

## **APPENDIX B: Retrofit Sites Spreadsheet**

*Spreadsheet Description*

The following provides descriptions for the Back Creek Site Calculations spreadsheet. The full spreadsheet is shown at the end of this Appendix. Table B-1 describes the first 22 columns which contain the basic information on the retrofit.

<b>Table B-1. Basic Retrofit Information</b>	
<b>Column Heading</b>	<b>Description</b>
Site ID	Numbered site location. For sites with multiple retrofits, the retrofits are identified by letter (e.g. A, B, etc.)
Address	Nearest address for retrofit location.
Neighborhood/ Location	The neighborhood or location name.
Site Description	Description of the retrofit location.
Practice	General retrofit description. Other cells in the spreadsheet reference this column.
RR or ST	Depending on the type of retrofit, indicates whether the retrofit is a Runoff Reduction (RR) retrofit or a Stormwater Treatment (ST) retrofit.
Drainage Area (acre)	Drainage area reaching the retrofit in acres. The Drainage Area is divided into impervious and turf.
Impervious Area (acre)	Area of the impervious cover within the drainage area.
%IC	Percent of the impervious cover (IC) within the drainage area.
%Turf	Percent of turf within the drainage area.
P (in)	The precipitation event in inches. The spreadsheet is using the 1-inch storm.
Rv	The runoff coefficient. $Rv = 0.05 + 0.009(IC\%)$
Target Storage WQv (CF)	The storage needed to capture and treat the runoff from the 1-inch storm in cubic feet.
Available Practice Width (ft)	The width of the retrofit in feet.
Available Practice Length (ft)	The length of the retrofit in feet.
Ponding Depth (in)	The ponding depth of the retrofit in inches.
Filter Media Depth (in)	The filter media depth of the retrofit in inches.
Gravel Depth (in)	The gravel depth of the retrofit in inches.
Top Surface Area (SF)	The surface area of the top of ponding of the retrofit in square feet.
Bottom Surface Area (SF)	The surface area of the top of the filter media, assuming 3:1 side slopes, in square feet.
Ponding Volume (CF)	The ponding volume of the retrofit in cubic feet.
Soil Storage Volume (CF)	The volume of water in the filter media, using 0.4 porosity, in cubic feet. <i>Soil Storage Volume = Bottom Surface Area × Filter Media Depth × Porosity</i>
Total Volume (CF)	The total storage volume of the retrofit in cubic feet. <i>Total Volume = Ponding Depth + Soil Storage Volume</i>
% Water Quality Volume	The percentage of the WQv treated by the retrofit. <i>% Water Quality Volume = Total Volume ÷ WQv</i>

Total phosphorus (TP), total nitrogen (TN), and total suspended solids (TSS) pollutant loads were calculated using the Maryland DNR’s Urban Stormwater Calculator, found here: [http://dnr2.maryland.gov/ccs/Pages/funding/trust-fund\\_grants.aspx](http://dnr2.maryland.gov/ccs/Pages/funding/trust-fund_grants.aspx). Back Creek is located within the Severn River watershed, with the MDE 8-digit number 2131002. The annual loading rate in lb/acre/yr for the Severn River watershed is shown in Table B-2 below.

<b>Table B-2. Annual Pollutant Loading Rate for Severn River (lbs/ac/yr)</b>		
<b>Parameter</b>	<b>Impervious</b>	<b>Pervious</b>
TP (lbs)	1.50	0.41
TN (lbs)	9.70	8.30
TSS (lbs)	548	83

The general equation to determine the pollutant load is as follows:

$$\text{Pollutant Load} = \text{Impervious Drainage Area} \times \text{Urban Impervious Runoff Load} + \text{Compacted Drainage Area} \times \text{Urban Pervious Runoff Load}$$

Table B-3 describes the next four columns concerning pollutant load.

<b>Table B-3. Pollutant Load</b>	
<b>Column Heading</b>	<b>Description</b>
TP Pollutant Load (lbs/yr)	The amount of total phosphorus runoff from the drainage area in pounds per year.
TN Pollutant Load (lbs/yr)	The amount of total nitrogen runoff from the drainage area in pounds per year.
TSS Pollutant Load (lbs/yr)	The amount of total suspended solid runoff from the drainage area in pounds per year.
Runoff Depth Captured per Impervious Acre (in)	The depth of water, spread over the impervious area of the drainage area, which was captured by the retrofit, in inches. This number is needed to calculate the pollutant removal rates.

The following calculations listed in Table B-4 use the guidance found in the Chesapeake Bay Program document, “Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects”. The document provides three retrofit removal adjustor curves, one for TP, TN, and TSS, to determine the pollutant removal rate for individual retrofits, given the Runoff Depth Captured per Impervious Acre in inches.

<b>Table B-4. Total Pollutant Removal</b>	
<b>Column Heading</b>	<b>Description</b>
Total Phosphorus Removal (%)	The percentage of TP removal by a retrofit using the CBP retrofit removal adjustor curves.
Total Phosphorus Removal (lbs/yr)	The amount of TP removed in pounds per year. Found by multiplying the TP Pollutant Load by the Total Phosphorus Removal (%).
Total Nitrogen Removal (%)	The percentage of TN removal by a retrofit using the CBP retrofit removal adjustor curves.
Total Nitrogen Removal (lbs/yr)	The amount of TN removed in pounds per year. Found by multiplying the TP Pollutant Load by the Total Nitrogen Removal (%).
Total Suspended Solids Removal (%)	The percentage of TSS removal by a retrofit using the CBP retrofit removal adjustor curves.
Total Suspended Solids Removal (lbs/yr)	The amount of TSS removed in pounds per year. Found by multiplying the TP Pollutant Load by the Total Suspended Solids Removal (%).

Finally, Table B-5 describes the last four columns in the spreadsheet. The Cost Effectiveness column was calculated for TP, TN, and TSS separately.

<b>Table B-5. Cost Estimate and Effectiveness</b>	
<b>Column Heading</b>	<b>Description</b>
Cost \$	The estimated design, construction, land acquisition, and 1 year of maintenance cost of the retrofit based on the amount of impervious area treated.
Cost Effectiveness (\$/lb/TP Removed)	The cost per pound of TP removed.
Cost Effectiveness (\$/lb/TN Removed)	The cost per pound of TN removed.
Cost Effectiveness (\$/lb/TSS Removed)	The cost per pound of TSS removed.

Back Creek Retrofit Sites
Input Value
Recommended Value
Calculated Value

Site ID	Address	Neighborhood/Location	Site Description	Practice	RR or ST	Drainage Area (acre)	Impervious Area (acre)	%iC
BMP_09	7101 Bay Front Drive	Baywoods	Wet pond retrofit	Wet Pond Upgrade	ST	4.57	2.50	55%
BMP_17	914 Bay Ridge Rd	Georgetown Plaza	Georgetown Plaza	Bioretention	RR	0.69	0.47	68%
BMP_21	934 Langdon Ct	Ambridge	Ambridge neighborhood pond	Conversion of Dry Pond to Wet Pond	ST	55.60	19.20	35%
Out_01	Edgewood Rd	Ellen O. Moyer Park	Osprey Nature Center	Regenerative Stormwater Conveyance	RR	34.60	15.10	44%
Out_04	SE of Timber Creek Dr and Bay Ridge Ave	SPCA	near SPCA	Regenerative Stormwater Conveyance	RR	120.70	54.60	45%
Out_07	NE of Windwhisper Ln and Georgetown Rd	Mariner's Point	Mariner's Point	Regenerative Stormwater Conveyance	RR	55.00	30.20	55%
RRI-01	Emory G Bowen Sr Alley	Eastport	alley at south end of Chester Ave next to Joan's Cove	Permeable Pavers	RR	0.64	0.32	49%
RRI-03	Norman Dr and Americana Dr	Eastport Shopping Center	corner of parking lot	Bioretention	RR	0.81	0.78	95%
RRI-04-A	Watergate Point #700	Watergate Point	concrete channel near parking lot	Bioretention	RR	0.20	0.17	85%
RRI-04-B	Watergate Point	Watergate Point	end of Monroe St	Bioretention	RR	1.30	0.86	66%
RRI-04-C	Watergate Point #705	Watergate Point	end of parking lot	Filtering Practice	ST	0.58	0.56	96%
RRI-04-D	Watergate Point #705	Watergate Point	roof top disconnection	Bioretention	RR	0.26	0.20	75%
RRI-04-E	Watergate Point #760	Watergate Point	parking lot near catch basin	Bioretention	RR	0.46	0.46	99%
RRI-04-F	Watergate Point #700	Watergate Point	roof top disconnection	Bioretention	RR	0.29	0.22	76%
RRI-04-G	Watergate Point #680	Watergate Point	roof top disconnection	Bioretention	RR	0.28	0.21	75%
RRI-06	1309 Bay Ridge Ave	Church of Nazarene	Church of Nazarene parking area	Bioretention	RR	0.34	0.31	90%
RRI-08-A	934 Langdon Ct	Ambridge	Ambridge neighborhood pond	Conversion of Dry Pond to Wet Pond	ST	67.78	21.40	32%
RRI-08-B	Across from 1819 Bay Ridge Ave	Overflow parking for 1819 Bay Ridge Ave	Overflow parking for 1819 Bay Ridge Ave	Impervious Cover Removal	RR	0.12	0.12	100%
RRI-09-A	1815 Bay Ridge Ave	SPCA	SPCA parking lot	Bioretention	RR	0.28	0.23	82%
RRI-09-B	1815 Bay Ridge Ave	SPCA	SPCA parking lot	Bioretention	RR	0.47	0.15	31%
RRI-11-A	14 Melrob Ct	Reserve at Quiet Waters	Quiet Waters - near parking lot	Bioretention	RR	1.94	1.04	54%
RRI-11-B	Brcin Ct	Reserve at Quiet Waters	Quiet Waters - near parking lot	Bioretention	RR	0.47	0.21	45%
RRI-16	123 Hillsmere Dr	Bay Ridge Plaza	Bay Ridge Plaza	Impervious Cover Removal	RR	0.33	0.33	100%
RRI-19-A	111 Dogwood Rd	Georgetown Elementary School	Georgetown Elementary School	Bioretention	RR	0.28	0.18	65%
RRI-19-B	112 Dogwood Rd	Georgetown Elementary School	Georgetown Elementary School	Bioretention	RR	0.47	0.34	72%
RRI-21-A	948 Bay Ridge Rd	Bay Forest Shopping Center	Giant parking lot	Bioretention	RR	2.29	1.93	84%
RRI-21-B	949 Bay Ridge Rd	Bay Forest Shopping Center	Giant parking lot	Bioretention	RR	0.46	0.36	78%
RRI-23-A	Silverwood Circle	Fairwinds of Annapolis - East	near tennis courts	Bioretention	RR	0.49	0.44	90%
RRI-23-B	Silverwood Circle	Fairwinds of Annapolis - East	old tennis court removal	Impervious Cover Removal	RR	0.29	0.29	100%
St. Luke's Church	1101 Bay Ridge Avenue	St. Luke's Church	large restoration project	Regenerative Stormwater Conveyance	RR	28.27	13.57	48%
Total Area						380.27	166.71	44%

Back Creek Retrofit Sites
Input Value
Recommended Value
Calculated Value

Site ID	%Turf	P (in)	Rv	Target Storage WQv (CF)	Available Practice Width (ft)	Available Practice Length (ft)	Ponding Depth (in)	Filter Media Depth (in)	Gravel Depth (in)	Top Surface Area (SF)	Bottom Surface Area (SF)	Ponding Volume (CF)	Soil Storage Volume (CF)	Total Volume (CF)	% Water Quality Volume
BMP_09	45%	1.00	0.54	8,996.96										10300.00	114%
BMP_17	32%	1.00	0.66	1,660.73										1647.00	99%
BMP_21	65%	1.00	0.36	72,817.80										73700.00	101%
Out_01	56%	1.00	0.44	55,611.60										55471.00	100%
Out_04	55%	1.00	0.46	200,285.25										200323.00	100%
Out_07	45%	1.00	0.54	108,645.90										108704.00	100%
RRI-01	51%	1.00	0.49	1,149.77	12	460			12	5,520	5,520	0.00	0.00	883.20	77%
RRI-03	5%	1.00	0.91	2,679.73	45	33	12	18	12	1,485	1,053	1,269.00	631.80	1900.80	71%
RRI-04-A	15%	1.00	0.81	587.81	24	28	6	24	12	672	525	299.25	420.00	719.25	122%
RRI-04-B	34%	1.00	0.64	3,041.02	15	38	12	24	12	570	288	429.00	230.40	659.40	22%
RRI-04-C	4%	1.00	0.91	1,933.36	10	30	12	36		300	96			2,045.75	106%
RRI-04-D	25%	1.00	0.72	686.14	12	45	6	36	12	540	378	229.50	453.60	683.10	100%
RRI-04-E	1%	1.00	0.94	1,578.26	30	20	12	24	12	600	336	468.00	268.80	736.80	47%
RRI-04-F	24%	1.00	0.73	766.85	15	60	6	24	12	900	684	396.00	547.20	943.20	123%
RRI-04-G	25%	1.00	0.72	731.32	15	50	6	24	12	750	564	328.50	451.20	779.70	107%
RRI-06	10%	1.00	0.86	1,075.91	30	30	12	24	12	900	576	738.00	460.80	1198.80	111%
RRI-08-A	68%	1.00	0.33	82,202.23	60	375	48	0	0	22,500	12,636	70,272.00	0.00	70272.00	85%
RRI-08-B	0%	1.00	0.95	401.62			1			5,073	5,073	422.76	0.00	422.76	105%
RRI-09-A	18%	1.00	0.79	790.51	8	40	6	24	12	320	185	126.25	148.00	274.25	35%
RRI-09-B	69%	1.00	0.33	562.08	20	25	12	24	12	500	266	383.00	212.80	595.80	106%
RRI-11-A	46%	1.00	0.53	3,745.02	18	75	6	24	12	1,350	1,080	607.50	864.00	1471.50	39%
RRI-11-B	55%	1.00	0.46	783.82	20	35	12	24	12	700	406	553.00	324.80	877.80	112%
RRI-16	0%	1.00	0.95	1,134.94			1			14,336	14,336	1,194.67	0.00	1,194.67	105%
RRI-19-A	35%	1.00	0.63	631.28	20	28	12	24	12	560	308	434.00	246.40	680.40	108%
RRI-19-B	28%	1.00	0.70	1,202.04	28	28	12	24	12	784	484	634.00	387.20	1021.20	85%
RRI-21-A	16%	1.00	0.81	6,707.17	60	40	12	24	12	1,200	918	1,059.00	734.40	1793.40	27%
RRI-21-B	22%	1.00	0.75	1,249.36	11	70	12	24	12	770	320	545.00	256.00	801.00	64%
RRI-23-A	10%	1.00	0.86	1,528.97	15	30	12	24	12	450	216	333.00	172.80	505.80	33%
RRI-23-B	0%	1.00	0.95	1,003.22			1			12,672	12,672	1,056.02		1056.02	105%
St. Luke's Church	52%	1.00	0.48	49,658.40										41609.00	84%
Total Area	56%	1.00	0.44	613,653.53											

Back Creek Retrofit Sites
Input Value
Recommended Value
Calculated Value

Site ID	TP Pollutant Load (lbs/yr)	TN Pollutant Load (lbs/yr)	TSS Pollutant Load (lbs/yr)	Runoff Depth Captured per Impervious Acre (in)	Pollutant Removal using CBP Retrofit Curves						Constrct., Design, Land Acq., 1 Yr Maint. Cost			
					Total Phosphorus Removal (%)	Total Phosphorus Removal (lbs/yr)	Total Nitrogen Removal (%)	Total Nitrogen Removal (lbs/yr)	Total TSS Removal (%)	Total TSS Removal (lbs/yr)	Cost \$	Cost Effectiveness (\$/lb TP Removed)	Cost Effectiveness (\$/lb TN Removed)	Cost Effectiveness (\$/lb TSS Removed)
BMP_09	4.60	41.43	1,541.81	1.13	56.7%	0.52	36.1%	2.99	72.2%	222.54	\$ 194,523.00	\$ 372,994.45	\$ 65,057.32	\$ 874.11
BMP_17	0.80	6.39	275.82	0.97	69.2%	0.55	59.2%	3.78	74.2%	204.57	\$ 200,288.00	\$ 363,933.14	\$ 53,020.28	\$ 979.08
BMP_21	43.72	488.36	13,542.80	1.06	55.7%	24.37	35.5%	173.23	70.9%	9,607.55	\$ 220,291.00	\$ 9,038.93	\$ 1,271.68	\$ 22.93
Out_01	30.65	308.32	9,893.30	1.01	70.1%	21.49	59.9%	184.82	75.2%	7,435.33	\$ 354,975.00	\$ 16,517.54	\$ 1,920.67	\$ 47.74
Out_04	109.00	1078.25	35,407.10	1.01	70.1%	76.41	59.9%	646.12	75.1%	26,601.09	\$ 845,797.00	\$ 11,068.59	\$ 1,309.03	\$ 31.80
Out_07	55.47	498.78	18,608.00	0.99	69.7%	38.68	59.6%	297.33	74.7%	13,906.60	\$ 668,361.00	\$ 17,278.56	\$ 2,247.88	\$ 48.06
RRI-01	0.61	5.79	200.49	0.77	64.1%	0.39	54.9%	3.18	68.7%	137.80	\$ 199,417.61	\$ 510,651.95	\$ 62,736.37	\$ 1,447.10
RRI-03	1.18	7.83	427.89	0.68	60.8%	0.72	52.1%	4.08	65.1%	278.76	\$ 44,453.51	\$ 62,057.28	\$ 10,900.04	\$ 159.47
RRI-04-A	0.27	1.89	95.06	1.17	72.7%	0.19	62.1%	1.18	77.9%	74.08	\$ 10,897.50	\$ 56,394.16	\$ 9,274.04	\$ 147.10
RRI-04-B	1.47	12.03	507.39	0.21	28.5%	0.42	24.4%	2.93	30.5%	154.89	\$ 15,461.23	\$ 36,902.62	\$ 5,271.58	\$ 99.82
RRI-04-C	0.85	5.62	308.53	1.01	55.0%	0.47	35.0%	1.97	70.0%	216.10	\$ 36,590.53	\$ 78,325.09	\$ 18,575.01	\$ 169.32
RRI-04-D	0.32	2.44	112.58	0.96	69.1%	0.22	59.1%	1.44	74.1%	83.42	\$ 14,265.41	\$ 64,450.04	\$ 9,893.16	\$ 171.01
RRI-04-E	0.69	4.46	250.98	0.44	48.7%	0.34	41.8%	1.87	52.2%	131.03	\$ 25,192.00	\$ 75,188.54	\$ 13,495.72	\$ 192.26
RRI-04-F	0.36	2.70	125.63	1.19	72.9%	0.26	62.3%	1.68	78.1%	98.17	\$ 15,763.75	\$ 60,634.44	\$ 9,371.63	\$ 160.58
RRI-04-G	0.34	2.60	119.99	1.03	70.5%	0.24	60.2%	1.57	75.5%	90.63	\$ 15,210.12	\$ 63,254.44	\$ 9,708.88	\$ 167.84
RRI-06	0.48	3.29	172.83	1.06	71.1%	0.34	60.7%	2.00	76.2%	131.63	\$ 18,835.66	\$ 55,293.29	\$ 9,415.00	\$ 143.09
RRI-08-A	51.11	592.54	15,574.90	0.90	53.3%	27.25	33.9%	201.07	67.9%	10,570.31	\$ 326,236.60	\$ 11,970.13	\$ 1,622.51	\$ 30.86
RRI-08-B	0.17	1.13	63.82	1.00	69.9%	0.12	59.8%	0.67	74.9%	47.81	\$ 18,040.11	\$ 147,736.04	\$ 26,726.69	\$ 377.34
RRI-09-A	0.36	2.61	128.27	0.33	40.4%	0.15	34.6%	0.90	43.3%	55.48	\$ 15,071.14	\$ 103,678.62	\$ 16,698.13	\$ 271.64
RRI-09-B	0.35	4.14	107.10	1.13	72.0%	0.25	61.6%	2.55	77.2%	82.69	\$ 25,913.20	\$ 101,853.48	\$ 10,170.54	\$ 313.37
RRI-11-A	1.93	17.53	643.76	0.39	44.9%	0.87	38.6%	6.76	48.1%	309.94	\$ 47,652.32	\$ 55,049.54	\$ 7,048.90	\$ 153.75
RRI-11-B	0.43	4.23	138.66	1.13	72.1%	0.31	61.6%	2.61	77.3%	107.19	\$ 25,913.20	\$ 84,112.64	\$ 9,930.39	\$ 241.76
RRI-16	0.49	3.19	180.35	1.00	69.9%	0.35	59.8%	1.91	74.9%	135.10	\$ 50,979.55	\$ 147,736.04	\$ 26,726.69	\$ 377.34
RRI-19-A	0.31	2.54	105.61	1.05	70.9%	0.22	60.6%	1.54	76.0%	80.22	\$ 18,085.37	\$ 83,133.20	\$ 11,767.47	\$ 225.45
RRI-19-B	0.57	4.41	198.18	0.82	65.8%	0.37	56.3%	2.48	70.5%	139.66	\$ 31,095.84	\$ 83,439.83	\$ 12,528.61	\$ 222.65
RRI-21-A	3.04	21.70	1,085.54	0.26	33.2%	1.01	28.5%	6.18	35.6%	386.61	\$ 50,075.92	\$ 49,585.94	\$ 8,097.28	\$ 129.53
RRI-21-B	0.58	4.30	203.99	0.62	58.4%	0.34	50.0%	2.15	62.5%	127.58	\$ 25,021.31	\$ 74,321.31	\$ 11,640.64	\$ 196.12
RRI-23-A	0.68	4.70	245.73	0.32	38.9%	0.27	33.4%	1.57	41.7%	102.36	\$ 13,441.50	\$ 50,695.43	\$ 8,576.05	\$ 131.32
RRI-23-B	0.44	2.82	159.42	1.00	69.9%	0.31	59.8%	1.69	74.9%	119.42	\$ 45,063.09	\$ 147,736.04	\$ 26,726.69	\$ 377.34
St. Luke's Church	59.09	343.57	714,360.86	0.85	66.5%	39.29	56.9%	195.38	7.0%	50,005.26				
Total Area	370.33	3479.60	814786.40			236.71		1757.62		121643.83	\$3,572,911.50			