

APPENDIX A

Pollutant Loading Calculations

APPENDIX A - Pollutant Load Calculations

Simple Method - chemical constituents

$$L=0.226 \cdot R \cdot C \cdot A$$

L=Annual load (lbs)

R=Annual runoff (inches)

C=Pollutant concentration (mg/l)

A=Drainage Area (acres)

0.226=Unit conversion factor

$$R=P \cdot P_j \cdot R_v$$

R=Annual runoff (inches)

P=Annual rainfall (inches)

P_j=Fraction of annual rainfall events that produce runoff

R_v = runoff coefficient = 0.05+0.9I_a

I_a = Impervious fraction

Assumptions:

	C values (mg/L)	
	residential runoff*	road runoff*
TSS	100	150
Phosphorus - total	0.4	0.5

* From The Watershed Treatment Model, 2001

Suggested Removal Rates for BMPs * (except where noted)

	TSS	TP	Bacteria
Gravel Wetland***	99	55	80
Bioretention Systems	90	60	35
Sediment Forebay**	25	20	ND
Water Quality Swales	70	40	0

* National Pollutant Removal Performance Database (Winer, June 2000)

**Massachusetts Stormwater Standards (2008)

***University of New Hampshire Stormwater Center (2007 Annual Report)

ND = no data

BMP Site BHP-1

Total Area (acres) 25.00
Impervious (acres) 5.74

$$R=P \cdot P_j \cdot R_v$$

I _a =	23%
R _v =	0.26
P*=	47.00
R=	10.85

*NCDC - Fitchburg Municipal Airport Station

$$L=0.226 \cdot R \cdot C \cdot A$$

	TSS	TP
C (residential) =	100	0.4
Annual Load, L (lbs/yr)=	6,133	24.5

Removal from Gravel Wetland (treating 25% of WQv)

Load Removed (lbs/yr)*	607	3.4
Total Load Remaining (lbs/yr)	5,526	21.2
Difference	10%	14%

*Based on removal ability of practice AND percent of WQv treated

APPENDIX A - Pollutant Load Calculations

BMP Site BHP-2

Total Area (acres) 5.28
Impervious (acres) 3.53

$$R=P \cdot P_j \cdot R_v$$

Ia=	67%
Rv=	0.65
P=	47.00
R=	27.53

$$L=0.226 \cdot R \cdot C \cdot A$$

	TSS	TP
C (road runoff)=	150	0.5
Annual Load, L (lbs/yr)=	4,932	16.4

Removal From Sediment Forebay/Extended Detention Retrofit (83% of WQv)

Load Removed (lbs/yr)*	2,466	2.7
Total Load Remaining (lbs/yr)	2,466	13.7
Difference	50%	17%

*Based on removal ability of practice AND percent of WQv treated

BMP Site BHP-3

Total Area (acres) 8.70
Impervious (acres) 1.69

$$R=P \cdot P_j \cdot R_v$$

Ia=	19%
Rv=	0.22
P=	47.00
R=	9.50

$$L=0.226 \cdot R \cdot C \cdot A$$

	TSS	TP
C (road runoff)=	150	0.5
Annual Load, L (lbs/yr)=	2,801	9.3

Removal From Gravel Wetland (100% of WQv)

Load Removed (lbs/yr)*	2,773	5.1
Total Load Remaining (lbs/yr)	28	4.2
Difference	99%	55%

*Based on removal ability of practice AND percent of WQv treated

APPENDIX A - Pollutant Load Calculations

BMP Site BHP-4

Total Area (acres) 45.20
Impervious (acres) 7.54

$$R = P * P_j * R_v$$

la=	17%
Rv=	0.20
P=	47.00
R=	8.47

$$L = 0.226 * R * C * A$$

	TSS	TP
C (road runoff)=	150	0.5
Annual Load, L (lbs/yr)=	12,973	43.2

Removal From Dry Swale (50% of WQv)

Load Removed (lbs/yr)*	4,541	8.6
Total Load Remaining (lbs/yr)	8,433	34.6
Difference	35%	20%

*Based on removal ability of practice AND percent of WQv treated

BMP Site BHP-5

Total Area (acres) 1.00
Impervious (acres) 0.29

$$R = P * P_j * R_v$$

la=	29%
Rv=	0.31
P=	47.00
R=	13.21

$$L = 0.226 * R * C * A$$

	TSS	TP
C (road runoff)=	150	0.5
Annual Load, L (lbs/yr)=	448	1.5

Removal from Rain Garden (100% of WQv)

Load Removed (lbs/yr)*	403	0.9
Total Load Remaining (lbs/yr)	45	0.6
Difference	90%	60%

*Based on removal ability of practice AND percent of WQv treated

APPENDIX A - Pollutant Load Calculations

BMP Site BHP-6

Total Area (acres) 4.40
Impervious (acres) 1.32

$$R=P*P_j*R_v$$

Ia=	30%
Rv=	0.32
P=	47.00
R=	13.56

$$L=0.226*R*C*A$$

	TSS	TP
C (road runoff)=	150	0.5
Annual Load, L (lbs/yr)=	2,022	6.7

Removal from Bioretention Area (100% of WQv)

Load Removed (lbs/yr)*	1,820	4.0
Total Load Remaining (lbs/yr)	202	2.7
Difference	90%	60%

*Based on removal ability of practice AND percent of WQv treated

BMP Site BHP-7

Total Area (acres) 3.40
Impervious (acres) 0.56

$$R=P*P_j*R_v$$

Ia=	16%
Rv=	0.20
P=	47.00
R=	8.37

$$L=0.226*R*C*A$$

	TSS	TP
C (road runoff)=	150	0.5
Annual Load, L (lbs/yr)=	965	3.2

Removal from Bioretention Area (100% of WQv)

Load Removed (lbs/yr)*	868	1.9
Total Load Remaining (lbs/yr)	96	1.3
Difference	90%	60%

*Based on removal ability of practice AND percent of WQv treated

APPENDIX A - Pollutant Load Calculations

BMP Site BHP-8

Total Area (acres) 3.70
Impervious (acres) 0.24

$$R = P * P_i * R_v$$

la=	7%
Rv=	0.11
P=	47.00
R=	4.62

$$L = 0.226 * R * C * A$$

	TSS	TP
C (road runoff)=	150	0.5
Annual Load, L (lbs/yr)=	580	1.9

Removal from Bioretention Area (100% of WQv)

Load Removed (lbs/yr)*	522	1.2
Total Load Remaining (lbs/yr)	58	0.8
Difference	90%	60%

*Based on removal ability of practice AND percent of WQv treated

Summary Table

	TSS	TP
Total Load Produced per year from all drainage areas (lbs)	30,855	107
Total Load Removed per year if all practices are implemented (lbs)	14,001	28
Total Load Removed per lifetime of practices (lbs over 20 yrs)	280,015	558

APPENDIX B

BMP Preliminary Sizing and Cost Calculations

APPENDIX B - Preliminary Sizing Calculations for Stormwater Retrofits

Water Quality Volume (WQv)

#	Project	% Imp.	Drainage Area		Imp. Area	WQv
		%	ac	sf	sf	cf
BHP-1	Intermittent Stream - Gravel Wetland	23%	25.00	1,089,000	250,000	20,833
BHP-2	Bromfield School Detention Pond - Sediment Forebay	67%	5.28	230,199	153,694	12,808
BHP-3	Lower Ball Field - Gravel Wetland	19%	8.70	378,972	73,500	6,125
BHP-4	Pond Road Drainage - Dry Swale	17%	45.20	1,968,912	328,497	27,375
BHP-5	Elementary School Ball Field - Rain Garden	29%	1.00	43,560	12,700	1,058
BHP-6	Bromfield School Entrance - Bioretention Area	30%	4.40	191,664	57,600	4,800
BHP-7	Town Beach Parking - Bioretention Area	16%	3.40	148,104	24,340	2,028
BHP-8	Town Beach Landing - Bioretention Area	7%	3.70	161,172	10,619	885

Note: Water Quality Volume based upon 1-inch of rainfall contributing impervious area

Project BHP-1 - Gravel Wetland

Drainage Area	1,089,000	sf
% Impervious	23%	
Impervious Area	250,000	sf
WQv	20,833	cf
Percent of WQv Required in Forebay	10	%
WQv Volume Required in Forebay	2,083	cft
WQv Depth of Forebay	3.0	ft
WQv Surface Length of Forebay	10	ft
WQv Surface Width of Forebay	20	ft
Sideslope Modification	75	%
WQv Volume Provided in Forebay	450	cft
Number of Wetland Cells	1	
WQv Volume Required in Each Cell	20,833	cft
WQv Depth of Cell	2.5	ft
WQv Surface Length of Cell	35	ft
WQv Surface Width of Cell	75	ft
Sideslope Reduction Percentage	75	%
WQv Volume Provided in Cell	4,922	cft
Total Volume of Wetland Provided	5,372	cft
Extended Detention Depth above WQv	2	ft

Project BHP-2 - Sediment Forebay/Outlet Retrofit

Required WQv	12808	cf
Provided WQv	10,673	cf

Project BHP-3 - Gravel Wetland

Drainage Area	378,972	sf
% Impervious	19%	
Impervious Area	73,500	sf
WQv	6,125	cf
Percent of WQv Required in Forebay	10	%
WQv Volume Required in Forebay	613	cft
WQv Depth of Forebay	3.0	ft
WQv Surface Length of Forebay	15	ft
WQv Surface Width of Forebay	20	ft
Sideslope Modification	75	%
WQv Volume Provided in Forebay	675	cft
Number of Wetland Cells	3	
WQv Volume Required in Each Cell	2,042	cft
WQv Depth of Cell	2.5	ft
WQv Surface Length of Cell	33	ft
WQv Surface Width of Cell	33	ft
Sideslope Reduction Percentage	75	%
WQv Volume Provided in Cell	2,042	cft
Total Volume of Wetland Provided	6,801	cft
Extended Detention Depth above WQv	2	ft

Project BHP-4 - Dry Swale

WQv	27375	cf
df	1.00	ft
K	2	ft/day
height of water above filter	9	in
hf (avg of above)	0.375	ft
tf	2	days
Surface Area Required	4977	sqft
Width of Swale Provided	4	ft
Length of Swale Provided	630	ft
Surface Area Provided	2520	sqft
Treatment Provided	0.51	in

Sizing Equations:

Bioretention

Required Surface Area (sf) = (WQv) (df) / [(k) (hf + df) (tf)]

Where: df = Filter bed depth (ft) k = Coefficient of permeability

hf = Ave. height of water above filter bed (ft) tf = Design time

Dry Swale

Same as Bioretention

Project BHP-5 - Rain Garden

WQv	1058	cf
df	1.00	ft
K	1	ft/day
height of water above filter	9	in
hf (avg of above)	0.375	ft
tf	2	days
Surface Area Required	385	sqft
Surface Area Provided	400	sqft
Treatment Provided	1.04	in

Project BHP-6 - Bioretention area

WQv	4800	cf
df	1.00	ft
K	2	ft/day
height of water above filter	9	in
hf (avg of above)	0.375	ft
tf	2	days
Surface Area Required	873	sqft
Surface Area Provided	900	sqft
Treatment Provided	1.03	in

Project BHP-7 - Bioretention area

WQv	2028	cf
df	1.00	ft
K	2	ft/day
height of water above filter	9	in
hf (avg of above)	0.375	ft
tf	2	days
Surface Area Required	369	sqft
Surface Area Provided	400	sqft
Treatment Provided	1.08	in

Project BHP-8 - Bioretention area

WQv	885	cf
df	1.00	ft
K	1	ft/day
height of water above filter	9	in
hf (avg of above)	0.375	ft
tf	2	days
Surface Area Required	322	sqft
Surface Area Provided	350	sqft
Treatment Provided	1.09	in

APPENDIX B - Preliminary Costs for Stormwater Retrofits

BHP1 - Planning Level Construction Quantities and Cost			
Item, Unit	Cost/Unit	Quantity	Cost
Sediment Forebay, sf	\$12	300	\$3,600
Constructed Gravel Wetland, sf	\$25	2600	\$65,000
8" HDPE Pipe, ft	\$25	70	\$1,750
In-stream Diversion Weir, ea	\$5,000	1	\$5,000
Overflow structure, ea	\$5,000	1	\$5,000
FES& Rip Rap, each	\$2,000	1	\$2,000
Clearing, sft	\$2	500	\$1,000
Potential rock removal, sft	\$12	1000	\$12,000
Subtotal			\$96,000
Contingency (30%)			\$29,000
Total Construction Cost			\$125,000
Other Cost Items			
Land Procurement			None
Design & Permitting Cost			\$6,600
Total Cost Estimate			\$131,600
Lifetime Maintenance Cost (20 yrs @5%)			\$65,000

BHP2 - Planning Level Construction Quantities and Cost			
Item, Unit	Cost/Unit	Quantity	Cost
Sediment Forebay, sf	\$15	350	\$5,250
Convert outlet structure, ea	\$2,000	1	\$2,000
Wetland plants, sf	\$2	1000	\$2,000
Subtotal			\$10,000
Contingency (30%)			\$3,000
Total Construction Cost			\$13,000
Other Cost Items			
Land Procurement			None
Design & Permitting Cost			\$1,300
Total Cost Estimate			\$14,300
Lifetime Maintenance Cost (20 yrs @3%)			\$4,000

BHP3 - Planning Level Construction Quantities and Cost			
Item, Unit	Cost/Unit	Quantity	Cost
Sediment Forebay, sf	\$12	300	\$3,600
Constructed Gravel Wetland, sf	\$15	4000	\$60,000
Grass Channel, ft	\$10	120	\$1,200
Rip Rap Spillway, ea	\$1,000	2	\$2,000
Headwall, ea	\$2,000	2	\$4,000
12" HDPE Pipe, ft	\$25	600	\$15,000
4' High Wall, lf	\$80	250	\$20,000
Fence, ft	\$25	500	\$12,500
Catchbasin, ea	\$3,000	2	\$6,000
Overflow structure, ea	\$5,000	1	\$5,000
High Flow Bypass Manhole, ea	\$6,000	1	\$6,000
Slope Stabilization, sf	\$1	4000	\$4,000
Clearing, sf	\$2	6000	\$12,000
Loam and Seed, sf	\$1	2000	\$2,000
Subtotal			\$154,000
Contingency (30%)			\$47,000
Total Construction Cost			\$201,000
Other Cost Items			
Land Procurement			None
Design & Permitting Cost			\$18,000
Total Cost Estimate			\$219,000
Lifetime Maintenance Cost (20 yrs @5%)			\$60,000

BHP-4 - Planning Level Construction Quantities and Cost			
Item, Unit	Cost/Unit	Quantity	Cost
Dry Swale, sf	\$15	2520	\$37,800
Grass Sideslope, sf	\$3	6500	\$19,500
Connect to Ex Drainage System, ea	\$500	1	\$500
Diversion Wall in CB, ea	\$1,000	1	\$1,000
Pretreatment Tank, ea	\$20,000	1	\$20,000
Check Dam, each	\$1,000	6	\$6,000
Catch Basin, each	\$3,000	2	\$6,000
8" HDPE Pipe, ft	\$25	400	\$10,000
4" HDPE Pipe, ft	\$20	30	\$600
4" HDPE Pipe Manifold Outlets, ea	\$200	10	\$2,000
FES& Rip Rap, each	\$2,000	1	\$2,000
Loam and Seed, sf	\$1	1000	\$1,000
Subtotal			\$107,000
Contingency (30%)			\$33,000
Total Construction Cost			\$140,000
Other Cost Items			
Land Procurement			None
Design & Permitting Cost			\$12,300
Total Cost Estimate			\$152,300
Lifetime Maintenance Cost (20 yrs @6%)			\$62,000

BHP-5 - Planning Level Construction Quantities and Cost			
Item, Unit	Cost/Unit	Quantity	Cost
Rain Garden, sf	\$15	400	\$6,000
Subtotal			\$6,000
Contingency (30%)			\$2,000
Total Construction Cost			\$8,000
Other Cost Items			
Land Procurement			None
Design & Permitting Cost			\$850
Total Cost Estimate			\$8,850
Lifetime Maintenance Cost (20 yrs @6%)			\$8,000

BHP-6 - Planning Level Construction Quantities and Cost			
Item, Unit	Cost/Unit	Quantity	Cost
Bioretention, sf	\$25	1000	\$25,000
Grass Channel, ft	\$10	350	\$3,500
Rip Rap Spillway, ea	\$1,000	1	\$1,000
Subtotal			\$30,000
Contingency (30%)			\$9,000
Total Construction Cost			\$39,000
Other Cost Items			
Land Procurement			None
Design & Permitting Cost			\$3,500
Total Cost Estimate			\$42,500
Lifetime Maintenance Cost (20 yrs @6%)			\$30,000

APPENDIX B - Preliminary Costs for Stormwater Retrofits

BHP-7 - Planning Level Construction Quantities and Cost			
Item, Unit	Cost/Unit	Quantity	Cost
Bioretention, sf	\$25	400	\$10,000
Grass Channel, ft	\$10	50	\$500
Rip Rap Spillway, ea	\$1,000	1	\$1,000
Limited Clearing, sf	\$2	500	\$1,000
Loam and Seed, sf	\$1	500	\$500
Subtotal			\$13,000
Contingency (30%)			\$4,000
Total Construction Cost			\$17,000
Other Cost Items			
Land Procurement			None
Design & Permitting Cost			\$1,700
Total Cost Estimate			\$18,700
Lifetime Maintenance Cost (20 yrs @6%)			\$12,000

BHP-8 - Planning Level Construction Quantities and Cost			
Item, Unit	Cost/Unit	Quantity	Cost
Bioretention, sf	\$25	350	\$8,750
Sediment Forebay, sf	\$12	75	\$900
4" bituminous speed bump, ft	\$10	40	\$400
Rip Rap Spillway, ea	\$1,000	1	\$1,000
Subtotal			\$12,000
Contingency (30%)			\$4,000
Total Construction Cost			\$16,000
Other Cost Items			
Land Procurement			None
Design & Permitting Cost			\$1,700
Total Cost Estimate			\$17,700
Lifetime Maintenance Cost (20 yrs @6%)			\$11,000

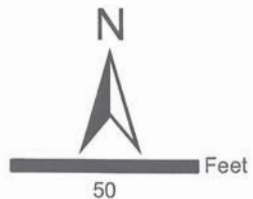
APPENDIX C

Conceptual Design of Proposed BMPs



Legend

-  Gravel Wetland
-  Drainage Area
-  Parcels
-  Streams
-  Natural Wetlands

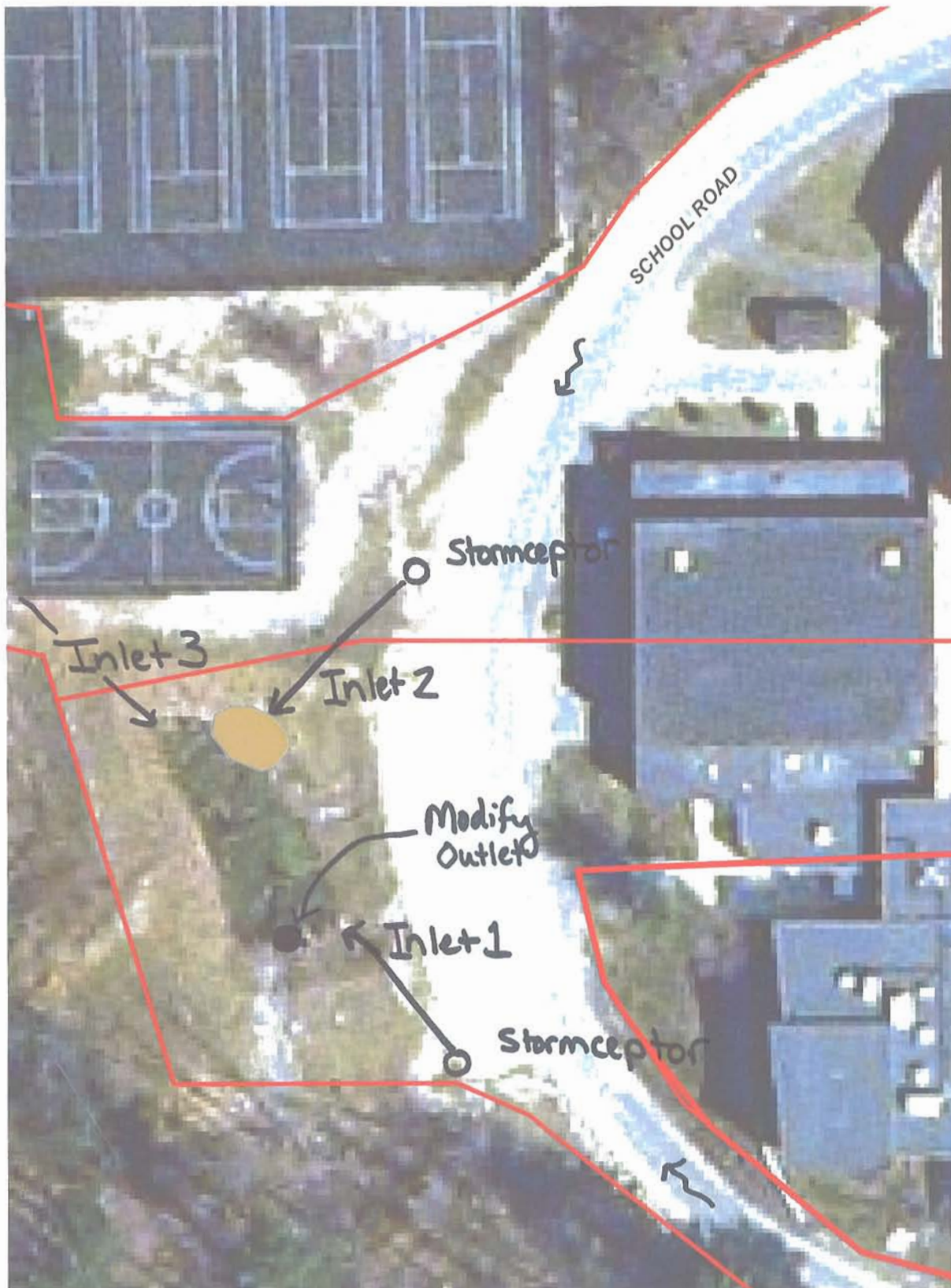


Horsley Witten Group
phone: 508-833-9600
www.horsleywitten.com


Site BHP-1
Bare Hill Pond
Harvard, MA

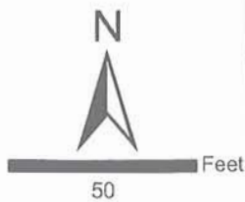
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J:\7143 Bare Hill Pond\GIS\Maps\Site 1

Figure C-1



Legend

-  Sediment Forebay
-  Drainage Area
-  Parcels
-  Streams
-  Flow Direction

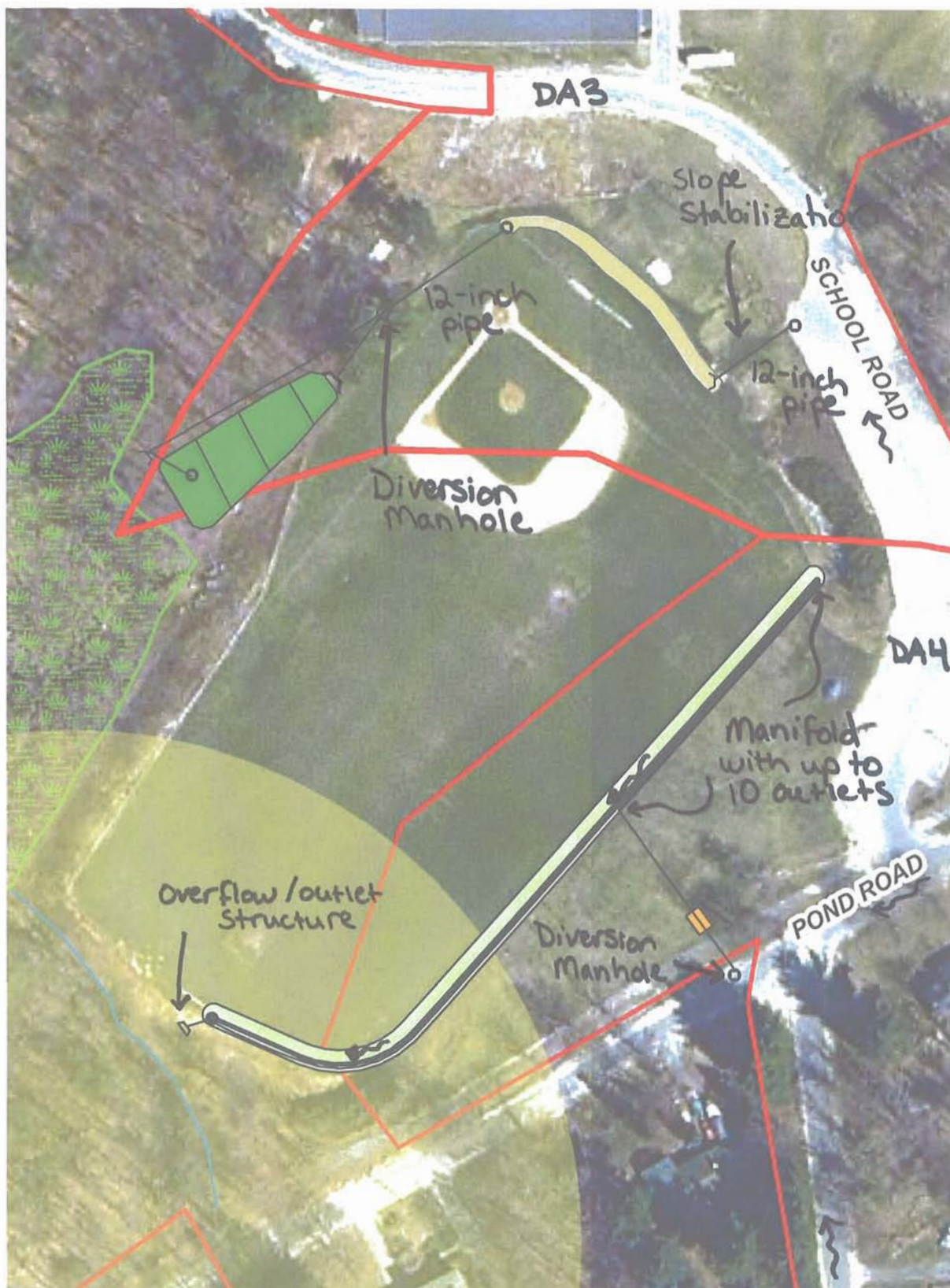


Horsley Witten Group
 phone: 508-833-0000
www.horsleywitten.com

Site BHP-2
 Bare Hill Pond
 Harvard, MA

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Figure C-2



Legend

- | | | | |
|---|---------------|---|--------------------|
|  | Drainage Area |  | Gravel Wetland |
|  | Parcels |  | Dry Swale |
|  | Streams |  | Grass Channel |
|  | Wetlands |  | Oil/Grit Separator |
| Zone I | |  | Flow direction |
- 
 100 Feet

Horsley Witten Group
 phone: 508-833-6600
www.horsleywitten.com




Sites BHP-3 and 4
 Bare Hill Pond
 Harvard, MA

4/13/08 mw
 J:\7143 Bare Hill Pond\GIS\Maps\Site 3


Figure C-3



Legend

-  Drainage Area
-  Parcels
-  Streams

-  Bioretention Area
-  Grass Channel

 Flow Direction

N

75 Feet

Horsley Witten Group
phone: 508-833-0900
www.horsleywitten.com

Sites BHP-5 and 6
Bare Hill Pond
Harvard, MA

4/13/08 mw
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Figure C-4



APPENDIX D

Soil Test Pit Data



Legend



Proposed Soil Test Pit Locations



Streams



400

Feet

Horsley Witten Group

phone: 508-833-6500
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Soil Testing Locations
Bare Hill Pond
Harvard, MA

4/9/08 mw

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C. On-Site Review

Deep Observation Hole Number: TP1 31-Mar-08 8:00 a.m. to 12:00 p.m. Cloudy 30 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole 405

Location (Identify on Plan) See Plan

2. Land Use: Edge of ball field Minimal 0% - 2%
(e.g. woodland, agricultural field, vacant lot, etc.) Surface Stones Slope (%)

Grass Ground Moraine See Plan
Vegetation Landform Position on landscape (attach sheet)

3. Distances from: Open Water Body >100 10 ft. >100 ft.
feet feet feet

Property Line > 10 ft. Drinking Water Well >100 ft. Other _____
feet feet

4 Parent Material: Compact Till Unsuitable Materials Present: Yes ☒ No ☐

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☒ Bedrock ☒

5 Groundwater Observed: Yes ☒ No ☐

If Yes: Depth Weeping from Pit _____ Depth Standing Water in Hole 2
feet

Estimated Depth to High Groundwater: 2 El. 404 ft.
feet elevation

Deep Observation Hole Number: TP1

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-33	Fill	10 YR 3/3	-	-	-	SL	5	0-1	-	-	
>33	R	10 YR 7/1	-	-	-	-	-	-	-	-	

Additional Notes A LAYER AND B LAYER REMOVED.

C. On-Site Review

Deep Observation Hole Number: TP2 31-Mar-08 8:00 a.m. to 12:00 p.m. Cloudy 30 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole 401

Location (Identify on Plan) See Plan

2. Land Use: Edge parking lot adjacent to painted rock few 0% - 5%
(e.g. woodland, agricultural field, vacant lot, etc.) Surface Stones Slope (%)

Grass Ground Moraine See Plan
Vegetation Landform Position on landscape (attach sheet)

3. Distances from: Open Water Body >100 Drainage Way > 100 ft. Possible Wet Area >100 ft.
feet feet feet

Property Line > 10 ft. Drinking Water Well >100 ft. Other _____
feet feet

4 Parent Material: Compact Till Unsuitable Materials Present: Yes ☒ No ☐

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☒ Bedrock ☒

5 Groundwater Observed: Yes ☐ No ☒

If Yes: Depth Weeping from Pit N/A Depth Standing Water in Hole N/A
feet

Estimated Depth to High Groundwater: >6.2 < El. 395 ft.
feet elevation

Deep Observation Hole Number: TP2

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8	A	10 YR 3/4	-	-	-	LS	10	2	WEAK BLOCKY	FRIABLE	
8-22	B	10 YR 5/6	-	-	-	LS	10	2	WEAK BLOCKY	FIRALBE	SO. ROOTS
22-74	C	2.5 Y 5/4	-	-	-	LS	10	2	WEAK BLOCKY	FIRALBE	
>74	R	10 YR 7/1	-	-	-	-	-	-	-	-	

Additional Notes _____

C. On-Site Review

Deep Observation Hole Number: TP3 31-Mar-08 8:00 a.m. to 12:00 p.m. Cloudy 30 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole 358

Location (Identify on Plan) See Plan

2. Land Use: Edge of ball field Minimal 0% - 2%
(e.g. woodland, agricultural field, vacant lot, etc.) Surface Stones Slope (%)

Grass Ground Moraine See Plan
Vegetation Landform Position on landscape (attach sheet)

3. Distances from: Open Water Body >100 Drainage Way > 100 ft. Possible Wet Area >50 ft.
feet feet feet

Property Line > 100 ft. Drinking Water Well >100 ft. Other _____
feet feet

4 Parent Material: Compact Till Unsuitable Materials Present: Yes ☐ No ☒

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5 Groundwater Observed: Yes ☒ No ☐

If Yes: Depth Weeping from Pit 5 ft Depth Standing Water in Hole N/A
feet

Estimated Depth to High Groundwater: 5 El. 353 ft.
feet elevation

Deep Observation Hole Number: TP3

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-16	A _p	10 YR 4/2	-	-	-	SL	20	2	WEAK BLOCKY	FIRM	
16-36	C ₁	2.5 Y 5/3	-	-	-	SL	20	2	WEAK BLOCKY	FIRM	POCKETS SL 10 YR 6/1
36-106	C ₂	7.5 YR 3/1	-	-	-	SL	20	2	WEAK BLOCKY	FIRM	

Additional Notes NO B LAYER PRESENT, PROBABLY MIXED WITH A LAYER DURING CONSTRUCTION OF BALL FIELD. WEEPING

OBSERVED WAS ON THE SOUTH, WEST AND EAST PIT FACE. NORTH PIT FACE C₁ LAYER AT 48", SOUTH FACE 36"

C. On-Site Review

Deep Observation Hole Number: TP4 31-Mar-08 8:00 a.m. to 12:00 p.m. Cloudy 30 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole 362

Location (Identify on Plan) See Plan

2. Land Use: Edge of ball field Minimal 0% - 2%
(e.g. woodland, agricultural field, vacant lot, etc.) Surface Stones Slope (%)

Grass Ground Moraine See Plan
Vegetation Landform Position on landscape (attach sheet)

3. Distances from: Open Water Body >100 Drainage Way > 10 ft. Possible Wet Area >100 ft.
feet feet feet

Property Line > 10 ft. Drinking Water Well >100 ft. Other _____
feet feet

4 Parent Material: Compact Till Unsuitable Materials Present: Yes ☐ No ☒

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5 Groundwater Observed: Yes ☒ No ☐

If Yes: Depth Weeping from Pit 5 ft Depth Standing Water in Hole N/A
feet

Estimated Depth to High Groundwater: 5 El. 357 ft.
feet elevation

Deep Observation Hole Number: TP4

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-4	A	10 YR 3/3	-	-	-	SL	2	2	WEAK BLOCKY	FRIABLE	
4-106	C	2.5 Y 6/3	-	-	-	SL	15	5	WEAK BLOCKY	FIRM	

Additional Notes NO B LAYER PRESENT, PROBABLY MIXED WITH A WHEN CREATING BALL FIELD. C LAYER CONTAINED POCKETS OF GRAVEL AND SILT. WEEPING OBSERVED ON UPHILL SIDE OF PIT AT 32" (NOT INDICATIVE OF WATER TABLE)

C. On-Site Review

Deep Observation Hole Number: TP5 31-Mar-08 8:00 a.m. to 12:00 p.m. Cloudy 30 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole 357

Location (Identify on Plan) See Plan

2. Land Use: Edge of ball field Minimal 0% - 2%
(e.g. woodland, agricultural field, vacant lot, etc.) Surface Stones Slope (%)

Grass Ground Moraine See Plan
Vegetation Landform Position on landscape (attach sheet)

3. Distances from: Open Water Body >100 Drainage Way > 10 ft. Possible Wet Area >100 ft.
feet feet feet

Property Line > 10 ft. Drinking Water Well >100 ft. Other _____
feet feet

4 Parent Material: Compact Till Unsuitable Materials Present: Yes ☐ No ☒

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5 Groundwater Observed: Yes ☒ No ☐

If Yes: Depth Weeping from Pit 5 ft Depth Standing Water in Hole 6
feet

Estimated Depth to High Groundwater: 5 El. 352 ft.
feet elevation

Deep Observation Hole Number: TP5

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-4	A	10 YR 3/3	-	-	-	SL	10	2	WEAK BLOCKY	FRIABLE	
4-74	C	2.5 Y 6/3	-	-	-	SL	10	10	WEAK BLOCKY	FIRM	

Additional Notes NO B LAYER PRESENT, PROBABLY MIXED WITH A WHEN CREATING BALL FIELD. C LAYER CONTAINED POCKETS OF
GRAVEL AND SILT. WEEPING OBSERVED ON UPHILL SIDE OF PIT AT 32" (NOT INDICATIVE OF WATER TABLE)

C. On-Site Review

Deep Observation Hole Number: TP6 31-Mar-08 8:00 a.m. to 12:00 p.m. Cloudy 30 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole 340

Location (Identify on Plan) See Plan

2. Land Use: Edge of Pond Minimal 0% - 2%
(e.g. woodland, agricultural field, vacant lot, etc.) Surface Stones Slope (%)

Grass Ground Moraine See Plan
Vegetation Landform Position on landscape (attach sheet)

3. Distances from: Open Water Body >20 Drainage Way > 100 ft. Possible Wet Area >100 ft.
feet feet feet

Property Line > 10 ft. Drinking Water Well >100 ft. Other _____
feet feet

4 Parent Material: Compact Till Unsuitable Materials Present: Yes ☐ No ☒

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5 Groundwater Observed: Yes ☒ No ☐

If Yes: Depth Weeping from Pit 5.4 ft Depth Standing Water in Hole 6
feet

Estimated Depth to High Groundwater: 5.4 El. 335 ft.
feet elevation

Deep Observation Hole Number: TP6

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
8-0	O	-	-	-	-	-	-	-	-	-	WOOD CHIPS
0-8	Fill	10 YR 6/2	-	-	-	LS	0-1	0-1	MASSIVE	LOOSE	
8-11	A _b	7.5 YR 3/1	-	-	-	LS	0-1	0-1	MASSIVE	LOOSE	
11-56	C ₁	10 YR 6/6	-	-	-	LS	5	2	MASSIVE	LOOSE	
56-106	C ₂	10 YR 6/4	-	-	-	LS	5	2	MASSIVE	LOOSE	

Additional Notes _____
