
Stormwater Management Report

BHMA Bernon Music Center

48 Woodbridge Street

South Hadley, Massachusetts 01075

Prepared for:

Berkshire Hills Music Academy
48 Woodbridge Street
South Hadley, MA 01075

Prepared by:

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Project:

1491-001

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Table of Contents

Stormwater Management Report.....	1
Introduction	1
Comparison of Pre- and Post-Development Conditions	1
Existing Conditions.....	1
Proposed Conditions.....	2
Hydrologic Analysis.....	2
Stormwater Quality.....	3
Regulatory Compliance with MADEP Stormwater Management Standards and Guidelines	4

Exhibits:

- Exhibit A: Existing Conditions Drainage Areas
- Exhibit B: Proposed Conditions Drainage Areas
- Exhibit C: HydroCAD Model Routing Diagram

Appendix A – HydroCAD Output for 2-Year Storm Event

Appendix B – HydroCAD Output for 10-Year Storm Event

Appendix C – HydroCAD Output for 100-Year Storm Event

Appendix D – Erosion and Sedimentation Control Plan & Operation and Maintenance Plan

Appendix E – Supplemental Calculations

Appendix F – Geotechnical Field Investigation Data

Appendix G – Illicit Discharge Compliance Statement

INTRODUCTION

Doucet & Associates, Inc. (D&A), on behalf of Berkshire Hills Music Academy (BHMA), has prepared this Stormwater Management Report for the proposed Bernon Music Center located at 48 Woodbridge Street in the Town of South Hadley. The land is identified by the Assessor's Office as Parcel 52-180.

This parcel is located on the west side of Woodbridge Street (Route 116), near the intersection of Meadow Lane. The proposed project will include an approximately 7,400 square foot building, with associated parking and utility infrastructure. Stormwater management measures will be implemented to balance pre- and post-development peak runoff rates, provide groundwater recharge, and provide water quality treatment for the entire developed area of the site.

This report describes the proposed stormwater management system and details the methodology used in designing the system components.

COMPARISON OF PRE- AND POST-DEVELOPMENT SITE CONDITIONS

In order to evaluate the impact of the proposed site improvements, existing conditions were first considered. Information from an Existing Conditions Survey by Harold L. Eaton and Associates, Inc. showing existing site features and topography was used to delineate subcatchments. The attached Existing and Proposed Drainage Exhibits provide the breakdown of subcatchment areas for the existing and developed site conditions and site drainage characteristics. The HydroCAD Drainage Diagram displays the set-up and routing of each subsubcatchment for existing and proposed conditions to their respective discharge points. An "analysis point" is the furthest downstream point for runoff from any proposed drainage area modifications; the wetland areas to the south and east of the subject parcel.

EXISTING CONDITIONS

The site is located at 48 Woodbridge Street and is zoned Residence A-1. The site is currently used by Berkshire Hills Music Academy, with operations in the historic Skinner Estate house. Additional buildings include a garage and the foundation of a recently demolished barn. Soils at the site are mapped as Windsor Loamy Sand and Agawam Fine Sandy Loam. The development will be built on a three acre portion of parcel 52-180. The existing estate house sits at a local high point; the proposed development area generally slopes downhill, south to north, from elevation 280 to 250. Site slopes vary between 3% and 17%.

Stormwater runoff generated within the proposed development area flows overland to the north and west of the site. The existing site is divided into three subsubcatchments which are summarized in this report.

PROPOSED CONDITIONS

The proposed project will include a $\pm 7,400$ square foot building, modification and expansion of an existing access drive, associated parking and utility infrastructure. Site access will continue from a secondary entrance off Woodbridge Street. The proposed conditions analyses limits are approximately the same as the existing conditions limits totaling ± 7.6 acres. There are seven subcatchment areas where stormwater runoff is collected and ultimately discharged from the site.

Stormwater is collected from the access drive by two open vegetated swales. The swales include raised outlet devices to mitigate the peak flow rates generated by the 2-, 10-, and 100-year storms. An existing catch basin has also been relocated to accommodate the increased width of the improved access drive. Runoff from this catch basin and the eastern swale are then discharged to a final swale to direct runoff away from down-gradient neighbors, improving existing conditions.

Runoff from the rooftop is collected by roof drains and piped to the northern swale

Stormwater runoff from the western subcatchment flows overland, mimicking existing conditions. This area was modeled to the extent of surveyed contour limits, however the BHMA property continues for an additional ± 30 acres in this direction.

HYDROLOGIC ANALYSIS

The Existing and Proposed Conditions Stormwater runoff has been analyzed using the HydroCAD Stormwater modeling computer program. This program utilizes Soil Conservation Service techniques outlined in Technical Release No. 20 (TR-20) to predict Stormwater runoff for given design storms. Evaluations were performed based upon a Type III, 24-hour storm for the 2-, 10- and 100-year storm events. The analysis is performed by modeling the drainage area as subcatchments, reaches and ponds. A subcatchment is an area of land that produces runoff that drains to a reach or a pond. A reach is generally a uniform stream or concentrated storm flow and is often used as analyses evaluation points. A pond is generally defined as a pond, swamp, underground detention/infiltration facility or dam, which impounds water from one or more sources.

Model subcatchments have been delineated using Soil Conservation Service methods. Curve Numbers based upon the type of development and soil classifications were used to estimate the runoff volumes. The time of concentration for each of the subcatchments coupled with the runoff characteristics have been used to generate the peak storm flow for each area. The detailed information and results are included within the Appendices of this report. The following table represents hydrologic model analyses results for both the EXISTING and PROPOSED CONDITIONS:

Table 1: Summary of Existing and Proposed Flow Rates

ANALYSIS POINT	STORM EVENT (YR.)	RAINFALL (INCHES)	EXISTING CONDITIONS PEAK FLOW RATE (CFS)	PROPOSED CONDITIONS PEAK FLOW RATE (CFS)	REDUCTION IN PEAK FLOW RATES (CFS)
A - Western	2	3.0	0.00	0.00	0.00
	10	4.5	0.04	0.05	+0.01*
	100	6.4	0.56	0.68	+0.12*
B - Northern	2	3.0	0.00	0.00	0.00
	10	4.5	0.02	0.01	0.01
	100	6.4	0.34	0.31	0.03
C - Eastern	2	3.0	0.02	0.00	0.02
	10	4.5	0.65	0.63	0.02
	100	6.4	3.20	3.18	0.02

Rainfall Data for Hampshire County taken from the MADEP Hydrology Handbook for Conservation Commissioners, Appendix F.

*The model predicts an extremely small increase of peak flow rates for the Western subcatchment during the 10- and 100-year storm. There is an additional ±30 acres of BHMA property beyond the subcatchment limits. It is D&A's opinion that such slight increases approach zero before reaching abutting properties to the west.

As demonstrated in Table 3, the analysis predicts that peak flow rates discharging from this site for the "PROPOSED CONDITIONS" have been mitigated for each design storm at each analysis point.

STORMWATER QUALITY

In order to enhance the quality of Stormwater leaving this site and to comply with the South Hadley Stormwater Management Bylaw and the Stormwater Design Manual to the maximum extent practicable, runoff from the proposed access drive will be directed over a 5-foot sod strip and into one of two water quality swales.

These open vegetated swales are expected to mitigate proposed improvements for peak flow rates, groundwater recharge and water quality as described in this report when compared to existing conditions.

In addition, as required under the provisions of the Clean Water Act, the applicant will be seeking coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit. As such, a detailed Stormwater Pollution Prevention Plan (SWPPP) will be developed and permit coverage attained prior to construction. The SWPPP will further address all short term and long-term Stormwater Management measures to be employed at this site. Erosion and Sediment Control drawings are included within the submitted project drawing set.

REGULATORY COMPLIANCE WITH MADEP STORMWATER MANAGEMENT STANDARDS AND GUIDELINES

The *Massachusetts Wetlands Protection Act* (M.G.L.c.131, s.40) and its implementing Regulations (310 CMR 10.00) set forth specific performance standards for stormwater discharging to a Resource Area or its Buffer Zone. The pertinent performance standards, with explanations of the proposed performance standards and the proposed project's compliance with these standards, have been documented as per the guidance set forth in the *Massachusetts Stormwater Handbook*, and are as follows. Refer to Appendix E for additional supporting calculations:

Standard #1 - No new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

No new stormwater conveyances are proposed to discharge untreated stormwater directly to, or cause erosion in, wetlands or waters of the Commonwealth. Stormwater runoff generated on site will be treated with best management practices (BMP's) to achieve sediment and contaminate removal rates to the maximum extent practicable (70% TSS removal) prior to final discharge. Due to a shallow shale layer and high groundwater elevations, traditional treatment and infiltration practices, such as basins and rain gardens, cannot achieve the required separation from groundwater. Proposed BMP's include:

- 5-foot sod strip (pre-treatment)
- Water quality swales

All stormwater discharges from the new stormwater infrastructure will discharge stormwater that is not infiltrated through rip-rapped end sections to prevent erosion and dissipate energy thereby protecting the outlet areas from erosion and scour. See Appendix E for supporting sizing calculations.

Standard #2 - Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.

Based on the hydraulic analysis, the proposed development is designed to be compliant with Standard 2. The proposed subcatchments have been modeled to analyze the same areas as the existing conditions. As stated in the hydraulic analysis provided within this report, model post-development peak discharge rates have been mitigated. The project is not located within a watershed subject to damage by flooding during the 2-year or 10-year 24-hour storm event, nor is it located adjacent to a water body or watercourse subject to adverse impacts from flooding during the 100-year 24-hour storm event. Refer to Table 1 for the breakdown of peak flow mitigation between the 2-, 10-, and 100-year storm events.

Standard #3 - Loss of annual recharge to groundwater should be minimized through the use of infiltration measures to the maximum extent practicable. The annual recharge from the post-development site should approximate the annual recharge from the pre-development site conditions based on soil types.

The proposed design is anticipated to comply with Standard 3 through recharge from the water quality swales. NRCS-mapped soils on site include Windsor Fine Sandy Loam classified as Hydrologic Soil Group “A,” and Agawam Fine Sandy Loam classified as Hydrologic Group “B.” Geotechnical field investigations were conducted on January 14, 2016. Soil Textural Analysis confirms that the site is consistent with NRCS maps and depth to seasonal high groundwater was established.

The required recharge volume is 0.6 inches of runoff per impervious square foot. The calculated required recharge volume is 1,215 cf. The water quality swales have been designed to store this volume and are expected to fully drain within 72 hours (see supporting calculations in Appendix E). The site is not located adjacent to areas classified as contaminated, sites that have an Activity and Use Limitation (AUL), solid waste landfills, nor is it near a Zone II or Interim Wellhead Protection Area of a public water supply. The project is not located within a basin or sub-basin that has been categorized as under high or medium stress by the Massachusetts Water Resources Commission.

Standard #4 - For new development, stormwater management systems must be designed to remove 80-percent of the average annual load (post development conditions) of Total Suspended Solids (TSS). It is presumed that this standard is met when: Suitable non-structural practices for source control and pollution prevention are implemented; Stormwater management best management practices (BMPs) are sized to capture the prescribed runoff volume; and Stormwater management BMPs are maintained as designed.

Stormwater runoff generated on site will be treated with BMP’s to achieve sediment and contaminate removal rates to the maximum extent practicable (70%) prior to final discharge. Due to a shallow shale layer and high groundwater elevations, traditional treatment and infiltration practices, such as basins and rain gardens, cannot achieve the required separation from groundwater. Proposed BMP’s include:

- 5-foot sod strip (pre-treatment)
- Water quality swales

The water quality swales are outfitted with raised outlet devices. This allows for some detention within the swales, providing infiltration of the required recharge and water quality volumes, and the mitigation of peak flow rates.

Standard #5 - Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs (listed in guidelines). The use of infiltration practices without pretreatment is prohibited.

As the project is not associated with a Land Use with Higher Potential Pollutant load, this standard is not applicable.

Standard #6 - Stormwater discharges to critical areas must utilize certain stormwater management BMP's approved for critical areas (listed in guidelines). Critical areas are Outstanding Resource Waters (ORW's), shellfish beds, swimming beaches, cold-water fisheries and recharge areas for public drinking water supplies.

As the site it is not within a Critical Area, this standard is not applicable.

Standard #7 - Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. However, if it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.

This is a partially redeveloped site. Due to a shallow shale layer and high groundwater elevations, stormwater runoff generated on site will be treated with BMP's to achieve sediment and contaminate removal rates to the maximum extent practicable (70% TSS removal) prior to final discharge.

Standard #8 - Erosion and sediment controls must be implemented to prevent impacts during construction and land disturbance activities.

Erosion and Sedimentation Control Plans (ESCP) have been created to mitigate pollutant sources during construction activities. Notes addressing stabilization of disturbed areas have been included in the plans and provide direction for minimizing disturbed areas. Erosion control silt fence barriers and straw wattles along with other stabilization measures are the primary BMP's used and are shown in order to protect down-gradient areas from suspended sediment. Further, this project will require permit coverage through the US EPA National Discharge Elimination System (NPDES). As such, all erosion and sedimentation design and procedures must comply with all applicable design guidance documents.

Standard #9 - All stormwater management systems must have an operation and maintenance plan to ensure that systems function as designed.

The Long Term Operation and Maintenance Plan has been created to comply with the required measures set forth in 2008 MA Stormwater Management Manual. The aforementioned ESCP in Standard 8 will address any pollution prevention measures not specified within the Long Term Operation and Maintenance Plan. A copy of the Long Term Operation and Maintenance Plan is provided in Appendix D and shall become part of the ownership documents for onsite BMP's. As part of the plan, a complete description of the protocols for installation, maintenance, and cleaning of each BMP has been included.

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

No known or suspected illicit discharges are conveyed to or through the stormwater management system at the project site. Measures to prevent illicit discharges have been implemented as part of the Operation and Maintenance Plan. An Illicit Discharge

Compliance Statement is included in Appendix G. Refer to the full site plan set for the locations of all drainage systems and wastewater management practices.

EXHIBITS

EXHIBIT A: EXISTING CONDITIONS DRAINAGE AREAS

EXHIBIT B: PROPOSED CONDITIONS DRAINAGE AREAS

EXHIBIT C: HYDROCAD ROUTING DIAGRAM

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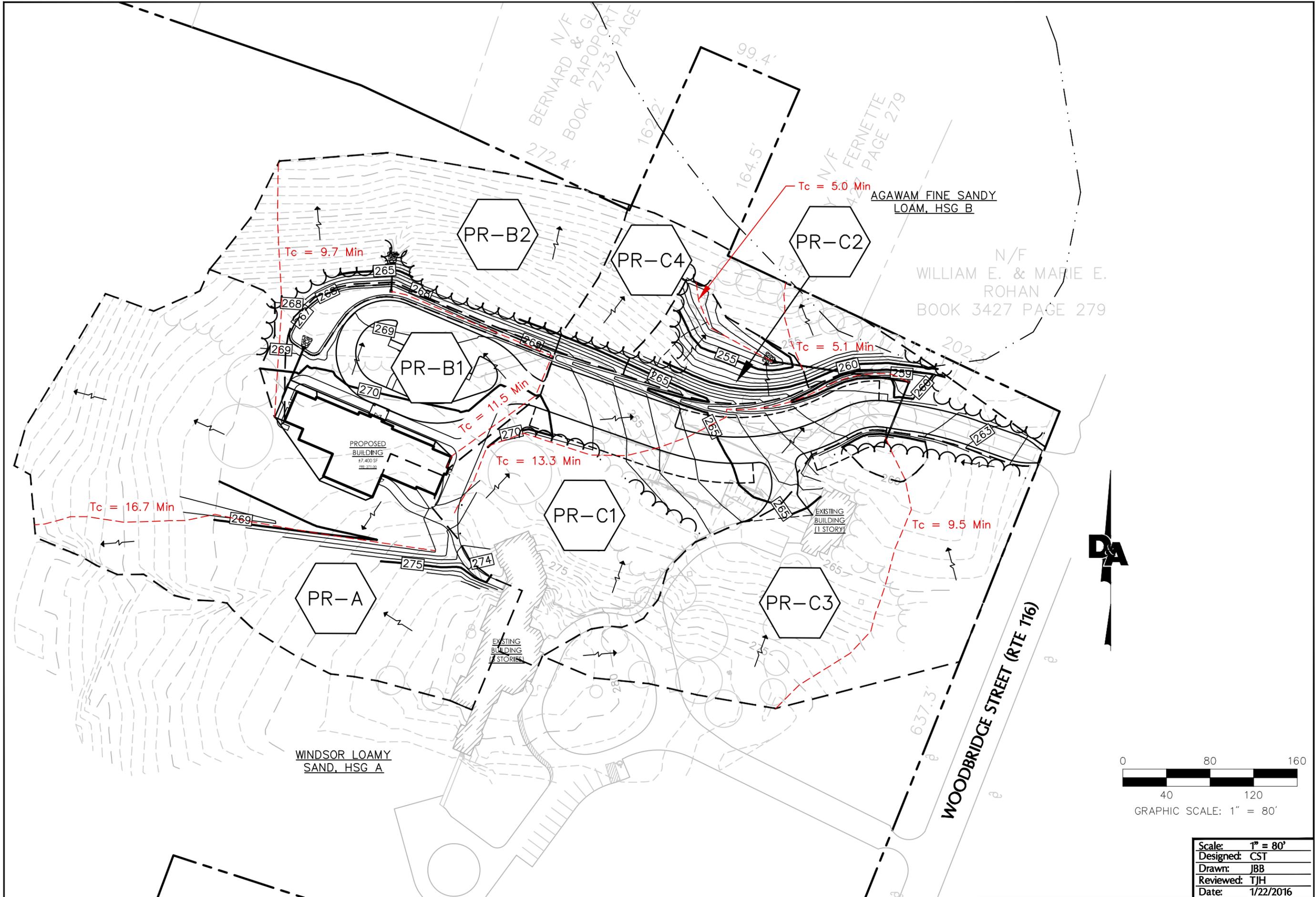


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Scale:	1" = 80'
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Drawn:	JBB
Reviewed:	TJH
Date:	1/22/2016

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 Date: 1/22/2016 10:16:16 AM



Scale:	1" = 80'
Designed:	CST
Drawn:	JBB
Reviewed:	TJH
Date:	1/22/2016



Western Drainage Area



Northern Drainage Area



Eastern Drainage Area



Western Drainage Area



Northern Swale



Northern Overland



Eastern Swale



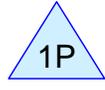
Eastern Outlet Swale



Eastern Drainage Area



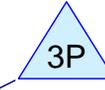
Eastern Overland



Northern Swale



Eastern Swale



Catch Basin



Analysis Point A



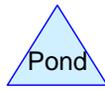
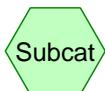
Analysis Point B



Outlet Swale



Analysis Point C



Drainage Diagram for BHMA Bernon Music Center
 Prepared by Doucet & Associates, Inc., Printed 1/18/2016
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APPENDIX A:
HYDROCAD OUTPUT FOR
2-YEAR STORM EVENT

BHMA Bernon Music Center

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Type III 24-hr 2-Year Rainfall=3.00"

Printed 1/18/2016

Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-A: Western Drainage Area Runoff Area=83,204 sf 2.08% Impervious Runoff Depth=0.00"
Flow Length=396' Tc=9.5 min CN=40 Runoff=0.00 cfs 0.000 af

Subcatchment EX-B: Northern Drainage Runoff Area=91,609 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=400' Tc=9.8 min CN=37 Runoff=0.00 cfs 0.000 af

Subcatchment EX-C: Eastern Drainage Runoff Area=154,803 sf 16.20% Impervious Runoff Depth>0.06"
Flow Length=473' Tc=10.6 min CN=48 Runoff=0.03 cfs 0.017 af

Subcatchment PR-A: Western Drainage Area Runoff Area=92,475 sf 4.59% Impervious Runoff Depth>0.00"
Flow Length=373' Tc=16.7 min CN=41 Runoff=0.00 cfs 0.000 af

Subcatchment PR-B1: Northern Swale Runoff Area=32,029 sf 55.76% Impervious Runoff Depth>0.81"
Flow Length=306' Tc=11.5 min CN=72 Runoff=0.51 cfs 0.049 af

Subcatchment PR-B2: Northern Overland Runoff Area=44,208 sf 0.05% Impervious Runoff Depth=0.00"
Flow Length=233' Tc=9.7 min CN=36 Runoff=0.00 cfs 0.000 af

Subcatchment PR-C1: Eastern Swale Runoff Area=65,985 sf 32.36% Impervious Runoff Depth>0.27"
Flow Length=481' Tc=13.3 min CN=58 Runoff=0.18 cfs 0.034 af

Subcatchment PR-C2: Eastern Outlet Swale Runoff Area=10,752 sf 0.00% Impervious Runoff Depth=0.00"
Tc=5.0 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment PR-C3: Eastern Drainage Runoff Area=63,824 sf 11.39% Impervious Runoff Depth>0.02"
Flow Length=301' Tc=9.5 min CN=44 Runoff=0.00 cfs 0.002 af

Subcatchment PR-C4: Eastern Overland Runoff Area=21,403 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=82' Slope=0.0730 '/ Tc=5.1 min CN=37 Runoff=0.00 cfs 0.000 af

Reach 1R: Outlet Swale Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
n=0.035 L=108.0' S=0.0199 '/ Capacity=14.79 cfs Outflow=0.00 cfs 0.000 af

Reach AP-A: Analysis Point A Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach AP-B: Analysis Point B Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach AP-C: Analysis Point C Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond 1P: Northern Swale Peak Elev=267.00' Storage=618 cf Inflow=0.51 cfs 0.049 af
Discarded=0.14 cfs 0.049 af Primary=0.00 cfs 0.000 af Outflow=0.14 cfs 0.049 af

Pond 2P: Eastern Swale Peak Elev=259.33' Storage=349 cf Inflow=0.18 cfs 0.034 af
Discarded=0.05 cfs 0.034 af Primary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.034 af

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Type III 24-hr 2-Year Rainfall=3.00"

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Pond 3P: Catch Basin

Peak Elev=258.69' Storage=3 cf Inflow=0.00 cfs 0.002 af
Discarded=0.00 cfs 0.002 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.002 af

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Type III 24-hr 2-Year Rainfall=3.00"

Printed 1/18/2016

Summary for Subcatchment EX-A: Western Drainage Area

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
1,730	98	Roofs, HSG A
8,594	36	Woods, Fair, HSG A
72,880	39	>75% Grass cover, Good, HSG A
83,204	40	Weighted Average
81,474		97.92% Pervious Area
1,730		2.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
3.0	296	0.0570	1.67		Shallow Concentrated Flow, 296' Shallow Short Grass Pasture Kv= 7.0 fps
9.5	396	Total			

Summary for Subcatchment EX-B: Northern Drainage Area

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
61,588	36	Woods, Fair, HSG A
29,063	39	>75% Grass cover, Good, HSG A
958	76	Gravel roads, HSG A
91,609	37	Weighted Average
91,609		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	100	0.0650	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
1.5	107	0.0280	1.17		Shallow Concentrated Flow, 107' Shallow Short Grass Pasture Kv= 7.0 fps
0.4	27	0.0550	1.17		Shallow Concentrated Flow, 27' Shallow Woodland Kv= 5.0 fps
0.1	14	0.0700	4.26		Shallow Concentrated Flow, 14' Shallow Unpaved Kv= 16.1 fps
1.5	152	0.1220	1.75		Shallow Concentrated Flow, 152' Shallow Woodland Kv= 5.0 fps
9.8	400	Total			

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Type III 24-hr 2-Year Rainfall=3.00"

Printed 1/18/2016

Summary for Subcatchment EX-C: Eastern Drainage Area

Runoff = 0.03 cfs @ 15.02 hrs, Volume= 0.017 af, Depth> 0.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
14,301	98	Paved parking, HSG A
10,782	98	Roofs, HSG A
70,650	36	Woods, Fair, HSG A
57,118	39	>75% Grass cover, Good, HSG A
1,952	76	Gravel roads, HSG A
154,803	48	Weighted Average
129,720		83.80% Pervious Area
25,083		16.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		Shallow Concentrated Flow, 67' Shallow Short Grass Pasture Kv= 7.0 fps
2.3	143	0.0420	1.02		Shallow Concentrated Flow, 143' Shallow Woodland Kv= 5.0 fps
0.4	96	0.0100	4.54	3.56	Pipe Channel, 96' Pipe 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.7	67	0.0900	1.50		Shallow Concentrated Flow, 67' Shallow Woodland Kv= 5.0 fps
10.6	473	Total			

Summary for Subcatchment PR-A: Western Drainage Area

Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
1,001	98	Paved parking, HSG A
3,239	98	Roofs, HSG A
8,263	36	Woods, Fair, HSG A
79,972	39	>75% Grass cover, Good, HSG A
92,475	41	Weighted Average
88,235		95.41% Pervious Area
4,240		4.59% Impervious Area

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Type III 24-hr 2-Year Rainfall=3.00"

Printed 1/18/2016

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0100	0.12		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
3.2	273	0.0400	1.40		Shallow Concentrated Flow, 273' Shallow Short Grass Pasture Kv= 7.0 fps
16.7	373	Total			

Summary for Subcatchment PR-B1: Northern Swale

Runoff = 0.51 cfs @ 12.18 hrs, Volume= 0.049 af, Depth> 0.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
11,531	98	Paved parking, HSG A
6,329	98	Roofs, HSG A
14,169	39	>75% Grass cover, Good, HSG A
32,029	72	Weighted Average
14,169		44.24% Pervious Area
17,860		55.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	16	0.0100	0.09		Sheet Flow, 16' Sheet Grass: Short n= 0.150 P2= 3.00"
0.8	39	0.0100	0.84		Sheet Flow, 39' Sheet Smooth surfaces n= 0.011 P2= 3.00"
6.0	37	0.0100	0.10		Sheet Flow, 37' Sheet Grass: Short n= 0.150 P2= 3.00"
0.2	8	0.0100	0.61		Sheet Flow, 8' Sheet Smooth surfaces n= 0.011 P2= 3.00"
0.1	20	0.0300	3.52		Shallow Concentrated Flow, 20' Shallow Paved Kv= 20.3 fps
0.2	25	0.0600	1.71		Shallow Concentrated Flow, 25' Shallow Short Grass Pasture Kv= 7.0 fps
1.1	161	0.0030	2.48	29.75	Channel Flow, 161' Channel Flow Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.035 Earth, dense weeds
11.5	306	Total			

Summary for Subcatchment PR-B2: Northern Overland

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

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Type III 24-hr 2-Year Rainfall=3.00"

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Area (sf)	CN	Description
24	98	Paved parking, HSG A
38,076	36	Woods, Fair, HSG A
6,108	39	>75% Grass cover, Good, HSG A
44,208	36	Weighted Average
44,184		99.95% Pervious Area
24		0.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	100	0.0300	0.19		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
1.1	133	0.1500	1.94		Shallow Concentrated Flow, 133' Shallow Woodland Kv= 5.0 fps
9.7	233	Total			

Summary for Subcatchment PR-C1: Eastern Swale

Runoff = 0.18 cfs @ 12.41 hrs, Volume= 0.034 af, Depth> 0.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
17,808	98	Paved parking, HSG A
3,545	98	Roofs, HSG A
10,594	36	Woods, Fair, HSG A
34,038	39	>75% Grass cover, Good, HSG A
65,985	58	Weighted Average
44,632		67.64% Pervious Area
21,353		32.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	100	0.0200	0.16		Sheet Flow, 100' Sheet Flow Grass: Short n= 0.150 P2= 3.00"
2.2	129	0.0200	0.99		Shallow Concentrated Flow, 129' Shallow Short Grass Pasture Kv= 7.0 fps
0.2	40	0.0380	3.96		Shallow Concentrated Flow, 40' Shallow Paved Kv= 20.3 fps
0.4	39	0.0510	1.58		Shallow Concentrated Flow, 39' Shallow Short Grass Pasture Kv= 7.0 fps
0.4	173	0.0300	7.84	94.09	Channel Flow, 173' Channel Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.035 Earth, dense weeds
13.3	481	Total			

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Type III 24-hr 2-Year Rainfall=3.00"

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Summary for Subcatchment PR-C2: Eastern Outlet Swale

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
10,752	39	>75% Grass cover, Good, HSG A
10,752		100.00% Pervious Area

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

Summary for Subcatchment PR-C3: Eastern Drainage Area

Runoff = 0.00 cfs @ 21.11 hrs, Volume= 0.002 af, Depth> 0.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
5,418	98	Paved parking, HSG A
1,851	98	Roofs, HSG A
28,353	36	Woods, Fair, HSG A
28,202	39	>75% Grass cover, Good, HSG A
63,824	44	Weighted Average
56,555		88.61% Pervious Area
7,269		11.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		Shallow Concentrated Flow, 67' Shallow Short Grass Pasture Kv= 7.0 fps
2.3	134	0.0370	0.96		Shallow Concentrated Flow, 134' Shallow Woodland Kv= 5.0 fps
9.5	301	Total			

Summary for Subcatchment PR-C4: Eastern Overland

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

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Type III 24-hr 2-Year Rainfall=3.00"

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Area (sf)	CN	Description
14,203	36	Woods, Fair, HSG A
7,200	39	>75% Grass cover, Good, HSG A
21,403	37	Weighted Average
21,403		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	82	0.0730	0.27		Sheet Flow, 82' Sheet Grass: Short n= 0.150 P2= 3.00"

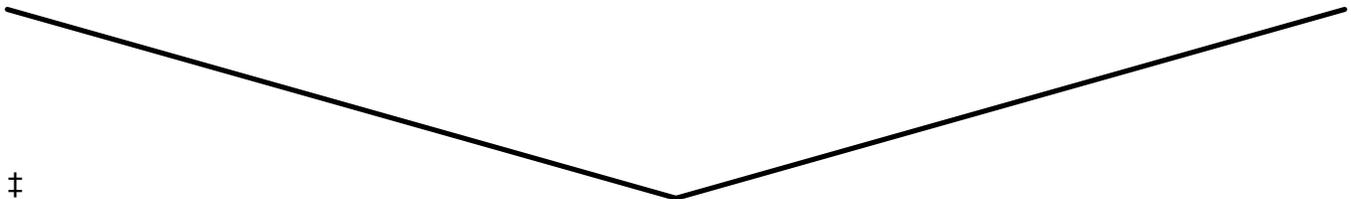
Summary for Reach 1R: Outlet Swale

Inflow Area = 3.227 ac, 20.36% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
 Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
 Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 5.00 hrs
 Average Depth at Peak Storage= 0.00'
 Bank-Full Depth= 1.00', Capacity at Bank-Full= 14.79 cfs

0.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
 Side Slope Z-value= 4.0 '/' Top Width= 8.00'
 Length= 108.0' Slope= 0.0199 '/'
 Inlet Invert= 254.00', Outlet Invert= 251.85'

**Summary for Reach AP-A: Analysis Point A**

Inflow Area = 2.123 ac, 4.59% Impervious, Inflow Depth > 0.00" for 2-Year event
 Inflow = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

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Summary for Reach AP-B: Analysis Point B

Inflow Area = 1.750 ac, 23.46% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Summary for Reach AP-C: Analysis Point C

Inflow Area = 3.718 ac, 17.67% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Northern Swale

Inflow Area = 0.735 ac, 55.76% Impervious, Inflow Depth > 0.81" for 2-Year event
 Inflow = 0.51 cfs @ 12.18 hrs, Volume= 0.049 af
 Outflow = 0.14 cfs @ 12.69 hrs, Volume= 0.049 af, Atten= 73%, Lag= 30.7 min
 Discarded = 0.14 cfs @ 12.69 hrs, Volume= 0.049 af
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs / 2
 Peak Elev= 267.00' @ 12.69 hrs Surf.Area= 2,483 sf Storage= 618 cf

Plug-Flow detention time= 54.1 min calculated for 0.049 af (99% of inflow)
 Center-of-Mass det. time= 49.8 min (926.5 - 876.8)

Volume	Invert	Avail.Storage	Storage Description		
#1	266.25'	7,373 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
266.25	0	0	0	0	
267.00	2,502	626	626	2,503	
268.00	3,615	3,041	3,667	3,633	
268.90	4,641	3,706	7,373	4,679	

Device	Routing	Invert	Outlet Devices
#1	Primary	262.09'	6.0" Round Culvert L= 26.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 262.09' / 261.84' S= 0.0096 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	267.90'	6.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Discarded	266.25'	2.410 in/hr Exfiltration over Wetted area Conductivity to Groundwater Elevation = 0.00'

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Discarded OutFlow Max=0.14 cfs @ 12.69 hrs HW=267.00' (Free Discharge)↑**3=Exfiltration** (Controls 0.14 cfs)**Primary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=266.25' (Free Discharge)↑**1=Culvert** (Passes 0.00 cfs of 1.48 cfs potential flow)↑**2=Orifice/Grate** (Controls 0.00 cfs)**Summary for Pond 2P: Eastern Swale**

Inflow Area = 1.515 ac, 32.36% Impervious, Inflow Depth > 0.27" for 2-Year event
 Inflow = 0.18 cfs @ 12.41 hrs, Volume= 0.034 af
 Outflow = 0.05 cfs @ 14.83 hrs, Volume= 0.034 af, Atten= 74%, Lag= 144.8 min
 Discarded = 0.05 cfs @ 14.83 hrs, Volume= 0.034 af
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 259.33' @ 14.83 hrs Surf.Area= 823 sf Storage= 349 cf

Plug-Flow detention time= 88.4 min calculated for 0.034 af (98% of inflow)
 Center-of-Mass det. time= 79.9 min (1,027.9 - 948.0)

Volume	Invert	Avail.Storage	Storage Description		
#1	258.50'	1,731 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
258.50	0	0	0	0	
259.00	650	108	108	650	
260.00	1,240	929	1,038	1,250	
260.50	1,540	694	1,731	1,557	

Device	Routing	Invert	Outlet Devices
#1	Primary	254.24'	12.0" Round Culvert L= 124.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 254.24' / 253.00' S= 0.0100 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.80'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Discarded	258.50'	2.410 in/hr Exfiltration over Wetted area Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.05 cfs @ 14.83 hrs HW=259.33' (Free Discharge)↑**3=Exfiltration** (Controls 0.05 cfs)**Primary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=258.50' (Free Discharge)↑**1=Culvert** (Passes 0.00 cfs of 5.65 cfs potential flow)↑**2=Orifice/Grate** (Controls 0.00 cfs)

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Type III 24-hr 2-Year Rainfall=3.00"

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Summary for Pond 3P: Catch Basin

Inflow Area = 1.465 ac, 11.39% Impervious, Inflow Depth > 0.02" for 2-Year event
 Inflow = 0.00 cfs @ 21.11 hrs, Volume= 0.002 af
 Outflow = 0.00 cfs @ 21.56 hrs, Volume= 0.002 af, Atten= 0%, Lag= 27.0 min
 Discarded = 0.00 cfs @ 21.56 hrs, Volume= 0.002 af
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 258.69' @ 21.56 hrs Surf.Area= 51 sf Storage= 3 cf

Plug-Flow detention time= 17.6 min calculated for 0.002 af (96% of inflow)
 Center-of-Mass det. time= 8.9 min (1,201.7 - 1,192.8)

Volume	Invert	Avail.Storage	Storage Description		
#1	258.50'	5,098 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
258.50	0	0	0	0	
259.00	360	60	60	360	
260.00	2,319	1,198	1,258	2,323	
261.00	5,599	3,840	5,098	5,610	

Device	Routing	Invert	Outlet Devices
#1	Primary	255.11'	12.0" Round Culvert L= 56.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 255.11' / 254.55' S= 0.0100 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.25'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Discarded	258.50'	2.410 in/hr Exfiltration over Wetted area Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.00 cfs @ 21.56 hrs HW=258.69' (Free Discharge)
 ↳ **3=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=258.50' (Free Discharge)
 ↳ **1=Culvert** (Passes 0.00 cfs of 5.67 cfs potential flow)
 ↳ **2=Orifice/Grate** (Controls 0.00 cfs)

APPENDIX B:
HYDROCAD OUTPUT FOR
10-YEAR STORM EVENT

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

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Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-A: Western Drainage Area Runoff Area=83,204 sf 2.08% Impervious Runoff Depth>0.14"
Flow Length=396' Tc=9.5 min CN=40 Runoff=0.04 cfs 0.022 af

Subcatchment EX-B: Northern Drainage Runoff Area=91,609 sf 0.00% Impervious Runoff Depth>0.07"
Flow Length=400' Tc=9.8 min CN=37 Runoff=0.02 cfs 0.011 af

Subcatchment EX-C: Eastern Drainage Runoff Area=154,803 sf 16.20% Impervious Runoff Depth>0.41"
Flow Length=473' Tc=10.6 min CN=48 Runoff=0.65 cfs 0.122 af

Subcatchment PR-A: Western Drainage Area Runoff Area=92,475 sf 4.59% Impervious Runoff Depth>0.16"
Flow Length=373' Tc=16.7 min CN=41 Runoff=0.05 cfs 0.029 af

Subcatchment PR-B1: Northern Swale Runoff Area=32,029 sf 55.76% Impervious Runoff Depth>1.82"
Flow Length=306' Tc=11.5 min CN=72 Runoff=1.27 cfs 0.111 af

Subcatchment PR-B2: Northern Overland Runoff Area=44,208 sf 0.05% Impervious Runoff Depth>0.05"
Flow Length=233' Tc=9.7 min CN=36 Runoff=0.01 cfs 0.004 af

Subcatchment PR-C1: Eastern Swale Runoff Area=65,985 sf 32.36% Impervious Runoff Depth>0.90"
Flow Length=481' Tc=13.3 min CN=58 Runoff=1.01 cfs 0.114 af

Subcatchment PR-C2: Eastern Outlet Swale Runoff Area=10,752 sf 0.00% Impervious Runoff Depth>0.11"
Tc=5.0 min CN=39 Runoff=0.00 cfs 0.002 af

Subcatchment PR-C3: Eastern Drainage Runoff Area=63,824 sf 11.39% Impervious Runoff Depth>0.26"
Flow Length=301' Tc=9.5 min CN=44 Runoff=0.12 cfs 0.032 af

Subcatchment PR-C4: Eastern Overland Runoff Area=21,403 sf 0.00% Impervious Runoff Depth>0.07"
Flow Length=82' Slope=0.0730 '/ Tc=5.1 min CN=37 Runoff=0.00 cfs 0.003 af

Reach 1R: Outlet Swale Avg. Flow Depth=0.31' Max Vel=1.68 fps Inflow=0.64 cfs 0.048 af
n=0.035 L=108.0' S=0.0199 '/ Capacity=14.79 cfs Outflow=0.63 cfs 0.048 af

Reach AP-A: Analysis Point A Inflow=0.05 cfs 0.029 af
Outflow=0.05 cfs 0.029 af

Reach AP-B: Analysis Point B Inflow=0.01 cfs 0.004 af
Outflow=0.01 cfs 0.004 af

Reach AP-C: Analysis Point C Inflow=0.63 cfs 0.051 af
Outflow=0.63 cfs 0.051 af

Pond 1P: Northern Swale Peak Elev=267.48' Storage=1,938 cf Inflow=1.27 cfs 0.111 af
Discarded=0.17 cfs 0.110 af Primary=0.00 cfs 0.000 af Outflow=0.17 cfs 0.110 af

Pond 2P: Eastern Swale Peak Elev=259.96' Storage=986 cf Inflow=1.01 cfs 0.114 af
Discarded=0.07 cfs 0.060 af Primary=0.64 cfs 0.044 af Outflow=0.71 cfs 0.103 af

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Pond 3P: Catch Basin

Peak Elev=259.26' Storage=196 cf Inflow=0.12 cfs 0.032 af
Discarded=0.04 cfs 0.029 af Primary=0.02 cfs 0.002 af Outflow=0.06 cfs 0.031 af

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Summary for Subcatchment EX-A: Western Drainage Area

Runoff = 0.04 cfs @ 13.82 hrs, Volume= 0.022 af, Depth> 0.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
1,730	98	Roofs, HSG A
8,594	36	Woods, Fair, HSG A
72,880	39	>75% Grass cover, Good, HSG A
83,204	40	Weighted Average
81,474		97.92% Pervious Area
1,730		2.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
3.0	296	0.0570	1.67		Shallow Concentrated Flow, 296' Shallow Short Grass Pasture Kv= 7.0 fps
9.5	396	Total			

Summary for Subcatchment EX-B: Northern Drainage Area

Runoff = 0.02 cfs @ 15.33 hrs, Volume= 0.011 af, Depth> 0.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
61,588	36	Woods, Fair, HSG A
29,063	39	>75% Grass cover, Good, HSG A
958	76	Gravel roads, HSG A
91,609	37	Weighted Average
91,609		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	100	0.0650	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
1.5	107	0.0280	1.17		Shallow Concentrated Flow, 107' Shallow Short Grass Pasture Kv= 7.0 fps
0.4	27	0.0550	1.17		Shallow Concentrated Flow, 27' Shallow Woodland Kv= 5.0 fps
0.1	14	0.0700	4.26		Shallow Concentrated Flow, 14' Shallow Unpaved Kv= 16.1 fps
1.5	152	0.1220	1.75		Shallow Concentrated Flow, 152' Shallow Woodland Kv= 5.0 fps
9.8	400	Total			

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

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Summary for Subcatchment EX-C: Eastern Drainage Area

Runoff = 0.65 cfs @ 12.37 hrs, Volume= 0.122 af, Depth> 0.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
14,301	98	Paved parking, HSG A
10,782	98	Roofs, HSG A
70,650	36	Woods, Fair, HSG A
57,118	39	>75% Grass cover, Good, HSG A
1,952	76	Gravel roads, HSG A
154,803	48	Weighted Average
129,720		83.80% Pervious Area
25,083		16.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		Shallow Concentrated Flow, 67' Shallow Short Grass Pasture Kv= 7.0 fps
2.3	143	0.0420	1.02		Shallow Concentrated Flow, 143' Shallow Woodland Kv= 5.0 fps
0.4	96	0.0100	4.54	3.56	Pipe Channel, 96' Pipe 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.7	67	0.0900	1.50		Shallow Concentrated Flow, 67' Shallow Woodland Kv= 5.0 fps
10.6	473	Total			

Summary for Subcatchment PR-A: Western Drainage Area

Runoff = 0.05 cfs @ 13.77 hrs, Volume= 0.029 af, Depth> 0.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
1,001	98	Paved parking, HSG A
3,239	98	Roofs, HSG A
8,263	36	Woods, Fair, HSG A
79,972	39	>75% Grass cover, Good, HSG A
92,475	41	Weighted Average
88,235		95.41% Pervious Area
4,240		4.59% Impervious Area

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

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0100	0.12		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
3.2	273	0.0400	1.40		Shallow Concentrated Flow, 273' Shallow Short Grass Pasture Kv= 7.0 fps
16.7	373	Total			

Summary for Subcatchment PR-B1: Northern Swale

Runoff = 1.27 cfs @ 12.17 hrs, Volume= 0.111 af, Depth> 1.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
11,531	98	Paved parking, HSG A
6,329	98	Roofs, HSG A
14,169	39	>75% Grass cover, Good, HSG A
32,029	72	Weighted Average
14,169		44.24% Pervious Area
17,860		55.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	16	0.0100	0.09		Sheet Flow, 16' Sheet Grass: Short n= 0.150 P2= 3.00"
0.8	39	0.0100	0.84		Sheet Flow, 39' Sheet Smooth surfaces n= 0.011 P2= 3.00"
6.0	37	0.0100	0.10		Sheet Flow, 37' Sheet Grass: Short n= 0.150 P2= 3.00"
0.2	8	0.0100	0.61		Sheet Flow, 8' Sheet Smooth surfaces n= 0.011 P2= 3.00"
0.1	20	0.0300	3.52		Shallow Concentrated Flow, 20' Shallow Paved Kv= 20.3 fps
0.2	25	0.0600	1.71		Shallow Concentrated Flow, 25' Shallow Short Grass Pasture Kv= 7.0 fps
1.1	161	0.0030	2.48	29.75	Channel Flow, 161' Channel Flow Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.035 Earth, dense weeds
11.5	306	Total			

Summary for Subcatchment PR-B2: Northern Overland

Runoff = 0.01 cfs @ 15.69 hrs, Volume= 0.004 af, Depth> 0.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

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

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Area (sf)	CN	Description
24	98	Paved parking, HSG A
38,076	36	Woods, Fair, HSG A
6,108	39	>75% Grass cover, Good, HSG A
44,208	36	Weighted Average
44,184		99.95% Pervious Area
24		0.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	100	0.0300	0.19		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
1.1	133	0.1500	1.94		Shallow Concentrated Flow, 133' Shallow Woodland Kv= 5.0 fps
9.7	233	Total			

Summary for Subcatchment PR-C1: Eastern Swale

Runoff = 1.01 cfs @ 12.22 hrs, Volume= 0.114 af, Depth> 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
17,808	98	Paved parking, HSG A
3,545	98	Roofs, HSG A
10,594	36	Woods, Fair, HSG A
34,038	39	>75% Grass cover, Good, HSG A
65,985	58	Weighted Average
44,632		67.64% Pervious Area
21,353		32.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	100	0.0200	0.16		Sheet Flow, 100' Sheet Flow Grass: Short n= 0.150 P2= 3.00"
2.2	129	0.0200	0.99		Shallow Concentrated Flow, 129' Shallow Short Grass Pasture Kv= 7.0 fps
0.2	40	0.0380	3.96		Shallow Concentrated Flow, 40' Shallow Paved Kv= 20.3 fps
0.4	39	0.0510	1.58		Shallow Concentrated Flow, 39' Shallow Short Grass Pasture Kv= 7.0 fps
0.4	173	0.0300	7.84	94.09	Channel Flow, 173' Channel Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.035 Earth, dense weeds
13.3	481	Total			

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

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Summary for Subcatchment PR-C2: Eastern Outlet Swale

Runoff = 0.00 cfs @ 14.69 hrs, Volume= 0.002 af, Depth> 0.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
10,752	39	>75% Grass cover, Good, HSG A
10,752		100.00% Pervious Area

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

Summary for Subcatchment PR-C3: Eastern Drainage Area

Runoff = 0.12 cfs @ 12.45 hrs, Volume= 0.032 af, Depth> 0.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
5,418	98	Paved parking, HSG A
1,851	98	Roofs, HSG A
28,353	36	Woods, Fair, HSG A
28,202	39	>75% Grass cover, Good, HSG A
63,824	44	Weighted Average
56,555		88.61% Pervious Area
7,269		11.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		Shallow Concentrated Flow, 67' Shallow Short Grass Pasture Kv= 7.0 fps
2.3	134	0.0370	0.96		Shallow Concentrated Flow, 134' Shallow Woodland Kv= 5.0 fps
9.5	301	Total			

Summary for Subcatchment PR-C4: Eastern Overland

Runoff = 0.00 cfs @ 15.26 hrs, Volume= 0.003 af, Depth> 0.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

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

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Area (sf)	CN	Description
14,203	36	Woods, Fair, HSG A
7,200	39	>75% Grass cover, Good, HSG A
21,403	37	Weighted Average
21,403		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	82	0.0730	0.27		Sheet Flow, 82' Sheet Grass: Short n= 0.150 P2= 3.00"

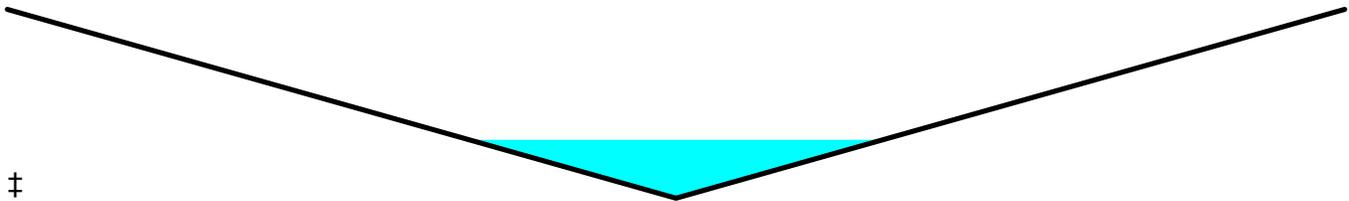
Summary for Reach 1R: Outlet Swale

Inflow Area = 3.227 ac, 20.36% Impervious, Inflow Depth > 0.18" for 10-Year event
 Inflow = 0.64 cfs @ 12.46 hrs, Volume= 0.048 af
 Outflow = 0.63 cfs @ 12.50 hrs, Volume= 0.048 af, Atten= 2%, Lag= 2.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
 Max. Velocity= 1.68 fps, Min. Travel Time= 1.1 min
 Avg. Velocity = 0.66 fps, Avg. Travel Time= 2.7 min

Peak Storage= 41 cf @ 12.47 hrs
 Average Depth at Peak Storage= 0.31'
 Bank-Full Depth= 1.00', Capacity at Bank-Full= 14.79 cfs

0.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
 Side Slope Z-value= 4.0 '/' Top Width= 8.00'
 Length= 108.0' Slope= 0.0199 '/'
 Inlet Invert= 254.00', Outlet Invert= 251.85'



Summary for Reach AP-A: Analysis Point A

Inflow Area = 2.123 ac, 4.59% Impervious, Inflow Depth > 0.16" for 10-Year event
 Inflow = 0.05 cfs @ 13.77 hrs, Volume= 0.029 af
 Outflow = 0.05 cfs @ 13.77 hrs, Volume= 0.029 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

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

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Summary for Reach AP-B: Analysis Point B

Inflow Area = 1.750 ac, 23.46% Impervious, Inflow Depth > 0.03" for 10-Year event
 Inflow = 0.01 cfs @ 15.69 hrs, Volume= 0.004 af
 Outflow = 0.01 cfs @ 15.69 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Summary for Reach AP-C: Analysis Point C

Inflow Area = 3.718 ac, 17.67% Impervious, Inflow Depth > 0.16" for 10-Year event
 Inflow = 0.63 cfs @ 12.50 hrs, Volume= 0.051 af
 Outflow = 0.63 cfs @ 12.50 hrs, Volume= 0.051 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Northern Swale

Inflow Area = 0.735 ac, 55.76% Impervious, Inflow Depth > 1.82" for 10-Year event
 Inflow = 1.27 cfs @ 12.17 hrs, Volume= 0.111 af
 Outflow = 0.17 cfs @ 13.12 hrs, Volume= 0.110 af, Atten= 87%, Lag= 56.9 min
 Discarded = 0.17 cfs @ 13.12 hrs, Volume= 0.110 af
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs / 2
 Peak Elev= 267.48' @ 13.12 hrs Surf.Area= 3,007 sf Storage= 1,938 cf

Plug-Flow detention time= 122.3 min calculated for 0.110 af (99% of inflow)
 Center-of-Mass det. time= 117.0 min (968.8 - 851.8)

Volume	Invert	Avail.Storage	Storage Description	
#1	266.25'	7,373 cf	Custom Stage Data (Conic) Listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
266.25	0	0	0	0
267.00	2,502	626	626	2,503
268.00	3,615	3,041	3,667	3,633
268.90	4,641	3,706	7,373	4,679

Device	Routing	Invert	Outlet Devices
#1	Primary	262.09'	6.0" Round Culvert L= 26.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 262.09' / 261.84' S= 0.0096 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	267.90'	6.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Discarded	266.25'	2.410 in/hr Exfiltration over Wetted area Conductivity to Groundwater Elevation = 0.00'

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

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Discarded OutFlow Max=0.17 cfs @ 13.12 hrs HW=267.48' (Free Discharge)

↑**3=Exfiltration** (Controls 0.17 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=266.25' (Free Discharge)

↑**1=Culvert** (Passes 0.00 cfs of 1.48 cfs potential flow)

↑**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 2P: Eastern Swale

Inflow Area = 1.515 ac, 32.36% Impervious, Inflow Depth > 0.90" for 10-Year event
 Inflow = 1.01 cfs @ 12.22 hrs, Volume= 0.114 af
 Outflow = 0.71 cfs @ 12.46 hrs, Volume= 0.103 af, Atten= 30%, Lag= 14.6 min
 Discarded = 0.07 cfs @ 12.46 hrs, Volume= 0.060 af
 Primary = 0.64 cfs @ 12.46 hrs, Volume= 0.044 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 259.96' @ 12.46 hrs Surf.Area= 1,211 sf Storage= 986 cf

Plug-Flow detention time= 106.2 min calculated for 0.103 af (91% of inflow)
 Center-of-Mass det. time= 62.2 min (957.9 - 895.7)

Volume	Invert	Avail.Storage	Storage Description		
#1	258.50'	1,731 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
258.50	0	0	0	0	
259.00	650	108	108	650	
260.00	1,240	929	1,038	1,250	
260.50	1,540	694	1,731	1,557	

Device	Routing	Invert	Outlet Devices
#1	Primary	254.24'	12.0" Round Culvert L= 124.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 254.24' / 253.00' S= 0.0100 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.80'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Discarded	258.50'	2.410 in/hr Exfiltration over Wetted area Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.07 cfs @ 12.46 hrs HW=259.96' (Free Discharge)

↑**3=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=0.63 cfs @ 12.46 hrs HW=259.96' (Free Discharge)

↑**1=Culvert** (Passes 0.63 cfs of 6.50 cfs potential flow)

↑**2=Orifice/Grate** (Weir Controls 0.63 cfs @ 1.29 fps)

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

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Summary for Pond 3P: Catch Basin

Inflow Area = 1.465 ac, 11.39% Impervious, Inflow Depth > 0.26" for 10-Year event
 Inflow = 0.12 cfs @ 12.45 hrs, Volume= 0.032 af
 Outflow = 0.06 cfs @ 13.66 hrs, Volume= 0.031 af, Atten= 52%, Lag= 72.2 min
 Discarded = 0.04 cfs @ 13.66 hrs, Volume= 0.029 af
 Primary = 0.02 cfs @ 13.66 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 259.26' @ 13.66 hrs Surf.Area= 706 sf Storage= 196 cf

Plug-Flow detention time= 65.3 min calculated for 0.031 af (97% of inflow)
 Center-of-Mass det. time= 50.9 min (1,031.4 - 980.5)

Volume	Invert	Avail.Storage	Storage Description		
#1	258.50'	5,098 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
258.50	0	0	0	0	
259.00	360	60	60	360	
260.00	2,319	1,198	1,258	2,323	
261.00	5,599	3,840	5,098	5,610	

Device	Routing	Invert	Outlet Devices
#1	Primary	255.11'	12.0" Round Culvert L= 56.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 255.11' / 254.55' S= 0.0100 ' S Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.25'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Discarded	258.50'	2.410 in/hr Exfiltration over Wetted area Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.04 cfs @ 13.66 hrs HW=259.26' (Free Discharge)
 ↑**3=Exfiltration** (Controls 0.04 cfs)

Primary OutFlow Max=0.01 cfs @ 13.66 hrs HW=259.26' (Free Discharge)
 ↑**1=Culvert** (Passes 0.01 cfs of 6.37 cfs potential flow)
 ↑**2=Orifice/Grate** (Weir Controls 0.01 cfs @ 0.33 fps)

APPENDIX C:
HYDROCAD OUTPUT FOR
100-YEAR STORM EVENT

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Type III 24-hr 100-Year Rainfall=6.40"

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Time span=5.00-24.00 hrs, dt=0.05 hrs, 381 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-A: Western Drainage Area Runoff Area=83,204 sf 2.08% Impervious Runoff Depth>0.63"
Flow Length=396' Tc=9.5 min CN=40 Runoff=0.56 cfs 0.100 af

Subcatchment EX-B: Northern Drainage Runoff Area=91,609 sf 0.00% Impervious Runoff Depth>0.45"
Flow Length=400' Tc=9.8 min CN=37 Runoff=0.34 cfs 0.078 af

Subcatchment EX-C: Eastern Drainage Runoff Area=154,803 sf 16.20% Impervious Runoff Depth>1.19"
Flow Length=473' Tc=10.6 min CN=48 Runoff=3.20 cfs 0.351 af

Subcatchment PR-A: Western Drainage Area Runoff Area=92,475 sf 4.59% Impervious Runoff Depth>0.69"
Flow Length=373' Tc=16.7 min CN=41 Runoff=0.68 cfs 0.122 af

Subcatchment PR-B1: Northern Swale Runoff Area=32,029 sf 55.76% Impervious Runoff Depth>3.32"
Flow Length=306' Tc=11.5 min CN=72 Runoff=2.37 cfs 0.203 af

Subcatchment PR-B2: Northern Overland Runoff Area=44,208 sf 0.05% Impervious Runoff Depth>0.39"
Flow Length=233' Tc=9.7 min CN=36 Runoff=0.13 cfs 0.033 af

Subcatchment PR-C1: Eastern Swale Runoff Area=65,985 sf 32.36% Impervious Runoff Depth>2.00"
Flow Length=481' Tc=13.3 min CN=58 Runoff=2.63 cfs 0.253 af

Subcatchment PR-C2: Eastern Outlet Swale Runoff Area=10,752 sf 0.00% Impervious Runoff Depth>0.57"
Tc=5.0 min CN=39 Runoff=0.06 cfs 0.012 af

Subcatchment PR-C3: Eastern Drainage Runoff Area=63,824 sf 11.39% Impervious Runoff Depth>0.89"
Flow Length=301' Tc=9.5 min CN=44 Runoff=0.84 cfs 0.109 af

Subcatchment PR-C4: Eastern Overland Runoff Area=21,403 sf 0.00% Impervious Runoff Depth>0.45"
Flow Length=82' Slope=0.0730 '/ Tc=5.1 min CN=37 Runoff=0.08 cfs 0.018 af

Reach 1R: Outlet Swale Avg. Flow Depth=0.56' Max Vel=2.51 fps Inflow=3.14 cfs 0.245 af
n=0.035 L=108.0' S=0.0199 '/ Capacity=14.79 cfs Outflow=3.10 cfs 0.245 af

Reach AP-A: Analysis Point A Inflow=0.68 cfs 0.122 af
Outflow=0.68 cfs 0.122 af

Reach AP-B: Analysis Point B Inflow=0.31 cfs 0.052 af
Outflow=0.31 cfs 0.052 af

Reach AP-C: Analysis Point C Inflow=3.18 cfs 0.264 af
Outflow=3.18 cfs 0.264 af

Pond 1P: Northern Swale Peak Elev=268.03' Storage=3,764 cf Inflow=2.37 cfs 0.203 af
Discarded=0.21 cfs 0.178 af Primary=0.23 cfs 0.019 af Outflow=0.44 cfs 0.198 af

Pond 2P: Eastern Swale Peak Elev=260.19' Storage=1,281 cf Inflow=2.63 cfs 0.253 af
Discarded=0.08 cfs 0.066 af Primary=2.36 cfs 0.169 af Outflow=2.44 cfs 0.235 af

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Type III 24-hr 100-Year Rainfall=6.40"

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Pond 3P: Catch Basin

Peak Elev=259.42' Storage=328 cf Inflow=0.84 cfs 0.109 af
Discarded=0.05 cfs 0.040 af Primary=0.71 cfs 0.065 af Outflow=0.76 cfs 0.105 af

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Type III 24-hr 100-Year Rainfall=6.40"

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Summary for Subcatchment EX-A: Western Drainage Area

Runoff = 0.56 cfs @ 12.33 hrs, Volume= 0.100 af, Depth> 0.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
1,730	98	Roofs, HSG A
8,594	36	Woods, Fair, HSG A
72,880	39	>75% Grass cover, Good, HSG A
83,204	40	Weighted Average
81,474		97.92% Pervious Area
1,730		2.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
3.0	296	0.0570	1.67		Shallow Concentrated Flow, 296' Shallow Short Grass Pasture Kv= 7.0 fps
9.5	396	Total			

Summary for Subcatchment EX-B: Northern Drainage Area

Runoff = 0.34 cfs @ 12.42 hrs, Volume= 0.078 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
61,588	36	Woods, Fair, HSG A
29,063	39	>75% Grass cover, Good, HSG A
958	76	Gravel roads, HSG A
91,609	37	Weighted Average
91,609		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	100	0.0650	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
1.5	107	0.0280	1.17		Shallow Concentrated Flow, 107' Shallow Short Grass Pasture Kv= 7.0 fps
0.4	27	0.0550	1.17		Shallow Concentrated Flow, 27' Shallow Woodland Kv= 5.0 fps
0.1	14	0.0700	4.26		Shallow Concentrated Flow, 14' Shallow Unpaved Kv= 16.1 fps
1.5	152	0.1220	1.75		Shallow Concentrated Flow, 152' Shallow Woodland Kv= 5.0 fps
9.8	400	Total			

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Type III 24-hr 100-Year Rainfall=6.40"

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Summary for Subcatchment EX-C: Eastern Drainage Area

Runoff = 3.20 cfs @ 12.18 hrs, Volume= 0.351 af, Depth> 1.19"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
14,301	98	Paved parking, HSG A
10,782	98	Roofs, HSG A
70,650	36	Woods, Fair, HSG A
57,118	39	>75% Grass cover, Good, HSG A
1,952	76	Gravel roads, HSG A
154,803	48	Weighted Average
129,720		83.80% Pervious Area
25,083		16.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		Shallow Concentrated Flow, 67' Shallow Short Grass Pasture Kv= 7.0 fps
2.3	143	0.0420	1.02		Shallow Concentrated Flow, 143' Shallow Woodland Kv= 5.0 fps
0.4	96	0.0100	4.54	3.56	Pipe Channel, 96' Pipe 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.7	67	0.0900	1.50		Shallow Concentrated Flow, 67' Shallow Woodland Kv= 5.0 fps
10.6	473	Total			

Summary for Subcatchment PR-A: Western Drainage Area

Runoff = 0.68 cfs @ 12.42 hrs, Volume= 0.122 af, Depth> 0.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
1,001	98	Paved parking, HSG A
3,239	98	Roofs, HSG A
8,263	36	Woods, Fair, HSG A
79,972	39	>75% Grass cover, Good, HSG A
92,475	41	Weighted Average
88,235		95.41% Pervious Area
4,240		4.59% Impervious Area

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Type III 24-hr 100-Year Rainfall=6.40"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0100	0.12		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
3.2	273	0.0400	1.40		Shallow Concentrated Flow, 273' Shallow Short Grass Pasture Kv= 7.0 fps
16.7	373	Total			

Summary for Subcatchment PR-B1: Northern Swale

Runoff = 2.37 cfs @ 12.16 hrs, Volume= 0.203 af, Depth> 3.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
11,531	98	Paved parking, HSG A
6,329	98	Roofs, HSG A
14,169	39	>75% Grass cover, Good, HSG A
32,029	72	Weighted Average
14,169		44.24% Pervious Area
17,860		55.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	16	0.0100	0.09		Sheet Flow, 16' Sheet Grass: Short n= 0.150 P2= 3.00"
0.8	39	0.0100	0.84		Sheet Flow, 39' Sheet Smooth surfaces n= 0.011 P2= 3.00"
6.0	37	0.0100	0.10		Sheet Flow, 37' Sheet Grass: Short n= 0.150 P2= 3.00"
0.2	8	0.0100	0.61		Sheet Flow, 8' Sheet Smooth surfaces n= 0.011 P2= 3.00"
0.1	20	0.0300	3.52		Shallow Concentrated Flow, 20' Shallow Paved Kv= 20.3 fps
0.2	25	0.0600	1.71		Shallow Concentrated Flow, 25' Shallow Short Grass Pasture Kv= 7.0 fps
1.1	161	0.0030	2.48	29.75	Channel Flow, 161' Channel Flow Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.035 Earth, dense weeds
11.5	306	Total			

Summary for Subcatchment PR-B2: Northern Overland

Runoff = 0.13 cfs @ 12.44 hrs, Volume= 0.033 af, Depth> 0.39"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.40"

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Type III 24-hr 100-Year Rainfall=6.40"

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Area (sf)	CN	Description
24	98	Paved parking, HSG A
38,076	36	Woods, Fair, HSG A
6,108	39	>75% Grass cover, Good, HSG A
44,208	36	Weighted Average
44,184		99.95% Pervious Area
24		0.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	100	0.0300	0.19		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
1.1	133	0.1500	1.94		Shallow Concentrated Flow, 133' Shallow Woodland Kv= 5.0 fps
9.7	233	Total			

Summary for Subcatchment PR-C1: Eastern Swale

Runoff = 2.63 cfs @ 12.20 hrs, Volume= 0.253 af, Depth> 2.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
17,808	98	Paved parking, HSG A
3,545	98	Roofs, HSG A
10,594	36	Woods, Fair, HSG A
34,038	39	>75% Grass cover, Good, HSG A
65,985	58	Weighted Average
44,632		67.64% Pervious Area
21,353		32.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	100	0.0200	0.16		Sheet Flow, 100' Sheet Flow Grass: Short n= 0.150 P2= 3.00"
2.2	129	0.0200	0.99		Shallow Concentrated Flow, 129' Shallow Short Grass Pasture Kv= 7.0 fps
0.2	40	0.0380	3.96		Shallow Concentrated Flow, 40' Shallow Paved Kv= 20.3 fps
0.4	39	0.0510	1.58		Shallow Concentrated Flow, 39' Shallow Short Grass Pasture Kv= 7.0 fps
0.4	173	0.0300	7.84	94.09	Channel Flow, 173' Channel Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.035 Earth, dense weeds
13.3	481	Total			

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Type III 24-hr 100-Year Rainfall=6.40"

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Summary for Subcatchment PR-C2: Eastern Outlet Swale

Runoff = 0.06 cfs @ 12.29 hrs, Volume= 0.012 af, Depth> 0.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
10,752	39	>75% Grass cover, Good, HSG A
10,752		100.00% Pervious Area

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

Summary for Subcatchment PR-C3: Eastern Drainage Area

Runoff = 0.84 cfs @ 12.19 hrs, Volume= 0.109 af, Depth> 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.40"

Area (sf)	CN	Description
5,418	98	Paved parking, HSG A
1,851	98	Roofs, HSG A
28,353	36	Woods, Fair, HSG A
28,202	39	>75% Grass cover, Good, HSG A
63,824	44	Weighted Average
56,555		88.61% Pervious Area
7,269		11.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		Sheet Flow, 100' Sheet Grass: Short n= 0.150 P2= 3.00"
0.7	67	0.0600	1.71		Shallow Concentrated Flow, 67' Shallow Short Grass Pasture Kv= 7.0 fps
2.3	134	0.0370	0.96		Shallow Concentrated Flow, 134' Shallow Woodland Kv= 5.0 fps
9.5	301	Total			

Summary for Subcatchment PR-C4: Eastern Overland

Runoff = 0.08 cfs @ 12.34 hrs, Volume= 0.018 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.40"

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Type III 24-hr 100-Year Rainfall=6.40"

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Area (sf)	CN	Description
14,203	36	Woods, Fair, HSG A
7,200	39	>75% Grass cover, Good, HSG A
21,403	37	Weighted Average
21,403		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	82	0.0730	0.27		Sheet Flow, 82' Sheet Grass: Short n= 0.150 P2= 3.00"

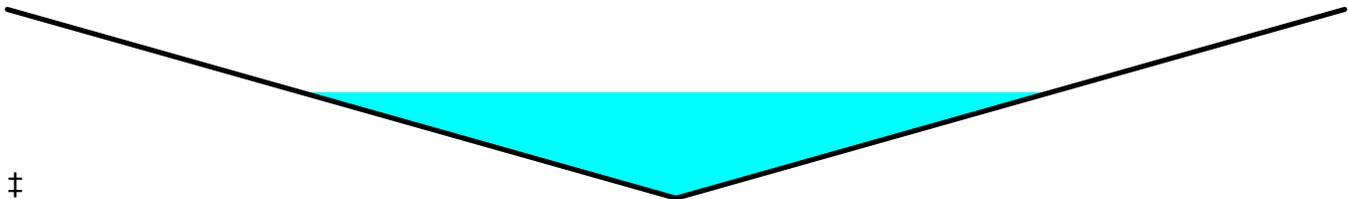
Summary for Reach 1R: Outlet Swale

Inflow Area = 3.227 ac, 20.36% Impervious, Inflow Depth > 0.91" for 100-Year event
 Inflow = 3.14 cfs @ 12.27 hrs, Volume= 0.245 af
 Outflow = 3.10 cfs @ 12.29 hrs, Volume= 0.245 af, Atten= 1%, Lag= 1.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
 Max. Velocity= 2.51 fps, Min. Travel Time= 0.7 min
 Avg. Velocity = 1.07 fps, Avg. Travel Time= 1.7 min

Peak Storage= 136 cf @ 12.27 hrs
 Average Depth at Peak Storage= 0.56'
 Bank-Full Depth= 1.00', Capacity at Bank-Full= 14.79 cfs

0.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
 Side Slope Z-value= 4.0 '/' Top Width= 8.00'
 Length= 108.0' Slope= 0.0199 '/'
 Inlet Invert= 254.00', Outlet Invert= 251.85'

**Summary for Reach AP-A: Analysis Point A**

Inflow Area = 2.123 ac, 4.59% Impervious, Inflow Depth > 0.69" for 100-Year event
 Inflow = 0.68 cfs @ 12.42 hrs, Volume= 0.122 af
 Outflow = 0.68 cfs @ 12.42 hrs, Volume= 0.122 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

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Type III 24-hr 100-Year Rainfall=6.40"

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Summary for Reach AP-B: Analysis Point B

Inflow Area = 1.750 ac, 23.46% Impervious, Inflow Depth > 0.36" for 100-Year event
 Inflow = 0.31 cfs @ 12.72 hrs, Volume= 0.052 af
 Outflow = 0.31 cfs @ 12.72 hrs, Volume= 0.052 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Summary for Reach AP-C: Analysis Point C

Inflow Area = 3.718 ac, 17.67% Impervious, Inflow Depth > 0.85" for 100-Year event
 Inflow = 3.18 cfs @ 12.30 hrs, Volume= 0.264 af
 Outflow = 3.18 cfs @ 12.30 hrs, Volume= 0.264 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Northern Swale

Inflow Area = 0.735 ac, 55.76% Impervious, Inflow Depth > 3.32" for 100-Year event
 Inflow = 2.37 cfs @ 12.16 hrs, Volume= 0.203 af
 Outflow = 0.44 cfs @ 12.75 hrs, Volume= 0.198 af, Atten= 82%, Lag= 35.0 min
 Discarded = 0.21 cfs @ 12.75 hrs, Volume= 0.178 af
 Primary = 0.23 cfs @ 12.75 hrs, Volume= 0.019 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs / 2
 Peak Elev= 268.03' @ 12.75 hrs Surf.Area= 3,644 sf Storage= 3,764 cf

Plug-Flow detention time= 181.2 min calculated for 0.197 af (97% of inflow)
 Center-of-Mass det. time= 165.2 min (999.5 - 834.3)

Volume	Invert	Avail.Storage	Storage Description	
#1	266.25'	7,373 cf	Custom Stage Data (Conic) Listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
266.25	0	0	0	0
267.00	2,502	626	626	2,503
268.00	3,615	3,041	3,667	3,633
268.90	4,641	3,706	7,373	4,679

Device	Routing	Invert	Outlet Devices
#1	Primary	262.09'	6.0" Round Culvert L= 26.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 262.09' / 261.84' S= 0.0096 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	267.90'	6.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Discarded	266.25'	2.410 in/hr Exfiltration over Wetted area Conductivity to Groundwater Elevation = 0.00'

BHMA Bernon Music Center

Type III 24-hr 100-Year Rainfall=6.40"

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Discarded OutFlow Max=0.21 cfs @ 12.75 hrs HW=268.03' (Free Discharge)

↑**3=Exfiltration** (Controls 0.21 cfs)

Primary OutFlow Max=0.23 cfs @ 12.75 hrs HW=268.03' (Free Discharge)

↑**1=Culvert** (Passes 0.23 cfs of 1.78 cfs potential flow)

↑**2=Orifice/Grate** (Weir Controls 0.23 cfs @ 1.16 fps)

Summary for Pond 2P: Eastern Swale

Inflow Area = 1.515 ac, 32.36% Impervious, Inflow Depth > 2.00" for 100-Year event
 Inflow = 2.63 cfs @ 12.20 hrs, Volume= 0.253 af
 Outflow = 2.44 cfs @ 12.26 hrs, Volume= 0.235 af, Atten= 7%, Lag= 3.7 min
 Discarded = 0.08 cfs @ 12.26 hrs, Volume= 0.066 af
 Primary = 2.36 cfs @ 12.26 hrs, Volume= 0.169 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 260.19' @ 12.26 hrs Surf.Area= 1,349 sf Storage= 1,281 cf

Plug-Flow detention time= 52.6 min calculated for 0.234 af (93% of inflow)
 Center-of-Mass det. time= 16.9 min (885.8 - 868.9)

Volume	Invert	Avail.Storage	Storage Description		
#1	258.50'	1,731 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
258.50	0	0	0	0	
259.00	650	108	108	650	
260.00	1,240	929	1,038	1,250	
260.50	1,540	694	1,731	1,557	

Device	Routing	Invert	Outlet Devices
#1	Primary	254.24'	12.0" Round Culvert L= 124.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 254.24' / 253.00' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.80'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Discarded	258.50'	2.410 in/hr Exfiltration over Wetted area Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.08 cfs @ 12.26 hrs HW=260.19' (Free Discharge)

↑**3=Exfiltration** (Controls 0.08 cfs)

Primary OutFlow Max=2.35 cfs @ 12.26 hrs HW=260.18' (Free Discharge)

↑**1=Culvert** (Passes 2.35 cfs of 6.63 cfs potential flow)

↑**2=Orifice/Grate** (Orifice Controls 2.35 cfs @ 2.99 fps)

BHMA Bernon Music Center

Type III 24-hr 100-Year Rainfall=6.40"

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Summary for Pond 3P: Catch Basin

Inflow Area = 1.465 ac, 11.39% Impervious, Inflow Depth > 0.89" for 100-Year event
 Inflow = 0.84 cfs @ 12.19 hrs, Volume= 0.109 af
 Outflow = 0.76 cfs @ 12.29 hrs, Volume= 0.105 af, Atten= 9%, Lag= 5.5 min
 Discarded = 0.05 cfs @ 12.29 hrs, Volume= 0.040 af
 Primary = 0.71 cfs @ 12.29 hrs, Volume= 0.065 af

Routing by Stor-Ind method, Time Span= 5.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 259.42' @ 12.29 hrs Surf.Area= 972 sf Storage= 328 cf

Plug-Flow detention time= 30.9 min calculated for 0.105 af (96% of inflow)
 Center-of-Mass det. time= 11.9 min (927.7 - 915.8)

Volume	Invert	Avail.Storage	Storage Description		
#1	258.50'	5,098 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
258.50	0	0	0	0	
259.00	360	60	60	360	
260.00	2,319	1,198	1,258	2,323	
261.00	5,599	3,840	5,098	5,610	

Device	Routing	Invert	Outlet Devices
#1	Primary	255.11'	12.0" Round Culvert L= 56.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 255.11' / 254.55' S= 0.0100 ' S Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	259.25'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Discarded	258.50'	2.410 in/hr Exfiltration over Wetted area Conductivity to Groundwater Elevation = 0.00'

Discarded OutFlow Max=0.05 cfs @ 12.29 hrs HW=259.42' (Free Discharge)
 ↳ **3=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=0.71 cfs @ 12.29 hrs HW=259.42' (Free Discharge)
 ↳ **1=Culvert** (Passes 0.71 cfs of 6.51 cfs potential flow)
 ↳ **2=Orifice/Grate** (Weir Controls 0.71 cfs @ 1.34 fps)

APPENDIX D:
EROSION AND SEDIMENTATION CONTROL PLAN
& OPERATION AND MAINTENANCE PLAN

**LONG-TERM OPERATION AND MAINTENANCE PLAN
PROCEDURES TO BE FOLLOWED FOR BHMA BERNON MUSIC CENTER
48 WOODBRIDGE STREET, SOUTH HADLEY, MA**

BACKGROUND

Maintenance of the onsite stormwater management system is vital to the successful treatment of stormwater ultimately leaving this site. This plan is intended to assist in maintaining stormwater controls to reduce stormwater pollution generated in the parking area of the property.

DURING CONSTRUCTION

An Erosion & Sediment Control Plan has been prepared and included in the permit drawing set to outline measures designed to address all facets of sediment and erosion control during construction. Some of the measures included in these plans are as follows:

- Silt fence and straw wattles
- Construction entrance
- Temporary seeding for stabilization of exposed soils
- Excavated sediment traps
- Inlet protection at catch basins

In addition, as required under the provisions of the Clean Water Act, the applicant will be seeking coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit. As such, a detailed Stormwater Pollution Prevention Plan (SWPPP) will be developed and permit coverage attained prior to construction. The SWPPP will further address all short and long term Stormwater Management measures to be employed at this site.

January 18, 2016

POST CONSTRUCTION

Stormwater Management System Owner:

The Owner,

Berkshire Hills Music Academy
48 Woodbridge Street
South Hadley, MA 01075

shall own the stormwater management system.

Party Responsible for Operation and Maintenance:

The Manager,

Berkshire Hills Music Academy
48 Woodbridge Street
South Hadley, MA 01075

shall be responsible for financing maintenance and emergency repairs of the stormwater management system, and shall employ this document to notify future property owners of the presence of the stormwater management system and the requirement for proper operation and maintenance.

INSPECTION AND MAINTENANCE

1. Sod Strip
 - A. Mow the sod strip as needed.
 - B. Remove trash and debris bi-annually.

2. Water Quality Swales
 - A. Visually inspect the swales bi-annually. Make sure vegetation is adequate and slopes are not eroding. Check for rilling and gulying. Repair eroded areas and revegetate as necessary.
 - B. Mow as needed.
 - C. Remove trash and debris at least once a year.
 - D. Re-seed as necessary/

OPERATIONS AND MAINTENANCE BUDGET

A budget to implement the long-term operation and maintenance plan has not yet been developed.

APPENDIX E:
SUPPLEMENTAL CALCULATIONS

SUPPLEMENTAL CALCULATIONS

The following calculations have been performed to accompany the Stormwater Management Report for the proposed BHMA Bernon Music Center in South Hadley, MA. The required computations have been completed per *Volume 3: Documenting Compliance with the Massachusetts Stormwater Management Standards*.

STANDARD 1

There are no discharges to a wetland on site. The discharge to Reach 1 in the HydroCAD model has a peak flow rate of 0.00 cfs in the 2-year storm. To prevent erosion or scour, a riprap apron was sized to dissipate the energy. The 100-year peak flow rate of 3.10 cfs from a 12" pipe was used.

$$D_{50} = 0.2D \left[\frac{Q}{(\sqrt{g})(D^{2.5})} \right]^{4/3} \left(\frac{D}{TW} \right)$$
$$D_{50} = 0.2(1 \text{ ft}) \left[\frac{3.10 \text{ cfs}}{\left(\sqrt{32.2 \text{ ft/s}^2} \right) (1 \text{ ft})^{2.5}} \right]^{4/3} \left(\frac{1 \text{ ft}}{0.25 \text{ ft}} \right) = 0.36 \text{ ft} = 4.3 \text{ in}$$

Use Class 2 $D_{50} = 6 \text{ in}$

Apron Length = $4D = 4(1 \text{ ft}) = 4 \text{ ft}$

Apron Depth = $3.3D_{50} = 1.65 \text{ ft}$, use 1.7 ft

Apron width is a function of the apron geometry. 5 ft was used.

STANDARD 2

Peak rate attenuation computations are presented in the HydroCAD output. See Appendices A, B, and C.

STANDARD 3

The project will add 24,292 sf of new impervious area to the site. The site consists of Hydrologic Soil Group (HSG) type A soils. The Required Recharge Volume (Rv) is:

$$F = 0.6''$$

$$Rv = F \times \text{impervious area}$$

$$Rv = \left(\frac{0.6''}{12''/ft} \right) (24,292 \text{ sf}) = 1,215 \text{ cf}$$

The proposed water quality swales are expected to accommodate the recharge requirement of the site. 4,128 cf of storage is provided.

Calculations for the drawdown of the water quality swales are shown below. A Rawls Rate of 2.41 inches/hour is used per Table 2.3.3. in *Volume 3: Documenting Compliance with the Massachusetts Stormwater Management Standards*.

$$\text{Time}_{\text{drawdown}} = \frac{Rv}{(K)(\text{BottomArea})}$$
$$\text{Time}_{1P} = \frac{1,215 \text{ cf}}{\left(\frac{2.41 \text{ in}}{\text{hr}} \right) \left(\frac{1 \text{ ft}}{12 \text{ in}} \right) (4,608 \text{ sf})} = 1.3 \text{ hr}$$

STANDARD 4

The Required Water Quality Volume (V_{WQ}) for the site is calculated below. The site is not classified as a LUHPPL, so the half-inch rule is used for this calculation:

$$V_{WQ} = \left(\frac{D_{WQ}}{12 \text{ in}/ft} \right) (A_{IMP})$$
$$V_{WQ} = \left(\frac{0.5 \text{ in}}{12 \text{ in}/ft} \right) (24,292 \text{ sf}) = 1,012 \text{ cf}$$

The proposed water quality swales are expected to provide the Water Quality Volume requirement of the site. 4,128 cf of storage is provided.

STANDARD 5

This site is not classified as a LUHPPL. As such, the half-inch rule was used when calculating the Required Water Quality Volume.

STANDARD 6

Not Applicable.

STANDARD 7

Not Applicable.

STANDARD 8

See Appendix D for Erosion & Sedimentation Control Plans.

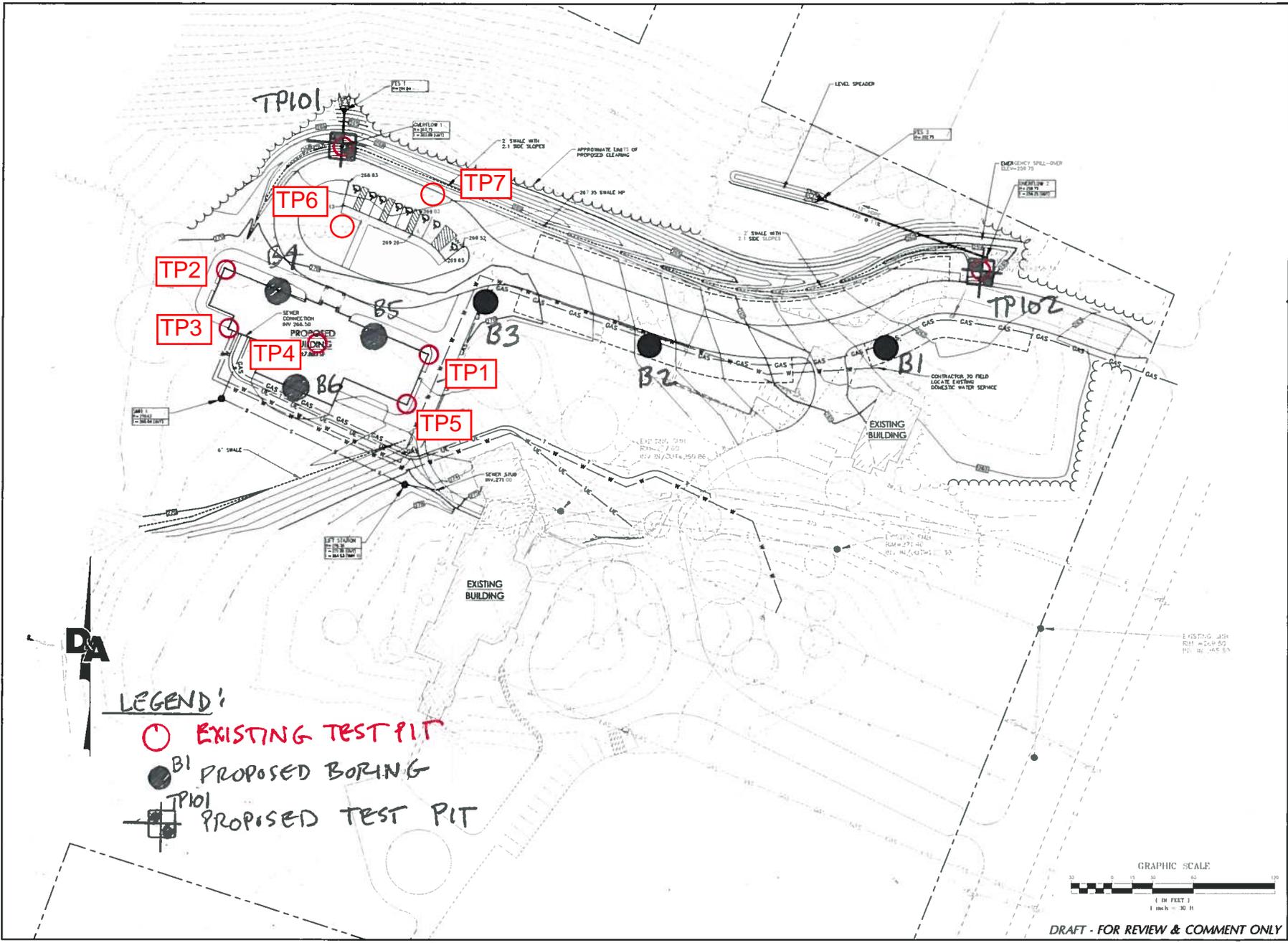
STANDARD 9

See Appendix D for the Long-Term Operation and Maintenance Plan.

STANDARD 10

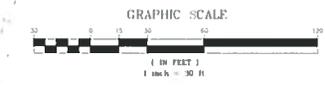
See Appendix G for the Illicit Discharge Compliance Statement.

APPENDIX F:
GEOTECHNICAL FIELD INVESTIGATION DATA



LEGEND:

- EXISTING TEST PIT
- B1 PROPOSED BORING
- ⊠ TP101 PROPOSED TEST PIT



DRAFT - FOR REVIEW & COMMENT ONLY

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PROPOSED BORINGS & TEST PITS

ID	DATE	BY	CHK
	1/8/15		

Berkshire Hills Music Academy
Performing Arts Building
 48 Woodbridge Street
 South Hadley, MA 01075

Site Grading & Utility Plan

Scale:	1" = 30'
Designed:	CST
Drawn:	JRS
Reviewed:	TJM
Date:	07/20/2015

SHEET
C-5
 5 of X
 Project No. 1491-001

Project Berkshire Hills Music Academy Performing Arts Building, South Hadley, MA
 Client Berkshire Hills Music Academy
 Contractor Seaboard Drilling, Inc.

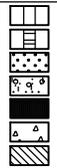
File No. 42826-000
 Sheet No. 1 of 1
 Start January 15, 2016
 Finish January 15, 2016

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	-	S	-	Rig Make & Model: Geoprobe-mounted 6620 DT
Inside Diameter (in.)	-	1 3/8	-	Bit Type: Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Hoist/Hammer: Automatic Hammer
Hammer Fall (in.)	-	30	-	PID Make & Model: None

H&A Rep. P. Dunaj
 Elevation 260.5 (est.)
 Datum NGVD 1929
 Location See Plan

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size [†] , structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test				
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0	2	S1	0.0	ML	259.3 1.2	Loose dark brown sandy SILT, with roots, no odor, dry	-	-	5	5	25	65				
3	3	16	2.0	SP		-TOPSOIL-	-	-	-	30	60	10				
3	3	S2	2.0	SP	257.0 3.5	Loose yellow-brown SAND, no odor, dry	-	-	5	20	25	10				
5	5	18	4.0	SP		Loose yellow-brown to brown SAND, no odor, dry										
10	13	S3	4.0	SW-SM	252.5 8.0	Medium dense brown SAND with gravel and silt, no odor, moist	5	15	5	10	25	40				
13	13	20	6.0	SW-SM		Similar to S3	5	15	5	10	25	40				
13	12	S4	6.0	SW-SM	252.4 8.1	-GLACIAL TILL-										
9	9	19	8.0	SW-SM												
20	20		8.0													
50/1		S5	8.0			Brown SHALE fragments										
		1	8.1			-PROBABLE TOP OF BEDROCK- BOTTOM OF EXPLORATION 8.1 FT										

H&A-TEST BORING-09 REV HA-LIB09-BOS-HAR.GLB HA-TB-CORE+WELL-07-2 W FENCE.GDT G:142826_BERKSHIRE MUSIC\000\GINT\42826-000_BORING.GPJ Jan 21, 16

Water Level Data				Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample			Overburden (ft) 8.1 Rock Cored (ft) - Samples 5S	Boring No. B1	
			Bottom of Casing Bottom of Hole Water						

Field Tests: Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

[†]Note: Maximum particle size is determined by direct observation within the limitations of sampler size.
 Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building, South Hadley, MA
 Client Berkshire Hills Music Academy
 Contractor Seaboard Drilling, Inc.

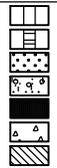
File No. 42826-000
 Sheet No. 1 of 1
 Start January 15, 2016
 Finish January 15, 2016

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	-	S	-	Rig Make & Model: Geoprobe-mounted 6620 DT
Inside Diameter (in.)	-	1 3/8	-	Bit Type:
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing:
				Hoist/Hammer: Automatic Hammer
				PID Make & Model: None

H&A Rep. P. Dunaj
 Elevation 265.0 (est.)
 Datum NGVD 1929
 Location See Plan

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size [†] , structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test				
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0	1	S1	0.0	ML		Loose dark brown sandy SILT, no odor, dry	-	-	5	5	25	65				
	1	20	2.0		264.0	-TOPSOIL-										
	1				1.0											
	1	S2	2.0	SP-SM		Loose orange-brown to light brown SAND, no odor, dry	-	-	5	10	75	10				
	1	18	4.0		261.5	-FILL-										
	3				3.5											
	5															
	7	S3	4.0	SW-SM		Medium dense brown SAND with silt and gravel, no odor, moist	5	15	10	10	30	30				
	8	9	5.1		260.0	-GLACIAL TILL-										
	50/1				5.0	SHALE fragments										
5					259.9	-PROBABLE TOP OF BEDROCK-										
					5.1	BOTTOM OF EXPLORATION 5.1 FT										

H&A-TEST BORING-09 REV HA-LIB09-BOS-HAR.GLB HA-TB-CORE+WELL-07-2 W FENCE.GDT G:\42826_BERKSHIRE MUSIC\000\GINT\42826-000_BORING.GPJ Jan 21, 16

Water Level Data				Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:			O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample		Overburden (ft)	Rock Cored (ft)
			Bottom of Casing	Bottom of Hole	Water				
								5.1	-
								3S	
								Boring No.	B2

Field Tests: Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

[†]Note: Maximum particle size is determined by direct observation within the limitations of sampler size.
 Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building, South Hadley, MA
 Client Berkshire Hills Music Academy
 Contractor Seaboard Drilling, Inc.

File No. 42826-000
 Sheet No. 1 of 1
 Start January 15, 2016
 Finish January 15, 2016

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	-	S	-	Rig Make & Model: Geoprobe-mounted 6620 DT
Inside Diameter (in.)	-	1 3/8	-	Bit Type: Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Hoist/Hammer: Automatic Hammer
Hammer Fall (in.)	-	30	-	PID Make & Model: None

H&A Rep. P. Dunaj
 Elevation 269.0 (est.)
 Datum NGVD 1929
 Location See Plan

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size [†] , structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test				
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0	1	S1	0.0	ML	268.1 0.9	Loose dark brown loamy sandy SILT, no odor, moist	-	-	5	5	25	65				
	2	16	2.0	SP-SM		Loose orange-brown to light brown SAND, no odor, dry	-	-	-	10	70	20				
	3					Similar to S1 below 0.9 ft										
	5	S2	2.0	SP-SM	266.0 3.0	-FILL-										
	35	17	4.0	SW		Loose light brown well-graded SAND with gravel and silt, no odor, dry	5	20	15	20	25	15				
	23			SW-SM	263.0 3.5	Dense red-brown silty SAND with gravel, no odor, dry	10	15	5	10	30	30				
	22	S3	4.0	SM	261.5 7.5	Similar to S2 below 3.5 ft, except moist and with perched groundwater from 5.0 to 6.0 ft	10	15	5	10	30	30				
	14	22	6.0	SW-SM		261.4 7.6	Medium dense gray sandy SILT with gray slate fragments at tip of sampler	10	20	5	5	10	50			
	13					-GLACIAL TILL-										
	12					-TOP OF BEDROCK-										
	10	S4	6.0	SM	261.4 7.6	BOTTOM OF EXPLORATION 7.6 FT										
	12	14	7.6													
	40															
	50/1															

H&A-TEST BORING-09 REV HA-LIB09-BOS-HAR.GLB HA-TB-CORE+WELL-07-2 W FENCE.GDT G:142826_BERKSHIRE MUSIC\000\GINT\42826-000_BORING.GPJ Jan 21, 16

Water Level Data				Sample ID	Well Diagram	Summary
Date	Time	Elapsed Time (hr.)	Depth (ft) to:	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample		Overburden (ft) 7.6 Rock Cored (ft) - Samples 4S Boring No. B3
			Bottom of Casing			
			Bottom of Hole			

Field Tests: Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

[†]Note: Maximum particle size is determined by direct observation within the limitations of sampler size.
 Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building, South Hadley, MA
 Client Berkshire Hills Music Academy
 Contractor Seaboard Drilling, Inc.

File No. 42826-000
 Sheet No. 1 of 1
 Start January 15, 2016
 Finish January 15, 2016

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	-	S	-	Rig Make & Model: Geoprobe-mounted 6620 DT
Inside Diameter (in.)	-	1 3/8	-	Bit Type:
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing:
				Hoist/Hammer: Automatic Hammer
				PID Make & Model: None

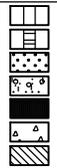
H&A Rep. P. Dunaj

Elevation 270.5 (est.)
 Datum NGVD 1929

Location See Plan

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size [†] , structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test							
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength			
0																			
1	1	S1	0.0	ML	269.8	Loose dark brown loamy sandy SILT with roots, no odor, moist	-	-	5	5	25	65							
3	3	17	2.0	SP-SM	0.7	-TOPSOIL-	-	-	-	10	70	20							
6	6					Loose orange-brown poorly-graded SAND with silt, no odor, dry													
					268.5	-SUBSOIL-													
17		S2	2.0	SW-SM	2.0	Dense light brown to brown well-graded SAND with gravel and silt, no odor, dry	10	15	10	20	25	20							
20		16	4.0																
16																			
21																			
50/3		S3	4.0		266.2	-GLACIAL TILL-													
		1	4.3		4.3	-TOP OF PROBABLE BEDROCK-													
						BOTTOM OF EXPLORATION 4.25ft													

H&A-TEST BORING-09 REV HA-LIB09-BOS-HAR.GLB HA-TB-CORE+WELL-07-2 W FENCE.GDT G:\42826_BERKSHIRE MUSIC\000\GINT\42826-000_BORING.GPJ Jan 21, 16

Water Level Data				Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:			O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample		Overburden (ft)	Rock Cored (ft)
			Bottom of Casing	Bottom of Hole	Water				
								4.25	-
									3S
								Boring No.	B4

Field Tests: Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

[†]Note: Maximum particle size is determined by direct observation within the limitations of sampler size.
 Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building, South Hadley, MA
 Client Berkshire Hills Music Academy
 Contractor Seaboard Drilling, Inc.

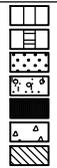
File No. 42826-000
 Sheet No. 1 of 1
 Start January 15, 2016
 Finish January 15, 2016

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	-	S	-	Rig Make & Model: Geoprobe-mounted 6620 DT
Inside Diameter (in.)	-	1 3/8	-	Bit Type: Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Hoist/Hammer: Automatic Hammer
Hammer Fall (in.)	-	30	-	PID Make & Model: None

H&A Rep. P. Dunaj
 Elevation 271.0 (est.)
 Datum NGVD 1929
 Location See Plan

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size [†] , structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test				
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0	1	S1	0.0	ML		Loose dark brown loamy sandy SILT with roots, no odor, dry	-	-	-	10	30	60				
	1	14	2.0	SP	270.2	-TOPSOIL-										
	1				0.8	Orange-brown poorly-graded SAND, no odor, dry	-	-	-	10	70	20				
	5	S2	2.0			Gray to red-brown silty SAND with gravel, no odor, dry										
	8	18	4.0	SM	268.5	-FILL-	5	20	5	10	20	40				
	15				2.5	Medium dense gray to red-brown silty SAND with gravel, no odor, dry										
	16															
	21	S3	4.0	SM		Similar to S2 below 2.5 ft, except wet below 5.0 ft.	5	20	5	10	20	40				
	16	21	6.0													
	13															
	12															
5	17	S4	6.0	SM		Medium dense red-brown silty SAND with gravel, no odor, wet to 7.0 ft	5	15	10	10	30	30				
	17	22	8.0													
	12															
	17															
					263.0	-GLACIAL TILL-										
	50/1	S5	8.0		8.0	SHALE fragments										
		1	8.1		262.9	-PROBABLE BEDROCK-										
					8.1	BOTTOM OF EXPLORATION 8.1 FT										

H&A-TEST BORING-09 REV HA-LIB09-BOS-HAR.GLB HA-TB-CORE+WELL-07-2 W FENCE.GDT G:\42826_BERKSHIRE MUSIC\000\GINT\42826-000_BORING.GPJ Jan 21, 16

Water Level Data				Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:			O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample		Overburden (ft)	Rock Cored (ft)
			Bottom of Casing	Bottom of Hole	Water				
								8.1	-
									5S
								Boring No.	B5

Field Tests: Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

[†]Note: Maximum particle size is determined by direct observation within the limitations of sampler size.
 Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building, South Hadley, MA
 Client Berkshire Hills Music Academy
 Contractor Seaboard Drilling, Inc.

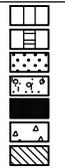
File No. 42826-000
 Sheet No. 1 of 1
 Start January 15, 2016
 Finish January 15, 2016

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	-	S	-	Rig Make & Model: Geoprobe-mounted 6620 DT
Inside Diameter (in.)	-	1 3/8	-	Bit Type:
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing:
				Hoist/Hammer: Automatic Hammer
				PID Make & Model: None

H&A Rep. P. Dunaj
 Elevation 272.0 (est.)
 Datum NGVD 1929
 Location See Plan

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size [†] , structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test				
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0	2	S1	0.0	ML	271.4	Loose dark brown loamy sandy SILT with roots, no odor, moist	-	-	5	5	25	65				
	1	18	2.0	SP-SM	0.6	-TOPSOIL-	-	-	-	10	65	25				
	1					Orange-brown to brown poorly-graded SAND and silt, moist										
	5	S2	2.0	SP-SM	269.0	Loose orange-brown to brown poorly-graded SAND and silt, no odor, moist	-	-	-	10	70	20				
	6	16	4.0	SM		-FILL-										
	15				3.0	Medium dense red-brown gravelly SAND with silt, no odor, dry	10	20	10	15	20	25				
	22															
	10	S3	4.0	SM		Similar to S2 below 3.0 ft	10	20	10	15	20	25				
	4	14	6.0													
	12															
	8															
	20	S4	6.0	SM	265.5	Similar to S3	10	20	10	15	20	25				
	50/1	4	6.5		6.5	-GLACIAL TILL-										
					265.4	SHALE fragments										
					6.6	-TOP OF PROBABLE BEDROCK- -BOTTOM OF EXPLORATION 6.6 FT										

H&A-TEST BORING-09 REV HA-LIB09-BOS-HAR.GLB HA-TB-CORE+WELL-07-2 W FENCE.GDT G:\42826_BERKSHIRE MUSIC\000\GINT\42826-000_BORING.GPJ Jan 21, 16

Water Level Data				Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:			O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample		Overburden (ft)	Rock Cored (ft)
			Bottom of Casing	Bottom of Hole	Water				
								6.6	-
								4S	
								Boring No.	B6

Field Tests: Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

[†]Note: Maximum particle size is determined by direct observation within the limitations of sampler size.
 Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building
Location 48 Woodbridge Street, South Hadley, MA
Client Berkshire Hills Music Academy
Contractor Seaboard Drilling, Inc.
Equipment Used Mini Excavator

File No. 42826-000
H&A Rep P. Dunaj
Date 15 Jan 2016
Weather Clear, 30's

Ground El.: 267.0 (est.)
El. Datum: NGVD 1929

Location: See Plan

Groundwater depths/entry rates (in./min.): NOT OBSERVED

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests				
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0			ML	Dark brown loamy sandy SILT with roots, no odor, dry	-	-	-	10	25	65				
1		265.7		-TOPSOIL-										
		1.3	SP- SM	Orange-brown poorly-graded SAND and silt, no odor, dry	-	-	5	5	60	30				
				-SUBSOIL-										
2		265.0	SM	Gray SILT with sand and gravel, no odor, dry	10	15	5	5	15	50				
		2.0		-GLACIAL TILL-										
		264.5		-TOP OF BEDROCK- BOTTOM OF EXPLORATION 2.5 FT										
		2.5												

Obstructions: -

Remarks: -

Field Tests			
Dilatancy	R - Rapid	S - Slow	N - None
Toughness	L - Low	M - Medium	H - High
Plasticity	N - Nonplastic L - Low M - Medium H - High		
Dry Strength	N - None	L - Low	M - Medium H - High V - Very High

Standing Water in Completed Pit
 at depth NOT OBSERVED ft
 measured after _____ hours elapsed

Boulders
 Diameter (in.) Number Approx. Vol. (cu.ft)
 12 to 24 =
 over 24 =

Test Pit Dimensions (ft)
 Pit Length x Width (ft) 6x3
 Pit Depth (ft) 2.5

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building
Location 48 Woodbridge Street, South Hadley, MA
Client Berkshire Hills Music Academy
Contractor Seaboard Drilling, Inc.
Equipment Used

File No. 42826-000
H&A Rep P. Dunaj
Date 14 Jan 2016
Weather

Ground El.: 260.0 (est.)
El. Datum: NGVD 1929

Location: See Plan

Groundwater depths/entry rates (in./min.):

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests				
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0			ML	Dark brown loamy sandy SILT with roots, no odor, dry	-	-	-	10	20	70				
		258.8 1.2		-TOPSOIL-										
			SP- SM	Yellow-brown poorly-graded SAND, no odor, dry	-	-	-	15	70	15				
2				-SUBSOIL-										
		257.2 2.8		-SUBSOIL-										
			SP	Light brown poorly-graded SAND, no odor, dry	-	-	5	15	70	10				
4				-GLACIO FLUVIAL DEPOSITS-										
		252.8 7.2		-GLACIAL TILL-										
			SW- SM	Red-brown well-graded SAND with gravel and silt, no odor, moist	10	15	10	20	20	25				
6				-GLACIO FLUVIAL DEPOSITS-										
		252.0 8.0		-GLACIAL TILL-										
8				-TOP OF BEDROCK- BOTTOM OF EXPLORATION 8.0 FT										

Obstructions: -	Remarks: -	Field Tests			
		Dilatancy	R - Rapid	S - Slow	N - None
		Toughness	L - Low	M - Medium	H - High
		Plasticity	N - Nonplastic L - Low M - Medium H - High		
		Dry Strength	N - None L - Low M - Medium H - High V - Very High		

Standing Water in Completed Pit			Boulders			Test Pit Dimensions (ft)	
at depth	7.5	ft	Diameter (in.)	Number	Approx. Vol. (cu.ft)	Pit Length x Width (ft) 10x3	
measured after	0.5	hours elapsed	12 to 24	=	=	Pit Depth (ft) 8.0	
			over 24	=	=		

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building
Location 48 Woodbridge Street, South Hadley, MA
Client Berkshire Hills Music Academy
Contractor Seaboard Drilling, Inc.
Equipment Used Rubber Tire Excavator

File No. 42826-000
H&A Rep P. Dunaj
Date 4 Nov 2015
Weather Sunny, 40's

Ground El.: 271.0 (est.)
El. Datum: NGVD 1929

Location: See Plan

Groundwater depths/entry rates (in./min.):

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests								
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength				
0			ML	-TOPSOIL-														
0.6		270.4	SP- SM	Orange-brown SAND with silt, no odor, dry	-	-	5	35	40	20								
3				-GLACIOFLUVIAL DEPOSITS-														
3.5		267.5	SM	Red-brown SAND with silt and gravel, no odor, dry	-	20	5	10	40	25								
6		265.0		-GLACIAL TILL-														
6.0		264.7		Gray shale														
6.3				-BEDROCK- BOTTOM OF EXPLORATION 6.3 FT														

Obstructions: -

Remarks: -

Field Tests			
Dilatancy	R - Rapid	S - Slow	N - None
Toughness	L - Low	M - Medium	H - High
Plasticity	N - Nonplastic L - Low M - Medium H - High		
Dry Strength	N - None	L - Low	M - Medium H - High V - Very High

Standing Water in Completed Pit
 at depth NOT OBSERVED ft
 measured after _____ hours elapsed

Boulders
 Diameter (in.) Number Approx. Vol. (cu.ft)
 12 to 24 =
 over 24 =

Test Pit Dimensions (ft)
 Pit Length x Width (ft)
 Pit Depth (ft) 6.3

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building
Location 48 Woodbridge Street, South Hadley, MA
Client Berkshire Hills Music Academy
Contractor Seaboard Drilling, Inc.
Equipment Used

File No. 42826-000
H&A Rep P. Dunaj
Date
Weather

Ground El.: 270.0 (est.) **Location:** See Plan **Groundwater depths/entry rates (in./min.):** NOT OBSERVED
El. Datum: NGVD 1929

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests								
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength				
0			ML	-TOPSOIL-														
1		269.0 1.0	SM	Brown silty SAND, no odor, dry	-	-	-	-	80	20								
2				-GLACIOFLUVIAL DEPOSITS-														
3		267.3 2.7		Red-brown SAND with silt and gravel, no odor, dry	-	20	5	10	40	25								
		266.5 3.5		-GLACIAL TILL- Gray shale														
		266.2 3.8		-BEDROCK- BOTTOM OF EXPLORATION 3.8 FT														

Obstructions: -	Remarks: -	Field Tests	
		Dilatancy	R - Rapid S - Slow N - None
		Toughness	L - Low M - Medium H - High
		Plasticity	N - Nonplastic L - Low M - Medium H - High
		Dry Strength	N - None L - Low M - Medium H - High V - Very High

Standing Water in Completed Pit		Boulders			Test Pit Dimensions (ft)	
at depth	NOT OBSERVED ft	Diameter (in.)	Number	Approx. Vol. (cu.ft)	Pit Length x Width (ft)	
measured after	hours elapsed	12 to 24	=	=	Pit Depth (ft) 3.8	
		over 24	=	=		

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building
Location 48 Woodbridge Street, South Hadley, MA
Client Berkshire Hills Music Academy
Contractor Seaboard Drilling, Inc.
Equipment Used

File No. 42826-000
H&A Rep P. Dunaj
Date
Weather

Ground El.: 271.0 (est.)
El. Datum: NGVD 1929

Location: See Plan

Groundwater depths/entry rates (in./min.):

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests								
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength				
0			ML	-TOPSOIL-														
1		269.5																
1.5		1.5	SP	Orange-brown SAND with gravel, stratified, no odor, dry	5	15	5	15	50	10								
2																		
3																		
4																		
5		266.0																
5.0		5.0	SM	Red-brown SAND with silt and gravel, no odor, dry	-	20	5	10	40	25								
5.5		265.5																
6		5.5		Gray shale														
		264.6																
		6.4		-BEDROCK- BOTTOM OF EXPLORATION 6.4 FT														

Obstructions: -

Remarks: -

Field Tests			
Dilatancy	R - Rapid	S - Slow	N - None
Toughness	L - Low	M - Medium	H - High
Plasticity	N - Nonplastic L - Low M - Medium H - High		
Dry Strength	N - None	L - Low	M - Medium H - High V - Very High

Standing Water in Completed Pit
 at depth NOT OBSERVED ft
 measured after _____ hours elapsed

Boulders
 Diameter (in.) Number Approx. Vol. (cu.ft)
 12 to 24 =
 over 24 =

Test Pit Dimensions (ft)
 Pit Length x Width (ft)
 Pit Depth (ft) 6.4

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building
Location 48 Woodbridge Street, South Hadley, MA
Client Berkshire Hills Music Academy
Contractor Seaboard Drilling, Inc.
Equipment Used

File No. 42826-000
H&A Rep P. Dunaj
Date
Weather

Ground El.: 271.0 (est.)
El. Datum: NGVD 1929

Location: See Plan

Groundwater depths/entry rates (in./min.):

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests								
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength				
0			ML	-TOPSOIL-														
		270.2 0.8	SP- SM	Orange-brown poorly-graded SAND with silt	-	-	5	20	60	15								
2																		
				-GLACIOFLUVIAL DEPOSITS-														
4		267.0 4.0	SM	Red-brown SAND with silt and gravel, no odor, dry	-	20	5	10	40	25								
				-GLACIAL TILL-														
		263.5 7.5		Gray shale														
		263.0 8.0		-BEDROCK- BOTTOM OF EXPLORATION 8.0 FT														

Obstructions: -

Remarks: -

Field Tests	
Dilatancy	R - Rapid S - Slow N - None
Toughness	L - Low M - Medium H - High
Plasticity	N - Nonplastic L - Low M - Medium H - High
Dry Strength	N - None L - Low M - Medium H - High V - Very High

Standing Water in Completed Pit		
at depth	7.5	ft
measured after	0.2	hours elapsed

Boulders		
Diameter (in.)	Number	Approx. Vol. (cu.ft)
12 to 24	=	
over 24	=	

Test Pit Dimensions (ft)	
Pit Length x Width (ft)	
Pit Depth (ft)	7.5

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building
Location 48 Woodbridge Street, South Hadley, MA
Client Berkshire Hills Music Academy
Contractor Seaboard Drilling, Inc.
Equipment Used

File No. 42826-000
H&A Rep P. Dunaj
Date
Weather

Ground El.: 272.0 (est.)
El. Datum: NGVD 1929

Location: See Plan

Groundwater depths/entry rates (in./min.):

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests								
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength				
0			ML	-TOPSOIL-														
1		271.0 1.0	SP	Orange-brown SAND, dry	-	-	-	20	70	10								
2																		
3																		
4		268.0 4.0 267.8 4.2	SM	Red-brown SAND with silt and gravel, no odor, dry -GLACIAL TILL- Gray shale	-	20	5	10	40	25								
5		267.0 5.0		-BEDROCK- BOTTOM OF EXPLORATION 5.0 FT														

Obstructions: -

Remarks: -

Field Tests

Dilatancy	R - Rapid	S - Slow	N - None
Toughness	L - Low	M - Medium	H - High
Plasticity	N - Nonplastic L - Low M - Medium H - High		
Dry Strength	N - None	L - Low	M - Medium H - High V - Very High

Standing Water in Completed Pit
 at depth NOT OBSERVED ft
 measured after _____ hours elapsed

Boulders

Diameter (in.)	Number	Approx. Vol. (cu.ft)
12 to 24	=	
over 24	=	

Test Pit Dimensions (ft)
 Pit Length x Width (ft)
 Pit Depth (ft) 5.0

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

HA-TESTPIT-07-1 HA-LIB09-BOS-HAR-GLB HA-TP07-1.GDT G:\42826_BERKSHIRE MUSIC\000\GINT\42826-000_PIT.GPJ Jan 21, 16

Project Berkshire Hills Music Academy Performing Arts Building
Location 48 Woodbridge Street, South Hadley, MA
Client Berkshire Hills Music Academy
Contractor Seaboard Drilling, Inc.
Equipment Used

File No. 42826-000
H&A Rep P. Dunaj
Date
Weather

Ground El.: 268.0 (est.)
El. Datum: NGVD 1929

Location: See Plan

Groundwater depths/entry rates (in./min.):

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests								
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength				
0			ML	-TOPSOIL-														
1		267.1 0.9	SP	Orange-brown SAND, dry	-	-	-	20	70	10								
2		265.8 2.2	SM	-GLACIOFLUVIAL DEPOSITS- Red-brown SAND with silt and gravel, no odor, dry	-	20	5	10	40	25								
3		264.5 3.5		-GLACIAL TILL- Gray shale														
		264.0 4.0		-BEDROCK- BOTTOM OF EXPLORATION 4.0 FT														

Obstructions: -

Remarks: -

Field Tests			
Dilatancy	R - Rapid	S - Slow	N - None
Toughness	L - Low	M - Medium	H - High
Plasticity	N - Nonplastic L - Low M - Medium H - High		
Dry Strength	N - None	L - Low	M - Medium H - High V - Very High

Standing Water in Completed Pit
 at depth NOT OBSERVED ft
 measured after _____ hours elapsed

Boulders
 Diameter (in.) Number Approx. Vol. (cu.ft)
 12 to 24 =
 over 24 =

Test Pit Dimensions (ft)
 Pit Length x Width (ft)
 Pit Depth (ft) 3.8

NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

Project Berkshire Hills Music Academy Performing Arts Building
Location 48 Woodbridge Street, South Hadley, MA
Client Berkshire Hills Music Academy
Contractor Seaboard Drilling, Inc.
Equipment Used

File No. 42826-000
H&A Rep P. Dunaj
Date
Weather

Ground El.: 266.0 (est.) **Location:** See Plan **Groundwater depths/entry rates (in./min.):**
El. Datum: NGVD 1929

Depth (ft)	Sample ID	Stratum Change Elev./Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (color, natural grain size and artificial component percentage estimates, maximum particle size, manual test properties, structure, odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Tests								
					% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength				
0			ML	-TOPSOIL-														
		265.4 0.6	SP	Orange-brown SAND, dry	-	-	-	20	70	10								
1																		
2		264.0 2.0	SM	-GLACIOFLUVIAL DEPOSITS- Red-brown SAND with silt and gravel, no odor, dry	-	20	5	10	40	25								
3																		
4		262.3 3.8		-GLACIAL TILL- Gray shale														
		262.0 4.0		-BEDROCK- BOTTOM OF EXPLORATION 4.0 FT														

Obstructions: -	Remarks: -	Field Tests
		Dilatancy R - Rapid S - Slow N - None Toughness L - Low M - Medium H - High Plasticity N - Nonplastic L - Low M - Medium H - High Dry Strength N - None L - Low M - Medium H - High V - Very High

Standing Water in Completed Pit at depth NOT OBSERVED ft measured after _____ hours elapsed	Boulders Diameter (in.) Number Approx. Vol. (cu.ft) 12 to 24 = over 24 =	Test Pit Dimensions (ft) Pit Length x Width (ft) Pit Depth (ft) 4.0
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NOTE: Soil identification based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

HA-TESTPIT-07-1 HA-LIB09-BOS-HAR-GLB HA-TP07-1.GDT G:\42826_BERKSHIRE MUSIC\000\GINT\42826-000_PIT.GPJ Jan 21, 16

APPENDIX G:
ILLCIT DISCHARGE COMPLIANCE STATEMENT

ILLICIT DISCHARGE COMPLIANCE STATEMENT
Berkshire Hills Music Academy – Bernon Music Center
48 Woodbridge Street, South Hadley, MA

In order to satisfy the requirements of the Massachusetts Department of Environmental Protection Stormwater Standard No. 10, this Illicit Discharge Statement is being submitted as verification that there appear to be no illicit discharges currently occurring at the site and also to prevent any possible future illicit discharges to the stormwater management system serving the site.

Recent visits to the project site have revealed that there are no known or suspected illicit discharges that are conveyed to or through the stormwater management system at the project site. As part of these site visits, the developed portions of the property – in particular the stormwater collection system - were observed for any evidence of ongoing or historic illicit discharges. No such evidence was found.

There are no known wastewater discharges, process wastes, raw materials, toxic pollutants, hazardous substances, oil, grease or other petroleum based substances present on the site that comingle with the stormwater runoff from the site.

Measures to prevent any possible future illicit discharges have been implemented as part of the Operation and Maintenance Plan.



Stamp of signing professional Engineer

Registered Professional Engineer

1/22/2016

Date