A Total Maximum Daily Load Implementation Plan For Fecal Coliform and Nitrate Reductions

DRAFT

Submitted to
The Stakeholders of
Muddy Creek, Dry River, Pleasant Run, and Mill Creek Watersheds

On Behalf of
The Commonwealth of Virginia:
Department of Conservation and Recreation

Prepared by

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Introduction

TMDL is an acronym for Total Maximum Daily Load, which is the maximum amount of pollutant that a water body can assimilate without surpassing the state water quality standard. If the water body surpasses the water quality standard 10% of the time during an assessment period, the water body is placed on the Commonwealth of Virginia's 303(d) List of Impaired Waters. Dry River, Muddy Creek, Pleasant Run, and Mill Creek were placed on this list because of violations of the fecal coliform (FC) bacteria water quality standard. In addition, Muddy Creek and Dry River were placed on the 303(d) list because of violations of the nitrate (NO_3-N) public drinking water standard. After this listing, FC and NO_3-N TMDL Plans were developed for each impairment. After TMDL plans are written, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act states in section 62.1-44.19:7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters". In fulfilling the state's requirement for the development of a TMDL Implementation Plan, a framework was established for reducing FC and NO_3-N levels and achieving the water quality goals for which TMDL allocations were developed. With successful completion of the implementation plan, Virginia will be well on the way to restoring the impaired waters and enhancing the value of this important resource. Additionally, development of an approved implementation plan will improve the localities chances for obtaining monetary assistance during implementation.

It has been documented time and again the detrimental affects of bacteria in food and water supplies. For example, May 2000, in Walkerton, Ontario a town of approximately 5000 people, there were seven confirmed deaths with four other deaths under investigation, and over 2000 poisonings all attributed to drinking water polluted by E. *coli* Type 0157:H7 (Raine, 2000)(Miller, 2000). Financially, the contamination resulted in a $250 million class action lawsuit filed against the Ontario government. The source of the pollution according to the Cattleman's Association was probably runoff from a feedlot located more than 5 miles from the wells used for the town's water supply. According to veterinarian Gerald Ollis, cattle are the "number one reservoir for this type of E. *coli* " and five to forty percent of cattle shed the bacteria at any given time. E. *coli* is a type of fecal coliform bacteria commonly found in intestines of humans and animals. August 8, 1994 VDH was notified of campers and counselors at a Shenandoah Valley summer camp developing bloody diarrhea. E. *coli* 0157:H7 was confirmed as the causative agent. In Franklin County Virginia, 1997, an outbreak of illnesses involving 3 children was attributed to E. *coli* (0157:H7) in Smith Mountain Lake. The children were exposed to the bacteria while swimming in the lake and a two year old hospitalized almost died as a result of the exposure (Roanoke Times, 1997). In August of 1998, 7 children and 2 adults at a Day-care Center in rural Floyd County were infected with E. *coli* (0157:H7). Upon investigation, two of the properties' wells tested positive for total coliform (Roanoke Times, 1998). June 6, 2000, Crystal Spring, Roanoke Virginia's second largest water source was shut down by Virginia Department of Health for E. *coli* contamination.

Isolated cases? No. Throughout the U.S., the Center for Disease Control estimates at least 73,000 cases of illnesses and 61 deaths per year caused by this one fecal coliform pathogen (i.e. E. *coli* 0157:H7 bacteria) (CDC, 2001). Other fecal coliform pathogens

(e.g. E. *coli* 0111) are responsible for similar illnesses. In addition, other bacterial and viral pathogens are indicated by the presence of fecal coliforms. Whether the source of contamination is human or livestock the threat of these pathogens appears more prevalent as both populations increase. As stakeholders we must assess the risk we are willing to accept and then implement measures to safeguard the public from these risks. Water quality standards are society's implementation of legislative measures resulting from an assessment of the acceptable risks.

Key components of the implementation plan are discussed in the following sections:

- τ Review of the TMDL Development Study;
- τ Description of Water Quality Monitoring;
- τ Process for Public Participation;
- τ Assessment of Needs; and
- τ Cost / Benefit Analysis, and Implementation.

Review of TMDL Development Plan

Dry River, Muddy Creek, Pleasant Run, and Mill Creek are part of the North River watershed, located in Rockingham County, Virginia. Muddy Creek and Dry River are located approximately 5 miles to the west of Harrisonburg, while Pleasant Run and Mill Creek are located approximately 3 miles to the southeast (Figure 1). The Dry River watershed, from northwest of Rawley Springs downstream to the North River, is approximately 10,051 acres of which forested (32%) and agricultural (54%) land uses dominate. Muddy Creek watershed, approximately 20,025 acres (34% forested and 57% agricultural land uses), is a tributary to Dry River. The total area of the Pleasant Run watershed is approximately 5,309 acres, with agriculture as the primary land use (about 72%) and the remaining watershed area split evenly between forest and rural development. The Mill Creek watershed is approximately 9,633 acres comprised of forest (15%), agricultural (67%), and urban (18%) land uses.

Summary of the TMDL development included:

- Most/all livestock must be excluded from streams within all impairments;
- Substantial land-based NPS load reductions are needed in Muddy Creek and Pleasant Run;
- Wampler Foods, Inc. must reduce nitrate levels in outflow by 35%;
- Most/all failing septic systems and straight pipes must be identified and corrected in Muddy Creek;
- No straight pipes exist in Dry River, Pleasant Run, and Mill Creek;
- Reduce wildlife direct deposition in Pleasant Run and Mill Creek by 15% and 60%, respectively; and
- Anthropogenic FC sources will be addressed in stage I of the implementation plan, setting aside any reduction of wildlife. The VADEQ will re-assess streams after stage I to determine if water quality standards had been attained, if not, wildlife sources will be addressed.

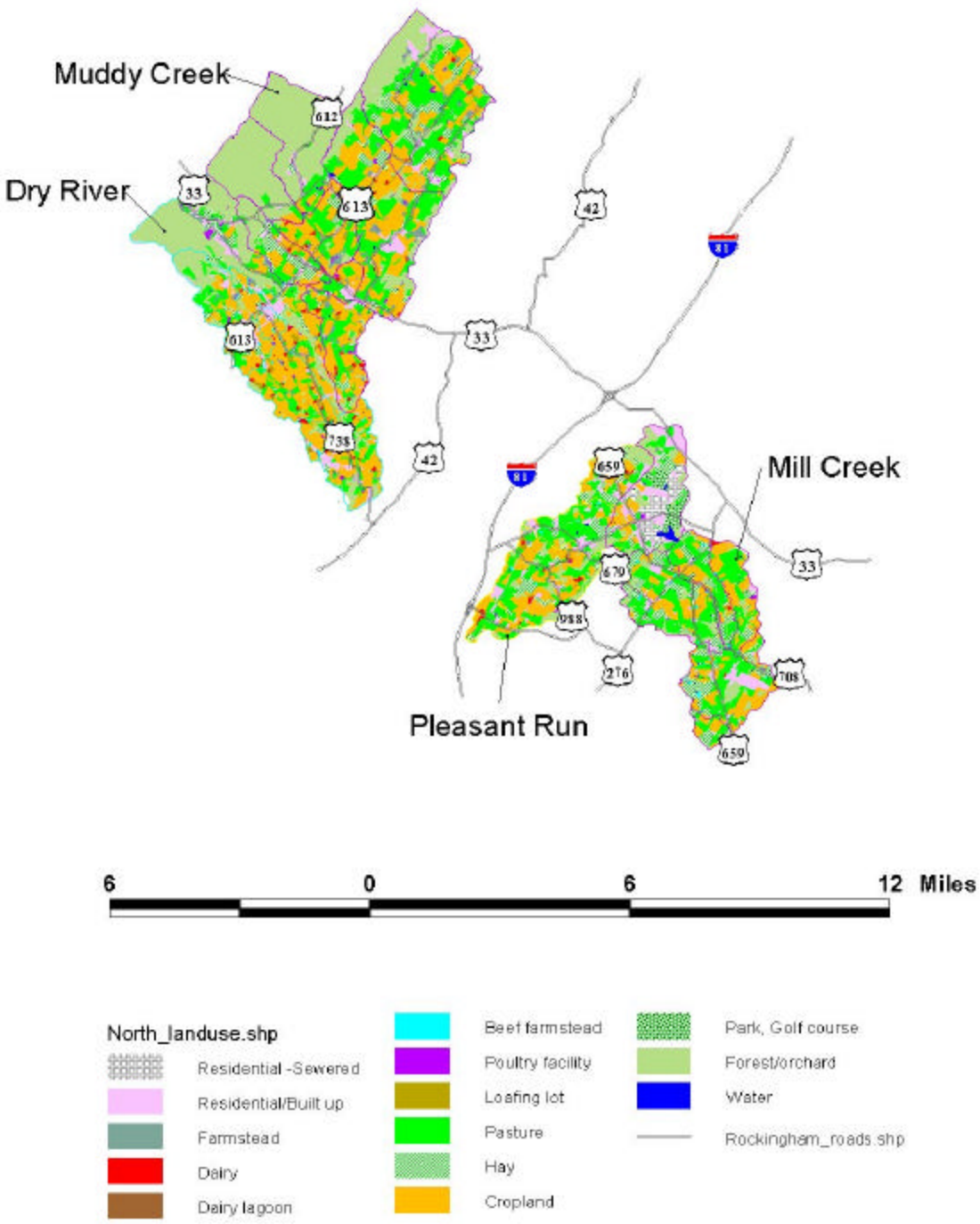
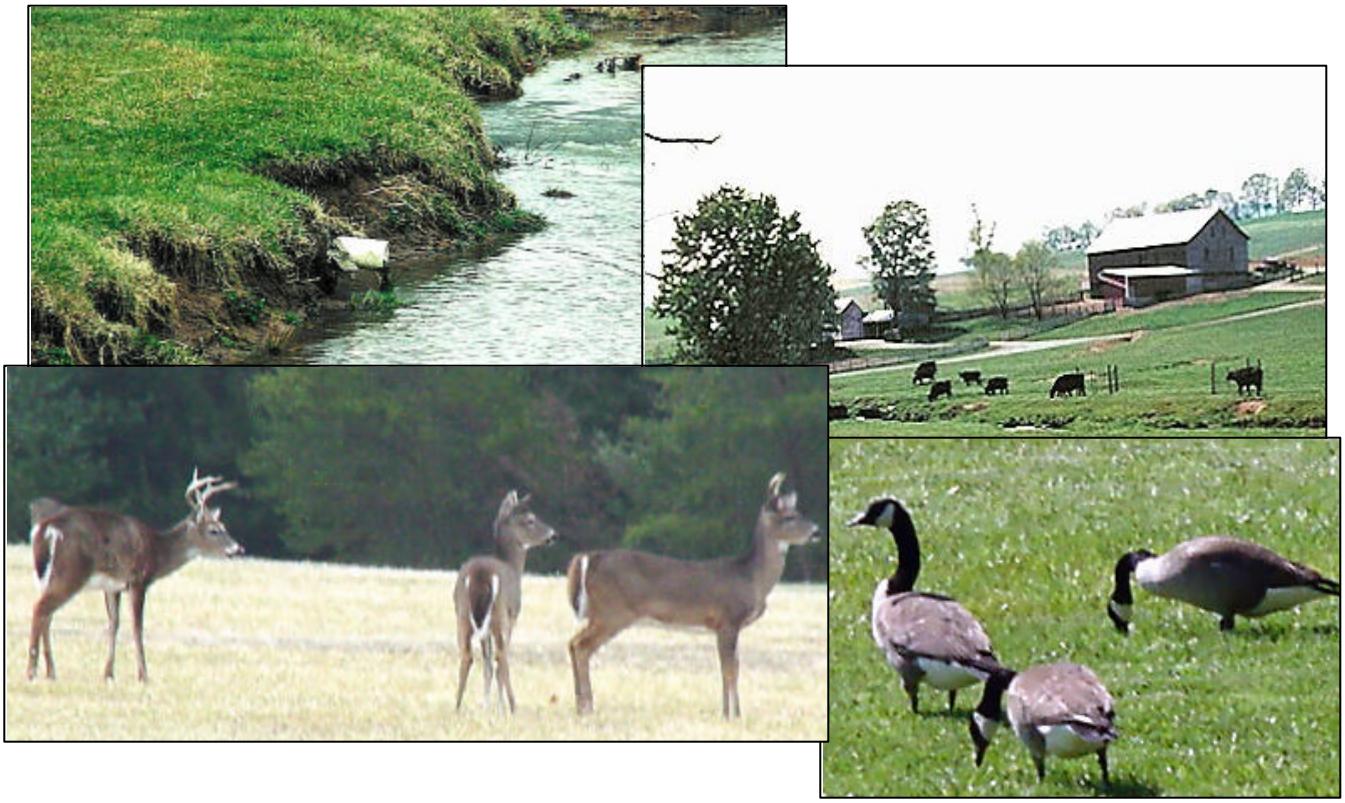


Figure 1 **Land uses in the Muddy Creek, Dry River, Pleasant Run, and Mill Creek watersheds.**



Description of Water Quality Monitoring

Monitoring at 25 fixed sampling sites throughout Muddy Creek, Dry River, Mill Creek, and Pleasant Run was performed bi-monthly (Figure 2). Of the 25 fixed sampling sites, 21 sites corresponded to subwatershed outlets outlined in the TMDL development. Of the remaining four sites, one site was located at the outlet of Upper Dry River watershed; one site was located at the outfall of the Wampler Foods Processing Plant; and two sites bracketed Onyx Hill. Ten additional samples were collected at sites in Muddy Creek to help refine the spatial distribution of sources. All water samples were analyzed for fecal coliform and fecal streptococcus. Bacterial Source Tracking was also run on each sample using Antibiotic Resistance Analysis, yielding the percentage of isolates classified as human, livestock, and wildlife. In addition, the water samples collected in Muddy Creek Watershed were analyzed for nitrate-nitrogen, total phosphorus, and total suspended solids. Monitoring indicated a contribution of fecal coliform from livestock, human, and wildlife sources (Table 1). In the Dry River Watershed, consistently higher fecal coliform concentrations were monitored at stations on Honey Run with livestock as the predominant source followed by wildlife. Human sources seem most significant in the Muddy Creek watershed coupled with livestock. For the Pleasant Run and Mill Creek Watersheds, consistently higher fecal coliform concentrations were monitored at lower subwatersheds near the outlet of each. Livestock appears to be an issue in these lower subwatersheds. In addition, livestock appears to be an issue in the Duck Run subwatershed followed by wildlife then human. High nitrate levels in the Muddy Creek Watershed appear to correspond to stations in which a high fecal coliform concentration was measured from livestock.

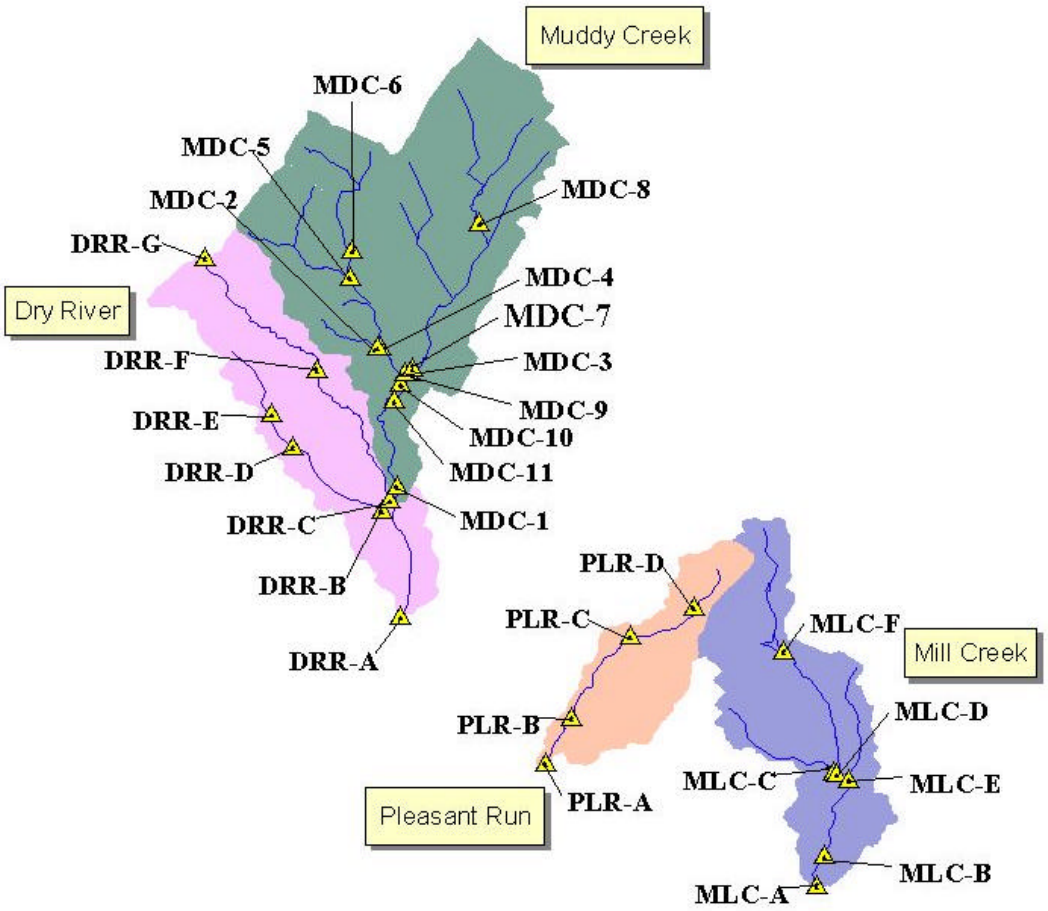


Figure 2 **Monitoring stations within Muddy Creek (MDC), Lower Dry River (DRR), Mill Creek (MLC), and Pleasant Run (PLR) Watersheds.**

Table 1 Preliminary water quality monitoring results for Dry River Muddy Creek, Pleasant Run, and Mill Creek.

Impairment	Station	% Violations (> 1,000 cfu/100ml)	Human (%)	Livestock (%)	Wildlife (%)	Nitrate (avg.) (mg/l)	% Violations (> 10 mg/l)
Pleasant Run	PLR-A	60	6	46	48	-----	-----
	PLR-B	60	12	52	36	-----	-----
	PLR-C	0	1	33	66	-----	-----
	PLR-D	20	4	49	47	-----	-----
Mill Creek	MLC-A	20	6	32	62	-----	-----
	MLC-B	20	8	72	20	-----	-----
	MLC-C	20	5	38	57	-----	-----
	MLC-D	40	19	44	37	-----	-----
	MLC-E	40	5	69	26	-----	-----
	MLC-F	0	9	61	30	-----	-----
Muddy Creek	MDC-1	40	14	54	32	5.42	0
	MDC-2[1]	0	6	34	60	5.63	0
	MDC-3	40	12	55	33	5.70	0
	MDC-4	20	9	23	68	3.70	0
	MDC-5[1]	20	32	40	28	0.62	0
	MDC-6[2]	0	2	25	73	0.12	0
	MDC-7	60	15	58	27	6.45	0
	MDC-8	60	41	44	15	6.80	0
	MDC-9	0	0	0	0	38.11	100
	MDC-10	40	5	42	53	9.37	25
	MDC-11	40	16	22	62	8.57	25
Dry River	DRR-A	20	8	59	33	-----	-----
	DRR-B	40	32	45	23	-----	-----
	DRR-C	0	4	36	60	-----	-----
	DRR-D	40	8	50	42	-----	-----
	DRR-E	40	12	60	28	-----	-----
	DRR-F	20	0	39	61	-----	-----
	DRR-G	0	5	25	70	-----	-----

1 – Sampled station in September and May only.

2 - Sampled station September through March.

Process for Public Participation

The actions and commitments described in this document are drawn together through input from citizens of the watersheds, the Rockingham County government, Rockingham County Board of Supervisors, Virginia Department of Conservation and Recreation (VADCR), Virginia Department of Environmental Quality (VADEQ), Virginia Department of Health (VDH), Virginia Cooperative Extension Service (VACES), Natural Resources Conservation Service (NRCS), Shenandoah Valley Soil and Water Conservation District (SVSWCD), Virginia Department of Agriculture and Consumer Services (VDACS), Rockingham County Farm Bureau Association, Virginia State Dairymen's Association, Virginia Poultry Federation, Inc., Wampler Foods, Inc., Pilgrim's Pride Corporation, and MapTech, Inc. Every citizen and interested party in the watersheds is encouraged to become involved in this initiative and contribute what they are able to help restore the health of the streams. Public participation took place on three levels. First, public meetings were held to provide an opportunity for informing the public as to the end goals and status of the project, as well as, a forum for soliciting participation in the smaller, more-targeted meetings (i.e. focus groups and steering committee). Second, focus groups were assembled from communities of people with common concerns regarding the TMDL process and were the primary arena for seeking public input. The following focus groups were formed: Agricultural, Residential, Commercial, Environmental, and Governmental. A representative from VADCR, Rockingham County, Rockingham County Farm Bureau Association, and MapTech attended each focus group in order to facilitate the process and integrate information collected from the various communities. Third, a steering committee was formed with representation from all of the focus groups, VADCR, VADEQ, VDH, Rockingham County, Rockingham County Farm Bureau Association, and MapTech. Over 1,100 man-hours were devoted to attending these meetings by individuals representing agricultural, residential, commercial, environmental, and governmental interests on a local, state, and federal level.

Throughout the public participation process, major emphasis was placed on discussing best management practices (BMP) specifications, location of control measures, education, technical assistance, and funding. A BMP Advisory Committee was formed by VADCR to address potential variances to the Virginia Agricultural Best Management Practices Cost-Share Program suggested by the Agricultural and Governmental Focus Groups. It was agreed by the Agricultural and Governmental Focus Groups and the BMP Advisory Committee that appending BMP component specifications required in different programs should not be pursued. However, concern was expressed that there needed to be more flexibility in the minimum buffer distance for streamside fencing.

The Agricultural and Governmental Focus Groups agreed that potential control measures identified through the implementation plan process would be practical, cost-effective, equitable, and based on the best science and research available. Implementation of the identified control measures should be administered in a timely manner to efficiently and economically target problem areas through stages. It was determined through Residential and Commercial Focus Group input that stream-walks must be performed during implementation to accurately identify straight pipes and failing septic systems. The group also recommended that a certified letter under Rockingham County or VDH letterhead would be sent to all homeowners identifying the period that individuals would be walking streams and how it is associated with the TMDL.

All members of the Agricultural, Residential, Commercial, Environmental, and Governmental Focus Groups agreed that education is key to getting people involved in implementation. There must be a proactive approach by agencies to contact farmers and residents to articulate exactly what the TMDL means to them and what will most practically get the job done. For the agricultural community, small workshops and farm visits would be needed to accomplish this. During workshops and farm visit, an informational packet would be handed out defining the TMDL and what it means to the farmer, options each farmer has for funding sources (e.g. voluntary, cost-share, and tax credit) with requirements of each and list of components with cost (e.g. alternative watering systems). For residential issues, small community meetings similar to small workshops proposed for the agricultural community were recommended for educating homeowners about septic system maintenance. It was generally recognized that homeowners are unaware of the need for regular septic system maintenance. A technician dealing with residential issues will contact homeowners after identification of straight pipes or failing septic systems and explain options available for correcting the problems and for funding sources. Notices using all media outlets will be posted regarding septic systems (e.g. a reminder to pump-out septic tank every 3-5 years). An educational packet will be included about septic system issues for new homeowners. Additionally, educational tools, such as a model septic system that could be used to demonstrate functioning and failing septic systems, and video of septic maintenance and repair, would be useful in communicating the problem and needs to the public.

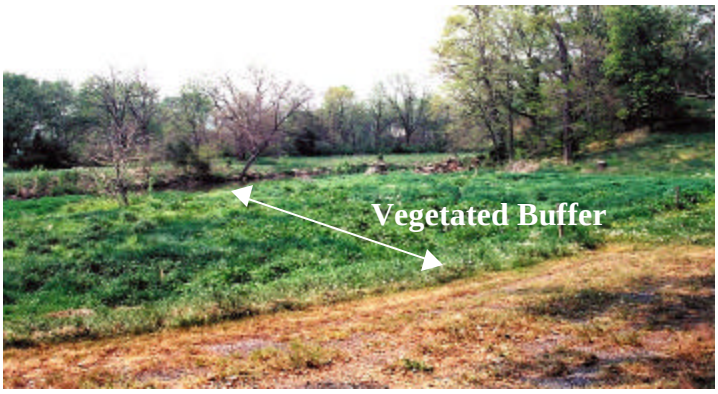
Traditionally, funding for residential issues have fallen on the landowner and funding for agricultural practices has been both voluntary and through the state's cost-share program. In addition to traditional sources of funding, approximately $1.6 million in 319 funding will be available this year for implementation in areas that have a state-approved implementation plan. A great deal of the implementation for agricultural practices in Muddy Creek and Dry River Watersheds is expected to be on a voluntary basis using tax credits where appropriate, and not through cost-share assistance. Whereas, a higher participation rate in state and federal cost-share programs is anticipated in the Pleasant Run and Mill Creek Watersheds. In addition to the anticipated 319 funds, funding grants will be written during implementation. Suggestions to stimulate implementation included:

1.) 25% tax credit pursued statewide for the maintenance of stream exclusion fencing and associated watering systems;
2.) Tax credit equal to cost-share percentage (e.g. up to 75%);
3.) Increase in the cost-share percentage to encourage participation in the cost-share program, especially in the Pleasant Run and Mill Creek Watersheds;
4.) Additional 15% incentive payment applied to estimated or actual cost (whichever is less) in TMDL areas for full livestock exclusion systems; and
5.) Fencing depot using commercial establishment to supply fencing materials at reduced costs to farmers in the TMDL implementation area.

Assessment of Needs

The quantity of control measures required during implementation was determined through spatial analyses of land use, stream-network, elevation, building-footprint, and soils maps along with regionally appropriate data archived in the DCR Agricultural BMP Database and TMDL Development documents. The map layers and archived data were combined to establish high and low estimates of control measures required overall, in each watershed, and in each subwatershed. Additionally, input from local agency representatives and contractors were used to verify the analyses. Estimates of control practices needed for full implementation in the four watersheds are listed in Table 2.

There is approximately 172 miles of stream in the four watersheds. The total length of fencing required for the four watersheds is expected to be 116 miles. Associated with the streamside fencing through pasture are 478 full livestock exclusion systems consisting of streamside fencing, cross fencing and watering source. Streamside fencing of cropland will not require a full livestock exclusion system; instead, it is assumed that temporary poly-wire will be used to restrict livestock from entering stream. As identified in the TMDL, one milking parlor discharge must be corrected each in the Dry River and Pleasant Run Watersheds. According to current standards, 120-day storage must be provided for parlor waste. Therefore, an animal waste control facility must be installed in each watershed to eliminate the direct discharge to stream.



In order to address the land reductions needed in Muddy Creek and Pleasant Run Watersheds, the benefit of including a 25 ft. buffer with streamside fencing was first calculated. Given that reductions were not sufficient to meet TMDL reduction goals, additional control measures will need to be implemented to obtain FC land reductions. If water quality goals are not met after full livestock stream exclusion is accomplished in Muddy Creek and Pleasant Run, land reductions can be addressed through installation of loafing lot management systems, manure incorporation in soil, installation of animal waste control facilities, pasture management, conversion of pasture to hayland, and export of waste. It was estimated using spatial analysis and TMDL report that 28 loafing lot management systems will need to be installed in Muddy Creek and in Pleasant Run. A cover crop on 5,154 cropland acres in Muddy Creek should account for total nitrogen reduction needed in September through December. If reductions in Pleasant Run cannot be achieved through designing and following nutrient management plans and planting cover crops; installing three poultry waste control facilities or exporting 684 tons per year of poultry litter will need to be implemented. In

Table 2 Estimation of average control measures with unit cost needed during implementation for agricultural and residential programs in Dry River, Muddy Creek, Pleasant Run, and Mill Creek Watersheds.

Control Measure	Unit	Estimated Units Needed	Average Cost / Unit ($)
Agricultural Program:			
Full Exclusion System	system	478	15,023
Cropland Fencing	feet	105,500	1.10
Hardened Crossing	system	190	2,000
Loafing Lot Management System	system	35	31,396
Dairy Waste Control Facility	system	18	61,499
Poultry Waste Control Facility	system	3	22,132
Cover Crop	ac	5,154	138
Technical Assistance	man-year	18	50,000
Administrative Assistance	man-year	6.5	35,000
Residential Program:			
Septic System	system	17	2,500
Alternative Waste Treatment System	system	27	7,500
Drainfield Maintenance	system	10	1,500
Technical Assistance	man-year	1	50,000
Administrative Assistance	man-year	0.5	35,000

addition to the reduction achieved from buffers installed with streamside fencing in Muddy Creek and Pleasant Run, FC reductions on pasture will be achieved through improved pasture management. It is anticipated that intensive pasture management could achieve specified FC and nitrogen reductions, however, if water quality goals are not being met alternative actions may need to be considered. For example, 1,201 and 279 downhill pasture acres might be converted to hayland in Muddy Creek and Pleasant Run, respectively, to achieve the needed reductions.

The number and location of failing septic systems and straight pipes were based on numbers reported in the TMDL. A reduction in the number of failing septic systems in Mill Creek and Dry River was deemed unnecessary by the TMDLs. Correspondingly, for Muddy Creek and Pleasant Run, 100% (29 total) and 25% (19 out of 76) of the failed septic systems distributed between subwatersheds must be identified and fixed during implementation. Based on assumptions outlined in the TMDL, no straight pipes in Dry River, Pleasant Run, and Mill Creek Watersheds exist. In Muddy Creek, six straight pipes, distributed evenly between subwatersheds MDC-4 and MDC-6, must be identified and replaced.

To determine the number of man-years necessary for agricultural technical assistance during implementation, the total practices needed to be installed per year during implementation was divided by the number of BMPs that a technician from SVSWCD has historically processed in a year. As a result, 18 technical man-years and 6.5 administrative man-years are needed to provide agricultural technical assistance through 5 years of implementation. Members of the Residential and Governmental Focus Groups estimated that one technical man-year and half administrative man-years would be required to provide residential technical assistance and educational outreach tasks identified during plan development. The number of man-years needed to provide technical assistance during implementation in the four watersheds is listed in Table 2.

Cost / Benefit Analysis

Associated cost estimations for systems needed for full livestock exclusion and land-applied reductions were calculated by multiplying the unit cost per the number of units in each subwatershed (Table 2). As depicted in Table 3, the total average cost to install control measures that will ensure full livestock exclusion from streams in the four watersheds is $7.67 million excluding technical assistance. The total cost to install control measures to obtain the land-applied reductions in the four watersheds is estimated at $2.98 million excluding technical assistance.

Table 3 Estimated total implementation cost for agricultural BMPs, residential BMPs, and technical assistance in Dry River, Muddy Creek, Pleasant Run, and Mill Creek Watersheds.

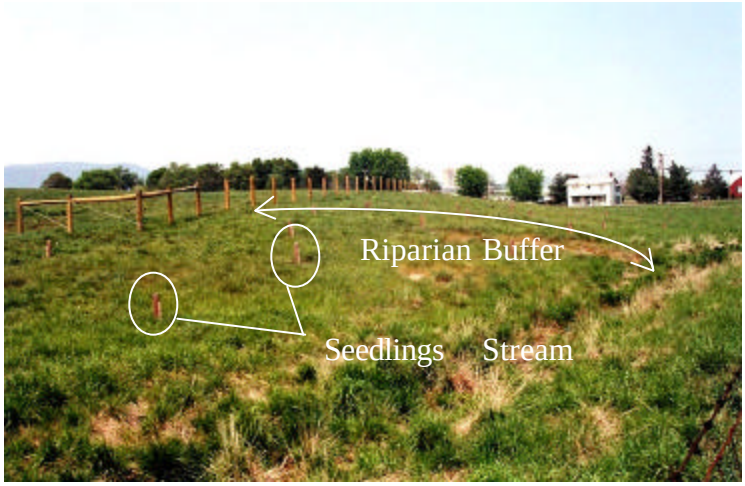
Control Measure	Average Total Cost (in million $)
Livestock Exclusion BMPs	7.67
Land-applied BMPs	2.98
Residential BMPs	0.26
Technical Assistance	
Agricultural Programs	1.13
Residential Programs	0.07
Total	12.11


Peat Moss Filtering System

Cost estimations to fix failed septic systems and replace identified straight pipes were based on the combination of drain-field maintenance, new septic systems, or alternative waste treatment system. Without site surveys at each location where system repair/replacement/installation is required, it is difficult to determine the proportion of sites needing alternative systems. In this light, it was assumed that sites were evenly split between needing standard systems (i.e. septic systems or drainfield maintenance) and alternative systems (e.g. peat moss filter systems). Among standard systems needed for

failed septic systems correction, it was assumed that 40% would require repair rather replacement. The total cost estimated for repair/replacement/installation of private sewage systems was $260,000.

It was determined by the SVSWCD, DCR, VDH, and Governmental Focus Group members that it would require $50,000 and $35,000 to support the salary, benefits, travel, and training of one technical man-year and administrative man-year, respectively. With quantification analysis yielding a need for 18 technical man-year and 6.5 administrative man-year, the total cost to provide agricultural technical assistance during implementation is expected to be $1.13 million (Table 3). For residential technical assistance, approximately $70,000 is needed to support one technical man-year and half an administrative man-year. (Table 3)



The primary benefit of implementation is cleaner waters in Virginia. Specifically, fecal contamination and nitrate concentrations in Dry River, Muddy Creek, Pleasant Run, and Mill Creek will be reduced to meet water quality standards. It is hard to gage the impact that reducing fecal contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the reductions required, the incidence of infection from fecal sources, through contact with surface waters, should be reduced considerably. Additionally, because of stream-bank protection that will be provided through exclusion of livestock from streams, and restoration of the riparian area through implementation of the Conservation Reserve Enhancement Program (CREP) in some areas, the aquatic habitat will be improved and progress will be made toward reaching the General Quality standard (Benthic) in these waters. The vegetated buffers that are established will also serve to reduce sediment and nutrient transport to the stream from upslope locations. In areas where pasture management is improved through implementation of grazing-land-protection BMPs, soil and nutrient losses should be reduced, and infiltration of precipitation should be increased, decreasing peak flows downstream. Reduction of nitrate concentrations in these waters will protect downstream drinking-water supplies, ensuring the prevention of negative health impacts, such as blue-baby syndrome, which is caused by excessive concentrations of nitrate.

An important objective of the implementation plan is to foster continued economic vitality and strength. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document will provide

economic benefits to the landowner, as well as, the expected environmental benefits. Specifically, alternative (clean) water sources, exclusion of cattle from streams, intensive pasture management, improved nutrient management, and private sewage system maintenance will each provide economic benefits.

A clean water source has been shown to improve weight gain and milk production in cattle. Fresh clean water is the primary nutrient for livestock with healthy cattle consuming, on a daily basis, close to 10% of their body weight during winter and 15% of their body weight in summer. Many livestock illnesses can be spread through contaminated water supplies. For instance, coccidia can be delivered through feed, water and haircoat contamination with manure (VCES, 2000). In addition, horses drinking from marshy areas or areas where wildlife or cattle carrying Leptospirosis have access tend to have an increased incidence of moonblindness associated with Leptospirosis infections (VCES, 1998). A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills. In addition to reducing the likelihood of animals contracting waterborne illnesses by providing a clean water supply, streamside fencing excludes livestock from wet, swampy environments as are often found next to streams where cattle have regular access. Keeping cattle in clean dry areas has been shown to reduce the occurrence of mastitis and foot rot. The Virginia Cooperative Extension Service (1998) reports that mastitis currently costs producers $100 per cow in reduced quantity and quality of milk produced. On a larger scale, mastitis costs the U.S. dairy industry about $1.7-2 billion annually or 11% of total U.S. milk production. While the spread of mastitis through a dairy heard can be reduced through proper sanitation of milking equipment, mastitis-causing bacteria can be harbored and spread in the environment where cattle have access to wet and dirty areas. Implementation of streamside fencing and well managed loafing areas will reduce the amount of time that cattle have access to these areas.

Taking the opportunity to instigate an improved pasture management system in conjunction with installing clean water supplies will also provide economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, increase stocking rates by 30 - 40%, and consequently, improve the profitability of the operation. With feed costs typically responsible for 70-80 percent of the cost of growing or maintaining an animal, and pastures providing feed at a cost of .01-.02 cents/lb of total digestible nutrients (TDN) compared to .04-.06 cents/lb TDN for hay, increasing the amount of time that cattle are fed on pasture is clearly a financial benefit to producers (VCES, 1996). Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. In addition

to reducing costs to producers, intensive pasture management can boost profits, by allowing higher stocking rates and increasing the amount of gain per acre. A side benefit is that cattle are more closely confined allowing for quicker checking and handling.


Streamside Fencing

The implementation of nutrient management plans in conjunction with cover crops and increased manure storage capacity will reduce levels of nitrate in streams during critical periods and potentially improve the efficiency of nutrient use on the farm. Cover crops can scavenge excess nutrients not used by production crops during the growing season and keep them in the crop/soil system. Additionally, increased interception and infiltration of rainfall by the cover crop will reduce runoff volumes and consequently soil and nutrient losses to surface waters. Increased manure storage capacity will allow producers the flexibility to time the application of manure so that nutrients are available to the crop at critical stages of growth. Additionally, applications can be timed so that nitrate is less available for runoff to streams during critical periods for water quality. Nutrients in manure and recovered from the soil with cover crops are a commodity that should be managed with the intent of making efficient use of the resource for production of crops. By doing so, the environment and downstream water supplies will be protected from nutrient (e.g. nitrate) losses, and the producer will import fewer nutrients to the farm. In general, many of the agricultural BMPs being recommended will provide both environmental benefits and economic benefits to the farmer.

The residential programs will play an important role in improving water quality, since human waste can carry with it human viruses in addition to the bacterial and protozoan pathogens that all fecal matter can potentially carry with it. In terms of economic benefits to homeowners, an improved understanding of private sewage systems, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20-25 years if properly maintained. Proper maintenance includes; knowing the location of the system components and protecting them by not driving or parking on top of them, and not planting trees where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every 3 to 5 years. The cost of proper maintenance, as outlined here, is relatively inexpensive in comparison to repairing or replacing an entire system. Additionally, the repair/replacement and pump-out programs will benefit owners of private sewage (e.g. septic) systems, particularly low-income homeowners, by sharing the cost of required maintenance.

Implementation

Potential funding sources available during implementation were identified during plan development. Detailed description of each source can be obtained from the SVSWCD, VADCR, NRCS, VCES, and VADEQ. Sources include:

- 319 Incremental Funds
- Virginia Agricultural Best Management Practices Cost-Share Program
- Virginia Agricultural Best Management Practices Tax Credit Program
- Virginia Agricultural Best Management Practices Loan Program
- Conservation Reserve Program (CRP)
- Conservation Reserve Enhancement Program (CREP)
- Environmental Quality Incentives Program (EQIP)
- Wildlife Habitat Incentive Program (WHIP)
- Wetland Reserve Program (WRP)
- Southeast Rural Community Assistance Project (SER-CAP)

One possible scenario for funding in the first year is presented in Table 4. This scenario represents 25% installation of needed agricultural systems addressing livestock exclusion (i.e. full livestock exclusion system, cropland fencing, and hardened crossings), 50% of residential systems fixed/replaced (i.e. septic replacement/installations, alternative system replacement/installations, and drain-field maintenance), two agricultural technical man-years, 0.5 agricultural administrative man-years, 0.5 residential technical man-years, and 0.25 residential administrative man-years. The scenario also takes into account two agricultural technical and one administrative man-years, respectively, currently funded with anticipation of same level of funding to continue.

Table 4 One possible scenario for funding in the first year.

Funding Source	Agricultural ($)	Residential ($)	Total ($)
Landowner	706,000	98,000	804,000
Tax Credits	107,000	0	107,000
PL566	144,000	0	144,000
319 Incremental Funds			
Practices	287,000	27,000	314,000
Technical Assistance	118,000	34,000	152,000
EQIP	0	0	0
CREP	773,000	0	773,000
Southeast R-CAP	0	5,000	5,000
Current Funded Technical	135,000	0	135,000
Total:	*2,136,000*	*163,000*	*2,299,000*

Progress toward end goals will be assessed during implementation through tracking of control measure installations and continued water quality monitoring. It is recommended that continued water quality monitoring be made based on the existing monitoring

network and spatial distribution of the staged implementation plan. Water quality analysis should include fecal coliform enumerations, NO3-N, and BST analysis. BST will provide an indication of the effectiveness of specific groups of control measures, specifically agricultural and urban.

Implementation is scheduled to begin in July 2001 after which four milestones need to be met within the next ten years (Figure 3). The first milestone will be two years after implementation begins, whereby 50% of the livestock exclusion systems and 100% of the residential control measures will be installed with a 2% to 16% expected reduction in exceedances of geometric mean water quality standard (Table 5). After four years from the start of implementation, 100% of the livestock exclusion systems will be installed resulting in a 37% to 100% anticipated reduction in exceedances. After the fifth year, if deemed necessary after evaluation of water quality, all control measures to reduce the land-applied NPS loads will be installed in order to meet the third milestone of 100% full implementation and 0% exceedances of the water quality standard. The final milestone will be delisting of the impaired segments from the Commonwealth of Virginia's 303(d) List of Impaired Waters, which is anticipated to occur by 2011. Based on meeting the above milestones, a five-year implementation plan outline was formulated as depicted in Tables 6 and 7.

Table 5 Estimation of fecal coliform geometric mean water quality standard violations at each milestone in Dry River, Muddy Creek, Pleasant Run, and Mill Creek.

Milestone	Dry River (%)	Muddy Creek (%)	Pleasant Run (%)	Mill Creek (%)
Existing	64	100	99	100
1	54	97	95	98
2	0	63	1	65
3	0	0	0	0

Implicit in the process of a staged implementation is targeting of control measures. Targeting ensures optimum utilization of resources. Targeting of critical areas for BMP installation was accomplished through analysis of land use, farm boundaries, stream network GIS layers, monitoring results, and survey responses. Monitored data collected during the development process was used together with spatial analysis results to identify subwatersheds where initial implementation resources would result in the greatest return in water quality improvement. If feasible, effort should be made to concentrate resources first in the following subwatersheds: DRR-B, DRR-D, DRR-E, MDC-1, MDC-7, MDC-8, PLR-A, PLR-B, MLC-B, MLC-D, and MLC-E. It was assumed that failed septic systems in close proximity to a stream would have a larger impact on water quality than a system upland. Therefore, spatial analysis was performed to identify residents within 300 feet of a stream. Using the results, efforts can be made to contact identified residents first during implementation to address septic system failures and straight pipes.

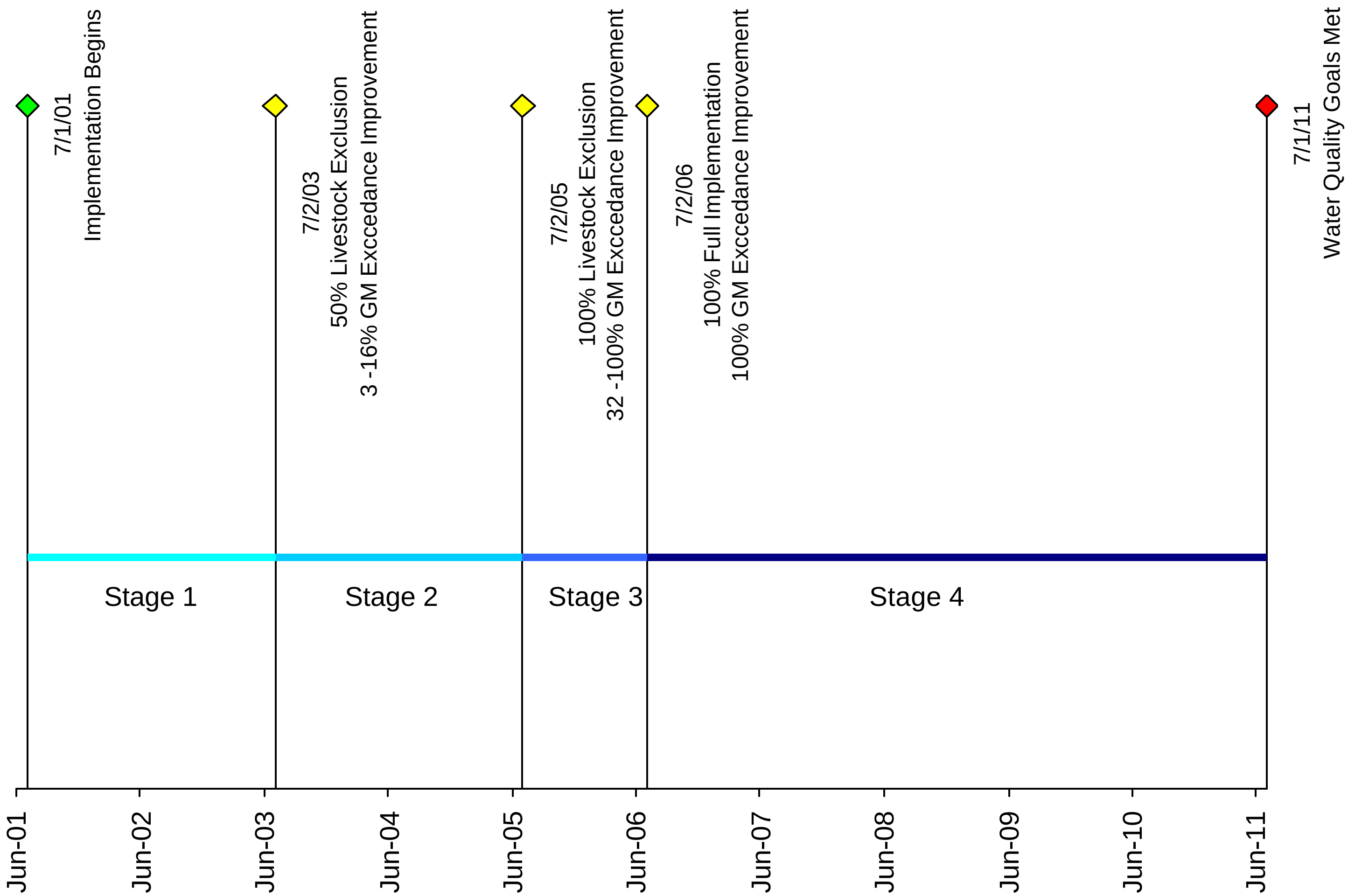


Figure 3 Implementation milestones for Dry River, Muddy Creek, Pleasant Run, and Mill Creek watersheds.

Table 6 **Percentage of practices to be installed addressing livestock exclusion, land-applied reductions, failed septic systems, and straight pipes with amount of technical assistance needed in Dry River, Muddy Creek, Pleasant Run, and Mill Creek Watersheds.**

Date	Livestock Exclusion	Land-Applied	Failed Septic & Straight Pipes	Agricultural Technical Assistance		Residential Technical Assistance	
				Technical (MAN-YEARS)	*Administrative* (MAN-YEARS)	*Technical* (MAN-YEARS)	*Administrative* (MAN-YEARS)
(year)	(%)	(%)	(%)				
1	25	0	50	4	1.5	0.5	0.25
2	25	0	50	4	1.5	0.5	0.25
3	25	0	0	4	1.5	0	0
4	25	0	0	3	1	0	0
5	0	100	0	3	1	0	0
Total	*100*	*100*	*100*	*18*	*6.5*	*1*	*0.5*

Table 7 **Cost associated with percentage of practices installed addressing livestock exclusion, land-applied reductions, failed septic systems, and straight pipes and technical assistance needed in Dry River, Muddy Creek, Pleasant Run, and Mill Creek Watersheds.**

Date	Livestock Exclusion	Land-Applied	Failed Septic & Straight Pipes	Agricultural Technical Assistance		Residential Technical Assistance		Total Cost Per Year
				Technical	*Administrative*	*Technical*	*Administrative*	
(year)	($)	($)	($)	($)	($)	($)	($)	($)
1	1,920,000	0	125,000	200,000	53,000	25,000	9,000	2,332,000
2	1,920,000	0	125,000	200,000	53,000	25,000	9,000	2,332,000
3	1,920,000	0	0	200,000	53,000	0	0	2,173,000
4	1,920,000	0	0	150,000	35,000	0	0	2,105,000
5	0	2,979,000	0	150,000	35,000	0	0	3,164,000
Total	*7,680,000*	*2,979,000*	*250,000*	*900,000*	*229,000*	*50,000*	*18,000*	*12,106,000*

Stakeholder's Roles and Responsibilities

Achieving the goals of this effort (i.e. improving water quality and removing these waters from the impaired waters list) is without a doubt dependent on stakeholder participation. Not only the local stakeholders charged with implementation of control measures, but also the stakeholders charged with overseeing our nation's human health and environmental programs must first acknowledge there is a water quality problem and then make changes in our operations, programs, and legislation to address these pollutants.

The USEPA has the responsibility of overseeing the various programs necessary for the success of the CWA. However, administration and enforcement of such programs falls largely to the states. In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are four state agencies responsible for regulating activities that impact water quality in Virginia. These agencies include: Virginia Department of Environmental Quality, Virginia Department of Conservation and Recreation, Virginia Department of Agriculture and Consumer Services, and Virginia Department of Health.

VADEQ has responsibility for monitoring the waters to determine compliance with state standards, and for requiring permitted, point dischargers to maintain loads within permit limits. They have the regulatory authority to levy fines and take legal action against those in violation of permits. Beginning in 1994, animal waste from confined animal facilities in excess of 300 animal units (cattle and hogs) has been managed through a Virginia general pollution abatement permit. These operations are required to implement a number of practices to prevent groundwater contamination. In response to increasing demand from the public to develop new regulations dealing with animal waste, in 1999, the Virginia General Assembly passed legislation requiring VADEQ to develop regulations for the management of poultry waste in operations having more than 200 animal units of poultry (about 20,000 chickens), (ELI, 1999).

VADCR holds the responsibility for addressing nonpoint sources (NPS) of pollution. One such program is Virginia's Erosion and Sediment Control Law. Under this provision, a person must have an approved erosion and sediment control plan and a certification that the plan will be implemented before they can obtain a building permit. However, most VADCR programs dealing with agricultural NPS pollution historically have been through education and voluntary incentive programs. These cost-share programs were originally developed to meet the needs of voluntary partial participation and not the TMDL-required 100% participation of stakeholders. To meet the needs of the TMDL program and achieve the goals set forth in the CWA, the incentive programs must be reevaluated to account for 100% participation. It should be noted that VADCR does not have regulatory authority over the majority of issues addressed here except for the Erosion and Sediment Control program.

Through Virginia's Agricultural Stewardship Act, VDACS Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis (Pugh, 2001). If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the

local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken which can include a civil penalty up to $5,000 per day. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures. VDACS has only 2 staff members dedicated to enforcing the Farm Stewardship Act, and very little funding is available to support water quality sampling. The Agricultural Stewardship Act is entirely complaint driven. As of May of this year, 152 complaints, of which 38% were founded, had been received statewide since the initiation of the legislation. No fines have resulted from these complaints.

VDH is responsible for maintaining safe drinking water measured by standards set by the USEPA. Their duties also include septic system regulation and regulation of biosolids land application. Like VDACS, VDH is complaint driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation that may take many weeks or longer to effect compliance. In the scheme of these TMDLs, VDH has the responsibility of enforcing actions to correct or eliminate failed septic systems and straight pipes, respectively.

State government has the authority to establish state laws that control delivery of pollutants to local waters. Local governments in conjunction with the state can develop ordinances involving pollution prevention measures. In addition, citizens have the right to bring litigation against persons or groups of people who can be shown to be causing some harm to the claimant. Through hearing the claims of citizens in civil court, and the claims of government representatives in criminal court, the judicial branch of government also plays a significant role in the regulation of activities that impact water quality.

The Clean Water Act Section 303(d) calls for the identification of impaired waters. It also requires that the streams be ranked by the severity of the impairment and a Total Maximum Daily Load be calculated for that stream that would bring its water back into compliance with the set water quality standard. Currently, TMDL implementation plans are not required in the Federal Code (pending administrative proceedings) however; Virginia State Code does incorporate the development of implementation plans for impaired streams. The nonpoint source part of the Clean Water Act was largely ignored by EPA until citizens began to realize that regulating only point sources was no longer maintaining water quality standards. Beyond the initiation of the CWA, the entire TMDL program has been complaint driven. Lawsuits from citizens and environmental groups citing USEPA was not carrying out the statutes of the CWA began as far back as the 1970's and have continued until the present. In the state of Virginia in 1998, the American Canoe Association and the American Littoral Society filed a complaint against EPA for failure to comply with provisions of §303d. The suit was settled by Consent Decree, which contained a TMDL development schedule through 2010. It is becoming more common for concerned citizens and environmental groups to turn to the courts for the enforcement of water quality issues.

In 1989, concerned residents of Castile, Wyoming County New York filed suit against Southview Farm. Southview had around 1,400 head of milking cows and 2,000 total

head of cattle. Tests on citizen's wells found them contaminated with nitrates traced to irresponsible handling of animal wastes by Southview. In 1990, Southview was given a notice of violations under the Clean Water Act. Rather than change their farming practices or address the contaminated wells they ignored the warning. In 1995, after court hearings and an appeal, the case was finally settled. Southview had to donate $15,000 to the Dairy Farms Sustainability Project at Cornell University, pay $210,000 in attorney fees for the plaintiff, and employ best management practices (Knauf, 2001). Closer to home, on the Eastern Shore of Virginia, a shellfish farmer sued his neighbor, a tomato grower. The shellfish farmer claimed the agricultural runoff created from the plasticulture operation was carrying pollutants that were destroying his shellfish beds. The suit was settled out of court in favor of the shellfish farm for an undisclosed amount.

Successful implementation depends on stakeholders taking responsibility for their role in the process. The primary role, of course, falls on the landowner. However, local, state and federal agencies also have a stake in seeing that Virginia's waters are clean and provide a healthy environment for its citizens. An important first step in correcting the existing water quality problem is recognizing that there is a problem and that the health of citizens, particularly those who are least able to protect themselves (i.e. children), is at stake. While it is unreasonable to expect that the natural environment (e.g. streams and rivers) can be made 100% free of risk to human health, it is possible and desirable to make what improvements we can. Virginia's approach to correcting NPS pollution problems has been and continues to be encouragement of participation through education and financial incentives. However, if voluntary approaches prove to be ineffective and the public "will" is to force compliance with existing laws through court actions, then landowners may be required to implement corrective actions without economic assistance from the state and may face punitive fines for non-compliance.

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