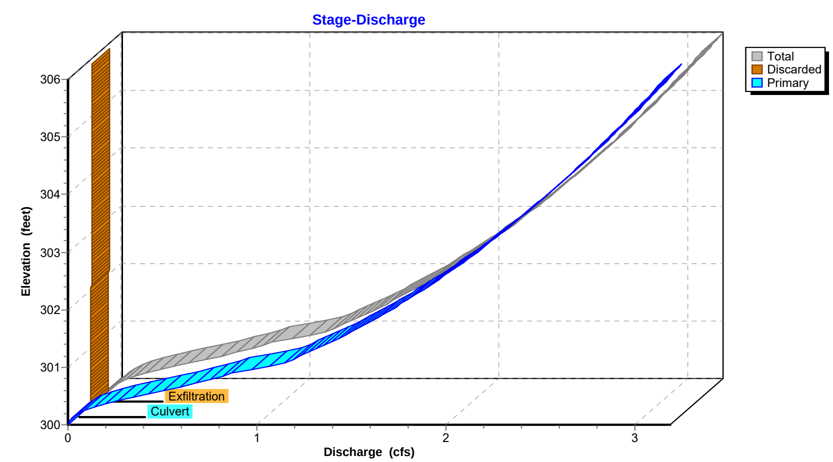
Discarded OutFlow Max=0.03 cfs @ 12.12 hrs HW=302.88' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=2.12 cfs @ 12.12 hrs HW=302.88' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 2.12 cfs @ 6.07 fps)

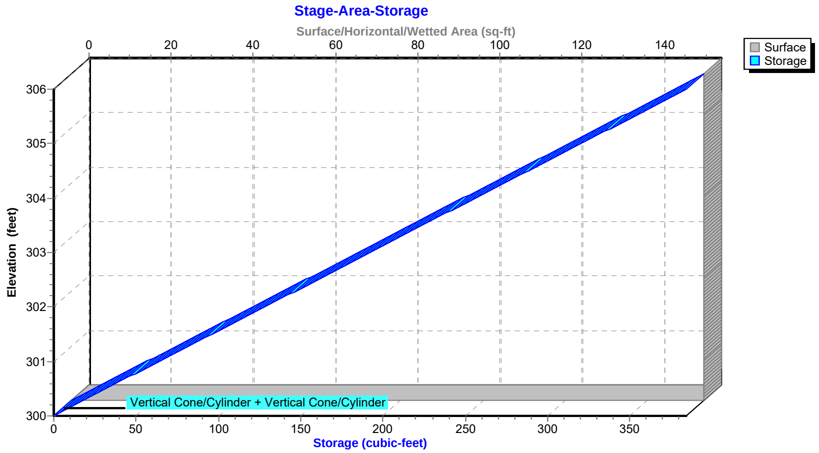
Pond 9P: IP1



Pond 9P: IP1



Pond 9P: IP1



Summary for Pond 12P: IP1

Inflow Area = 0.281 ac,100.00% Impervious, Inflow Depth > 6.31" for 100-Year event
Inflow = 2.17 cfs @ 12.12 hrs, Volume= 0.148 af
Outflow = 2.04 cfs @ 12.16 hrs, Volume= 0.148 af, Atten= 6%, Lag= 2.2 min
Discarded = 0.03 cfs @ 12.16 hrs, Volume= 0.027 af
Primary = 2.01 cfs @ 12.16 hrs, Volume= 0.120 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 302.63' @ 12.16 hrs Surf.Area= 154 sf Storage= 198 cf

Plug-Flow detention time= 1.9 min calculated for 0.148 af (100% of inflow)
Center-of-Mass det. time= 1.8 min (732.0 - 730.1)

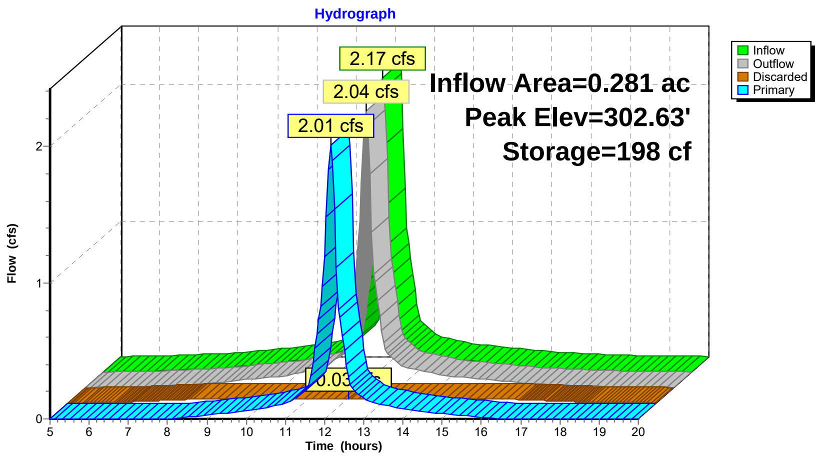
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	281 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder** 924 cf Overall - 220 cf Embedded = 704 cf x 40.0% Voids
#2	300.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1 220 cf Overall - 5.0" Wall Thickness = 170 cf
		451 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	300.00'	**8.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 300.00' / 300.00' S= 0.0000 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 220.00'

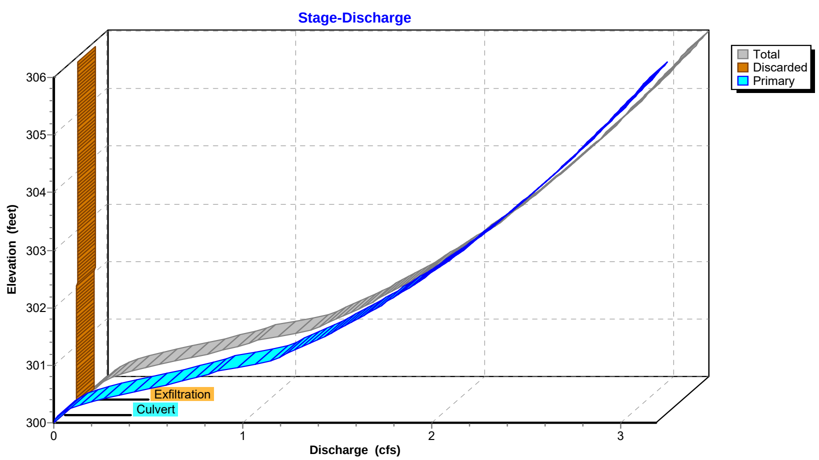
Discarded OutFlow Max=0.03 cfs @ 12.16 hrs HW=302.60' (Free Discharge)
└─**2=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=2.00 cfs @ 12.16 hrs HW=302.60' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.00 cfs @ 5.72 fps)

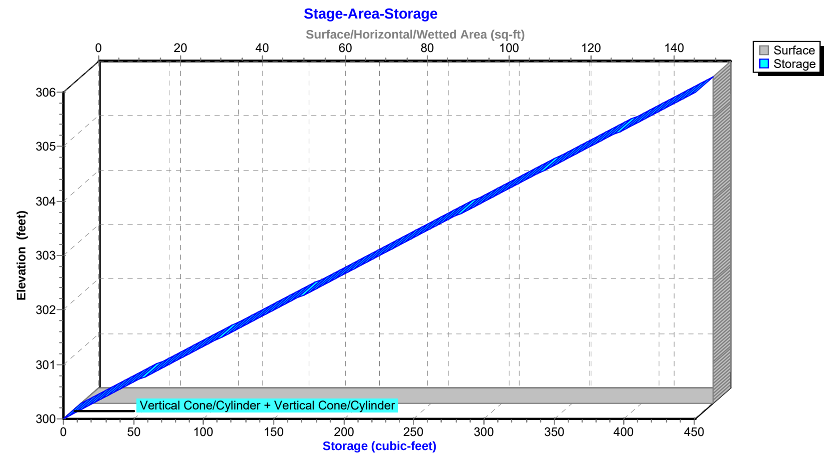
Pond 12P: IP1



Pond 12P: IP1



Pond 12P: IP1



Summary for Pond 13P: IP1

Inflow Area = 0.281 ac,100.00% Impervious, Inflow Depth > 5.15" for 100-Year event
Inflow = 2.01 cfs @ 12.16 hrs, Volume= 0.120 af
Outflow = 2.01 cfs @ 12.16 hrs, Volume= 0.120 af, Atten= 0%, Lag= 0.4 min
Discarded = 0.03 cfs @ 12.16 hrs, Volume= 0.022 af
Primary = 1.98 cfs @ 12.16 hrs, Volume= 0.098 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 302.35' @ 12.16 hrs Surf.Area= 154 sf Storage= 177 cf

Plug-Flow detention time= 11.3 min calculated for 0.120 af (100% of inflow)
Center-of-Mass det. time= 11.4 min (740.9 - 729.6)

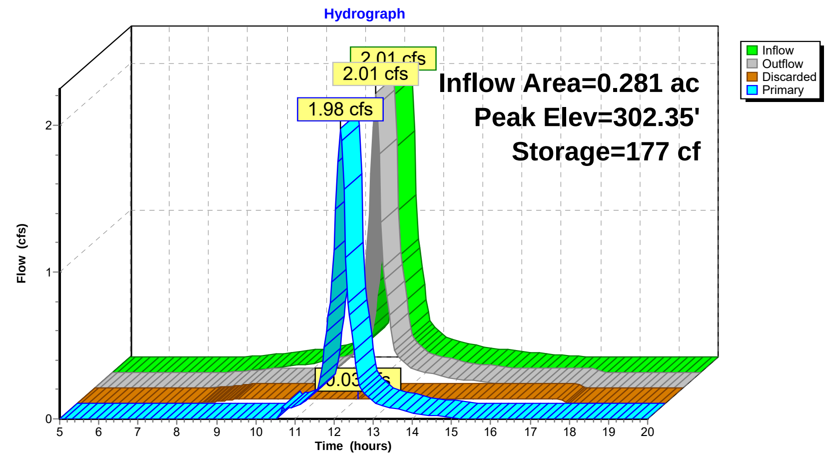
Volume	Invert	Avail.Storage	Storage Description
#1	300.00'	281 cf	**14.00'D x 6.00'H Vertical Cone/Cylinder** 924 cf Overall - 220 cf Embedded = 704 cf x 40.0% Voids
#2	300.00'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder** Inside #1 220 cf Overall - 5.0" Wall Thickness = 170 cf
		451 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	300.00'	**8.210 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 220.00'
#2	Primary	302.00'	**2.0" x 2.0" Horiz. Orifice/Grate X 5.00 columns** X 5 rows C= 0.600 in 24.0" x 24.0" Grate (17% open area) Limited to weir flow at low heads

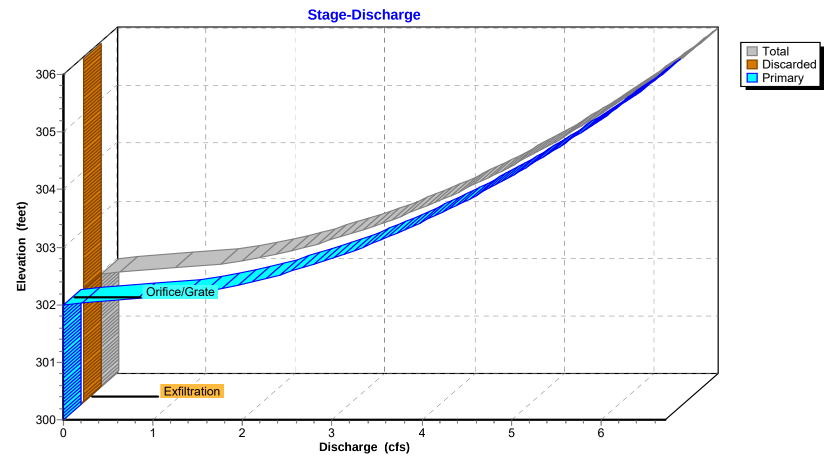
Discarded OutFlow Max=0.03 cfs @ 12.16 hrs HW=302.34' (Free Discharge)
└**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=1.95 cfs @ 12.16 hrs HW=302.34' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.95 cfs @ 2.81 fps)

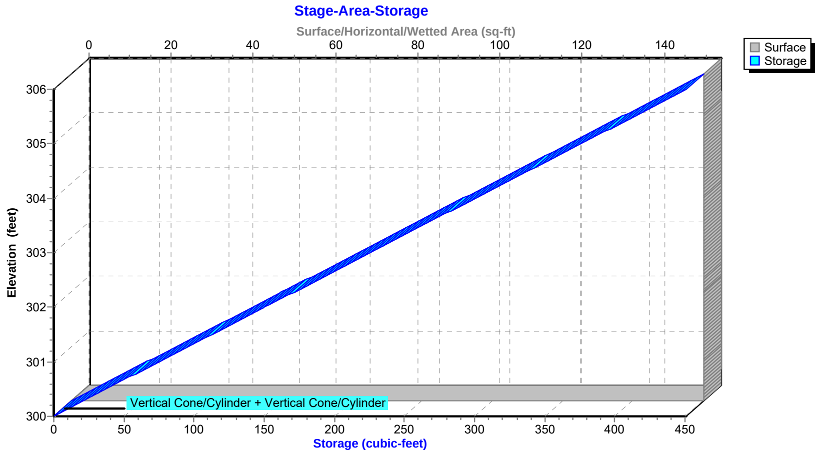
Pond 13P: IP1



Pond 13P: IP1



Pond 13P: IP1


Stage-Area-Storage
Surface/Horizontal/Wetted Area (sq-ft)
0
20
40
60
80
100
120
140
Surface
Storage
306
305
304
303
302
301
300
Elevation (feet)
Vertical Cone/Cylinder + Vertical Cone/Cylinder
0
50
100
150
200
250
300
350
400
450
Storage (cubic-feet)

OPERATION AND MAINTENANCE PLAN

FOR

THE ENGINE YARD
40 ALPINE ROW
(AM 279 PARCEL 181)
FRANKLIN, MASSACHUSETTS

JUNE 21, 2021

Prepared By:

Level Design Group, L.L.C.
249 South Street, Unit 1
Plainville, MA 02762

Prepared For:

Walker Development & Construction, Inc.
Attn: Mr. Jeffrey Walker
5 Mt. Royal Ave, Suite 40
Marlborough, MA 01752

LDG Project No.:
1880.00

The proposed Stormwater Management System is designed to function properly provided that routine maintenance is performed. It is the responsibility during construction and until final development of the site and/or property and the formation of an Association to be formed that the Owner and Developer, Walker Development & Construction, Inc. (or any other future Owner/Developer), shall be responsible for the long-term maintenance to provide the required maintenance outlined in this plan for the site infiltration systems as well as the remainder of the on-site storm drainage system.

Upon completion of construction and the formation of the Association, maintenance of driveways, catch basins, and the stormwater appurtenances required to ensure that sedimentation and pollution is controlled and that storm water detention and infiltration capacity is sustained are the on-going responsibility of the Association to ensure the proper functioning of these facilities. The connection point of the site drainage system is a Town Drainage system which is currently to be maintained by the Town of Franklin to maintain flow from Alpine Row. The following maintenance practices will be used:

DRIVEWAYS & PARKING AREAS

Spring Maintenance
Driveways and Parking Areas are to be swept monthly to remove sand which has accumulated. Sand shall be removed from the site and legally disposed of.

Summer & Fall Maintenance
Leaves and debris which accumulates within the Driveways and Parking Areas during the summer and fall shall be collected and legally disposed of.

Winter Maintenance & Snow Removal
Snow removal within Driveways and Parking Area shall be stockpiled in the designated Snow Stockpile Areas outside of the traveled driveways. These areas should be located within or adjacent to the parking surface and should drain to the stormwater management system. Under no circumstances shall snow be directed onto abutting parcels or into the on-site resource areas (wetlands, wetland buffer zone, and riverfront areas).

Estimated Yearly Cost *$1,000.00 (not including cost for snow plowing)*

GUTTERS AND DOWNSPOUTS

Summer & Fall Maintenance
Leaves and debris which accumulates within the gutters during the summer and fall shall be collected and legally disposed of. Excessive water shall not be introduced to clean the gutters and the downspouts, and materials shall be collected so as not to clog the subsurface basin.

Estimated Yearly Cost *$500.00*

CATCH BASINS

Catch basins shall be inspected and cleaned four times per year or when the sumps are 50% full.

Spring Maintenance
Catch basins require the removal of sediment each spring. This procedure is comprised of removing the catch basin grate followed by removal of sediment trapped in the structure with a clamshell shovel. The outlet pipe from the catch basin shall be inspected and any obstructions are to be removed. The sediment and debris removed from the catch basin shall be legally disposed of.

Fall Maintenance
Catch basin grates shall be cleared of leaves and debris so they may function properly.

Estimated Yearly Cost *$2,000.00*

CDS and Vort Sentry Stormwater Treatment Units

The Units 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, i.e., unstable soils or heavy winter sanding will cause the treatment chamber to fill more quickly, but regular sweeping will slow accumulation.

Inspection
Inspection is the key to effective maintenance and is easily performed. Pollutant deposition and transport 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 (i.e. spring and fall) however more frequent inspections may be necessary in equipment washdown areas and in climates where winter sanding operations may lead to rapid accumulations of a large volume of sediment. It is useful and often required as part of a permit to keep a record of each inspection. A simple inspection and maintenance log form for doing so is available for download at www.ContechES.com/stormwater

The Units should be cleaned when the sediment has accumulated to a depth of two feet in the treatment chamber. This determination can be made by taking two measurements with a stadia rod or similar measuring device; 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 the distance given in Table 2, the Units should be maintained to ensure effective treatment.

Cleaning
Cleaning of the Units should be done during dry weather conditions when no flow is entering the system. Cleanout of the Units with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. Simply remove the manhole cover and insert the vacuum hose into the sump. All pollutants can be removed from this one access point from the surface with no requirements for Confined Space Entry. In installations where the risk of petroleum spills is

small, liquid contaminants may not accumulate as quickly as sediment. However, 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 adsorbent pads, which solidify the oils. These are usually much easier to remove from the unit individually, and less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Floating trash can be netted out if you wish to separate it from the other pollutants. Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. If anyone physically enters the unit, Confined Space Entry procedures need to be followed. Disposal of all material removed from the CDS Units should be done is accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

SUBSURFACE INFILTRATION PIT

Once the system has gone online, inspections should occur after every storm event accumulating greater than 1 inch of rainfall for the first year to ensure proper stabilization and function. Attention should be paid to how long water remains standing in the chambers after a storm. Thereafter, the system should be inspected at least twice per year. Observations and measurements shall be made from the observation ports provided. Important items to check for include: differential settlement, cracking, erosion or leakage. If the system appears to be clogged or not functioning properly at any time, the system is to be flushed in accordance with the 10 year maintenance procedure listed below. Sediment should be removed from the system as necessary. Removal procedures should not take place until the pipes in the system are thoroughly dry. A vacuum truck is usually the most effective and convenient method. If the sediment has traveled past the reach of the vacuum truck the system shall be thoroughly flushed with water, a fire hose or the like is typically the most effective method of flushing. The manhole downstream of this process shall be plugged and sediment collected at this point.

If inspection of the inflow point indicates sediments are accumulating, removal of sediment within the basin may be required. Remove sediments from the catch basin discharge pipes which outlet into the basin. Sediment shall be flushed from the basin at least once every 10 years. Sediments should be flushed and captured on the outlet side of the basin prior to discharge. If the sediment has traveled past the reach of a vacuum truck the system shall be thoroughly flushed with water, a fire hose or the like is typically the most effective method of flushing. The manhole downstream of this process shall be plugged and sediment collected at this point. Sediment which is removed shall be legally disposed of.

The system shall be monitored at several intervals during and after a small and large rainfall event to ensure runoff is detained. Inlet and outlet pipes shall be kept free of obstructions. Any material obstructing the pipes shall be removed and legally disposed of.

Estimated Yearly Cost *<u>$1,000.00</u>*

LEVEL
DESIGN GROUP

PUBLIC SAFETY FEATURES

Many of the Public Safety Features of the Stormwater Management System are incorporated into its design. The infiltration basins are located below the surface which provides a greater level of safety over surface basins.

Despite all the well-designed safety features within the Stormwater Management System all components of the system must be properly maintained to be effective. All maintenance procedures detailed above must be done on schedule and documented. Standing or stagnant water provides mosquito-breeding habitat and increases the potential for disease transmission. The basins are designed to fully infiltrate within 72 hours after a storm even which will prevent standing water from becoming a safety hazard. Routine monitoring for and management of mosquito-breeding conditions by qualified maintenance staff is required during the peak breading season between April and September ensure that unforeseen conditions do not develop.

While risks can be mitigated through proper design and maintenance, it is impossible to entirely eliminate risk. Therefore, education regarding stormwater management facilities and their inherent risks is valuable and should be a part of every community's activities. Employees and tenants of the adult retirement community shall be given an overview of the Stormwater System and which areas to avoid. Public participation also increases the level of maintenance as community members can notify staff if a component of the stormwater system is not functioning properly.

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL508 695 2221 FAX508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM

LEVEL
DESIGN GROUP

STORMWATER MANAGEMENT OPREATOIN AND MAINTENANCE LOG

It is the responsibility of the site operator, Property Owner and/or Association to provide the maintenance of the Stormwater Management System Maintenance in accordance with any and all permits issued by the Town of Franklin. The log form below is a template and shall be reproduced as needed. Copies of all log forms shall be kept on file for a minimum of three years from the date of inspection.

Name of Inspector:
Date and Time of Inspection:
Weather Conditions:

Stormwater BMP	Observations	Action Required

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL508 695 2221 FAX508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM

Illicit Discharge Statement

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL508 695 2221 FAX508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM

LEVEL
DESIGN GROUP

Illicit Discharge Statement

For
THE ENGINE YARD
40 ALPINE ROW
(AM 279 PARCEL 181)
FRANKLIN, MASSACHUSETTS

All illicit discharges to the Stormwater Management System are prohibited. The Stormwater Management System is the system for conveying, treating, and infiltrating stormwater. Illicit discharges to Stormwater Management Systems are discharges that are not entirely comprised of stormwater, but do not include discharges from the following activities or facilities:

- Firefighting
- Water Line Flushing
- Potable Water Sources
- Landscape Irrigation
- Potable Water Sources
- Uncontaminated Groundwater
- Air-conditioning Condensation
- Dechlorinated Water from Swimming Pools
- Water used for street washing
- Water used for clean residential buildings without detergents
- Foundation Drains

The site will be operated and maintained in accordance with the Operation and Maintenance Plan dated June 21, 2021 prepared by Level Design Group, LLC.

I,______________________ ***(Applicant)*** do hereby agree to comply with requirements set forth within the Illicit Discharge Statement and will not knowingly discharge illicit materials to the stormwater management system once it is brought online **upon** completion of construction.

Signature:__________________________________ Date: _________________

249 SOUTH STREET UNIT 1 PLAINVILLE MA 02762
TEL508 695 2221 FAX508 695 2219 CONTACT@LEVELDG.COM LEVELDG.COM

LONG TERM POLLUTION PREVENTION PLAN

FOR

THE ENGINE YARD
40 ALPINE ROW
(AM 279 PARCEL 181)
FRANKLIN, MASSACHUSETTS

JUNE 21, 2021

Prepared By:

Level Design Group, L.L.C.
249 South Street, Unit 1
Plainville, MA 02762

Prepared For:

Walker Development & Construction, Inc.
Attn: Mr. Jeffrey Walker
5 Mt. Royal Ave, Suite 40
Marlborough, MA 01752

LDG Project No.:
1880.00

GOOD HOUSEKEEPING PRACTICES

It is the responsibility of the Owner/Developer, Walker Development & Construction, Inc. (or any other future Owner/Developer), to provide for maintenance of the parking areas and the storm drainage system until the site is turned over to the condominium association which will be created prior to the sale of any units. The responsible party shall utilize good housekeeping practices as outlined in the Operation and Maintenance Plan required for the maintenance of the Stormwater Management System.

PROVISIONS FOR STORAGE OF MATERIALS AND WASTE PRODUCTS INSIDE OR UNDER COVER

The storage of hazardous materials and waste is prohibited from being stored outdoor at the site. Any hazardous materials shall be stored under cover.

VEHICLE WASHING CONTROLS

Outdoor vehicle washing is allowed only for occupants of the condominium development for non-commercial vehicles owned by the residents of the units. No commercial vehicle washing operations is allowed in this area.

REQUIREMENTS FOR ROUTINE INSPECTION AND MAINTENANCE OF STORMWATER BMPS

The Owner / Operator shall keep a Maintenance Log Sheets of scheduled tasks outlined Operation and Maintenance Plan.

SPILL PREVENTION AND RESPONSE PLANS

The risk of significant spills requiring action at this site is limited and will most likely be associated with motor vehicle use or maintenance. In the event of a significant spill contact:

> Massachusetts Department of Environmental Protection 24-hour emergency response notification line – (888) 304-1133

PROVISIONS FOR MAINTENANCE OF LAWNS, GARDENS, AND OTHER LANDSCAPED AREAS

The use of chemical fertilizers shall not be used on-site. If chemical fertilizers are required to be used, the fertilizers must be worked into the soil to prevent washouts and stormwater contamination of fertilizers.

REQUIREMENTS FOR STORAGE AND USE OF FERTILIZERS, HERBICIDES, AND PESTICIDES

If fertilizers, herbicides, and pesticides are to be used and stored on site they are to be stored in their original containers and keep in a dry, safe area where children do not have access to.

REQUIREMENTS FOR SNOW PLOWING AND STORAGE

Snow plowing within the site shall be performed by a licensed contractor. Snow is to be directed to identify snow storage areas as detailed in the Operation and Maintenance Plan. Under no circumstance shall snow be pushed into or dumped into the on-site wetland and pond areas.

PROVISIONS SOLID WASTE MANAGEMENT

Solid waste and recycling is to be disposed in designated areas in enclosed receptacles with covers and hauled by private certified waste management service operators. Solid waste management systems shall be inspected and maintained in accordance with state, local, and federal solid waste management regulations.

EMERGENCY AND REGULATORY CONTACTS

Franklin Fire Department:	911 / (508) 528-2323
Franklin Police Department:	911 / (508) 528-1212
Massachusetts Department of Environmental Protection – Southeast Regional Office:	(508) 946-2700
United State Environmental Protection Agency:	(617) 918-1111