Acton Water District

Kennedy and Marshall Wells
Water Treatment Plant

Stormwater Management Plan

August 2007

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STORMWATER MANAGEMENT PLAN

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SECTION 1

INTRODUCTION

1.1 STORMWATER MANAGEMENT PLAN APPROACH

The Acton Water District (AWD) provides water to its consumers from twenty-one sources located within the Town of Acton. The subject of this analysis involves two of these wells, the Kennedy and Marshall Wells. The Kennedy well and associated treatment facility is located on a 60+ acre parcel owned by the AWD located west of Route 27 in the northern portion of Acton. This parcel was formerly part of the adjacent sand and gravel mining operations. The Marshall well is located several hundred feet away on the east side of Route 27 on a 10+ acre parcel owned by the AWD.

The proposed improvements include construction of a new water treatment plant (WTP) to facilitate the removal of iron, manganese, color and naturally-occurring organic matter at the Kennedy and Marshall Wells. The new building, to be located on the on the Kennedy well parcel, will have a 6,800± square foot (s.f.) footprint. Two sand filter/lagoons for filtering the effluent from the plant will be located adjacent to the building, totaling approximately 3,000 s.f. Additionally, there will be approximately 11,000 s.f. of gravel surface added to create parking and driveways associated with the new building.

This Stormwater Management Plan is prepared per the Stormwater Management Volume One: Stormwater Policy Handbook as prepared by the Massachusetts Department of Environmental Protection. The information in this Stormwater Management Plan covers the handling of stormwater during the construction phase of the project and identifies design features that will provide treatment of the stormwater prior to discharge throughout the life of the project.

1.2 ORGANIZATION OF THE SWMP

This SWMP was prepared to comply with the requirements for the nine Standards as required for the Notice of Intent and approval by the local Conservation Commission.

Standard #1:	Untreated Stormwater
Standard #2:	Post-development Peak Discharge Rates
Standard #3:	Recharge to Groundwater
Standard #4:	80% TSS Removal
Standard #5:	Higher Potential Pollutant Loads
Standard #6:	Protection of Critical Areas
Standard #7:	Re-development Projects
Standard #8:	Erosion/Sedimentation Controls
Standard #9:	Operation/Maintenance Plan

This information is presented herein under the following report format:

Section 2:	Untreated Stormwater
Section 3:	Pre and Post Development Runoff Calculations
Section 4:	Recharge to Groundwater
Section 5:	Stormwater Quality Provisions
Section 6:	Higher Potential Pollutant Loads
Section 7:	Protection of Critical Areas
Section 8:	Re-Development Projects
Section 9:	Erosion/Sedimentation Control Plan
Section 10:	Operation/Maintenance Plan

SECTION 2

UNTREATED STORMWATER

2.1 EXISTING CONDITIONS

The existing Kennedy and Marshall wells are located west and east of Route 27, respectively. The Kennedy well is located on property owned by the AWD, formerly part of the adjacent sand and gravel mining operations. Due to changes in topography from the previous use, the watershed in which the Water Treatment Plant is proposed is a self-contained watershed that relies on infiltration as the primary outlet for stormwater. The highly permeable soils of the area allow for infiltration of the runoff, providing recharge to the groundwater aquifer. A low area within this 5.8-acre watershed acts as storage during large storm events while runoff continues to infiltrate.

A portion of the site is located within the 100-year floodplain of the Butter and Nashoba Brooks. The Flood Insurance Rate Maps indicate that the floodplain, also known as the floodway fringe, is located at elevation 174 feet in this area.

2.2 NEW STORMWATER CONVEYANCES

The stormwater plan has been designed to meet the requirements of Stormwater Management Policy. All stormwater in this watershed will continue to infiltrate to groundwater so there will be no surface discharge from this watershed. Therefore, the stormwater flows leaving the site will not exceed pre-development runoff rates after construction and will meet the water quality criteria.

Roof runoff from water treatment plant will be directed to a drywell. New parking and driveway areas associated with the proposed water treatment facility will be gravel. The sand filters/lagoons are intended to filter effluent from the water treatment plant and no runoff will enter the lagoons. Once filtered, this water plus any direct rainfall will flow into an infiltration trench.

SECTION 3

PRE AND POST DEVELOPMENT RUNOFF ANALYSIS

3.1 EXISTING SITE DESCRIPTION

The Kennedy and Marshall wells are located on approximately 60 and 10 acre properties, respectively. The properties are approximately 1,200 feet north of the confluence of the Nashoba and Butter Brooks. Portions of the project site are located within the 100-year floodplain of these brooks. Several wetlands are located in this area also; however, the watershed of the proposed project site is not hydraulically connected to these resources.

3.2 SOILS

Soils in the area surrounding the facility are classified by the United States Natural Resource Conservation Service (formerly Soil Conservation Service) as belonging to the Hinckley Series and Udorthents. The Hinckley soils are primarily deep, well drained to excessively well drained sands and gravelly sands. Hinkley Soils are classified as belonging to Hydrologic Soil Group 'A'. Udorthents are typically non-native fill materials with varying characteristics. The Udorthents at this location have been identified as sandy materials belonging to Hydrologic Soil Group 'B', which are moderately to well-drained soils.

3.3 GENERAL METHODOLOGY

The stormwater management system has been designed in accordance with the guidelines included in Volume Two: Stormwater Technical Handbook, prepared by the MA Department of Environmental Protection and the MA Office of Coastal Zone Management. The site has been analyzed for pre-development and post-development runoff corresponding to the 2 and 10 year storms. The hydrologic analysis was performed using a computer software package called HydroCAD, which mimics closely the standard methodologies TR-20 and TR-55 as developed by the USDA Soil Conservation Service.

3.4 STORMWATER QUANTITY ANALYSIS AND DESIGN

Existing Conditions The model for existing conditions was established to determine flow at the previously mentioned discharge point from the site. The total drainage area analyzed is approximately 5.8 acres. Field visits were performed to determine the existing drainage paths and areas, and to verify topographic information.

The watershed consists of densely wooded areas and weed/brush areas with poor ground cover. The infiltration rate of the storage area is based on the soil type for the area. Soils defined as hydrologic soil group B is defined as having an infiltration rate of 0.15 to 0.3 inches per hour when wet; therefore, the infiltration rate for this site was conservatively estimated to be 0.15 inches per hour. The analysis indicates the following peak rates of pre-development runoff from the site and the maximum water surface elevation in the storage area.

Existing Conditions Summary						
Analysis Point	**2-Year Storm**		**10-Year Storm**		**100-Year Storm**	
	Peak Rate of Runoff (cfs)	Maximum Water Surface Elevation (ft)	Peak Rate of Runoff (cfs)	Maximum Water Surface Elevation (ft)	Peak Rate of Runoff (cfs)	Maximum Water Surface Elevation (ft)
1P (Exfiltration)	0.04	171.55	0.81	172.01	4.19	172.52

The stormwater runoff calculations for the predevelopment condition can be found in Appendix A along with the drainage area boundary map.

Proposed Conditions In the post-development stormwater model, the existing conditions watershed boundary is divided into three (3) subcatchment areas. A separate subcatchment was created for both the roof runoff and the sand filter/lagoons. The rest of the watershed will remain the same as in existing condition with the exception of changes to the land cover and minor grading. No outlet from the watershed will be created in proposed conditions; therefore, all of the stormwater from this watershed will continue to infiltrate to groundwater.

The combined area of the three subcatchments is approximately 5.8 acres. There will be a slight increase in the volume of runoff created due to the addition of gravel and impervious surfaces; however, the existing storage area has sufficient capacity to detain this change in volume. The maximum elevation of the storage area is 174 feet. Under proposed conditions, the maximum water surface elevation during a 100-year storm event is 172.61 feet, which is a negligible increase over existing conditions. The analysis of the proposed conditions indicates the following peak rates of runoff from the site (infiltration) and the maximum water surface elevation in the storage area.

Proposed Conditions Summary						
Analysis Point	**2-Year Storm**		**10-Year Storm**		**100-Year Storm**	
	Peak Rate of Runoff (cfs)	Maximum Water Surface Elevation (ft)	Peak Rate of Runoff (cfs)	Maximum Water Surface Elevation (ft)	Peak Rate of Runoff (cfs)	Maximum Water Surface Elevation (ft)
1P (Exfiltration)	0.07	171.71	1.08	172.08	4.79	172.61
2P (Dry well)	0.69	N/A	1.01	N/A	1.46	N/A
3R (Infiltration)	0.35	N/A	0.51	N/A	0.73	N/A

The stormwater runoff calculations for the post-development condition can be found in Appendix A along with the drainage area boundary map.

SECTION 4

RECHARGE TO GROUNDWATER

4.1 GROUNDWATER RECHARGE

Maintaining recharge levels for the well site is extremely important to the long term use of the site as a drinking water source for the Town. The proposed design has taken advantage of minimizing impacts to the existing site which would alter current groundwater patterns in the area. Creating an outlet from this watershed to any of the surrounding wetlands may have resulted in a decrease in the volume of stormwater being infiltrated. The proposed plan calls for all of the stormwater from this watershed to continue to be infiltrated as it is in existing conditions.

4.2 SOIL TYPES

Soils in the area surrounding the facility are classified by the United States Natural Resource Conservation Service (formerly Soil Conservation Service) as belonging to the Hinckley Series and Udorthents. The Hinckley soils are primarily deep, well drained to excessively well drained sands and gravelly sands. Hinkley Soils are classified as belonging to Hydrologic Soil Group 'A'. Udorthents are typically non-native fill materials with varying characteristics. The Udorthents at this location have been identified as sandy materials belonging to Hydrologic Soil Group 'B', which are moderately to well-drained soils.

4.3 INFILTRATION BEST MANAGEMENT PRACTICES

The infiltration best management practices (BMPs) proposed for this project include the following measures:

- Dry Well
- Infiltration Basin

SECTION 5

STORMWATER QUALITY PROVISIONS

5.1 STORMWATER QUALITY PROVISIONS

The proposed project will use infiltration as the primary method to meet the total suspended solids removal goal for the site. The roof runoff from the proposed building will be directed to a drywell for treatment and recharge to groundwater. Direct rainfall on the sand filter/lagoons will flow into infiltration trenches and runoff from the remainder of the watershed will be infiltrated in the existing storage area.

5.2 TSS REMOVAL BEST MANAGEMENT PRACTICES

The TSS removal best management practices (BMPs) proposed for this project includes the following measures:

- Improved condition of vegetative cover;
- Use of permeable (gravel) parking areas and driveways;
- Directing the runoff from the roof of the building to an infiltration basin; and
- Maintaining infiltration of the entire watershed.

5.3 TSS REMOVAL CALCULATION

The State of Massachusetts requires that BMPs are selected such that a total of 80% TSS removal is provided for each drainage area. Note that because the only outlet from this watershed is infiltration, there will be no TSS leaving the watershed.

SECTION 6

HIGHER POTENTIAL POLLUTANT LOADS

The Massachusetts Department of Environmental Protection has identified certain land uses which generate higher concentrations of pollutants than found in typical runoff. The construction of the new water treatment building and associated additional gravel area are not land uses which would trigger higher potential pollutant loads.

SECTION 7

PROTECTION OF CRITICAL AREAS

The highly permeable soils and the existing storage area will allow all of the runoff from the watershed to continue to infiltrate and recharge groundwater, including any increase created by the proposed development. Because no hydraulic connections to the adjacent wetlands will be created with this project, no impact to these resources is anticipated.

During construction, the wetlands will be protected with the proper erosion controls as outlined in Section 9.

SECTION 8

RE-DEVELOPMENT PROJECTS

The proposed improvements to the Acton Water District Kennedy Well site do not qualify as a redevelopment project. Although this is an expansion of the current use at the site, the project will result in a net increase in impervious area with the construction of the new building.

SECTION 9

EROSION/SEDIMENTATION CONTROL PLAN

9.1 IMPLEMENTATION OF EROSION AND SEDIMENTATION CONTROLS

Prior to the start of any earthwork on the site, the sedimentation and erosion control barriers will be installed. Section 9.3 provides a listing of controls and a sequence of construction.

9.2 INSPECTION AND MAINTENANCE OF STORMWATER CONTROLS

Stormwater controls must be maintained in good operating condition until all disturbed soils are permanently stabilized. To ensure this, the following areas will be inspected by the Resident Engineer once every two weeks and after every rainfall event of 0.5 inches or greater:

The following standard maintenance practices will apply to the erosion and sedimentation controls for the project:

- All erosion and sediment control measures will be properly maintained. If repairs or other maintenance is necessary, it will be initiated by the Contractor within 24 hours of report;

- Silt fence will be inspected for depth of sediment, tears, to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground;

- Built up sediment will be removed from silt fence when it has reached one-third the height of the fence and at end of the job;

- The existing stabilized entrance on the adjacent Gravel Haul Road (at the intersection of Route 27), will be maintained throughout construction;

- Erosion control measures will be maintained for disturbed areas of the site that have not been stabilized;

- Erosion control measures will be installed and maintained for the construction staging area, fueling area, stockpiles, and material storage areas until those areas have been stabilized after construction; and,

- Temporary and permanent seeding and planting will be inspected for bare spots, washouts, and healthy growth.

If the inspections reveal the need for additional control devices to prevent erosion and sedimentation, the Contractor will promptly install additional protection devices as required. Control devices in need of repair will be repaired promptly after identification. A stockpile of 300 linear feet of silt fence will be maintained on the site and under cover for emergency repairs and routine maintenance.

The Owner (or their representative) will be responsible for preparing an inspection and maintenance report (Attached in Appendix B) following each inspection and filing completed reports after maintenance action has taken place by the Contractor. The Contractor's superintendent will be responsible for maintenance and repair activities and completing and signing the maintenance action part of inspection and maintenance reports.

9.3 STORMWATER CONTROLS FOR CONSTRUCTION PERIOD

PROJECT SCHEDULE:

The project construction phasing will generally proceed in the following sequence:

1. Installation of sedimentation/erosion control barriers at the down-gradient limit of work.

2. Excavation and site preparation.

3. Building construction and pipe installation

4. Loaming and hydroseeding disturbed areas as construction on those areas is completed.

5. Inspection of seeding success and removal of sedimentation/erosion control barriers once permanent stabilization has become established pursuant to the specifications and satisfaction of the Resident Engineer.

EROSION AND SEDIMENT CONTROLS:

1. Temporary stabilization measures shall be instituted to minimize effects of sedimentation and erosion during construction.

2. Permanent stabilization measures shall be employed to minimize effects of sedimentation and erosion after the completion of construction. Detailed information is included in Specification Section 02485 - Loaming and Seeding attached in Appendix D.

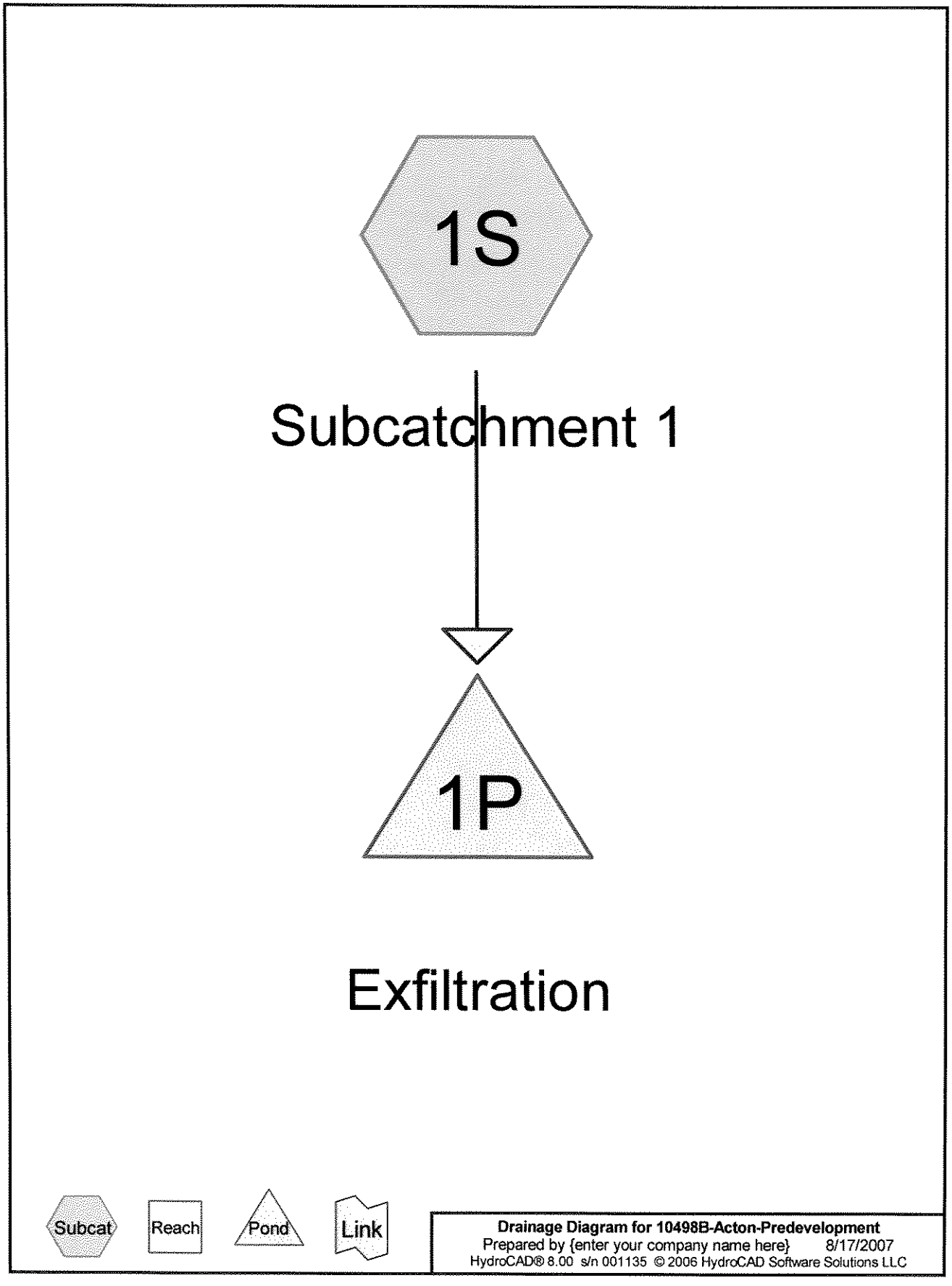
SECTION 10

OPERATION/MAINTENANCE PLAN

The inspection and maintenance forms for the project can be found in Appendix B of this report. The forms address the required controls required by the Contractor during the construction phase and the responsibilities of the owner upon completion of construction.

APPENDIX A

HydroCAD Drainage Model Calculations



Drainage Diagram for 10498B-Acton-Predevelopment
Prepared by {enter your company name here} 8/17/2007
HydroCAD® 8.00 s/n 001135 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
1.900	30	Woods, Good, HSG A (1S)
0.600	35	Brush, Fair, HSG A (1S)
2.000	55	Woods, Good, HSG B (1S)
0.900	56	Brush, Fair, HSG B (1S)
0.300	76	Gravel roads, HSG A (1S)
0.100	85	Gravel roads, HSG B (1S)
5.800		

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

Subcatchment 1S: Subcatchment 1 Runoff Area=5.800 ac Runoff Depth>0.04"
Flow Length=365' Tc=18.1 min CN=47 Runoff=0.04 cfs 0.020 af

Pond 1P: Exfiltration Peak Elev=171.55' Storage=691 cf Inflow=0.04 cfs 0.020 af
Outflow=0.01 cfs 0.004 af

Total Runoff Area = 5.800 ac Runoff Volume = 0.020 af Average Runoff Depth = 0.04"
100.00% Pervious Area = 5.800 ac 0.00% Impervious Area = 0.000 ac

Subcatchment 1S: Subcatchment 1

Runoff = 0.04 cfs @ 15.19 hrs, Volume= 0.020 af, Depth> 0.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (ac)	CN	Description
0.300	76	Gravel roads, HSG A
1.900	30	Woods, Good, HSG A
0.600	35	Brush, Fair, HSG A
0.100	85	Gravel roads, HSG B
2.000	55	Woods, Good, HSG B
0.900	56	Brush, Fair, HSG B
5.800	47	Weighted Average
5.800		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	115	0.1700	0.18		**Sheet Flow, A1 to B1** Woods: Light underbrush n= 0.400 P2= 3.00"
7.6	250	0.0120	0.55		**Shallow Concentrated Flow, B1 to SP** Woodland Kv= 5.0 fps
18.1	365	Total			

Pond 1P: Exfiltration

Inflow Area = 5.800 ac, Inflow Depth > 0.04" for 2 Year event
Inflow = 0.04 cfs @ 15.19 hrs, Volume= 0.020 af
Outflow = 0.01 cfs @ 20.00 hrs, Volume= 0.004 af, Atten= 77%, Lag= 288.3 min
Primary = 0.01 cfs @ 20.00 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 171.55' @ 20.00 hrs Surf.Area= 3,031 sf Storage= 691 cf

Plug-Flow detention time= 205.7 min calculated for 0.004 af (20% of inflow)
Center-of-Mass det. time= 57.7 min (1,044.2 - 986.5)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	104,335 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
171.00	0	0	0
171.33	1,298	214	214
171.66	3,893	857	1,071
172.00	18,240	3,763	4,833
174.00	81,262	99,502	104,335

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**0.150 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.01 cfs @ 20.00 hrs HW=171.55' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

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

Subcatchment 1S: Subcatchment 1 Runoff Area=5.800 ac Runoff Depth>0.31"
Flow Length=365' Tc=18.1 min CN=47 Runoff=0.81 cfs 0.151 af

Pond 1P: Exfiltration Peak Elev=172.01' Storage=5,103 cf Inflow=0.81 cfs 0.151 af
Outflow=0.06 cfs 0.033 af

Total Runoff Area = 5.800 ac Runoff Volume = 0.151 af Average Runoff Depth = 0.31"
100.00% Pervious Area = 5.800 ac 0.00% Impervious Area = 0.000 ac

Subcatchment 1S: Subcatchment 1

Runoff = 0.81 cfs @ 12.51 hrs, Volume= 0.151 af, Depth> 0.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=4.50"

Area (ac)	CN	Description
0.300	76	Gravel roads, HSG A
1.900	30	Woods, Good, HSG A
0.600	35	Brush, Fair, HSG A
0.100	85	Gravel roads, HSG B
2.000	55	Woods, Good, HSG B
0.900	56	Brush, Fair, HSG B
5.800	47	Weighted Average
5.800		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	115	0.1700	0.18		**Sheet Flow, A1 to B1** Woods: Light underbrush n= 0.400 P2= 3.00"
7.6	250	0.0120	0.55		**Shallow Concentrated Flow, B1 to SP** Woodland Kv= 5.0 fps
18.1	365	Total			

Pond 1P: Exfiltration

Inflow Area = 5.800 ac, Inflow Depth > 0.31" for 10 Year event
Inflow = 0.81 cfs @ 12.51 hrs, Volume= 0.151 af
Outflow = 0.06 cfs @ 20.00 hrs, Volume= 0.033 af, Atten= 92%, Lag= 449.6 min
Primary = 0.06 cfs @ 20.00 hrs, Volume= 0.033 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 172.01' @ 20.00 hrs Surf.Area= 18,700 sf Storage= 5,103 cf

Plug-Flow detention time= 251.0 min calculated for 0.033 af (22% of inflow)
Center-of-Mass det. time= 110.9 min (1,002.7 - 891.8)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	104,335 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
171.00	0	0	0
171.33	1,298	214	214
171.66	3,893	857	1,071
172.00	18,240	3,763	4,833
174.00	81,262	99,502	104,335

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**0.150 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.06 cfs @ 20.00 hrs HW=172.01' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

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

Subcatchment 1S: Subcatchment 1 Runoff Area=5.800 ac Runoff Depth>1.02"
Flow Length=365' Tc=18.1 min CN=47 Runoff=4.19 cfs 0.494 af

Pond 1P: Exfiltration Peak Elev=172.52' Storage=18,523 cf Inflow=4.19 cfs 0.494 af
Outflow=0.12 cfs 0.068 af

Total Runoff Area = 5.800 ac Runoff Volume = 0.494 af Average Runoff Depth = 1.02"
100.00% Pervious Area = 5.800 ac 0.00% Impervious Area = 0.000 ac

Subcatchment 1S: Subcatchment 1

Runoff = 4.19 cfs @ 12.32 hrs, Volume= 0.494 af, Depth> 1.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=6.50"

Area (ac)	CN	Description
0.300	76	Gravel roads, HSG A
1.900	30	Woods, Good, HSG A
0.600	35	Brush, Fair, HSG A
0.100	85	Gravel roads, HSG B
2.000	55	Woods, Good, HSG B
0.900	56	Brush, Fair, HSG B
5.800	47	Weighted Average
5.800		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	115	0.1700	0.18		**Sheet Flow, A1 to B1** Woods: Light underbrush n= 0.400 P2= 3.00"
7.6	250	0.0120	0.55		**Shallow Concentrated Flow, B1 to SP** Woodland Kv= 5.0 fps
18.1	365	Total			

Pond 1P: Exfiltration

Inflow Area = 5.800 ac, Inflow Depth > 1.02" for 100 Year event
Inflow = 4.19 cfs @ 12.32 hrs, Volume= 0.494 af
Outflow = 0.12 cfs @ 20.00 hrs, Volume= 0.068 af, Atten= 97%, Lag= 460.9 min
Primary = 0.12 cfs @ 20.00 hrs, Volume= 0.068 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 172.52' @ 20.00 hrs Surf.Area= 34,575 sf Storage= 18,523 cf

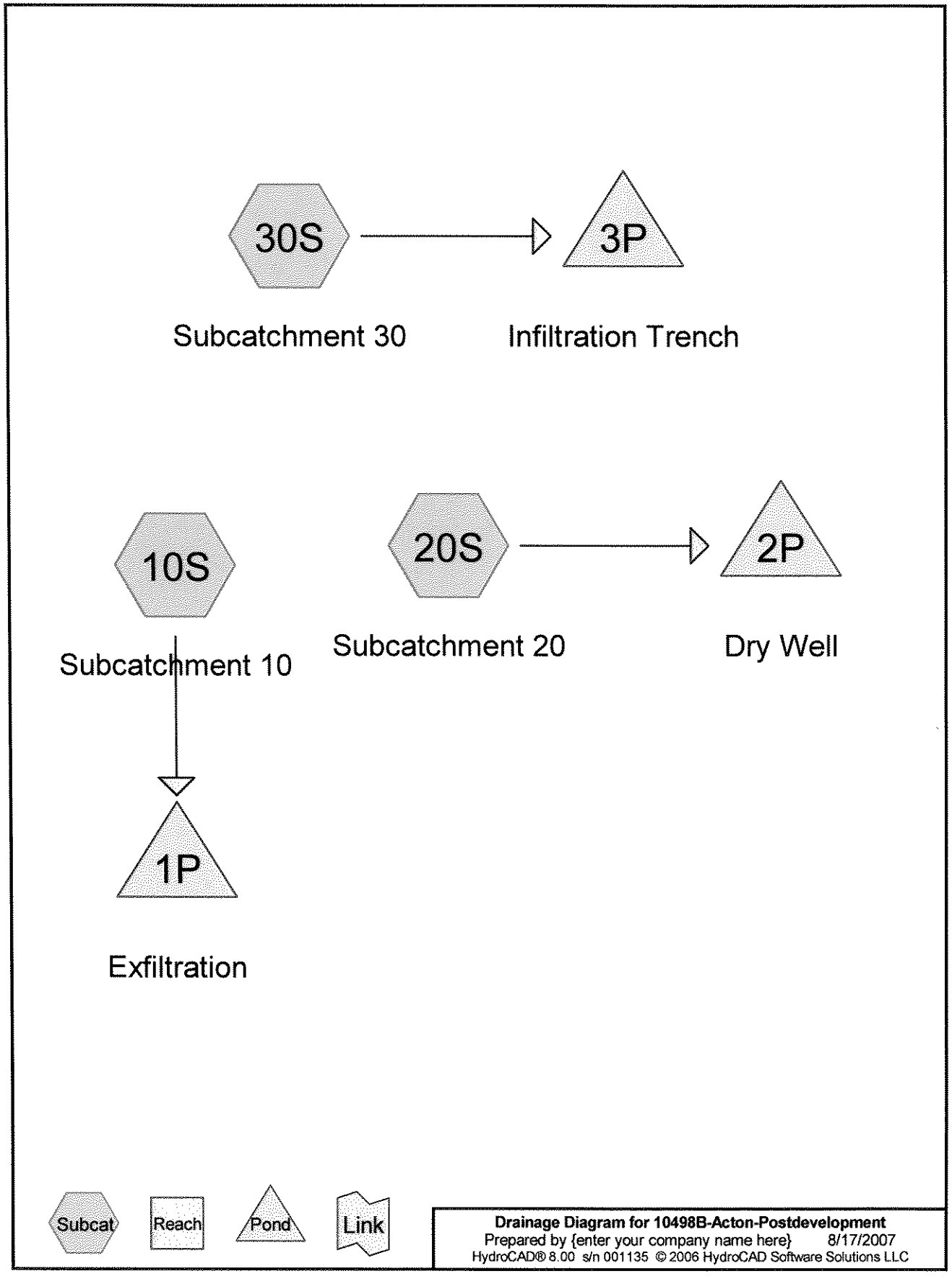
Plug-Flow detention time= 252.0 min calculated for 0.068 af (14% of inflow)
Center-of-Mass det. time= 130.7 min (984.4 - 853.7)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	104,335 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
171.00	0	0	0
171.33	1,298	214	214
171.66	3,893	857	1,071
172.00	18,240	3,763	4,833
174.00	81,262	99,502	104,335

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**0.150 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.12 cfs @ 20.00 hrs HW=172.52' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.12 cfs)



Drainage Diagram for 10498B-Acton-Postdevelopment
Prepared by {enter your company name here} 8/17/2007

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
1.600	30	Woods, Good, HSG A (10S)
0.100	35	Brush, Fair, HSG A (10S)
0.300	39	>75% Grass cover, Good, HSG A (10S)
2.000	55	Woods, Good, HSG B (10S)
0.900	56	Brush, Fair, HSG B (10S)
0.500	76	Gravel roads, HSG A (10S)
0.100	85	Gravel roads, HSG B (10S)
0.200	98	Paved parking & roofs (20S)
0.100	100	(30S)
5.800		

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Subcatchment 10 Runoff Area=5.500 ac Runoff Depth=0.09"
Flow Length=365' Tc=18.1 min CN=49 Runoff=0.07 cfs 0.042 af

Subcatchment 20S: Subcatchment 20 Runoff Area=0.200 ac Runoff Depth=2.87"
Tc=0.0 min CN=98 Runoff=0.69 cfs 0.048 af

Subcatchment 30S: Subcatchment 30 Runoff Area=0.100 ac Runoff Depth=3.10"
Tc=0.0 min CN=100 Runoff=0.35 cfs 0.026 af

Pond 1P: Exfiltration Peak Elev=171.71' Storage=1,287 cf Inflow=0.07 cfs 0.042 af
Outflow=0.02 cfs 0.034 af

Pond 2P: Dry Well Inflow=0.69 cfs 0.048 af
Primary=0.69 cfs 0.048 af

Pond 3P: Infiltration Trench Inflow=0.35 cfs 0.026 af
Primary=0.35 cfs 0.026 af

Total Runoff Area = 5.800 ac Runoff Volume = 0.115 af Average Runoff Depth = 0.24"
94.83% Pervious Area = 5.500 ac 5.17% Impervious Area = 0.300 ac

Subcatchment 10S: Subcatchment 10

Runoff = 0.07 cfs @ 13.99 hrs, Volume= 0.042 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (ac)	CN	Description
0.500	76	Gravel roads, HSG A
1.600	30	Woods, Good, HSG A
0.100	35	Brush, Fair, HSG A
0.300	39	>75% Grass cover, Good, HSG A
0.100	85	Gravel roads, HSG B
2.000	55	Woods, Good, HSG B
0.900	56	Brush, Fair, HSG B
5.500	49	Weighted Average
5.500		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	115	0.1700	0.18		**Sheet Flow, A10 to B10** Woods: Light underbrush n= 0.400 P2= 3.00"
7.6	250	0.0120	0.55		**Shallow Concentrated Flow, B10 to SP** Woodland Kv= 5.0 fps
18.1	365	Total			

Subcatchment 20S: Subcatchment 20

Runoff = 0.69 cfs @ 12.00 hrs, Volume= 0.048 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (ac)	CN	Description
0.200	98	Paved parking & roofs
0.200		Impervious Area

Subcatchment 30S: Subcatchment 30

Runoff = 0.35 cfs @ 12.00 hrs, Volume= 0.026 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (ac)	CN	Description
0.100	100	
0.100		Impervious Area

Pond 1P: Exfiltration

Inflow Area = 5.500 ac, Inflow Depth = 0.09" for 2 Year event
Inflow = 0.07 cfs @ 13.99 hrs, Volume= 0.042 af
Outflow = 0.02 cfs @ 24.18 hrs, Volume= 0.034 af, Atten= 71%, Lag= 611.3 min
Primary = 0.02 cfs @ 24.18 hrs, Volume= 0.034 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 171.71' @ 24.18 hrs Surf.Area= 5,631 sf Storage= 1,287 cf

Plug-Flow detention time= 776.5 min calculated for 0.034 af (81% of inflow)
Center-of-Mass det. time= 703.7 min (1,752.9 - 1,049.2)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	100,943 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
171.00	0	0	0
171.33	1,298	214	214
171.67	3,893	882	1,097
172.00	18,240	3,652	4,749
174.00	77,954	96,194	100,943

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**0.150 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 24.18 hrs HW=171.71' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 2P: Dry Well

Inflow Area = 0.200 ac, Inflow Depth = 2.87" for 2 Year event
Inflow = 0.69 cfs @ 12.00 hrs, Volume= 0.048 af
Primary = 0.69 cfs @ 12.00 hrs, Volume= 0.048 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Pond 3P: Infiltration Trench

Inflow Area = 0.100 ac, Inflow Depth = 3.10" for 2 Year event
Inflow = 0.35 cfs @ 12.00 hrs, Volume= 0.026 af
Primary = 0.35 cfs @ 12.00 hrs, Volume= 0.026 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Subcatchment 10 Runoff Area=5.500 ac Runoff Depth=0.46"
Flow Length=365' Tc=18.1 min CN=49 Runoff=1.08 cfs 0.209 af

Subcatchment 20S: Subcatchment 20 Runoff Area=0.200 ac Runoff Depth=4.26"
Tc=0.0 min CN=98 Runoff=1.01 cfs 0.071 af

Subcatchment 30S: Subcatchment 30 Runoff Area=0.100 ac Runoff Depth=4.50"
Tc=0.0 min CN=100 Runoff=0.51 cfs 0.037 af

Pond 1P: Exfiltration Peak Elev=172.08' Storage=6,356 cf Inflow=1.08 cfs 0.209 af
Outflow=0.07 cfs 0.167 af

Pond 2P: Dry Well Inflow=1.01 cfs 0.071 af
Primary=1.01 cfs 0.071 af

Pond 3P: Infiltration Trench Inflow=0.51 cfs 0.037 af
Primary=0.51 cfs 0.037 af

Total Runoff Area = 5.800 ac Runoff Volume = 0.318 af Average Runoff Depth = 0.66"
94.83% Pervious Area = 5.500 ac 5.17% Impervious Area = 0.300 ac

Subcatchment 10S: Subcatchment 10

Runoff = 1.08 cfs @ 12.46 hrs, Volume= 0.209 af, Depth= 0.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=4.50"

Area (ac)	CN	Description
0.500	76	Gravel roads, HSG A
1.600	30	Woods, Good, HSG A
0.100	35	Brush, Fair, HSG A
0.300	39	>75% Grass cover, Good, HSG A
0.100	85	Gravel roads, HSG B
2.000	55	Woods, Good, HSG B
0.900	56	Brush, Fair, HSG B
5.500	49	Weighted Average
5.500		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	115	0.1700	0.18		**Sheet Flow, A10 to B10** Woods: Light underbrush n= 0.400 P2= 3.00"
7.6	250	0.0120	0.55		**Shallow Concentrated Flow, B10 to SP** Woodland Kv= 5.0 fps
18.1	365	Total			

Subcatchment 20S: Subcatchment 20

Runoff = 1.01 cfs @ 12.00 hrs, Volume= 0.071 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=4.50"

Area (ac)	CN	Description
0.200	98	Paved parking & roofs
0.200		Impervious Area

Subcatchment 30S: Subcatchment 30

Runoff = 0.51 cfs @ 12.00 hrs, Volume= 0.037 af, Depth= 4.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=4.50"

Area (ac)	CN	Description
0.100	100	
0.100		Impervious Area

Pond 1P: Exfiltration

Inflow Area = 5.500 ac, Inflow Depth = 0.46" for 10 Year event
Inflow = 1.08 cfs @ 12.46 hrs, Volume= 0.209 af
Outflow = 0.07 cfs @ 24.08 hrs, Volume= 0.167 af, Atten= 93%, Lag= 697.2 min
Primary = 0.07 cfs @ 24.08 hrs, Volume= 0.167 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 172.08' @ 24.08 hrs Surf.Area= 20,705 sf Storage= 6,356 cf

Plug-Flow detention time= 854.2 min calculated for 0.167 af (80% of inflow)
Center-of-Mass det. time= 769.4 min (1,717.0 - 947.7)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	100,943 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
171.00	0	0	0
171.33	1,298	214	214
171.67	3,893	882	1,097
172.00	18,240	3,652	4,749
174.00	77,954	96,194	100,943

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**0.150 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.07 cfs @ 24.08 hrs HW=172.08' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Pond 2P: Dry Well

Inflow Area = 0.200 ac, Inflow Depth = 4.26" for 10 Year event
Inflow = 1.01 cfs @ 12.00 hrs, Volume= 0.071 af
Primary = 1.01 cfs @ 12.00 hrs, Volume= 0.071 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Pond 3P: Infiltration Trench

Inflow Area = 0.100 ac, Inflow Depth = 4.50" for 10 Year event
Inflow = 0.51 cfs @ 12.00 hrs, Volume= 0.037 af
Primary = 0.51 cfs @ 12.00 hrs, Volume= 0.037 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S: Subcatchment 10 Runoff Area=5.500 ac Runoff Depth=1.32"
Flow Length=365' Tc=18.1 min CN=49 Runoff=4.79 cfs 0.603 af

Subcatchment 20S: Subcatchment 20 Runoff Area=0.200 ac Runoff Depth=6.26"
Tc=0.0 min CN=98 Runoff=1.46 cfs 0.104 af

Subcatchment 30S: Subcatchment 30 Runoff Area=0.100 ac Runoff Depth=6.50"
Tc=0.0 min CN=100 Runoff=0.73 cfs 0.054 af

Pond 1P: Exfiltration Peak Elev=172.61' Storage=21,270 cf Inflow=4.79 cfs 0.603 af
Outflow=0.13 cfs 0.332 af

Pond 2P: Dry Well Inflow=1.46 cfs 0.104 af
Primary=1.46 cfs 0.104 af

Pond 3P: Infiltration Trench Inflow=0.73 cfs 0.054 af
Primary=0.73 cfs 0.054 af

Total Runoff Area = 5.800 ac Runoff Volume = 0.762 af Average Runoff Depth = 1.58"
94.83% Pervious Area = 5.500 ac 5.17% Impervious Area = 0.300 ac

Subcatchment 10S: Subcatchment 10

Runoff = 4.79 cfs @ 12.31 hrs, Volume= 0.603 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=6.50"

Area (ac)	CN	Description
0.500	76	Gravel roads, HSG A
1.600	30	Woods, Good, HSG A
0.100	35	Brush, Fair, HSG A
0.300	39	>75% Grass cover, Good, HSG A
0.100	85	Gravel roads, HSG B
2.000	55	Woods, Good, HSG B
0.900	56	Brush, Fair, HSG B
5.500	49	Weighted Average
5.500		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	115	0.1700	0.18		**Sheet Flow, A10 to B10** Woods: Light underbrush n= 0.400 P2= 3.00"
7.6	250	0.0120	0.55		**Shallow Concentrated Flow, B10 to SP** Woodland Kv= 5.0 fps
18.1	365	Total			

Subcatchment 20S: Subcatchment 20

Runoff = 1.46 cfs @ 12.00 hrs, Volume= 0.104 af, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=6.50"

Area (ac)	CN	Description
0.200	98	Paved parking & roofs
0.200		Impervious Area

Subcatchment 30S: Subcatchment 30

Runoff = 0.73 cfs @ 12.00 hrs, Volume= 0.054 af, Depth= 6.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=6.50"

Area (ac)	CN	Description
0.100	100	
0.100		Impervious Area

Pond 1P: Exfiltration

Inflow Area = 5.500 ac, Inflow Depth = 1.32" for 100 Year event
Inflow = 4.79 cfs @ 12.31 hrs, Volume= 0.603 af
Outflow = 0.13 cfs @ 24.17 hrs, Volume= 0.332 af, Atten= 97%, Lag= 711.8 min
Primary = 0.13 cfs @ 24.17 hrs, Volume= 0.332 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 172.61' @ 24.17 hrs Surf.Area= 36,321 sf Storage= 21,270 cf

Plug-Flow detention time= 1,019.7 min calculated for 0.332 af (55% of inflow)
Center-of-Mass det. time= 881.8 min (1,783.6 - 901.8)

Volume	Invert	Avail.Storage	Storage Description
#1	171.00'	100,943 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
171.00	0	0	0
171.33	1,298	214	214
171.67	3,893	882	1,097
172.00	18,240	3,652	4,749
174.00	77,954	96,194	100,943

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**0.150 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.13 cfs @ 24.17 hrs HW=172.61' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.13 cfs)

Pond 2P: Dry Well

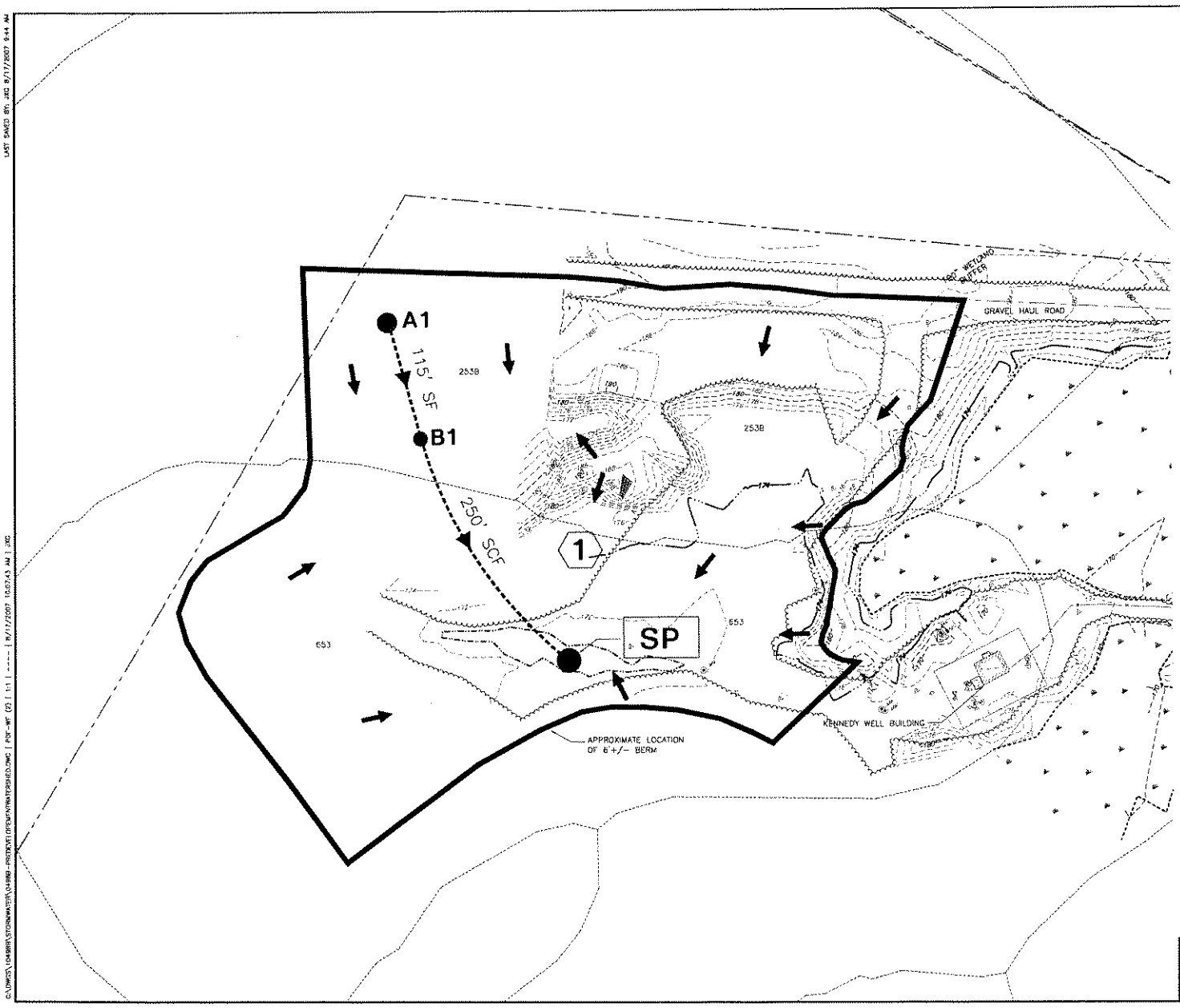
Inflow Area = 0.200 ac, Inflow Depth = 6.26" for 100 Year event
Inflow = 1.46 cfs @ 12.00 hrs, Volume= 0.104 af
Primary = 1.46 cfs @ 12.00 hrs, Volume= 0.104 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

Pond 3P: Infiltration Trench

Inflow Area = 0.100 ac, Inflow Depth = 6.50" for 100 Year event
Inflow = 0.73 cfs @ 12.00 hrs, Volume= 0.054 af
Primary = 0.73 cfs @ 12.00 hrs, Volume= 0.054 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs



LEGEND

- WATERSHED
- SUBCATCHMENT
- TC FLOW PATH
- REACH FLOW PATH
- FLOW ARROW
- SP1 — STUDY POINT
- (4) — SUBCATCHMENT
- F_4 — TC FLOW PATH POINT OF INTEREST
- SOIL BOUNDARY
- SF — SHEET FLOW
- SCF — SHALLOW CONCENTRATED FLOW

SOILS LEGEND

253B – HINCKLEY LOAMY SAND, HSG A

653 – UDORTHENTS, SANDY, HSG B

NOTE:
PORTIONS OF WATERSHED BOUNDARY LOCATED OUTSIDE OF THE TOPOGRAPHIC SURVEY WERE DELINEATED BASED ON USGS SURVEY INFORMATION AND FIELD OBSERVATION.

DRAINAGE AREA 1

3.0 acres – WOODS
1.5 acres – BRUSH/GRASS/WEEDS
0.4 acres – GRAVEL ROAD

5.8 acres – TOTAL

GRAPHIC SCALE

(IN FEET)
1 inch = 40 ft.

FOR PERMITTING PURPOSES ONLY

ACTON WATER DISTRICT
ACTON, MASSACHUSETTS
KENNEDY AND MARSHALL WELLS
WATER TREATMENT PLANT

PREDEVELOPMENT WATERSHED PLAN

Wright-Pierce
Office of Management Since England

DWG 1 of 2

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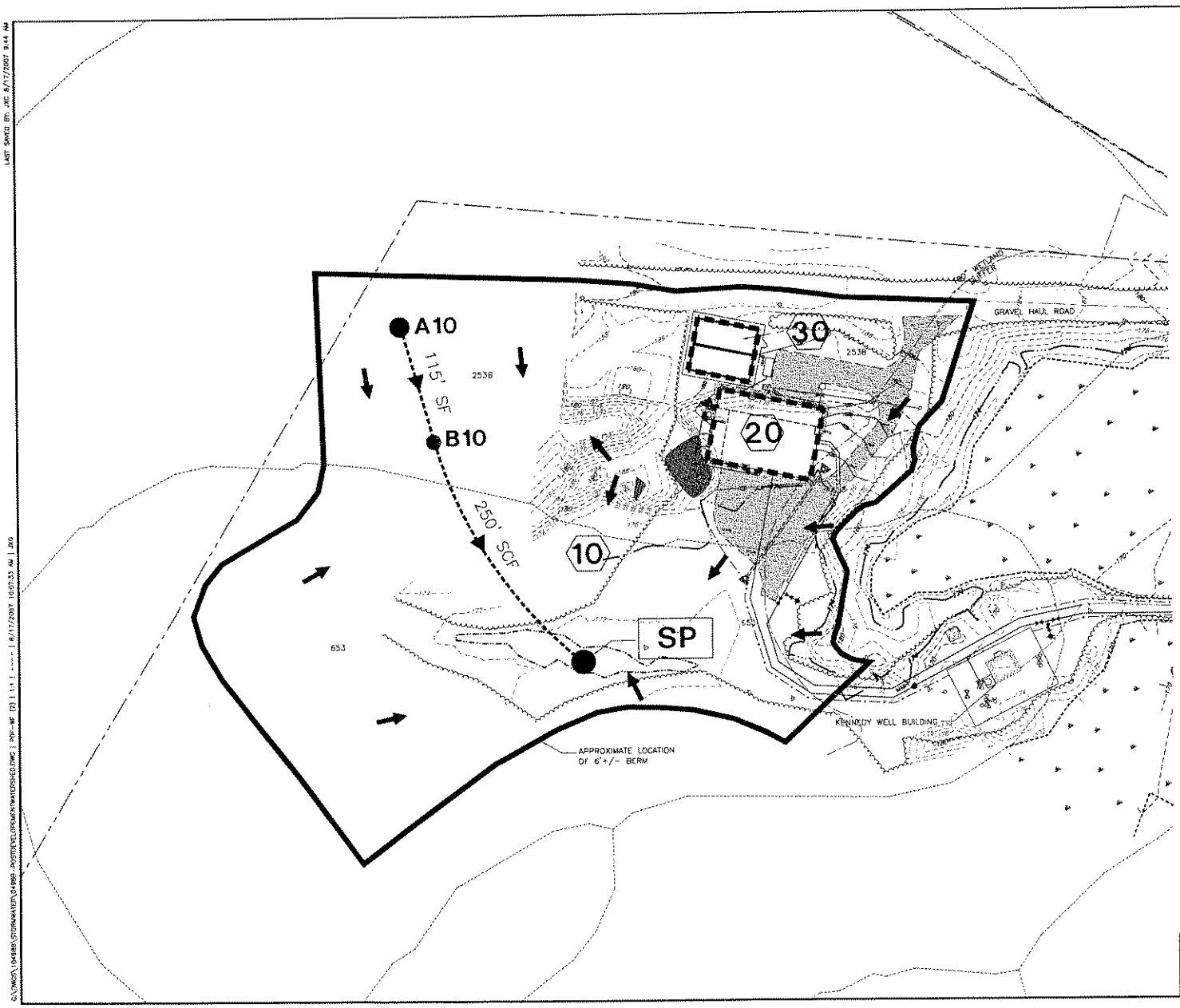


FOR PERMITTING PURPOSES ONLY

ACTON WATER DISTRICT
ACTON, MASSACHUSETTS
KENNEDY AND MARSHALL WELLS
WATER TREATMENT PLANT
POSTDEVELOPMENT WATERSHED PLAN

Wright-Pierce
Engineers throughout New England
www.wright-pierce.com

DWG 2 of 2

APPENDIX B

Inspection of Maintenance Reports

APPENDIX B

INSPECTION AND MAINTENANCE REPORTS

The inspection and maintenance forms in this appendix are to be used by the Contractor during the construction phase and the owner upon completion of construction.

INSPECTION AND MAINTENANCE REPORT FORM

TO BE COMPLETED EVERY 14 DAYS AND/OR WITHIN 24 HOURS OF
A RAINFALL EVENT OF 0.5 INCHES OR MORE

SITE STABILIZATION

Inspector:_____ Date:_____

Days Since Last Rainfall:_____ Amount of Last Rainfall:____ Inches

Area	Date since last disturbed	Stabilized? (yes/no)	Stabilized with	Condition

Contractor's Superintendent: _____ Date:_____

Stabilization Action Required:

_____

_____

_____

_____

_____

_____

Performed by: _____ On or Before: _____

INSPECTION AND MAINTENANCE REPORT FORM

SILT FENCE

Inspector: _____ Date: _____

Depth of material behind silt fence	Condition of landfill side slopes	Any evidence of overtopping of the silt fence?	Condition of drainage swales

Contractor's Superintendent: _____ Date: _____

Maintenance action required for silt fence:

_____

_____

_____

_____

Performed by: _____ On or Before: _____

INSPECTION AND MAINTENANCE REPORT FORM

STORMWATER STRUCTURES

Inspector: _____ Date: _____

Any evidence of erosion or sedimentation at culvert inlet or outlet?	Condition of riprap inlet and outlet aprons at culvert	Accumulation of silt or debris in stormwater storage area?

Contractor's Superintendent: _____ Date: _____

Maintenance action required for stormwater structures:

_____

_____

_____

_____

Performed by: _____ On or Before: _____

INSPECTION AND MAINTENANCE REPORT FORM

ACCESS ROAD

Inspector: _____ Date: _____

Does much sediment get tracked on to road?	Is the gravel clean or is it filled with sediment?	Does all traffic use the stabilized entrance to leave the site?

Contractor's Superintendent: _____ Date: _____

Maintenance action required to stabilize access road:

_____

_____

_____

_____

Performed by: _____ On or Before: _____

INSPECTION AND MAINTENANCE REPORT FORM

Inspector: _____ Date: _____

Contractor's Superintendent: _____

Changes required to the Construction Pollution Prevention Plan:

_____

_____

_____

_____

Reasons for changes:

_____

_____

_____

_____

I certify that the foregoing statements are, to the best of my knowledge, true and accurate.

Inspector
Signature: _____ Date: _____

Contractor's Superintendent
Signature: _____ Date: _____

APPENDIX C

Specification Section 02485 - Loaming and Seeding

SECTION 02485

LOAMING & SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, place, and test topsoil, seed, lime, and fertilizer where shown on the drawings and protect and maintain seeded areas disturbed by construction work, as directed by the Engineer.

B. Related Work Specified Elsewhere (When Applicable): Earthwork, excavation, backfill, compaction, site grading and temporary erosion control are specified in the appropriate Sections of this Division.

1.2 SUBMITTALS AND TESTING

A. Seed:

1. Furnish the Engineer with duplicate signed copies of a statement from the vendor, certifying that each container of seed delivered to the project site is fully labeled in accordance with the Federal Seed Act and is at least equal to the specification requirements.
2. This certification shall appear in, or with, all copies of invoices for the seed.
3. The certification shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates and certificates have been approved.
4. Each lot of seed shall be subject to sampling and testing, at the discretion of the Engineer, in accordance with the latest rules and regulations under the Federal Seed Act.

B. Topsoil:

1. Inform the Engineer, within 30 days after the award of the Contract, of the sources from which the topsoil is to be furnished.
2. Obtain representative soil samples, taken from several locations in the area under consideration for topsoil removal, to the full stripping depth.
3. Have soil samples tested by an independent soils testing laboratory, approved by the Engineer, at the Contractor's expense.
4. Have soil samples tested for physical properties and pH (or lime requirement), for organic matter, available phosphoric acid, and available potash, in accordance with standard practices of soil testing.
5. Approval, by the Engineer, to use topsoil for the work will be dependent upon the results of the soils tests.

C. Lime & Fertilizer:

1. Furnish the Engineer with duplicate copies of invoices for all lime and fertilizer used on the project showing the total minimum carbonates and minimum percentages of the material furnished that pass the 90 and 20 mesh sieves and the grade furnished.

2. Each lot of lime and fertilizer shall be subject to sampling and testing at the discretion of the Engineer.
3. Sampling and testing shall be in accordance with the official methods of the Association of Official Agricultural Chemists.
4. Upon completion of the project, a final check may be made comparing the total quantities of fertilizer and lime used to the total area seeded. If the minimum rates of application have not been met, the Engineer may require the Contractor to distribute additional quantities of these materials to meet the minimum rates.

1.3 DELIVERY, STORAGE & HANDLING

A. Seed:
1. Furnish all seed in sealed standard containers, unless exception is granted in writing by the Engineer.
2. Containers shall be labeled in accordance with the United States Department of Agriculture's rules and regulations under the Federal Seed Act in effect at the time of purchase.

B. Fertilizer:
1. Furnish all fertilizer in unopened original containers.
2. Containers shall be labeled with the manufacturer's statement of analysis.

1.4 JOB CONDITIONS

A. Topsoil: Do not place or spread topsoil when the subgrade is frozen, excessively wet or dry, or in any condition otherwise detrimental, in the opinion of the Engineer, to the proposed planting or to proper grading.

B. Seeding:
1. Planting Seasons: The recommended seeding time is from April 1 to September 15. The Contractor may seed at other times. Regardless of the time of seeding, the Contractor shall be responsible for each seeded area until it is accepted.
2. Weather Conditions:
   a. Do not perform seeding work when weather conditions are such that beneficial results are not likely to be obtained, such as drought, excessive moisture, or high winds.
   b. Stop the seeding work when, in the opinion of the Engineer, weather conditions are not favorable.
   c. Resume the work only when, in the opinion of the Engineer, conditions become favorable, or when approved alternate or corrective measures and procedures are placed into effect.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Seed:

1. Provide the grass seed mixture approved by the Engineer, having the following composition:
   a. Park Mixture:
      50 percent Creeping Red Fesque
      30 percent Kentucky Bluegrass
      20 percent Annual Ryegrass
   b. Roadside Mixture:
      50 percent Creeping Red Fescue
      15 percent Kentucky Bluegrass
       5 percent White Clover
       2 percent Red Top
       3 percent Birdsfoot Trefoil
      25 percent Annual Ryegrass
2. Do not use seed which has become wet, moldy, or otherwise damaged in transit or during storage.

B. Topsoil:
1. Provide the quantity of topsoil necessary, in the opinion of the Engineer, to complete the work.
2. Provide topsoil that is natural, friable clay-loam soil possessing the characteristics of representative soils in the vicinity which produce heavy growths of crops, grass, or other vegetation.
3. Provide topsoil which is reasonably free from subsoil, brush, objectionable weeds, other litter, clay lumps, stones, stumps, roots, objects larger than 2 inches in diameter, and toxic substances which might be harmful to plant growth or be a hindrance to grading, planting, and maintenance operations.
4. Obtain topsoil from naturally well drained areas.

C. Lime:
1. Provide lime which is ground limestone containing not less than 85% of total carbonate and of such fineness that 90% will pass a No. 20 sieve and 50% will pass a No. 100 sieve.
2. Coarser materials will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing a No. 100 sieve. No additional payment will be made to the Contractor for the increased quantity.

D. Fertilizer:
1. Provide a commercial fertilizer approved by the Engineer.
2. Provide fertilizer containing the following minimum percentage of nutrients by weight:
   10% Available phosphoric acid
   10% Available potash
   10% Available nitrogen (75% of the nitrogen shall be organic)

PART 3 - EXECUTION

3.1 PREPARATION

A. Equipment:

1. Provide all equipment necessary for the proper preparation of the ground surface and for the handling and placing of all required materials.
2. Demonstrate to the Engineer that the equipment will apply materials at the specified rates.

B. Soil: Perform the following work prior to the application of lime, fertilizer or seed.
1. Scarify the subgrade to a depth of 2 inches to allow the bonding of the topsoil with the subsoil.
2. Apply topsoil to a depth of 4 inches or as directed on areas to be seeded.
3. Trim and rake the topsoil to true grades free from unsightly variations, humps, ridges or depressions.
4. Remove all objectionable material and form a finely pulverized seed bed.

3.2 PERFORMANCE

A. Grading:
1. Grade the areas to be seeded as shown on the Drawings or as directed by the Engineer.
2. Leave all surfaces in even and properly compacted condition.
3. Maintain grades on the areas to be seeded in true and even conditions, including any necessary repairs to previously graded areas.

B. Placing Topsoil:
1. Uniformly distribute and evenly spread topsoil on the designated areas.
2. Spread the topsoil in such a manner that planting work can be performed with little additional soil preparation or tillage.
3. Correct any irregularities in the surface resulting from topsoiling or other operations to prevent the formation of depressions where water may stand.
4. Thoroughly till the topsoil to a depth of at least 3 inches by plowing, discing, harrowing, or other approved method until the condition of the soil is acceptable to the Engineer.

C. Placing Fertilizer:
1. Distribute fertilizer uniformly at a rate determined by the soils test over the areas to be seeded.
2. Incorporate fertilizer into the soil to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the Engineer.
3. The incorporation of fertilizer may be a part of the tillage operation specified above.
4. Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will be acceptable.

D. Placing Lime:
1. Uniformly distribute lime immediately following or simultaneously with the incorporation of fertilizer.
2. Distribute lime at a rate determined from the pH test, to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the Engineer.

E. Seeding:
1. Level out any undulations or irregularities in the surface resulting from tillage, fertilizing, liming or other operations before starting seeding operations.

2. Hydroseeding:
    a. Hydroseeding may be performed where approved and with equipment approved by the Engineer.
    b. Sow the seed over designated areas at a minimum rate of 5 pounds per 1000 square feet.
    c. Seed and fertilizing materials shall be kept thoroughly agitated in order to maintain a uniform suspension within the tank of the hydroseeder.
    d. The spraying equipment must be designed and operated to distribute seed and fertilizing materials evenly and uniformly on the designated areas at the required rates.
3. Drill Seeding:
    a. Drill seeding may be performed with approved equipment having drills not more than 2 inches apart.
    b. Sow the seed uniformly over the designated areas to a depth of l/2 inch and at a rate of 5 pounds per 1,000 square feet.
4. Broadcast Seeding:
    a. Broadcast seeding may be performed by equipment approved by the Engineer.
    b. Sow the seed uniformly over the designated areas at a rate of 5 pounds per 1,000 square feet.
    c. Sow half the seed with the equipment moving in one direction and the remainder of the seed with the equipment moving at right angles to the first sowing.
    d. Cover the seed to an average depth of l/2 inch by means of a brush harrow, spike-tooth harrow, chain harrow, cultipacker, or other approved devices.
    e. Do not perform broadcast seeding work during windy weather.

F. Compacting:
1. Seeded areas must be raked lightly after sowing unless seeding is to be directly followed by application of an approved mulch.
2. Compact the entire area immediately after the seeding operations have been completed.
3. Compact by means of a cultipacker, roller, or other equipment approved by the Engineer weighing 60 to 90 pounds per linear foot of roller.
4. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, use a pneumatic roller (not wobbly wheel) that has tires of sufficient size to obtain complete coverage of the soil.
5. When using a cultipacker or similar equipment, perform the final rolling at right angles to the prevailing slopes to prevent water erosion, or at right angles to the prevailing wind to prevent dust.

3.3 PROTECTION & MAINTENANCE

A. Protection:
1. Protect the seeded area against traffic or other use.
2. Erect barricades and place warning signs as needed.

B. Maintenance:

1. At the time of the first cutting, set mower blades two inches high. All lawns shall receive at least two mowings before acceptance. Coordinate schedule for mowing with Engineer.
2. Maintenance shall also include all temporary protection fences, barriers and signs and all other work incidental to proper maintenance.
3. Maintain grass areas until a full stand of grass is indicated, which will be a minimum of 45 days after all seeding work is completed, and shall not necessarily related to Substantial Completion of the General Contract.
4. Protection and maintenance of grass areas shall consist of watering, weeding, cutting, repair of any erosion and reseeding as necessary to establish a uniform stand for the specified grasses, and shall continue until Acceptance by the Engineer of the work of this section. It shall also include the furnishing and applying of such pesticides as are necessary to keep grass areas free of insects and disease. All pesticides shall be approved by Engineer prior to use.

3.4 ACCEPTANCE

A. At final acceptance of the project all areas shall have a close stand of grass with no weeds present and no bare spots greater than three inches (3") in diameter over greater than five percent (5%) of the overall seeded area.

END OF SECTION

APPENDIX D

Specification Section 02270 - Erosion and Sedimentation Control

SECTION 02270

TEMPORARY EROSION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. The work under this section shall include provision of all labor, equipment, materials and maintenance of temporary erosion control devices as specified herein, as shown on the Drawings and as directed by the Engineer.
   2. Erosion control measures shall be provided as necessary to correct conditions that develop prior to the completion of permanent erosion control devices or as required to control erosion that occurs during normal construction operations.
   3. Construction operations shall comply with all federal, state and local regulations pertaining to erosion control.
   4. Erosion control measures shall be in accordance with Massachusetts Department of Environmental Protection's - Stormwater Management Standards - (referred to hereafter as MADEP SMS) and "Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas".
   5. After awarded the Contract, prior to commencement of construction activities, meet with the Engineer to discuss erosion control requirements and develop a mutual understanding relative to details of erosion control.

B. Related Work Specified Elsewhere:
   1. Site work is specified in appropriate sections of this Division.

C. Design Criteria:
   1. Conduct all construction in a manner and sequence that causes the least practical disturbance of the physical environment.
   2. Stabilize disturbed earth surfaces in the shortest time and employ such temporary erosion control devices as may be necessary until such time as adequate soil stabilization has been achieved.

1.2 SUBMITTALS

A. The Contractor shall furnish the Engineer, in writing, his work plan giving proposed locations for storage of topsoil and excavated material before beginning construction. A schedule of work shall accompany the work plan. Acceptance of this plan will not relieve the Contractor of the responsibility of completion of the work as specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Baled Hay:

1. At least 14" by 18" by 30" securely tied to form a firm bale, staked as necessary to hold the bale in place.

B. Sand Bags:
1. Heavy cloth bags of approximately one cubic foot capacity filled with sand or gravel.

C. Mulches:
1. Loose hay, straw, peat moss, wood chips, bark mulch, crushed stone, wood excelsior, or wood fiber cellulose.

D. Mats and Nettings:
1. Twisted Craft paper, yarn, jute, excelsior wood fiber mats, glass fiber and plastic film.

E. Permanent Seed:
1. Conservation mix appropriate to the predominant soil conditions as specified in the MADEP SMS and subject to approval by the Engineer.

F. Temporary Seeding:
1. Use species appropriate for soil conditions and season as specified in the BMP and subject to approval by the Engineer.

H. Water:
1. The Contractor shall provide water and equipment to control dust, as directed by the Engineer.

I. Filter Fabrics:
1. Filter fabric shall be of one of the commercially available brands such as Mirafi, Typar or equivalent. Fabric types for particular applications shall be approved by the Engineer prior to installation.

2.2 CONSTRUCTION REQUIREMENTS

A. Temporary Erosion Checks:
1. Temporary erosion checks shall be constructed in ditches and other locations as necessary.
2. Baled hay, sand bags or siltation fence may be used in an arrangement to fit local conditions.

B. Temporary Berms:
1. Temporary barriers shall be constructed along the toe of embankments when necessary to prevent erosion and sedimentation.

C. Temporary Seeding:
Areas to remain exposed for a time exceeding 3 weeks shall receive temporary seeding as indicated below:

Season	Seed	Rate
April 1 to June 1 Aug. 15 to Sept. 15	Annual Ryegrass	40 lbs/Acre
May 1 to June 30	Foxtail Millet	30 lbs/Acre
April 1 to July 1 Aug. 15 to Sept. 15	Oats	80 lbs/Acre

Aug. 15 to Oct. 15	Winter Rye	120 lbs/Acre

D. Siltation fences shall consist of porous filter fabric with a wire mesh backing and shall be supported by posts as per manufacturer's recommendations. Fabric shall be approved by the Engineer.

E. Mulch All Areas Receiving Seeding:
Use either wood cellulose fiber mulch (750 lbs/acre); or straw mulch with chemical tack (as per manufacturer's specifications). Wetting for small areas may be permitted. Biodegradable netting is recommended in areas to be exposed to drainage flow.

F. Erosion control matting for slopes and ditches shall be anchored with pegs and/or staples per manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Temporary Erosion Checks:
1. Temporary erosion checks shall be constructed in ditches and at other locations designated by the Engineer. The Engineer may modify the Contractor's arrangement of silt fences, bales and bags to fit local conditions.
2. Baled hay, silt fences, or sandbags, or some combination, may be used in other areas as necessary to inhibit soil erosion.
3. Siltation fence, if called for in the plans, shall be located and installed as shown.
4. Sedimentation ponds shall be sited and constructed to the grades and dimensions as shown on the Drawings and will include drainage pipe and an emergency spillway.

B. Maintenance:
Erosion control features shall be installed prior to excavation wherever appropriate. Temporary erosion control features shall remain in place and shall be maintained until a satisfactory growth of grass is established. The Contractor shall be responsible for maintaining erosion control features throughout the life of the construction contract. Maintenance will include periodic inspections by the Owner or Engineer for effectiveness of location, installation and condition with corrective action taken by the Contractor as appropriate.

C. Removing and Disposing of Materials:
1. When no longer needed, material and devices for temporary erosion control shall be removed and disposed of as approved by the Engineer.
2. When removed, such devices may be reused in other locations provided they are in good condition and suitable to perform the erosion control for which they are intended.
3. When dispersed over adjacent areas, the material shall be scattered to the extent that it causes no unsightly conditions nor creates future maintenance problems.

4. Sedimentation basins, if no longer required, will be filled in, the pipe removed, the surface loamed and grass cover shall be established.

END OF SECTION

APPENDIX E

Stormwater Management Form

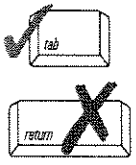
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

Stormwater Management Form

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

A. Property Information

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



1. The proposed project is:

a. New development	☒ Yes	☐ No	
b. Redevelopment	☐ Yes	☐ No	
c. Combination	☐ Yes	☐ No	(If yes, distinguish redevelopment components from new development components on plans).

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

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

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

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

B. Stormwater Management Standards

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

Standard #1: Untreated stormwater

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

Standard #2: Post-development peak discharges rates

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

Post-development peak discharge does not exceed pre-development rates on the site at the point of discharge or downgradient property boundary for the 2-yr, 10-yr, and 100-yr, 24-hr storm.

b. ☒ Without stormwater controls

c. ☐ With stormwater controls designed for the 2-yr, and 10-yr storm, 24-hr storm.

d. ☒ The project as designed will not increase off-site flooding impacts from the 100-yr, 24-hr storm.

B. Stormwater Management Standards (cont.)

Standard #3: Recharge to groundwater

Amount of impervious area (sq. ft.) to be infiltrated: 6,800
a. square feet

Volume to be recharged is based on:

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

1. % of impervious area	2. Hydrologic soil group	3. % of impervious area	4. Hydrologic soil group
100	A		
5. % of impervious area	**6. Hydrologic soil group**	**7. % of impervious area**	**8. Hydrologic soil group**

c. ☐ Site specific pre-development conditions:

1. Recharge rate
2. Volume

d. Describe how the calculations were determined:

Runoff from roof of the proposed building will be recharged to groundwater via a drywell; however, the entire watershed will ultimately be recharged as the existing storage area acts as an infiltration basin.

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

Drywell, Infiltration basin

Does the annual groundwater recharge for the post-development site approximate the annual recharge from existing site conditions?

f. ☒ Yes ☐ No

Standard #4: 80% TSS Removal

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

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

All of the runoff from this watershed will be infiltrated; therefore, there will be no surface water discharge from the watershed that may contain TSS.

B. Stormwater Management Standards (cont.)

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

not applicable

Standard #5: Higher potential pollutant loads

See Stormwater Policy Handbook Vol. I, page I-23, for land uses of high pollutant loading (see Instructions).

Does the project site contain land uses with higher potential pollutant loads

a. ☐ Yes ☒ No b. If yes, describe land uses:

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

not applicable

Standard #6: Protection of critical areas

See Stormwater Policy Handbook Vol. I, page I -25, for critical areas (see Instructions).

Will the project discharge to or affect a critical area?

a. ☒ Yes ☐ No b. If yes, describe areas:

The project is located in a groundwater recharge area for a public water supply.

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

The only runoff from impervious areas to be infiltrated is uncontaminated rooftop runoff. No additional impervious cover is proposed for this project and the proposed use is not associated with high pollutant loads.

B. Stormwater Management Standards (cont.)

Note: components of redevelopment projects which plan to develop previously undeveloped areas do not fall under the scope of Standard 7.

Standard #7: Redevelopment projects

Is the proposed activity a redevelopment project?

a. ☐ Yes ☒ No

b. If yes, the following stormwater management standards have been met:

not applicable

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

not applicable

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

Standard #8: Erosion/sediment control

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

Standard #9: Operation/maintenance plan

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

Appendix B of the Stormwater Management Plan	August 2007
b. Plan/Title	c. Date
d. Plan/Title	e. Date

C. Submittal Requirements

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

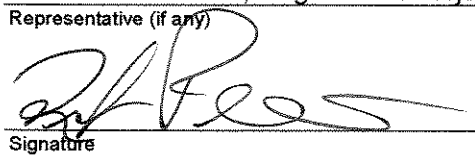
DEP recommends that applicants submit this form, as well as, supporting documentation and plans, with the Notice of Intent to provide stormwater management information for Commission review consistent with the wetland regulations (310 CMR 10.05 (6)(b)) and DEP's Stormwater Management Policy (March 1997).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

D. Signatures

Chris Allen, Acton Water District Manager — Applicant Name
8/17/07 — Date

Signature

Richard Protasowicki, Wright-Pierce Project Manager — Representative (if any)
8/20/07 — Date



Signature