Charles County
NPDES Design Concepts

Acton-Hamilton
Community Report

Charles County, Maryland

Prepared for:
Charles County Department of Planning and Growth Management

KCI Technologies, Inc.
December 2008

KCI TECHNOLOGIES

INTRODUCTION

In 2004, KCI prepared the Charles County Watershed Restoration Study to address requirements outlined in Section III.F. of the County's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Stormwater System (MS4) permit. This permit requires Charles County to identify and retrofit 10% of the untreated impervious area within the Development District. The intent of the 2004 study was to look at the areas within the Development District that were not treated and recommend stormwater management retrofits. Seven watersheds within the Development District were studied in 2004, including Acton-Hamilton, which at the time, had the third largest amount of untreated impervious area.

One of the results of the study consisted of planning-level concept plans for stormwater quality improvements for the Acton-Hamilton Community. Charles County is in the process of soliciting design services to begin implementation of these improvements. This report provides concept plans based on the recommendations of the study performed in 2004, which have been taken to a higher level of design as a basis for bid and award of a final design contract.

STUDY AREA

The Acton-Hamilton Community is located in Waldorf, Maryland near the intersection of Route 301 and Acton Road. There is one unnamed tributary that drains the area and flows into Mattawoman Creek. A portion of the headwaters within Acton Hamilton are piped across Route 301. The remainder of the drainage within Acton-Hamilton is in its natural state. The older neighborhoods within Acton-Hamilton appear to have limited stormwater management (SWM), although there are newer neighborhoods and commercial areas with SWM ponds.

Land use in the Acton-Hamilton Community consists of the following:

- Low Density Residential: 1 acre residential lot for every dwelling unit
- Medium Density Residential: ½ acre residential lot for every dwelling unit
- High Density Residential: 1/8 acre residential lot for every dwelling unit
- Commercial: Retail, office, or wholesale properties
- Open Space: Forested areas

According to the 2004 study, the majority of untreated impervious area originates in Commercial and Medium Density Residential land uses. Runoff from these areas flows into streams without the benefit of pollutant or sediment removal, degrading the water quality within the stream.

Soils in the area of Acton-Hamilton consist mostly of the Beltsville-Evesboro-Sassafras association. These are in the “C” Hydrologic Soil Group (HSG). Soils in this HSG have low infiltration rates and generally impede the downward movement of water. Because of these characteristics, infiltration practices, such as infiltration trenches, are not recommended.

CONCEPTUAL DESIGN REPORT

A desktop analysis was performed to determine the most likely sites for stormwater management, including low-impact development (LID). The focus of the desktop analysis was the areas and treatment selected in the 2004 Watershed Restoration Study. Specific conditions that were researched throughout the Acton-Hamilton Community include:

1. Amount of right-of-way available,
2. Absence of utilities within the proposed site,
3. Amount of untreated impervious area draining to the site, and

Prior to visiting any proposed sites, ArcGIS shapefiles provided by the County or generated by KCI were used to prepare field maps. To verify the existing conditions, a windshield survey was conducted in the 4 sub-areas within Acton-Hamilton, AH1 through AH4. Details that are not necessarily available in GIS format, such as the existence of curbs, additional existing stormdrains, and rooftop drainage were assessed. When a potential stormwater retrofit site was found, the site was marked on the field map, photographs were taken, and a short description of the existing conditions was prepared.

In the office, drainage areas were delineated in ArcGIS to each proposed retrofit site. This was done using 2 foot contours and stormdrain shapefiles as well as the orthophotos. The amount of impervious area within each drainage area was also determined using ArcGIS and the roadway and building shapefiles. See the attached map for project locations and drainage areas.

To determine the water quality volume (WQv) required at each retrofit site, procedures from the *2000 Maryland Stormwater Design Manual* were used including the following equation:

$$WQv = \frac{(0.05+0.009*I)(A)}{12}$$

where:
I = Percent impervious cover
A = Drainage area (in acres)

The majority of proposed concept plans are in line with what was suggested in the 2004 study. However, there are two sites where a different retrofit type is suggested due to the site conditions. In AH4, parking lot bioretention was recommended in 2004; however, the site conditions would not allow for a bioretention area because of existing utilities. A dry swale has been recommended as a substitute.

There are open space areas between townhouses off of Western Parkway that were proposed as possible bioretention or tree planting areas. These areas do not receive any runoff from the surrounding impervious areas, so they are not recommended as retrofits.

The proposed facility types within the Acton-Hamilton Community include a wet pond retrofit, dry swales, bioretention, and Filterra® Bioretention Systems. Table 1 gives the total area treated and the impervious area treated by all of the projects. Descriptions and sketches of each type of facility are included below.

Table 1: Area Treated by All Projects

TREATMENT TYPE	SITES	TOTAL DRAINAGE AREA (ac)	IMPERVIOUS AREA TREATED (ac)
Bioretention	AH3 S3 AH3 S5 AH3 S6	5.97	2.96
Pond retrofit	AH1 S1	15.15	5.75
Filterra®	AH3 S4	0.85	0.85
Dry Swale	AH1/AH2 S2 AH4 S7 AH4 S8	58.21	13.58
TOTAL		**80.18**	**23.14**

Along with ponds and bioretention areas, there are also non-structural methods for treating stormwater runoff, usually categorized as green infrastructure. Planter strips placed along a roadway, native landscaping, and increased tree cover are just a few of the ways to decrease the impact that rain events have on water quality and runoff volume. There are models and calculators available that can give rough estimates of green infrastructure treatment value, many of which are referenced in the new Watershed Forestry Resource Guide (http://www.forestsforwatersheds.org/). Many of these methods, including street tree planting and planters, are appropriate for highly developed areas such as urban streets and commercial sites. Low Impact Development can take advantage of forested areas within a site layout; thereby improving the water quality conditions downstream of the development. The Acton-Hamilton Community has already been developed, however, and has few urban streets and commercial areas.

The cost estimates for each proposed retrofit site were developed using unit costs for the estimated size of the facility. All of the costs include engineering and surveying, construction, mobilization, and a contingency. Operation and maintenance costs are also projected for the expected life of the facility, which is generally 20 years.

To estimate a cost for bioretention areas and dry swales, the items needed to construct the facility are broken down by surface area (square yards) or length (feet), depending on the type of facility. For example, a dry swale's components are cost by length while a bioretention area is cost by surface area. The cost for a wet pond is also based on its components, although these components do not come in set proportions. The cost for a wet pond is determined by item. The cost for all of these individual items is based on Maryland State Highway Administration (MSHA) bid prices.

The one exception to pricing by component is the Filterra® Bioretention System. This is a proprietary system, so the cost set by the manufacturer is included as a lump sum.

Right-of-way acquisition costs were based on assessed property values for lots located on the roadway in question. The Maryland Department of Assessments and Taxation Real Property Data Search site was used to identify the land values for properties. Using the lot area and the assessed value for these lots, an average value per square foot was established for the lots along the roadway. This cost per square foot was used to determine the right-of-way acquisition costs for the retrofits.

SHALLOW WETLAND

Shallow wetlands provide water quality volume (WQv) in a shallow pool that has a large surface area. Facilities such as these treat urban stormwater through the use of small permanent pools. These small pools allow suspended sediments to settle out of the water column as well as allow vegetative uptake of various nutrients.

A shallow wetland consists of high marshes, low marshes, a micropool, and a forebay. High marshes are areas that are less than 6 inches in depth that contain wetland plantings. At least 35% of the marsh area of the shallow wetland is made up of high marshes. Low marshes are areas that have a water depth between 6 inches and 18 inches and compose at least 65% of the marsh area. The arrangement of high and low marshes within the shallow wetland helps to elongate the flowpath of water that enters the facility, which ensures the greatest treatment possible.

Figure 1: Plan view of Shallow Wetland

A forebay is located at the inlet to a stormwater management (SWM) facility and provides storage for settlement of sediment. The storage volume located within the forebay contributes toward the total WQv. A micropool, which is a smaller permanent pool within the shallow wetland, also provides storage of WQv and prevents the resuspension of settled particles before water leaves the facility.

Plantings within the shallow wetland are chosen specifically for their ability to thrive in a wet environment. The landscaping will provide different plant types to encourage a variety of wildlife and water fowl within the facility.

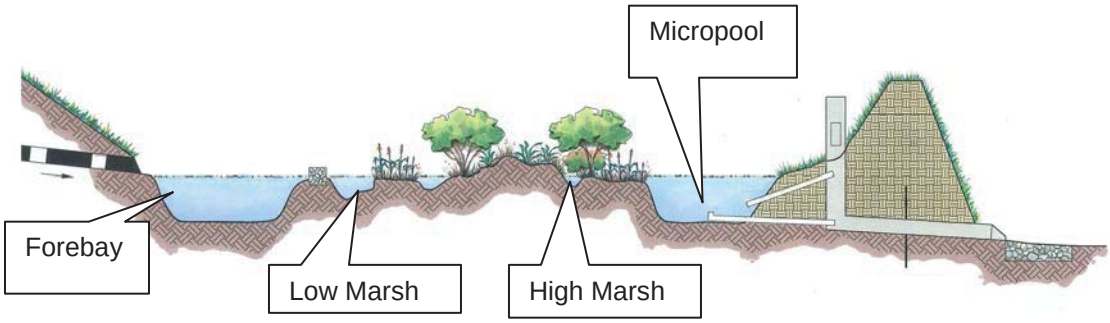


Figure 2: Profile of Shallow Wetland

BIORETENTION

A bioretention area combines open space with SWM through the use of landscaping and permeable soils to treat runoff from parking lots and urban areas. The permeable soils filter suspended sediments and some pollutants out of the runoff while the landscaping promotes evapotranspiration of the runoff and uptake of nutrients.

Bioretention areas generally consist of a stone diaphragm, filter fabric, filter media, landscaping, and an underdrain system. The stone diaphragm reduces the velocity of the runoff from the impervious surface that is entering the facility and also removes suspended material that may clog the filter media. The filter fabric, which is placed between the planting soil and the gravel surrounding the underdrain, is a geotextile barrier used to prevent the filter media from settling into the underlying stone. The underdrain system is a 6 inch perforated pipe system that collects the water that has filtered through the permeable media and transports it to a downstream open channel or connects into a nearby storm drain.

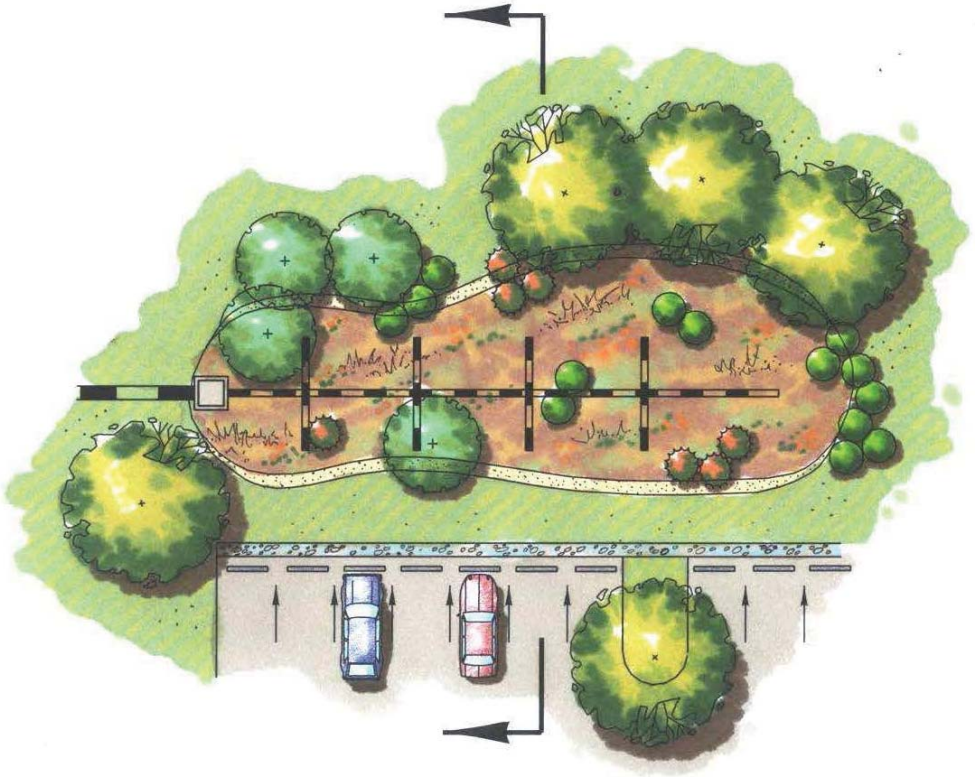


Figure 3: Plan view of Bioretention area

The landscaping in a bioretention area is also very important. The plants chosen are native plant species that are tolerant of standing water. A wide variety of trees, shrubs, and herbaceous plants are selected for varying levels of vegetative uptake, for encouragement of various wildlife species, and for improved aesthetics. The permeable soil in the bioretention area is approximately 2.5 feet to 4 feet deep with 3 inches of mulch above it.

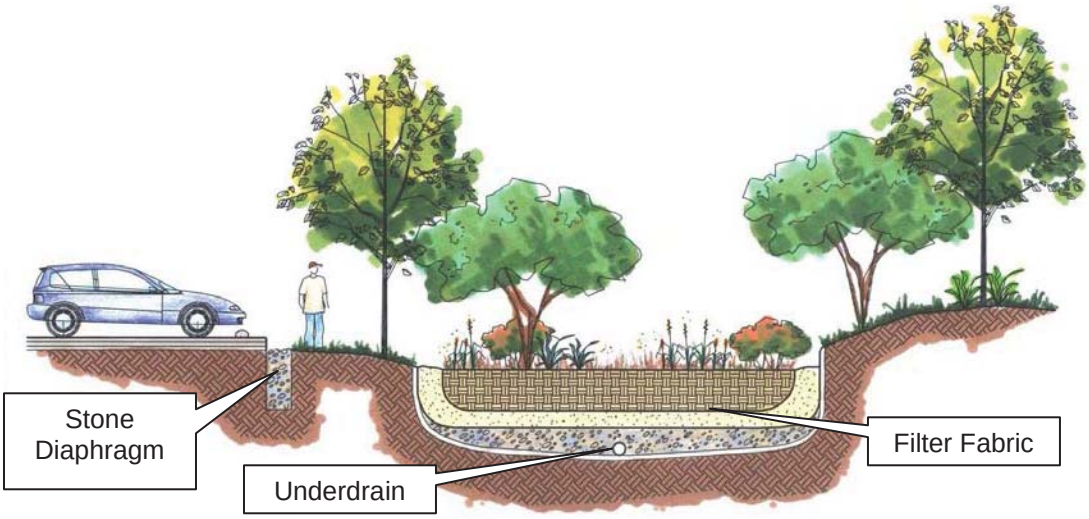


Figure 4: Cross section of Bioretention area

The ponding within the bioretention area is typically 6 inches to 12 inches. There is generally a catch basin or weir provided within the ponding area that will be used for overflow when the ponding area reaches its maximum volume.

The type of bioretention area proposed in Acton-Hamilton is parking lot bioretention. Parking lot bioretention is placed within the median(s) of a parking lot. Because medians are typically curbed, this type of bioretention requires curb removal to allow runoff into the facility. Parking lot bioretention is restricted in the amount of surface area that can be obtained without removing parking spaces, so the surface area of the facility is typically the surface area of the median.

DRY SWALE

A dry swale is an open channel used to convey drainage and promote the filtering of stormwater runoff. Dry swales, which are used to treat WQv, may also contain an underdrain beneath the filter material to ensure runoff is conveyed away within 48 hours.

A dry swale contains filter material, an underdrain system, and check dams. The filter material is typically 2.5 feet of permeable soil underlain by filter fabric and a gravel bed surrounding an underdrain system consisting of a 6 inch perforated pipe. The pipe conveys the filtered water to the downstream channel or storm drain.

A check dam is a small dam used within the channel to temporarily pool water, which promotes deposition of sediment and reduces flow velocities. Check dams allow channels to have a longitudinal slope of up to 4% and still provide WQv with non-erosive flow velocities.

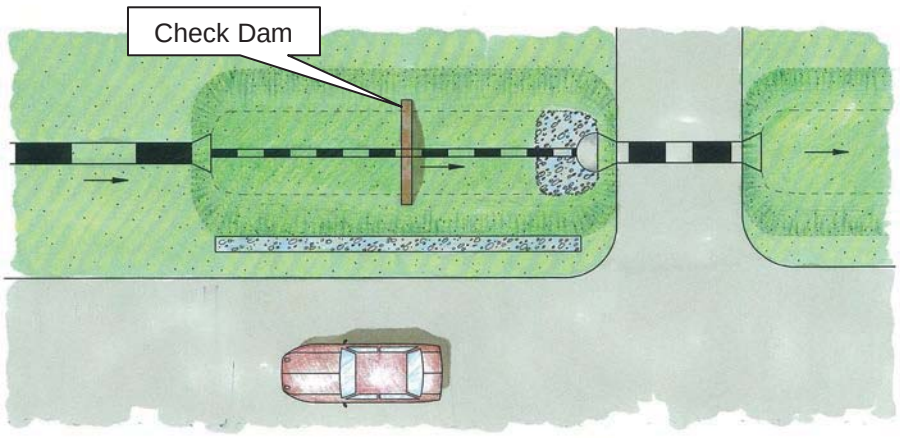


Figure 5: Plan view of Dry Swale

The side slopes of a dry swale are typically designed to be flatter than 3:1. The vegetative cover usually consists of grass with some riprap at swale inlets and outlets. The bottom width of the dry swale is between 2 feet and 8 feet and the maximum ponding depth is 18 inches.

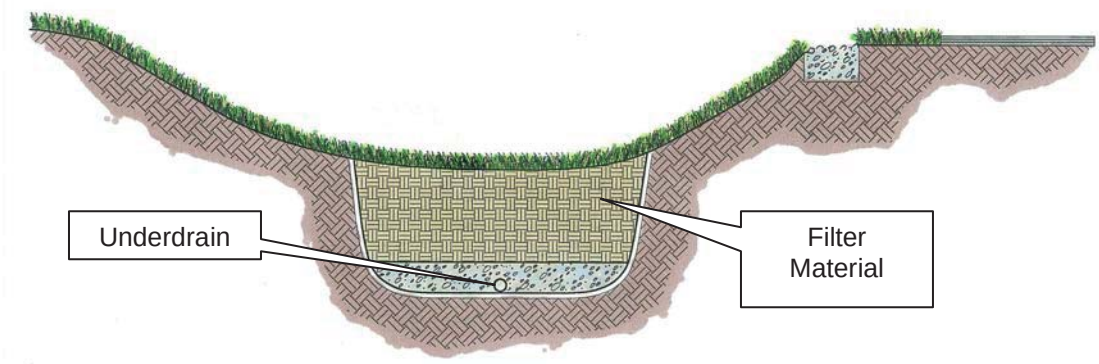


Figure 6: Cross section of Dry Swale

FILTERRA® BIORETENTION SYSTEM

A Filterra® Bioretention System is a self-contained bioretention stormwater treatment system. This bioretention system filters stormwater runoff through the soil treatment media that comes with every Filterra®. It can be used for both new and retrofit projects to remove various pollutants as well as suspended solids commonly found in stormwater runoff.

A Filterra® works to first filter runoff before it discharges into storm drains. The system consists of a concrete box that contains soil filter media, mulch, a perforated pipe underdrain system, and an optional plant. The Filterra® receives water through a curb inlet and filters the runoff through the media, allowing filtration of sediments and other pollutants as well as vegetative uptake from the landscaping. The filtered water then flows through the underdrain into the existing stormdrain located nearby. For larger storms, higher flows bypass the Filterra® system to the existing nearby stormdrain to ensure the filter media does not wash away or back up into the street.

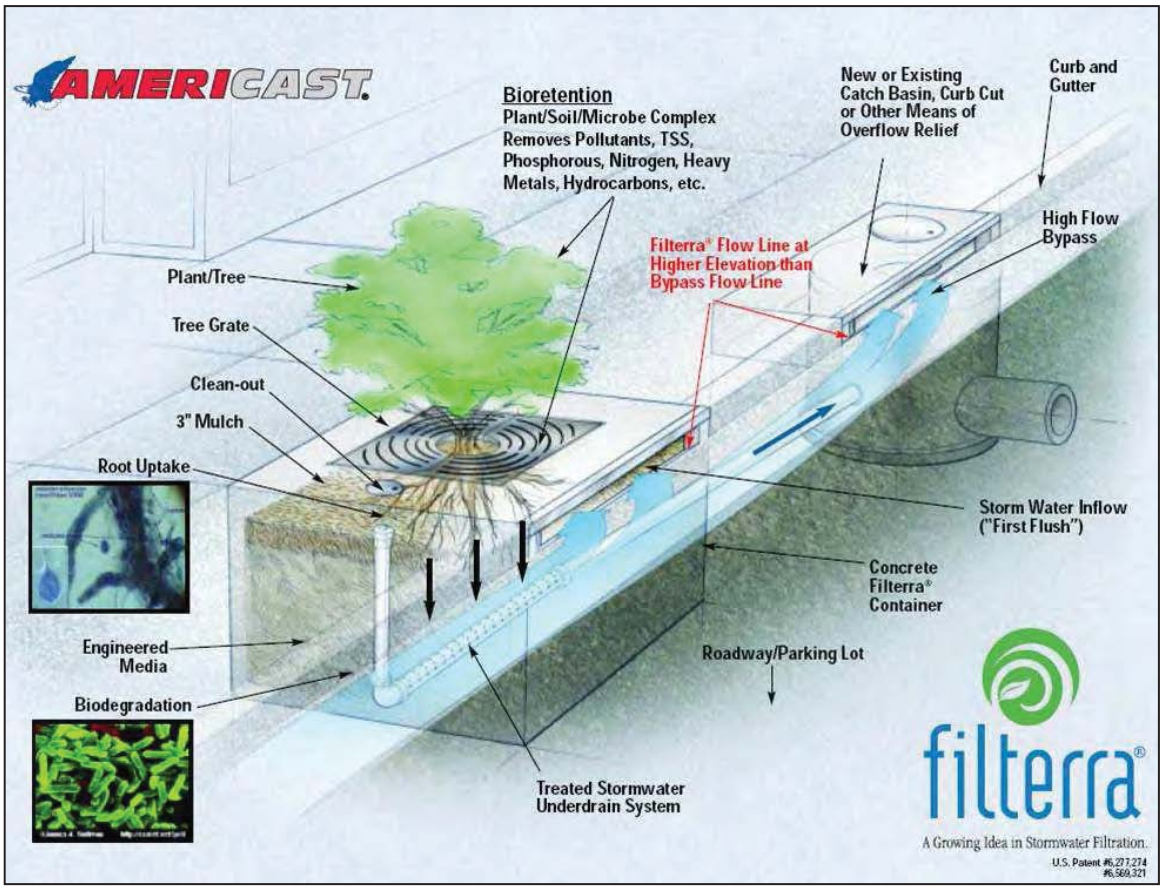


Figure 7: Filterra
Source: http://www.filterra.com/pdf/FilterraSchematic.pdf

There are many options available with a Filterra®, including size and landscaping. The footprint of a Filterra® is variable and can be changed based on the space available and the treatment needed at the project site. Another option of a Filterra® system is a tree grate on the top of the Filterra® that can contain a bush, small tree, or sod for additional removal of pollutants.

Maintenance is performed through the grates located on the top of the Filterra® system. Built up sediment and trash are removed through the grate with no disruption to the filtering system.


Project Location and Drainage Area Map
N
W
E
S
AH1 Site1
AH1/AH2 Site 2
Site9
AH3 Site6
AH3 Site3
AH3 Site5
AH3 Site4
AH4 Site7
AH4 Site8
Proposed Filterra Locations (PF7 Site 2)
Storm drain
Streams

Project Name: AH1 Site 1
Project Type: Proposed Retention Pond
Drainage Area: 32.51 acres
Treated Impervious Area: 18 acres

Project Location: This project is located at the end of Tred Avon Court.

Project Description: The majority of the Acton-Hamilton neighborhood, consisting of Tred Avon and Myrtle Oak Courts, is drained by a closed stormdrain system. This stormdrain system discharges into an existing dry pond located at the north end of Tred Avon Court. Currently, this dry pond appears to utilize a low flow PVC pipe with a stone weir as an overflow.

As part of the Acton Lane Roadway Improvement Project, this facility will be converted to a forebay for a larger retention pond. According to the design plans by AB Consultants, Inc, a total of 32.51 acres will drain to the new facility. The retention pond appears to be able to treat 1.42 ac-ft of water quality volume, corresponding to approximately 18 acres of impervious area. This appears to exceed the new impervious area proposed by the project by nearly 16 acres. Therefore, the project appears to treat the impervious area draining to the existing facility.

Site Photo of AH1 Site 1:

Project Name: AH1/AH2 Site 2
Project Type: Dry Swales
Drainage Area: 55.84 Acres
Treated Impervious Area: 11.78 Acres

Project Location: These projects are located in the area of Timberbrook Drive.

Project Description: Timberbrook Drive has a 60 foot right-of-way according to the plats for the neighborhood. In the field, the roadway was measured to be 24 feet wide on Timberbrook Drive and 20 feet wide on the other roads. The remainder of right-of-way on either side the road is currently being used for parking by the residents. Next to the parking area, there are existing ditches that convey water between driveway culverts. The other roads within the neighborhood, such as Kipling Drive and Lantern Lane, do not have sufficient right-of-way to accommodate dry swales. Below is the estimated right-of-way width that would need to be purchased along each road:

- 4 feet on Lancelot Drive
- 4 feet on Lantern Lane
- 6 feet on Kipling Drive
- 1 feet on Hunting Lane

A total of 149 dry swales would be installed between the driveways along the above named roads. The dry swales would receive runoff from the roadway and some of the rooftops. This runoff would be filtered in the dry swales to remove suspended sediment and some pollutants before transporting the water downstream. The water would be transported in the swales by an underdrain. This would eventually drain into the stream located behind the houses on the west side of Timberbrook Drive.

The existing ditches appear to be outside of the right-of-way on most roads. To install dry swales within the right-of-way, many of the driveway culverts would need to be moved to be within the right-of-way to ensure that water would still convey. This would require most if not all of the off-street parking areas to be removed. Another option is to ask permission from the residents to install a dry swale in the existing ditch on their property. The dry swale would look similar to the existing ditch and maintenance requirements for the property owners would still be similar. This will also allow the residents to keep most of their off-street parking areas.

The following page contains a map of the proposed dry swale stationing along the roads. Computations are also included along each road for each dry swale sizing, including length, slope, width and cost, on the following pages.

AH1/AH2 Site 2

Imperviousness	21.1	%
RCN	81	
Total Length of Swale	13,126	ft.
WQv req'd	1.12	ac-ft

Potential Project Benefits:

Water Quality	Dry swales would filter sediment out of the runoff as well as other pollutants, thus improving the water quality.
Instream Habitat	This project would improve instream habitat by reducing the amount of sediment suspended and other pollutants in the water that can harm flora and fauna.

Potential Project Constraints:

Environmental	This project may accumulate sediment quickly as there is no pre-treatment for the runoff coming from the roadway, so routine maintenance would be very important.
Facility Access	Access is excellent from Timberbrook Drive. Construction activities may take up a portion of the road, but traffic would still be able to pass.
Design / Construction	If the option to move driveway culverts is chosen, the residents would be unable to use their driveway for a period of time. If the residents give permission for the dry swale to be constructed in the existing ditch, there would be less impact on access to their driveways.

AH1/AH2 Site 2 Proposed Dry Swale Stationing

Timberbrook Drive

LEFT SIDE OF ROAD

DrySwale	Swale Slope (%)	Side Slope (X:1)	Channel Length (ft)	Top Width (ft)	Bottom Width (ft)	# Check Dams Needed	10-YR Q in Swale (cfs)	Cost
0+91 to 1+68	0.5	2.5	77	4.93	2.43	1	1.65	$2,267
1+89 to 3+08	0.5	2.5	119	6.38	5.13	1	3.37	$5,479
3+66 to 4+11	0.5	3	45	8.44	5.44	0	5.03	$2,498
4+42 to 5+93	1	3	145	6.55	5.35	2	4.88	$6,902
6+13 to 6+58	0.75	3	45	8.44	5.44	0	6.15	$2,498
7+21 to 7+80	0.75	3	59	6.44	3.44	0	8.34	$2,332
8+08 to 9+09	0.75	3	101	7.52	6.02	1	8.01	$5,470
9+28 to 10+02	1	3	74	6.41	4.01	1	9.05	$3,084
10+63 to 11+83	1.25	3	120	7.91	6.71	2	10.43	$7,018
12+01 to 12+64	1.25	3	63	7.53	5.13	1	11.31	$3,190
12+87 to 13+47	1.3	3	60	7.91	5.51	1	11.97	$3,221
13+71 to 14+64	1.5	3	93	6.81	5.01	1	15.92	$4,397
14+80 to 15+08	1	3	28	11.3	7.7	0	14.94	$2,128
15+28 to 15+70	1.6	3	42	9.04	6.04	1	15.41	$2,533
15+91 to 16+64	1.25	3	73	8.67	6.87	1	17.48	$4,538
16+81 to 17+51	1.5	3	70	9.04	7.24	1	19.74	$4,558
17+68 to 18+34	1.5	3	66	9.59	7.79	1	20.69	$4,588
18+58 to 19+30	1.5	4	72	8.79	6.39	1	20.77	$4,372
19+50 to 20+14	1.1	3	64	7.42	5.02	1	21.13	$3,185
20+32 to 21+44	2	3	112	8.48	7.28	2	36.78	$7,060
21+64 to 22+32	1	3	68	9.31	7.51	1	11.28	$4,575
22+70 to 23+33	0.75	3	63	7.53	5.13	0	8.77	$3,190
23+50 to 23+74	0.5	3	24	11.3	7.1	0	6.79	$1,766
24+03 to 24+65	0.75	3	62	7.66	5.26	0	5.43	$3,204
24+93 to 25+59	0.5	3	66	7.19	4.79	0	4.25	$3,163
25+80 to 26+55	0.75	3	75	7.3	4.9	0	2.64	$3,172
26+78 to 27+40	0.5	3	62	7.66	5.26	0	2.24	$3,204
27+61 to 28+35	0.5	3	74	8.55	6.75	0	2.3	$4,529
28+50 to 29+44	0.5	3	94	6.73	4.93	0	3.79	$4,384
29+62 to 30+51	0.5	3	89	7.11	5.31	0	3.94	$4,422

Timberbrook Drive

RIGHT SIDE OF ROAD

DrySwale	Slope	Side Slope (%)	Channel Length (ft)	Top Width (ft)	Bottom Width (ft)	# Check Dams Needed	10-YR Q in Swale (cfs)	Cost
0+99 to 2+31	0.5	3	132	8.7	6.3	1	4.88	$7,878
2+62 to 3+08	0.5	3	46	12.4	7.6	0	12.16	$3,687
3+67 to 4+09	0.75	3	42	12.1	6.7	0	15.18	$3,155
4+34 to 5+87	1	3	153	7.5	5.1	1	14.78	$7,674
6+14 to 6+59	0.75	3	45	11.3	5.9	0	21.09	$3,089
7+09 to 7+43	1.25	3	34	13.4	7.4	0	21.71	$2,840
7+59 to 9+15	1.5	3	150	7.6	5.2	2	25.18	$7,704
9+34 to 11+18	1.25	3	184	8.3	6.5	2	30.18	$10,863
11+41 to 12+31	1.5	3	90	10.2	7.2	1	32.49	$6,235
12+62 to 14+05	1.6	3	143	8.0	5.6	2	35.15	$7,768
14+24 to 15+89	1.1	3	165	9.2	7.4	1	38.89	$10,996
16+09 to 17+26	1.1	3	117	9.8	7.4	1	42.54	$8,022
17+45 to 17+83	1.7	3	38	12.0	6.0	0	46.76	$2,745
17+99 to 18+87	1.8	3	88	10.4	7.4	2	59.5	$6,259
19+08 to 19+87	1.8	3	79	9.6	6.0	1	58.81	$4,955
20+05 to 20+79	1.5	3	74	10.3	6.7	1	56.17	$5,026
20+96 to 21+94	1.7	3	98	9.3	6.3	1	79.1	$6,139
22+25 to 22+91	1	3	66	12.6	7.8	1	25.45	$5,396
23+12 to 23+34	1.2	4	22	13.9	6.7	0	14.29	$1,806
23+68 to 24+64	1	3	90	8.5	4.9	1	17.83	$4,795
24+80 to 25+59	1	3	79	9.6	6.0	1	8.19	$4,955
25+78 to 26+89	0.5	3	111	10.3	7.9	1	5.54	$8,072
27+09 to 28+35	0.5	2.5	126	9.1	7.1	1	4.82	$8,135
28+85 to 29+66	1	3	81	9.4	5.8	1	8.05	$4,925
29+82 to 30+23	1	3	41	12.4	7.0	0	10.93	$3,175
30+43 to 31+25	0.7	3	82	9.3	5.7	1	15.9	$4,913
31+43 to 32+33	1	3	90	8.5	4.9	1	17.83	$4,795

Lantern Road

LEFT SIDE OF ROAD

DrySwale	Slope	Side Slope (%)	Channel Length (ft)	Top Width (ft)	Bottom Width (ft)	# Check Dams Needed	10-YR Q in Swale (cfs)	Cost
0+21 to 1+42	0.75	3	121	5.7	2.1	1	27.52	$3,775
1+70 to 3+22	0.75	3	152	5.4	2.4	2	25.24	$4,791
3+83 to 4+92	0.75	3	109	6.3	2.7	1	17.67	$3,950
5+23 to 6+17	0.75	3	94	7.3	3.7	1	14.11	$4,159
6+58 to7+51	0.5	3	93	11.2	7.6	0	10.52	$7,023
7+83 to 8+04	1	2	21	11.2	7.2	0	4.71	$1,546

RIGHT SIDE OF ROAD

DrySwale	Slope	Side Slope (%)	Channel Length (ft)	Top Width (ft)	Bottom Width (ft)	# Check Dams Needed	10-YR Q in Swale (cfs)	Cost
0+86 to 1+84	0.5	3	98	5.9	4.1	1	5.6	$3,889
2+05 to 3+29	0.5	3	124	4.6	2.8	1	4.76	$3,700
3+95 to 5+12	0.75	3	117	4.9	3.1	1	3.68	$3,753
5+45 to 7+09	0.5	3	153	4.5	3.0	1	2.71	$4,590
7+40 to 8+07	0.5	3	67	6.4	4.0	0	1.96	$2,803

Kipling Road

LEFT SIDE OF ROAD

DrySwale	Slope	Side Slope (%)	Channel Length (ft)	Top Width (ft)	Bottom Width (ft)	# Check Dams Needed	10-YR Q in Swale (cfs)	Cost
0+18 to 1+06	0.5	3	88	7.4	4.4	1	4.58	$4,161
1+45 to 2+17	0.5	3	72	9.1	6.1	0	8.64	$4,349
2+39 to 4+37	1	3	198	5.5	3.7	2	11.12	$7,271
4+63 to 7+11	1	3	248	6.6	5.4	4	33.55	$11,844
7+33 to 8+57	1	3	124	8.8	7.0	2	28.18	$7,797
8+71 to 9+37	0.75	3	66	9.9	6.9	1	22.55	$4,425
9+61 to 9+87	1	3	26	12.5	6.5	0	18.56	$1,984
10+18 to 10+77	0.75	3	59	9.2	5.6	0	16.38	$3,498
11+13 to 11+83	1	3	70	9.3	6.3	1	12.43	$4,374
12+13 to 13+38	0.75	3	125	6.5	4.1	1	7.93	$5,320
13+68 to 14+78	0.5	3	110	7.4	5.0	0	4.34	$5,465
15+37 to 16+47	0.75	3	110	7.4	5.0	1	8.68	$5,465
16+76 to 18+35	1	3	159	5.1	2.7	2	26.37	$4,999
18+90 to 19+66	1	3	76	8.6	5.6	1	23.52	$4,305
19+90 to 20+47	1	3	57	9.5	5.9	1	19.38	$3,525
20+80 to 21+41	0.75	3	61	10.7	7.7	0	17.47	$4,485
21+69 to 22+47	0.75	3	78	10.1	7.1	1	11.4	$5,335
22+71 to 22+92	0.75	3	21	11.2	5.2	0	9.18	$1,378
23+18 to 24+93	0.75	3	175	6.2	4.4	1	4.36	$7,434

Kipling Road

RIGHT SIDE OF ROAD

DrySwale	Slope	Side Slope (%)	Channel Length (ft)	Top Width (ft)	Bottom Width (ft)	# Check Dams Needed	10-YR Q in Swale (cfs)	Cost
0+19 to 0+67	0.5	3	48	8.7	6.3	0	2.46	$2,892
0+88 to 1+26	0.5	3	38	8.8	5.8	0	2.61	$2,225
1+51 to 2+27	0.5	3	76	5.5	3.1	0	3.52	$2,620
2+48 to 3+21	0.5	3	73	5.7	3.3	0	3.61	$2,651
3+44 to 4+21	0.5	3	77	5.4	3.0	0	5.71	$2,612
4+38 to 4+89	0.5	3	51	8.2	5.8	0	7.61	$2,864
5+11 to 6+09	0.75	3	98	5.7	3.9	1	6.72	$3,763
6+40 to 7+02	0.5	3	62	9.0	7.2	0	4.74	$4,023
7+28 to 7+85	0.5	3	57	5.9	2.9	0	6.45	$1,997
8+08 to 9+22	0.5	3	114	4.9	3.1	1	4.93	$3,648
9+56 to 9+74	0.5	3	18	11.6	6.8	0	7.18	$1,331
9+98 to 10+83	0.5	3	85	4.9	2.5	0	3.28	$2,536
11+08 to 11+90	0.5	3	82	5.1	2.7	0	1.69	$2,565
12+16 to 13+39	0.5	3	123	4.5	2.7	1	1.43	$3,582
13+63 to 14+73	0.5	3	110	5.1	3.3	1	3.08	$3,678
15+38 to 16+97	0.5	3	159	5.3	4.1	1	7.05	$5,940
17+17 to 18+39	0.5	3	122	4.6	2.8	1	6.97	$3,592
18+95 to 20+43	0.5	3	148	7.5	3.9	1	4.9	$6,761
20+68 to 20+91	0.5	3	23	13.3	7.9	0	4.12	$1,943
21+22 to 22+39	0.5	3	117	4.8	3.0	1	4.85	$3,632
22+71 to 22+93	0.5	3	22	10.9	6.7	0	3.32	$1,545
23+26 to 24+17	0.5	3	91	4.6	2.2	0	3.13	$2,482
24+48 to 24+86	0.5	3	38	7.4	3.8	0	2.43	$1,687

Lancelot Drive

LEFT SIDE OF ROAD

DrySwale	Swale Slope (%)	Side Slope (X:1)	Channel Length (ft)	Top Width (ft)	Bottom Width (ft)	# Check Dams Needed	10-YR Q in Swale (cfs)	Cost
17+26 to 17+80	0.5	3	54	7.1	4.1	0	2.25	$2,432
16+56 to 17+01	0.5	3	45	8.6	5.6	0	2.55	$2,542
15+73 to 16+32	0.5	3	59	8.2	5.8	0	4.64	$3,285
14+27 to 15+41	1	3	114	5.6	3.8	1	4.7	$4,314
13+30 to 13+91	0.5	3	61	7.9	5.5	0	7.4	$3,265
11+55 to 13+06	0.75	3	151	6.4	5.2	1	6.78	$6,982
10+59 to 11+37	0.5	3	78	6.2	3.8	1	9.16	$3,101
9+49 to 10+36	0.75	3	87	5.5	3.1	1	10.43	$3,021
8+30 to 9+29	1	3	99	4.9	2.5	1	11.08	$2,899
6+03 to 7+62	1	3	159	4.0	2.2	2	12.61	$3,994
5+24 to 5+85	1	3	61	6.3	3.3	1	14.01	$2,352
4+35 to 5+03	0.75	3	68	5.7	2.7	1	15.58	$2,268
3+80 to 4+07	0.75	3	27	10.2	6.0	0	18.35	$1,747
2+83 to 3+55	1	3	72	5.4	2.4	1	17.36	$2,218
1+85 to 2+63	1	3	78	6.2	3.8	1	17.79	$3,101
0+53 to 1+63	1	3	110	5.8	4.0	1	21.07	$4,347

Lancelot Drive

RIGHT SIDE OF ROAD

DrySwale	Slope	Side Slope (%)	Channel Length (ft)	Top Width (ft)	Bottom Width (ft)	# Check Dams Needed	10-YR Q in Swale (cfs)	Cost
16+57 to 17+84	0.5	3	127	5.0	3.2	1	1.53	$4,186
15+62 to 16+33	0.5	3	71	6.7	4.3	0	4.03	$3,141
14+56 to 15+30	0.5	3	74	6.5	4.1	1	3.92	$3,114
13+67 to 14+37	0.75	3	70	6.8	4.4	1	5.01	$3,147
11+93 to 13+43	0.5	3	150	4.3	2.5	1	6.64	$4,020
9+67 to 11+29	1	3	162	3.9	2.1	2	8.97	$3,927
8+27 to 9+44	0.75	3	117	5.4	3.6	1	9.57	$4,249
6+03 to 7+65	1	3	162	3.9	2.1	2	12.42	$3,927
5+09 to 5+80	1	3	71	9.0	7.2	1	10.92	$4,584
4+53 to 4+81	1	3	28	11.4	7.8	0	15.07	$2,144
3+50 to 4+23	1	3	73	8.7	6.9	1	15.7	$4,573
2+23 to 3+19	1	3	96	6.6	4.8	1	17.49	$4,401
1+00 to 1+97	1	3	97	6.6	4.8	1	17.39	$4,400

Hunting Lane

LEFT SIDE OF ROAD

DrySwale	Slope	Side Slope (%)	Channel Length (ft)	Top Width (ft)	Bottom Width (ft)	# Check Dams Needed	10-YR Q in Swale (cfs)	Cost
0+28 to 1+35	0.5	3	107	4.1	2.3	1	2.67	$2,731
1+63 to 2+67	0.5	3	104	4.2	2.4	1	2.72	$2,754
3+86 to 4+97	0.5	3	111	4.0	2.2	1	4.28	$2,708
5+24 to 5+82	0.5	3	58	5.7	3.3	0	5.85	$2,069
5+97 to 6+85	0.5	3	88	5.0	3.2	0	4.98	$2,872

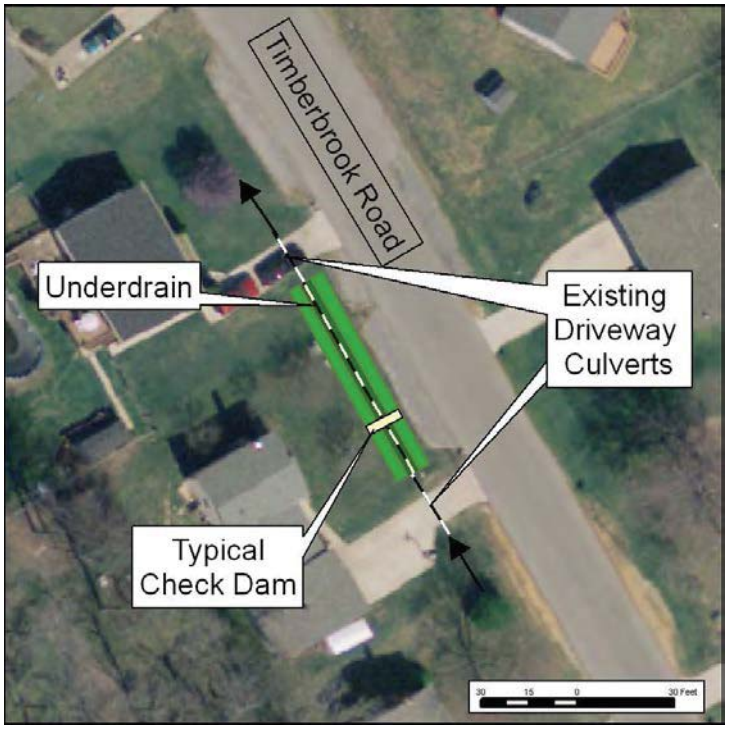
RIGHT SIDE OF ROAD

DrySwale	Slope	Side Slope (%)	Channel Length (ft)	Top Width (ft)	Bottom Width (ft)	# Check Dams Needed	10-YR Q in Swale (cfs)	Cost
0+28 to 1+18	0.5	3	90	5.0	3.2	1	1.52	$2,930
1+43 to 2+62	0.5	3	121	5.5	4.3	1	3.03	$4,782
3+84 to 4+38	0.5	3	54	8.3	6.5	0	4.45	$3,188
4+65 to 5+58	0.5	3	93	4.8	3.0	0	4.87	$2,909
5+80 to 6+84	0.5	3	104	4.3	2.5	1	4.53	$2,829

Costs for AH1/AH2 Site 2:

ITEM	QTY	UNITS	UNIT COST	TOTAL
Green Technology				
Dry Swale w/ underdrain	8,559	SY	$72.00	$616,248
Right-of-Way purchase	24,800	SF		$217,769
			Direct Construction Subtotal	$834,017
Indirect Costs				
E/SC, MOT, MOS (10% of Directs or $1,000)	1	LS	$83,401.70	$83,402
Construction Stakeout (2%)	1	LS	$16,680.34	$16,680
			Base Construction Cost	$934,099
			Mobilization (10% of Directs or $1,000)	$83,402
			Subtotal	$1,017,501
			Contingency (30%)	$305,250
			Construction Subtotal	$1,322,751
			Engineering and Surveys (25%of Construction or $20,000)	$132,275
			Total Capital Cost	**$1,455,026**
Operations and Maintenance Costs				
Annual Maintenance	6	Percent	$50,041	
Discount Rate	5	Percent		
Expected Life	20	Years		
			Net Present Value of O&M Costs	$623,622
			Life Cycle Cost	**$2,078,700**

AH1/AH2 Site 2 Concept Sketch:



Site Photo of AH1/AH2 Site 2:

Second Site Photo of AH1/AH2 Site 2:

Project Name: AH3 Site 3
Project Type: Bioretention area
Drainage Area: 1.50 Acres
Treated Impervious Area: 0.86 Acres

Project Location: This project is located near 3176 to 3203 Westdale Ct.

Project Description: A bioretention area is recommended in the large median of the parking lot on Westdale Court. The parking lot for the townhouses drains toward this median, which already has one curb cut. More curb cuts would be provided to allow runoff from the parking lot into the median for treatment. The runoff would flow over a grass filter strip before it reaches the permeable soil, which would filter out large sediment particles. Several different species of bushes and trees would be planted to encourage vegetative uptake of different nutrients. Beneath the proposed bioretention area, there would be an underdrain system consisting of several perforated pipes that are connected to the existing inlet in the median along Westdale Court. The underdrain system would collect the filtered water and transport it to the existing inlet to be eventually discharged into the stream.

AH3 Site 3

Imperviousness	57.3	%
RCN	90	
Q_{10}	9.86	cfs
WQv req'd	0.07	ac-ft
Surface Area req'd	2568	sq. ft.

Potential Project Benefits:

Water Quality	Bioretention areas filter sediment out of the runoff as well as allow vegetative uptake of nutrients.
Instream Habitat	This project will improve instream habitat by reducing the amount of suspended sediment and nutrients in the water.

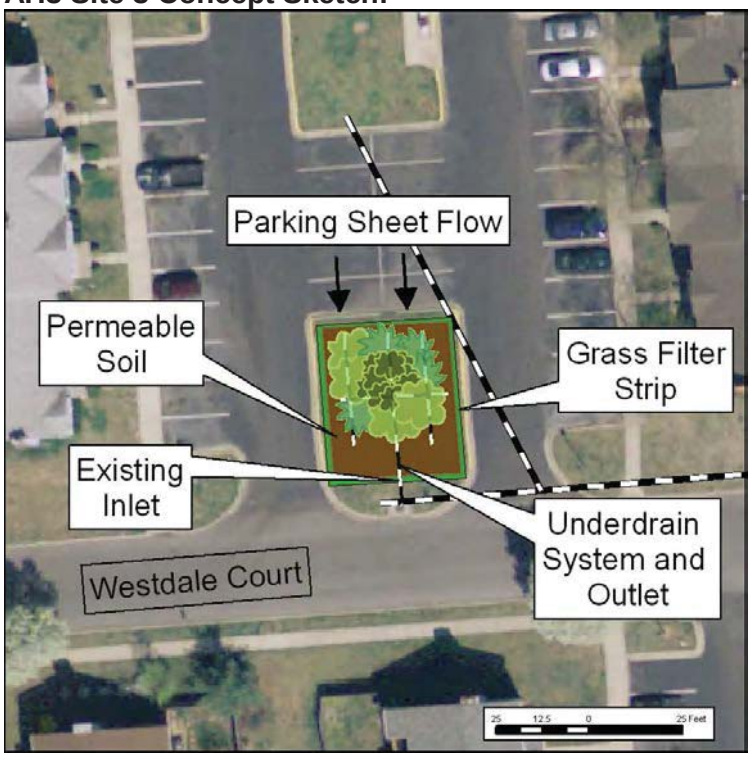
Potential Project Constraints:

Environmental	There are no known environmental concerns.
Facility Access	Access to the facility is excellent from Westdale Court. Parking may be impacted during construction.
Design / Construction	Due to surface area limitations, the required water quality volume would not be met.

Costs for AH3 Site 3:

ITEM	QTY	UNITS	UNIT COST	TOTAL
Bioretention				
Parking Lot	163	SY	$240.00	$39,120
Sidewalk		SY	$230.00	$0
Open Space		SY	$220.00	$0
			Direct Construction Subtotal	$39,120
Indirect Costs				
E/SC, MOT, MOS (10% of Directs or $1,000)	1	LS	$3,912.00	$3,912
Construction Stakeout (2% of Directs)	1	LS	$782.40	$782
			Base Construction Cost	$43,814
			Mobilization (10% of Directs or $1,000)	$3,912
			Subtotal	$47,726
			Contingency (30%)	$14,318
			Construction Subtotal	$62,044
			Envt'l Studies / Permitting (5% of Construction or $5,000)	$5,000
			Engineering and Surveys (25%of Construction or $20,000)	$20,000
			Total Capital Cost	**$87,044**
Operations and Maintenance Costs				
Annual Maintenance	6	Percent	$2,347	
Discount Rate	5	Percent		
Expected Life	20	Years		
			Net Present Value of O&M Costs	$29,251
			Life Cycle Cost	**$116,300**

AH3 Site 3 Concept Sketch:



Site Photo of AH3 Site 3:

Project Name: AH3 Site 4
Project Type: Filterra® Bioretention System
Treated Impervious Area: 0.85 Acres

Project Location: This project is in 5 locations throughout AH3 (see Map below for sites).

Project Description: The roads in this area of Acton Hamilton are curbed and are drained by storm drains, which flow directly into local streams. A Filterra® Bioretention System would be placed above certain existing inlets to intercept runoff from the roadway and from nearby townhouses. The Filterra® locations would be chosen where conflicts with the existing storm drain pipes would not be an issue and ponding would be minimized. The goal is to treat as much runoff as possible with the Filterra® System before it is discharged into a stream. At the southern-most recommended location, the position of the electrical wiring for the light post would need to be verified before placement of the Filterra is finalized.

The Filterra® System size that is recommended is an 8 foot by 4 foot as it will fit best in most places while treating the largest possible drainage area. See the table below for Filterra® box sizes and corresponding treatment area.

Filterra® System Sizes and Treatment Area

Filterra® Box Sizes (ft)	Maximum Treatment Area (acres)
4x6	0.12
4x8	0.17
4x12	0.25
6x6	0.19
Standard 6x8	0.25
6x10	0.31
6x12	0.38

There are several options available with a Filterra® System, including plant type, grate type, and top slab height. A tree may not be a feasible option for the top of the Filterra System if it will encroach on the sidewalk. For these locations, a small shrub may be selected instead of a tree. Many of the Filterra® Systems will be placed with grass on either side. Instead of a large concrete slab showing, it is possible to plant sod over a recessed top slab to better integrate with the surrounding landscape.

The standard cost of one Filterra® System includes the concrete box, permeable media and mulch, underdrain, plant, and tree grate. The cost also includes delivery to the site, activation, and one year of maintenance. Things that are not included are unloading and installing the Filterra System and modification of the existing inlet to receive the underdrain.

Potential Project Benefits:

Water Quality	This project will filter sediment out of the runoff and remove some pollutants through vegetative uptake.
Instream Habitat	This project will improve instream habitat by reducing the amount of suspended sediment and nutrients in the water.

Potential Project Constraints:

Environmental	There are no known environmental constraints.
Facility Access	Access to the facility is excellent from the roadways. Parking may be impacted during construction.
Design / Construction	The location of the electric utility will need to be verified in one location. Also, Filterra® Systems are required to be reviewed by the manufacturer to ensure best use and placement. This is done at no additional cost, but may add lead time.

Costs for AH3 Site 4:

ITEM	QTY	UNITS	UNIT COST	TOTAL
Stormwater Treatment Structures				
Hydrodynamic Separators (Baysaver)		EA	$10,000.00	$0
Bioretention Structures (Filterra)	5	EA	$10,000.00	$50,000
Catch Basin Inserts		EA	$150.00	$0
			Direct Construction Subtotal	$50,000
Indirect Costs				
E/SC, MOT, MOS (10% of Directs or $1,000)	1	LS	$1,000.00	$5,000
Construction Stakeout (2% of Directs)	1	LS	$200.00	$1,000
			Base Construction Cost	$56,000
			Mobilization (10% of Directs or $1,000)	$5,000
			Subtotal	$61,000
			Contingency (30%)	$18,300
			Construction Subtotal	$79,300
			Engineering and Surveys (25%of Construction or $5,000)	$19,825
			Total Capital Cost	**$99,125**
Operations and Maintenance Costs				
Annual Maintenance	6	Percent	$600	
Discount Rate	5	Percent		
Expected Life	20	Years		
			Net Present Value of O&M Costs	$37,387
			Life Cycle Cost	**$136,600**

AH3 Site 4 Concept Sketch:

Project Name: AH3 Site 5
Project Type: Bioretention area
Drainage Area: 2.82 Acres
Treated Impervious Area: 1.22 Acres

Project Location: This project is located in the cul-de-sac on the west end of Westdale Ct.

Project Description: A bioretention area is proposed in the median located at the west end of Westdale Court. A large portion of the parking lot currently drains into this median via concrete channels cut into the curb, where it appears to pool at the low point in the grassy area before draining to the outlet, receiving little or no treatment. The outlet is an existing open-backed inlet that drains to the nearby stream located to the southwest of the median. As the soil in this area is in Hydrologic Soil Groups C and D, the bioretention area would have an underdrain that connects directly into the existing inlet to drain filtered water from the bioretention area. With some regrading and curb removal, bioretention in this area would treat a large portion of the parking lot and nearby roadway.

AH3 Site 5

Imperviousness	43.3	%
RCN	90	
Q_{10}	18.54	cfs
WQv req'd	0.10	ac-ft
Surface Area req'd	3748	sq. ft.

Potential Project Benefits:

Water Quality	Bioretention areas filter sediment out of the runoff as well as allow vegetative uptake of nutrients.
Instream Habitat	This project will improve instream habitat by removing suspended sediments and pollutants in the runoff that can damage flora and fauna.

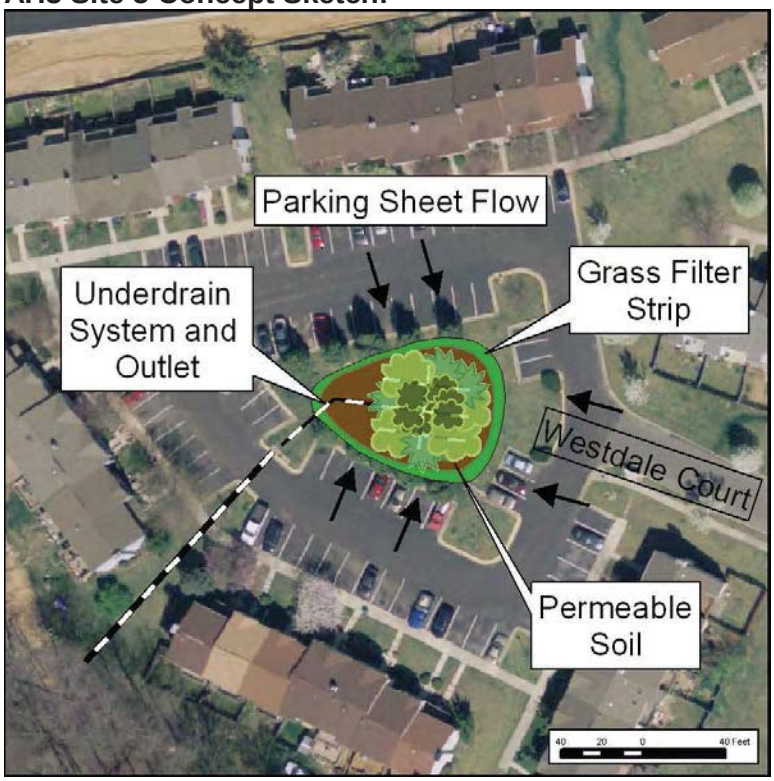
Potential Project Constraints:

Environmental	There are no known environmental constraints.
Facility Access	Access to the facility is good from Westdale Ct. Parking may be effected during construction of the facility.
Design / Construction	It is unknown if the median is owned by the neighborhood or by the County, so permission may need to be granted by the owner.

Costs for AH3 Site 5:

ITEM	QTY	UNITS	UNIT COST	TOTAL
Bioretention				
Parking Lot	425	SY	$240.00	$102,000
Sidewalk		SY	$230.00	$0
Open Space		SY	$220.00	$0
			Direct Construction Subtotal	$102,000
Indirect Costs				
E/SC, MOT, MOS (10% of Directs or $1,000)	1	LS	$10,200.00	$10,200
Construction Stakeout (2% of Directs)	1	LS	$2,040.00	$2,040
			Base Construction Cost	$114,240
			Mobilization (10% of Directs or $1,000)	$10,200
			Subtotal	$124,440
			Contingency (30%)	$37,332
			Construction Subtotal	$161,772
			Envt'l Studies / Permitting (5% of Construction or $5,000)	$8,089
			Engineering and Surveys (25%of Construction or $20,000)	$40,443
			Total Capital Cost	**$210,304**
Operations and Maintenance Costs				
Annual Maintenance	6	Percent	$6,120	
Discount Rate	5	Percent		
Expected Life	20	Years		
			Net Present Value of O&M Costs	$76,269
			Life Cycle Cost	**$286,600**

AH3 Site 5 Concept Sketch:



Site Photo of AH3 Site 5:

Project Name: AH3 Site 6
Project Type: Bioretention
Drainage Area: 1.65 Acres
Treated Impervious Area: 0.88 Acres

Project Location: This project is located at the southern end of Brookside Place.

Project Description: A large portion of the parking lot and roadway currently drains into this area via concrete channels. The concrete channels convey the water downstream for about 20 feet before they end in an earthen ditch.

For treatment, the concrete channels would be removed, leaving the curb cuts to allow water into the proposed bioretention area. The runoff would flow over a grass filter strip before it reached the permeable soil. The area would be regarded to allow flow to pool in the bioretention area. The three pine trees in the area may need to be removed, but appropriate vegetation would be planted in their place to encourage vegetative uptake of pollutants. An underdrain would transport the filtered water downstream to the existing ditch.

AH3 Site 6

Imperviousness	53.3	%
RCN	90	
Q_{10}	10.85	cfs
WQv req'd	0.07	ac-ft
Surface Area req'd	2442	sq. ft.

Potential Project Benefits:

Water Quality	Bioretention areas filter sediment out of the runoff as well as allow vegetative uptake of nutrients.
Instream Habitat	This project will improve instream habitat by removing suspended sediments and pollutants in the runoff that can damage flora and fauna.

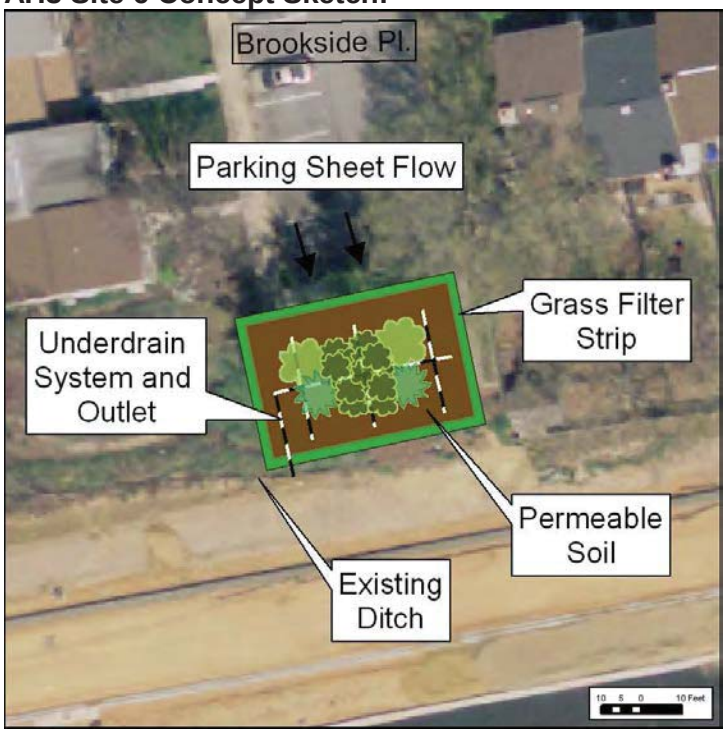
Potential Project Constraints:

Environmental	Three existing pine trees in the area, about 8 inches in diameter each, may need to be removed, but other vegetation would be planted in their place.
Facility Access	Access to the facility is good from the parking lot. Parking spaces may be impacted during construction.
Design / Construction	Due to limited space, the required water quality volume would not be met within the median.

Costs for AH3 Site 6:

ITEM	QTY	UNITS	UNIT COST	TOTAL
Bioretention				
Parking Lot	200	SY	$240.00	$48,000
Sidewalk		SY	$230.00	$0
Open Space		SY	$220.00	$0
			Direct Construction Subtotal	$48,000
Indirect Costs				
E/SC, MOT, MOS (10% of Directs or $1,000)	1	LS	$4,800.00	$4,800
Construction Stakeout (2% of Directs)	1	LS	$960.00	$960
			Base Construction Cost	$53,760
			Mobilization (10% of Directs or $1,000)	$4,800
			Subtotal	$58,560
			Contingency (30%)	$17,568
			Construction Subtotal	$76,128
			Envt'l Studies / Permitting (5% of Construction or $5,000)	$5,000
			Engineering and Surveys (25%of Construction or $20,000)	$20,000
			Total Capital Cost	**$101,128**
Operations and Maintenance Costs				
Annual Maintenance	6	Percent	$2,880	
Discount Rate	5	Percent		
Expected Life	20	Years		
			Net Present Value of O&M Costs	$35,891
			Life Cycle Cost	**$137,100**

AH3 Site 6 Concept Sketch:



Site Photo of AH3 Site 6:

Project Name: AH4 Site 7
Project Type: Dry Swale
Drainage Area: 1.15 Acres
Treated Impervious Area: 0.80 Acres

Project Location: This project is located behind the brick building along Business Park Drive.

Project Description: A large portion of the parking lot, roadway, and rooftop currently drain into this median through curb cuts, though there seems to be little treatment. To increase the treatment provided, more runoff would be allowed to enter this median through larger curb cuts. Some minor regrading of the median would be necessary to allow runoff to flow into the treatment area. A dry swale would be cut through the low portion of the median to filter the sediment that is running off of the parking lot.

There are existing storm drains that meet at the grate in the middle of the median. The underdrain of the dry swale would connect directly into the existing stormdrain network. Depending on the depth of these storm drains, the dry swale may need to be split in two sections, each draining to the center grate, to avoid impacting the existing pipes.

Along with the existing storm drains, there is also a utility box within the median. The exact location of existing utilities should be investigated to ensure construction or the dry swale itself would not impact any utilities.

Potential Project Benefits:

Water Quality	This project will filter sediment out of the runoff before it flows into the stream.
Instream Habitat	This project will improve instream habitat by removing suspended sediments in the runoff that can damage flora and fauna.

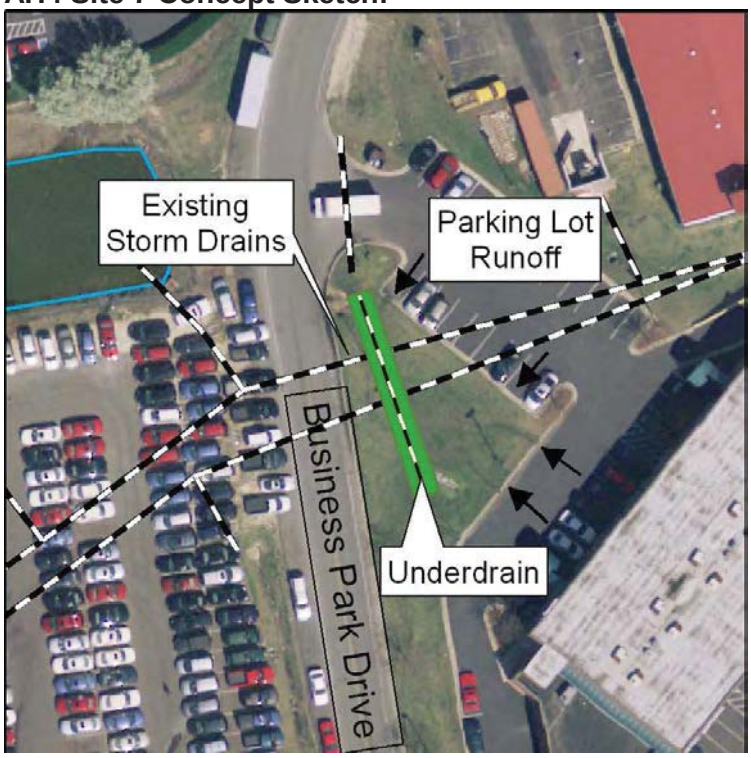
Potential Project Constraints:

Environmental	There are no known environmental constraints.
Facility Access	Access is good from the parking lot. Parking may be impacted during construction, but traffic should not be impacted.
Design / Construction	The depth and location of the existing storm drain pipes and other utilities should be confirmed to ensure the dry swale would not impact them.

Costs for AH4 Site 7:

ITEM	QTY	UNITS	UNIT COST	TOTAL
Green Technology				
Dry Swale w/ underdrain	75	SY	$70.00	$5,250
			Direct Construction Subtotal	$5,250
Indirect Costs				
E/SC, MOT, MOS (10% of Directs or $1,000)	1	LS	$1,000.00	$1,000
Construction Stakeout (2%)	1	LS	$105.00	$105
			Base Construction Cost	$6,355
			Mobilization (10% of Directs or $1,000)	$1,000
			Subtotal	$7,355
			Contingency (30%)	$2,207
			Construction Subtotal	$9,562
			Engineering and Surveys (25%of Construction or $20,000)	$20,000
			Total Capital Cost	**$29,562**
Operations and Maintenance Costs				
Annual Maintenance	6	Percent	$315	
Discount Rate	5	Percent		
Expected Life	20	Years		
			Net Present Value of O&M Costs	$3,926
			Life Cycle Cost	**$33,500**

AH4 Site 7 Concept Sketch:



Site Photo of AH4 Site 8:

Project Name: AH4 Site 8
Project Type: Dry Swale
Drainage Area: 1.22 Acres
Treated Impervious Area: 1.00 Acres

Project Location: This project is located next to American Hardware and Hearth on Crain Highway.

Project Description: A large portion of two commercial parking lots and roof tops drain toward this grassy area. To increase the treatment provided, more runoff will be allowed to enter this area through curb cuts and a dry swale will be installed in the grassy area. A dry swale, as opposed to a bioretention area, is proposed at this site due to the limited surface area. An underdrain will transport the filtered water to the existing stream located behind the commercial buildings.

AH4 Site 8

Imperviousness	82	%
WQv req'd	0.08	ac-ft
Q_{10}	8.86	cfs
Bottom Width	7.5	ft
Top Width	12.3	ft
Slope	2.5	%

Potential Project Benefits:

Water Quality	This project will filter sediment and uptake the nutrients out of the runoff before it flows into the stream.
Instream Habitat	This project will improve instream habitat by removing suspended sediments in the runoff that can damage flora and fauna.

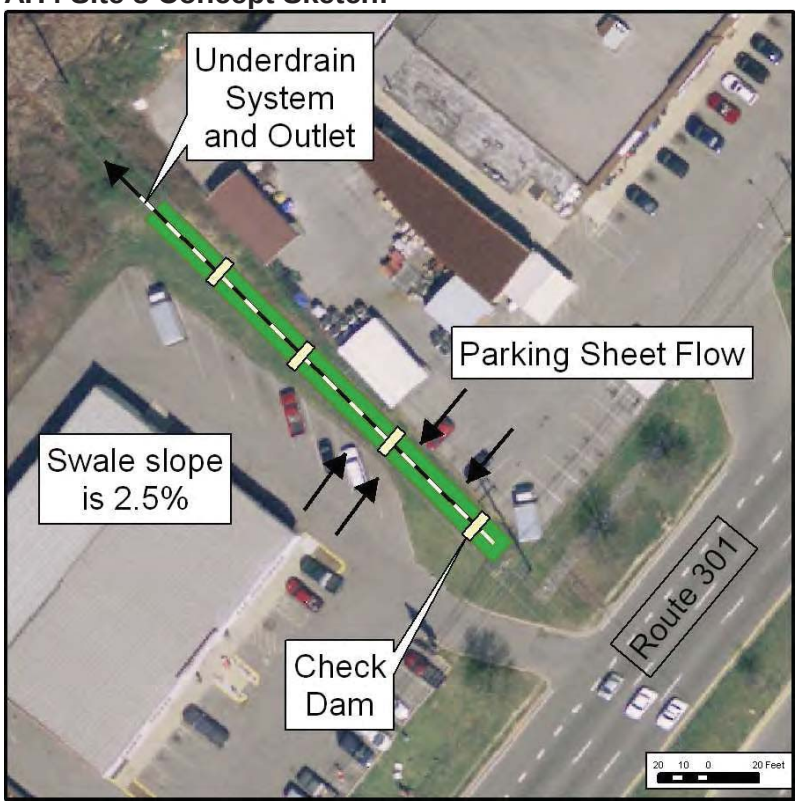
Potential Project Constraints:

Environmental	There are no known environmental constraints.
Facility Access	The access to the facility is from the parking lot of the Hardware store. Parking may be affected during construction.
Design / Construction	The top width of the swale would vary depending on the distance between the parking lots and to accommodate the necessary treatment volume.

Costs for AH4 Site 8:

ITEM	QTY	UNITS	UNIT COST	TOTAL
Green Technology				
Dry Swale w/ underdrain	272	SY	$70.00	$19,040
			Direct Construction Subtotal	$19,040
Indirect Costs				
E/SC, MOT, MOS (10% of Directs or $1,000)	1	LS	$1,904.00	$1,904
Construction Stakeout (2%)	1	LS	$380.80	$381
			Base Construction Cost	$21,325
			Mobilization (10% of Directs or $1,000)	$1,904
			Subtotal	$23,229
			Contingency (30%)	$6,969
			Construction Subtotal	$30,197
			Envt'l Studies / Permitting (5% of Construction or $5,000)	$5,000
			Engineering and Surveys (25%of Construction or $20,000)	$20,000
			Total Capital Cost	**$55,197**
Operations and Maintenance Costs				
Annual Maintenance	6	Percent	$1,142	
Discount Rate	5	Percent		
Expected Life	20	Years		
			Net Present Value of O&M Costs	$14,237
			Life Cycle Cost	**$69,500**

AH4 Site 8 Concept Sketch:



Site Photo of AH4 Site 8:

Project Name: Site 9
Project Type: Pond Retrofit
Drainage Area: 6.96 acres
Treated Impervious Area: 2.78 acres

Project Location: This project is located along Westdale Drive.

Project Description: The nearby roadways and rooftops drain into this existing dry pond located along Westdale Drive. There is also a stormdrain system that picks up drainage from Western Parkway and discharges into the dry pond.

This dry facility would be retrofit into a shallow marsh to provide water quality treatment. The existing riser structure would be modified to allow water to pond within the open area. The bottom of the facility would also be graded to provide deeper areas where the water quality volume can be met. Also, wetland vegetation would be planted throughout the facility to promote vegetative uptake of nutrients. The site is large enough that all of the water quality volume can be met within the facility.

The safety features of this shallow marsh are important to this project. Not only is it easily accessible to nearby residents, but a playground is located across Westdale Drive. The safety aspect would be accounted for by installing a fence around the facility and including a safety bench within the marsh.

Note: this project is not located within the 2004 study area.

Site 9

Imperviousness	39.9	%
RCN	90	
Q_{10}	45	cfs
WQv req'd	0.24	ac-ft
Surface Area req'd	0.10	acres

Potential Project Benefits:

Stream Stability	This retrofit will reduce the outflow velocities from this facility, therefore increasing the stream stability at the outfall of the facility.
Water Quality	Water quality treatment will be provided through vegetative uptake and settling within the marsh, so water quality will improve.
Instream Habitat	Since water quality will improve, the instream habitat will be more hospitable to flora and fauna.

Potential Project Constraints:

Environmental	There are no expected environmental constraints.
Facility Access	Access to the facility is excellent from Westdale Drive and Meadow Lane.
Design / Construction	Construction would not block traffic or take up parking spaces.

Costs for Site 9:

ITEM	QTY	UNITS	UNIT COST	TOTAL
Site Work				
Clear and Grub	0.5	AC	$5,000.00	$2,500
Pond Construction				
Grading and Excavation (Class I)	825	CY	$50.00	$41,250
Forebay	50	CY	$50.00	$5,000
Safety Bench	60	CY	$30.00	$1,800
Modify Riser	1	LS	$1,500.00	$1,500
Fencing	900	LF	$20.00	$18,000
SWM Landscaping	1,600	SY	$15.00	$24,000
			Direct Construction Subtotal	$94,050
Indirect Costs				
E/SC, MOT, MOS (10% of Directs or $3,000)	1	LS	$6,405.00	$9,405
Construction Stakeout (2% of Directs)	1	LS	$1,281.00	$1,881
			Base Construction Cost	$105,336
			Mobilization (10% of Directs or $1,000)	$9,405
			Subtotal	$114,741
			Contingency (30%)	$34,422
			Construction Subtotal	$149,163
			Envt'l Studies / Permitting (5% of Construction or $5,000)	$7,458
			Engineering and Surveys (25%of Construction or $40,000)	$40,000
			Total Capital Cost	**$196,621**
Operations and Maintenance Costs				
Annual Maintenance	6	Percent	$3,843	
Discount Rate	5	Percent		
Expected Life	20	Years		
			Net Present Value of O&M Costs	$70,324
			Life Cycle Cost	**$267,000**

Site 9 Concept Sketch:

Site Photo of Site 9:


KCI