Alewife and Mill Brook: Mystic Headwaters Project 2013-01/604

Egerton Road, Arlington
Concept Plan for a Green Infrastructure Retrofit

Town of Arlington, MA

October 2014

Prepared for:
Mystic River Watershed Association and the Town of Arlington, MA

Prepared by:
Chester Engineers
18 Commercial Street, Salem MA

CHESTER ENGINEERS

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INTRODUCTION

This report summarizes the conceptual design for green infrastructure improvements at the intersection of Egerton Road and Herbert Road in Arlington, Massachusetts. Three intersections along Herbert Road, at Egerton, Milton and Melrose, present opportunities for green-street retrofits. On the northeast side of Herbert, runoff flows down each of these one-way side streets and collects in catch basins within the turning zone. These intersections are unusually wide, offering an opportunity to treat runoff within bioretention curb extensions while decreasing pedestrian crossing distance and slowing down traffic. In consultation with the Town Engineer, the decision was made to focus efforts on one intersection, Egerton at Herbert, with the hope that the design could be replicated at the other two intersections.

The proposed green infrastructure retrofit on Egerton Road will divert runoff into two curb extensions on either side of the street, each containing a sediment forebay and bioretention basin. These bioretention basins will beautify the streetscape, decrease crossing distance for pedestrians, and reduce the discharge of pollutants into Alewife Brook.

DESIGN CONSIDERATIONS

Egerton Road is a one-way street, approximately 26 feet wide, surrounded by multi-family houses on small lots. Two catch basins, on the northeast and southeast corners of Egerton at Herbert, capture runoff from the road surface, roofs and driveways extending approximately 260 feet toward Massachusetts Ave. This runoff currently flows to Alewife Brook without treatment.

On-street parking is allowed on both sides of Egerton Road. A water line runs along the south side of Egerton; a sewer line down the center; and a gas line along the north side. Gas and water line conflicts will need to be considered in the final design. A fire hydrant is located next to the catch basin at the southeast corner of Egerton and Herbert.

Soils in the area are NRCS Hydrologic Soil Group A. The intersection does not lie within any resource areas or flood zones. Depth to high groundwater elevation is unknown. Existing soils and groundwater elevation will need to be investigated before the next phase of design to ensure adequate infiltration capacity and the required 2-foot vertical separation between seasonal high groundwater and the bottom of the system.

Through discussions with the Town Engineer, several criteria were established for this design:

- Maintain a minimum street width of 14.5 feet.
- Curb radius must allow SU-30 vehicle to turn right onto Herbert Rd.
- Extend curb a maximum of 20 feet from crosswalk to maintain existing parking spaces.
- Treat the first one-half inch of runoff, if space permits.

Photo 1. Egerton Road looking northeast from Herbert Road

Photo 2. Storm drain and hydrant on south side of intersection

CONCEPT DESIGN

Two curb extension bioretention basins are proposed at the Egerton Road/Herbert Road intersection. On the north side of the intersection, space available for the curb extension was limited by the need to comply with the SU-30 standard for vehicle passage around a sharp curve. The layout on both sides incorporates a sediment forebay that is designed for improved vehicle movement around the obstruction, with a 2 foot-wide opening at the gutter line to accept the roadway runoff. On the north side of the intersection, runoff will move from the sediment forebay over a weir into a bioretention basin approximately 20 feet long, averaging 5 feet wide and 5 inches deep, containing 40 cubic feet of storage capacity for infiltrating stormwater.

Ideally, basins are sized for the full one-half inch first flush to accommodate intense storms of one-half inch per hour. This is often not practical in urban settings where space is limited. Therefore, considering an average storm of 6 hours duration, and an infiltration rate of 3 inches/hour, a basin of this size would infiltrate 150 cubic feet of runoff in the 6-hour period. Combined with the 40 cubic feet of storage remaining in the basin to be infiltrated, total basin capacity is 190 cubic feet. This represents 20% of the first flush runoff for that location, calculated at 950 cubic feet. Runoff in excess of basin capacity will enter a beehive catch basin and drain across Egerton Road to connect with the beehive catch basin on the south side of the intersection and from there, on to the municipal storm drain system. The 5 inches of polluted runoff allowed to pool in the bioretention basin will continue to infiltrate through plant roots and engineered soil into the water table at a rate of 2 to 3 inches/hour, until drained completely within 2 to 3 hours.

On the south side of Egerton Road, runoff collected in the forebay will spill over a wier and into a bioretention basin approximately 24 feet long, 7 feet wide, averaging 8 inches deep, containing 112 cubic feet of storage capacity for infiltrating stormwater. Combined with 252 cubic feet that infiltrates over a six hour rainfall event, the total bioretention basin capacity is 364 cubic feet. This represents 33% of the one-half inch first flush runoff for that location, calculated at 1,100 cubic feet. Runoff in excess of basin capacity will enter the beehive catch basin, built over the existing outflow pipe from the existing catch basin (to be removed). From there, runoff will combine with flow from the north side of the intersection and will drain through the existing pipe to the municipal storm drain system. The 8 inches of polluted runoff remaining in the bioretention basin will continue to infiltrate as above, draining completely within 2 ½ to 4 hours.

EXPECTED POLLUTANT REMOVAL

Estimated removal totals for three common pollutants are presented in Table 1. These estimates are based on the depth of runoff treated (see drainage calculations in Attachment B) and pollutant loading rates and removal efficiencies reported in the Stormwater Best Management Practices Performance Analysis (Tetra Tech, 2010)[1].

Table 1 Total Estimated Removal for Three Common Pollutants

Site	Drainage Area (acre)	Pollutant Loading Rate (lb/ac/yr) [a]		Percent Pollutant Removal [b]	Annual Load Removed (lbs)
North side	0.53	TSS	465.08	46%	112.5
		TP	1.1	19%	0.1
		Zn	0.79	53%	0.2
South side	0.61	TSS	465.08	70%	197.7
		TP	1.1	34%	0.2
		Zn	0.79	79%	0.4

Source: Tetra Tech (2010) page 161 Bioretention BMP Performance Table.
[a] Annual pollutant loading rates for high-density residential.
[b] North side percent removal based on depth of runoff treated = 0.1 inches. South side depth of runoff treated = 0.2 inches.

COST ESTIMATE

The estimated construction cost for the bioretention basins illustrated in the Concept Plan is approximately $29,000, including contingencies. See Table 2 for an itemized breakdown of quantities and unit costs.

[1] Tetra Tech (2010) Stormwater Best Management Practices (BMP) Performance Analysis, Revised Document, March 2010, prepared for USEPA-Region 1. Boston, MA

Table 2 Estimate of Probable Construction Costs

Item Description	Unit	Unit Price	Quantity	Cost
Erosion and sediment control	LS	$1,000	1	$1,000
Traffic management allowance	LS	$4,000	1	$4,000
Tree protection	EA	$200	2	$400
Pavement removal	SY	$12	30	$360
Excavation	CY	$24	30	$720
Remove existing catch basin	EA	$420	2	$840
River rock	CY	$100	3	$300
Non-woven geotextile fabric	SY	$4	15	$60
Granite check dam	LF	$50	16	$800
Engineered soil	CY	$80	25	$2,000
Bark mulch (3")	CY	$65	3	$195
Shrubs (containers, 24" o.c.)	EA	$30	65	$1,950
Catch basin frame and grate (Beehive)	EA	$500	2	$1,000
Precast concrete catch basin	EA	$2,600	2	$5,200
12" RCP	LF	$60	32	$1,920
Granite Curb	LF	$35	100	$3,500
			Subtotal	$24,245
			5% Mobilization	$1,212
			15% Contingency	$3,819
			Total	**$29,000**

MAINTENANCE

Operation and maintenance needs for the green infrastructure retrofit are summarized below.

Monthly maintenance includes:

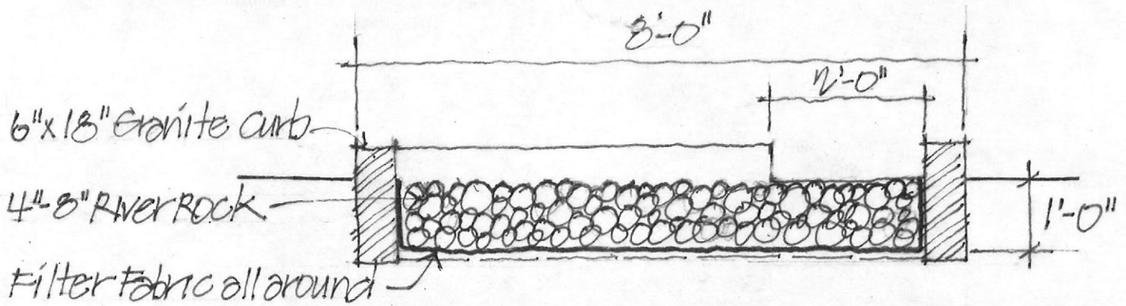
- Remove all trash and debris.
- Inspect inlets along gutter into sediment forebay. Remove any debris that might impede flow.
- Inspect beehive grates. Remove any debris that might impede flow. Repair any damage as needed.
- Inspect for erosion or deep settling/shifting of mulch layer and underlying soil. Replace soil and mulch as needed.
- During the growing season, remove weeds and invasive species by hand. Refer to Invasive Plant Atlas of New England (IPANE) database of invasive and potentially invasive plants.

Annual maintenance includes:

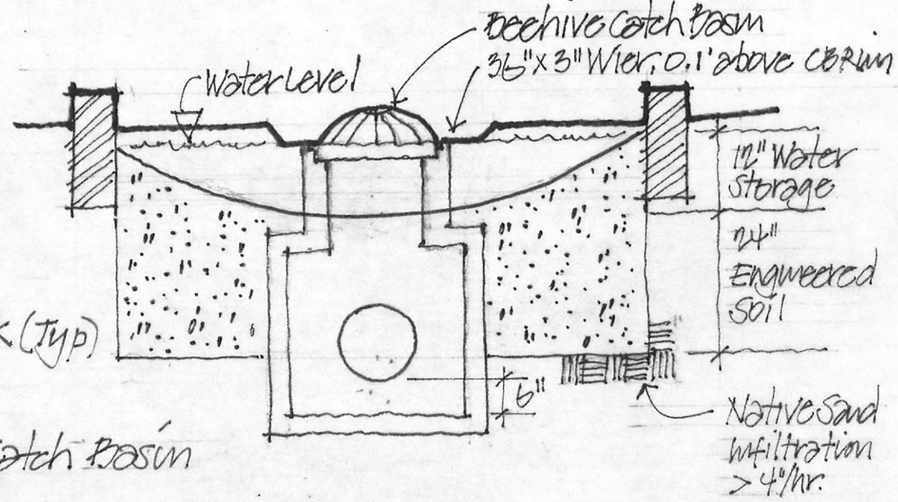
- Remove accumulated sediment in the forebay.
- Inspect for the development of hardpan at the bottom of the basin. Hardpan occurs when the soil becomes cemented, forming an impervious layer. Where this has occurred, scarify the soil to a depth of 6 inches.
- Remove old mulch layer and apply a 3-inch layer of clean hardwood mulch evenly throughout, being careful not to smother or damage the plants.
- Prune shrubs to remove any dead or damaged limbs.
- Manually cut grasses to a height no shorter than 3 inches (in April). Remove cut grass from basin and dispose of off-site.

ATTACHMENT A: SKETCH PLAN

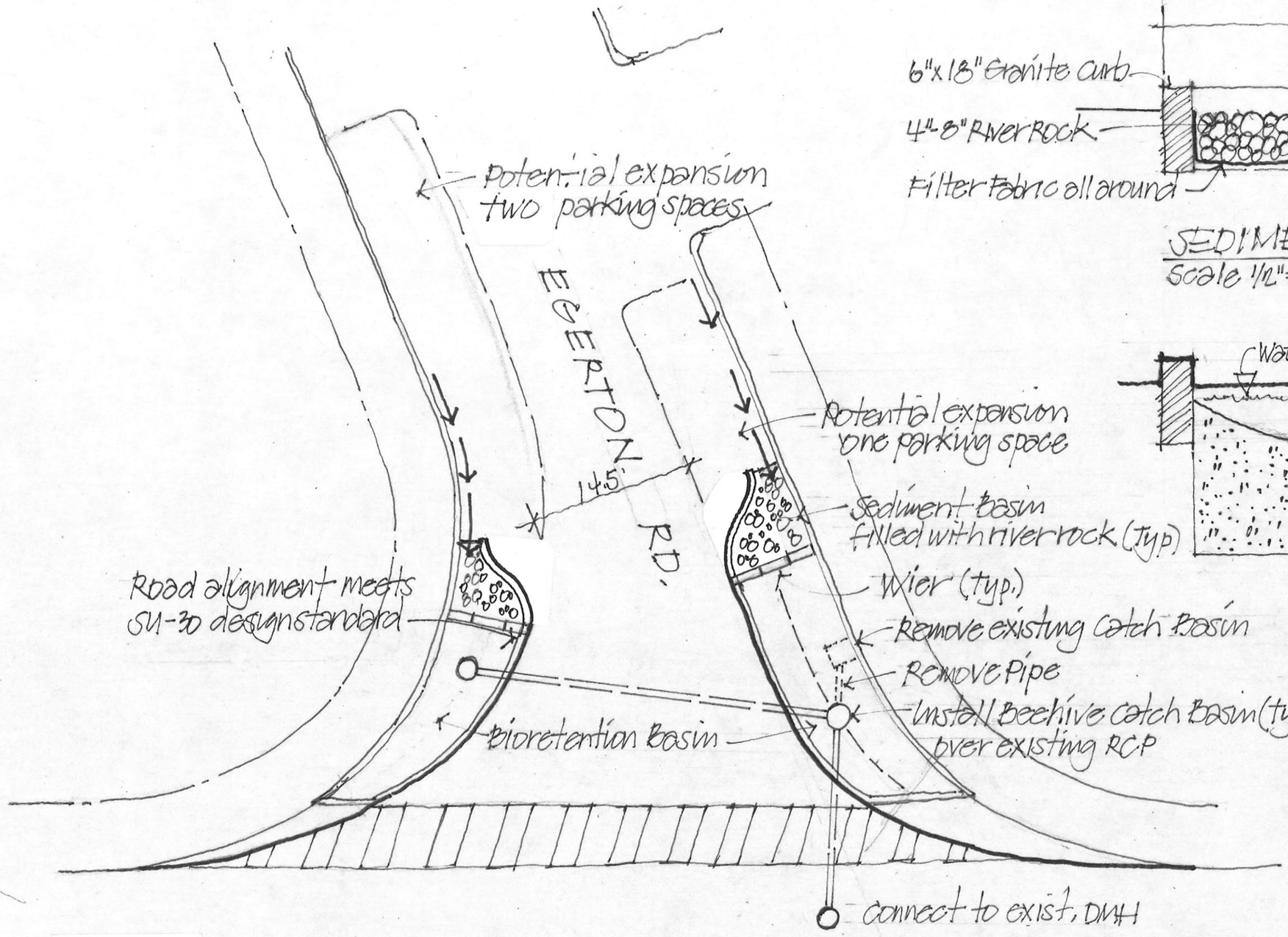
Figure 1. Design Concept for Egerton Rd/Herbert Rd Intersection



SEDIMENT BASIN
Scale 1/2"=1'-0"



BIORETENTION BASIN
Scale 1/2"=1'-0"



SKETCH PLAN

Design Concept for Egerton Rd./Herbert Rd. Intersection
Arlington, MA
by
Bioengineering Group

June 2014

0 5 10 20 scale 1"=10' N.

ATTACHMENT B: DRAINAGE CALCULATIONS

Egerton Rd, Arlington
Drainage Calculations

Drainage Area Inputs

Drainage area	Description	Existing Outlet	Planned Outlet	Watershed Area (sf)	Area (acres)	Soil Group	Cover Type	CN
North side Egerton Rd	Curb to center crown, extending to center crown on Herbert, north to catch basin on Herbert	Catch basin on Egerton at north corner of Egerton and Herbert	Gutter flow to biobasin	7,400	0.170	A	Paved	98
North house lots	Roofs and driveways on 4 lots including half roof on corner lot.	Catch basin on Egerton at north corner of Egerton and Herbert	Gutter flow to biobasin	15,500	0.356	A	Paved	89
South side Egerton	Curb to center crown, extending to center crown on Herbert, north to catch basin on Herbert	Catch basin on Egerton at south corner of Egerton and Herbert	Gutter flow to biobasin	6,450	0.148	A	Paved	98
South house lots	Roofs and driveways on 4 lots including half roof on corner lot.	Catch basin on Egerton at south corner of Egerton and Herbert	Gutter flow to biobasin	20,000	0.459	A	Paved	89

First Flush (0.5 inch) Volume Calculation

	Drainage Area (sf)	Drainage Area (acre)	Runoff Design Depth (in)	First Flush Runoff Volume (cu.ft.)	Concept Design Capacity (cu.ft.)	Percent of First Flush	Runoff Depth Treated (in)
North side	22,900	0.53	0.5	954	190	20%	**0.10**
South side	26,450	0.61	0.5	1102	364	33%	**0.17**
			TOTAL	**2056**	**554**	**27%**	**0.13**

Pollutant Removal Estimate

Site	Drainage Area (acre)	Pollutant Load (lb/ac/yr) [a]		Percent Pollutant Removal [b]	Annual Load Removed (lbs)
North side	0.53	TSS	465.08	46%	112.5
		TP	1.1	19%	0.1
		Zn	0.79	53%	0.2
South side	0.61	TSS	465.08	70%	197.7
		TP	1.1	34%	0.2
		Zn	0.79	79%	0.4

Source: Tetra Tech (2010) page 161 Bioretention BMP Performance Table.

[a] Annual pollutant loading rates for high-density residential.

[b] North side percent removal based on depth of runoff treated = 0.1 inches. South side depth of runoff treated = 0.2 inches.

	Total lbs/year	Total lbs/year removed	Total % removal
TSS	526.90	310.1	59%
TP	1.25	0.3	27%
Zn	0.90	0.6	67%