Residential/Government Working Group #2 Handout

Chickahominy River and Tributaries – Implementation Plan Development

Henrico, Hanover, New Kent, Charles City Counties and City of Richmond, VA

Our Task

Include all stakeholders in order to develop a plan to install Best Management Plans (BMPs) that will reduce bacteria from entering the impaired water bodies.

Primary Roles of Residential/Government Working Groups

- Assist in determining types and extent of BMPs needed
- Assist in determining cost for each BMP
- Identify economic incentives/hardships with each BMP
- Identify technical and financial resources to carry out implementation plan
- Report findings to Steering Committee

Goals of Meeting

- Discuss revised estimates of implementation measures that will result in reductions in residential bacterial loads.

Discussion

- Are there any additional educational needs which should be addressed?
- What alternative funding sources are available?
- Efficiency data from James River-City of Richmond table

Total Maximum Daily Load (TMDL) Study Results

Segments on the Chickahominy River, Collins Run, Beaverdam Creek, Boatswain Creek, and Stony Creek do not meet water quality standards (WQS)for bacteria. These standards are designed to identify waters that are not suitable for “primary contact recreation” (swimming) because of the risk of illness. The TMDL study identified the sources of bacteria and how much each source category needs to be reduced to restore water quality. A watershed approach was followed during allocation in determining the needed reductions in bacteria loads to streams in order to meet the water quality standards. In the watershed approach, the same percentage reduction is applied throughout the entire watershed and the resulting improvement in simulated water quality conditions is assessed at all impaired subwatershed outlets. Additional reductions to sources are modeled until simulated water quality conditions meet the standard at all impaired subwatersheds. Simulated water quality conditions were compared to WQS at 11 locations including impaired subwatersheds, previously developed TMDLs, and outlet of entire study area. The subwatershed map is shown in the "Maps" section at the end of the document. The area of interest in this IP is the entire drainage area of the **non-tidal** Chickahominy River.

The implementation plan will outline a staged approach to meet the reductions to human, pet, and agricultural sources determined in the TMDL study. Wildlife is considered a background condition and reductions to wildlife bacteria loads are not explicitly addressed in the TMDL implementation plan.

Accounting for BMPs Installed

It is recognized that the SWCDs/NRCS have been working in the watershed to establish Best Management Practices (BMPs) that are both cost-effective and beneficial to the environment. Table 1 was created from the DCR Ag BMP database website

(http://dswcapps.dcr.virginia.gov/htdocs/progs/BMP_query.aspx). Costs listed in Table 1 are obtained by averaging costs per practice from the DCR database.

Table 1. BMPs Already Installed

	CHARLES CITY, COUNTY			NEW KENT, COUNTY			All		
Row Labels	**Sum Extent**	**Sum Cost**	**Count Extent**	**Sum Extent**	**Sum Cost**	**Count Extent**	**Sum Extent**	**Sum Cost**	**Count Extent**
Grass filter strips (acre)	2.75	613	2				2.75	613	2
Sediment retention, erosion or water control structures ***(was not clear what type of land use/cover this was applied for) (systems)***				1	23895	1	1	23895	1

Residential BMPs Needed

In order to meet the water quality standards, residential BMPs are needed in residential areas that treat or prevent bacteria from traveling to surface waters (Table 2). Some of the measures deal with addressing failing septic systems and straight pipes while other measures deal with other sources of bacteria within residential areas. Bacteria accumulated on the ground surface from human, pet, and wildlife sources travels with runoff through backyards to nearby streams and water bodies. Therefore, reducing runoff from backyards through rain gardens and rain barrels reduces the amount of bacteria transported to streams. Of the 35 straight pipes identified, it was assumed that 70% of them (25 units) would be fixed through connecting to a sewer network. Around 5% would were assumed to need an alternative waste treatment system, and the remaining would be fixed via installing septic systems. For septic sytems, 15% installation/replacement, 25% for repairs, and 60% for connection to existing sewer network.

Table 2. Estimated Residential BMPs Needed.

Control Measure	Unit	Units Needed	Cost per Unit ($)	Source of Cost estimate
Straight Pipe Corrections:		**35**		
Sewer Connection	system	25	$7,838	Hanover County Public Works (connection only)
Alternative Waste Treatment System Installation (RB-5)	system	2	$20,000	James River/Richmond IP
Septic System Installation/Replacement (RB-4)	system	8	$8,000	James River/Richmond IP
Failing Septic Systems Corrections:		**387**		
Septic System Installation/Replacement (RB-4)	system	57	$8,000	James River/Richmond IP
Septic System Repair (RB-3)	system	100	$3,500	James River/Richmond IP
Sewer Connection	system	230	$7,838	Hanover County Public Works (connection only)
Bioretention	Acre-treated	200	$19,000	Cost may vary, please ask group for comments on the given cost James River/Richmond IP
Rain Garden*	Acre-treated	1,000	$19,000	Cost may vary, please ask group for comments on the given cost James River/Richmond IP
Vegetated Buffer	acre	14.5	$360	James River/Richmond IP
Pet Waste Composter**	#	16,500	$50	James River/Richmond IP
Pet Litter Control Program	program	1	$71,872	
Baggy, Sign and Waste Basket Station	Station	30	$170	James River/Richmond IP
Bag Refills	Each	300,000	$0.10	James River/Richmond IP
Mailings (to each household)	Each	102,145	$0.36	James River/Richmond IP
Overflow correction***	program	1 or 3	?	

*Will vary on lot size but average cost around 0.50 per sq. foot.

**Including pet waste composters allowed us to eliminate the need for retention ponds for residential areas. Retention ponds still needed for ag-areas.

***Overflows mostly in Henrico, Hanover and a few in City of Richmond. Suggestion of 3 different SSO BMPs given locality's plan to eliminate SSOs. What is ultimate goal of compliance and enforcement? Localities can extrapolate from where they were as compared to where they are now to predict when they will complete and how much for the total cost to eliminate all SSOs.

To better illustrate the locations of needed BMPs related to home-owners, a breakdown is given in Table 3 for straight pipes and failing septic systems by subwatershed.

Table 3. Home owners' related potential BMPs by subwatershed (columns 6 and 7).

Sub-watershed	Human Population	Housing Units	Homes with Sewer	Homes with Septic	Estimated Homes with Failing Septic System	Estimated Homes with Straight Pipes
1	696	333	6	326	11	1
2	181	73	1	72	2	0
3	108	45	0	45	1	0
4	254	100	0	100	3	0
5	1,192	471	0	469	16	2
6	4,522	1,823	27	1,794	60	2
7	2,770	1,133	21	1,111	37	1
8	1,502	618	225	393	13	0
9	3,356	1,523	1,428	95	3	0
10	13,995	5,502	4,592	909	30	1
11	5,820	2,211	2,169	42	1	0
12	12,658	5,656	5,592	63	2	1
13	4,839	1,833	1,689	144	5	0
14	12,135	5,306	5,051	254	8	1
15	1,525	670	255	413	14	2
16	34,755	13,285	12,095	1,187	40	3
17	2	1	0	1	0	0
18	14	6	0	6	0	0
19	315	152	0	152	5	0
20	75	28	0	28	1	0
21	596	267	0	267	9	0
22	6,126	2,507	2,330	171	6	6
23	876	434	416	17	1	1
24	307	136	0	136	5	0
25	20,769	8,100	6,930	1,167	39	3
26	101,467	47,745	46,398	1,341	45	6
27	5,296	2,187	1,295	887	30	5
Total	**236,151**	**102,145**	**90,520**	**11,590**	**387**	**35**

Bacteria removing efficiencies for BMPs used in the Chickahominy River are listed in Table 4.

Table 4. Potential control measure efficiencies in removing bacteria.

Control Measure	Bacteria Removal Efficiency Value or Range Cited	Efficiency Used in IP Model	Reference
Direct Reduction Efficiency			
Streamside Fencing	100%	100%	1
Corrected Straight-pipe	100%	100%	1
Repaired Septic System	100%	100%	1
Pet Waste Pick-Up Program	25%	25%	3
Pet Waste Composters	99%	99%	1
Waste Storage Facilities	85%	85%	16
*Buffer Efficiency**			
Vegetated Buffer	94% - 99.9%	99%	12
Runoff Treatment Efficiency			
Improved Pasture Management	50%	50%	4
Loafing Lot Management.	60.8% - 64.3%	60%	15
Manure Incorporation	90%	90%	2
Wet Ponds	-6% - 99%	70%	6
Rain Garden	70%	70%	5
Bioretention Basins	90%	90%	4
Submerged Gravel Wetland	78%	78%	7
Sand Filter	36% - 83%/65%	60%	8,9
Shallow Marsh	55% - 97%	78%	10
Extended Detention Pond	48%	48%	13
Infiltration Trench	90%	90%	14
Conservation Tillage	61%	61%	2,17
Street Sweeping	0.6% - 2%	2%	11

*Buffer efficiencies shown here apply to runoff generated outside of the buffer area, but within a distance equal to twice the buffer width. Additional reductions result from the conversion of land from its existing condition to the buffer area.

1 Removal efficiency is defined by the practice.

2 Commonwealth of Virginia. 2005. Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy for the James River, Lynnhaven, and Poquoson Coastal Basins. http://www.richmondregional.org/Publications/Reports_and_Documents/Planning/2005_james_river_tributary_strategy.pdf (Number of sampling events is not provided by the source.)

3 Swann, C. 1999. A survey of residential nutrient behaviors in the Chesapeake Bay. Widener Burrows, Inc. Chesapeake Bay Research Consortium. Center for Watershed Protection. Ellicott City, MD. 112pp. http://www.stormwatercenter.net/Pollution_Prevention_Factsheets/AnimalWasteCollection.htm

4 Hunt, W.F., J.T. Smith, and J.M. Hathaway. 2007. Nutrient, Metal, and bacteria removal by an urban bioretention area in Charlotte, NC. Journal of Environmental Engineering. (Number of sampling events is not provided by the source.)

5 Hunt, William F, Jonathan T Smith, and Jon Hathaway. City of Charlotte Pilot BMP Monitoring Program , Mal Marshall Bioretention Final Monitoring Report. City of Charlotte, 2007. (33 sampling events)

6 Center for Watershed Protection. 2007. National Pollutant Removal Performance Database Version 3. http://www.richmondregional.org/Publications/Reports_and_Documents/Planning/2005_james_river_tributary_strategy.pdf (11 sampling events)

7 Vegetated Rock Filter Treats Stormwater Pollutants in Florida. Watershed Protection Techniques. Center for Watershed Protection. Spring 1996. Vol. 2(2):372-374. (150 sampling events)

8 Developments in Sand Filter Technology to Improve Stormwater Runoff Quality. Watershed Protection Techniques. Center for Watershed Protection. Summer 1994. Vol. 1(2): 47-54. (Number of sampling events is not provided by the source.)

9 Barrett, M. E., 2003. Performance, Cost, and Maintenance Requirements of Austin Sand Filters. DOI: 10.1061/(ASCE)0733-9496(2003)129:3(234). (Number of sampling events is not provided by the source.)

10 Center for Watershed Protection. 2007. National Pollutant Removal Performance Database Version 3. http://www.richmondregional.org/Publications/Reports_and_Documents/Planning/2005_james_river_tributary_strategy.pdf (3 Sampling Events)

11 Zarriello, Phillip J., Robert F. Breault, and Peter K. Weiskel. Potential Effects of Structural Controls and Street Sweeping on Stormwater Loads to the Lower Charles River , Massachusetts. Northborough, Massachusetts, 2002. (Number of sampling events is not provided by the source.)

12 Tate, K. W., Atwill, E. R., Bartolome, J. W. & Nader, G. 2006 Significant Escherichia coli attenuation by vegetative buffers on annual grasslands. J. Environ. Qual. 35, 795–805. (27 sampling events on 48 plots)

13 Borden, R. C., J.L. Dorn, J.B. Stillman and S.K. Liehr. 1996. Draft Report. Evaluation of Ponds and Wetlands For Protection of Public Water Supplies. Water Resources Research Institute of the University of North Carolina. Department of Civil Engineering. North Carolina State University. Raleigh, North Carolina. (Number of sampling events is not provided by the source.)

14 Schueler, T.R., 1992. A Current Assessment of Urban Best Management Practices. Metropolitan Washington Council of Governments. (Number of sampling events is not provided by the source.)

15 Barnett, J. R., R. C. Warner, and C. T. Agouridis. “The effectiveness of a combination weep berm-grass filter riparian control system for reducing fecal bacteria and nutrients from grazed pastures.” Web. (4 simulations conducted over 3 plots.)

16 Based on measurements of bacteria density as excreted and after storage.

17 Bacteria removal efficiency estimated based on sediment and nutrient removal efficiency.

Questions for the group:

- What is an expected cost and time frame if we were to stop the SSOs from happening or stop their load from reaching streams?
- The number of pet waste composters is estimated based on the assumption that half of the units would be used by households that contain one dog and half would be used in households that contain two dogs. Number of units can be reduced to 11,000 if all are used in houses with two dogs.

Steering Committee Representation

So far, we have the following volunteer(s): (Sharon Conner – Hanover SWCD) slconner@hanovercounty.gov; Mark.Alling@deq.virginia.gov; Ram.Gupta@dcr.virginia.gov; Megan.Sommers@dcr.virginia.gov; Margaret.Smigo@deq.virginia.gov; (Jody Bryan-citizen) jmb823@gmail.com; (**Olivia Hall-**Henrico Co.) hal57@co.henrico.va.us; JBeckley@scientist.com (**James Beckley** - citizen) and christinebeish@gmail.com (**Christine Beish** - citizen). The names in bold are folks who volunteered for the Residential or Government working group and then also volunteered to be on the steering committee. Please provide your telephone # on the sign-in sheet and check your email above.

Table 4. Estimated domestic animal populations in areas contributing to impaired segments in the Chickahominy River and Tributaries watershed study area.

Sub-watershed	Dogs	Cats
1	178	199
2	39	44
3	24	27
4	53	60
5	252	282
6	973	1,090
7	605	678
8	330	370
9	813	911
10	2,938	3,290
11	1,181	1,322
12	3,020	3,382
13	979	1,096
14	2,833	3,173
15	358	401
16	7,094	7,944
17	1	1
18	3	4
19	81	91
20	15	17
21	143	160
22	1,339	1,499
23	232	260
24	73	81
25	4,325	4,844
26	25,496	28,552
27	1,168	1,308
Total	**54,546**	**61,086**

Cat and dog populations were derived from American Veterinary Medical Association Center for Information Management demographics in 1997. It was assumed that on average, each house contains 0.53 dogs and 0.6 cats.

Table 5. Volume of sanitary sewer overflows reported within the study area between October 2002 and March 2011.

Subwatershed	Volume (1,000 Gallon)
8	13
9	10,737
10	25
11	108
12	121,164
13	182
14	8
15	2
16	265
22	504
25	2,205
26	8,626
27	154
Total	143,993

Records were provided by DEQ that showed date of occurrence, location, and volume estimate. Records were summarized by subwatershed.