TMDL Implementation Plan Development for a Rapidly Urbanizing Watershed in Northern Virginia

USDA/CSREES
2007 National
Water Conference

Savannah, GA

Center for TMDL and Watershed Studies

CSREES Mid-Atlantic Regional Water Quality Program
Applying knowledge to improve water quality

CSREES USDA Education Research Extension

Virginia Tech 1872
Invent the Future

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Objective and Outline

- Objective

  Present an overview of TMDL implementation planning in Virginia using a case-study watershed.

- Introduction to TMDL implementation planning in Virginia
- Review of Opequon Creek TMDL studies
- Implementation Plan Development
  - Public participation
  - Quantifying corrective measures
  - Implementation milestones
  - Progress to date

You've got a TMDL, so what?

- As currently (1992) specified in Section 303d of the Clean Water Act…

  *TMDL development is a **planning exercise only**, TMDL implementation is not required.*

- However, in Virginia…
  - Water Quality Monitoring, Information, and Restoration Act (WQMIRA) passed in 1997 requires development of TMDL **Implementation Plans** (IPs)

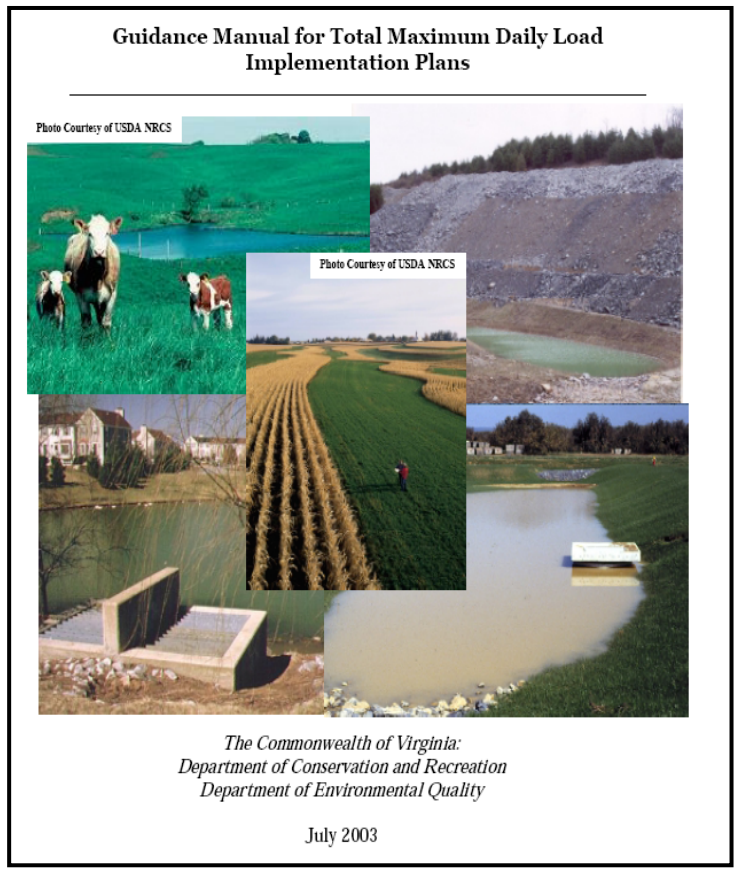
    "The [Water Quality Control] Board shall develop and implement a plan to achieve fully supporting status for impaired waters."

- TMDLs are pollutant-specific, but IPs are not necessarily pollutant- or waterbody-specific

TMDL Implementation Planning

Document that details actions or strategies that must be undertaken to achieve load reductions to ensure that water quality standards are met

Implementation Guidance Manual

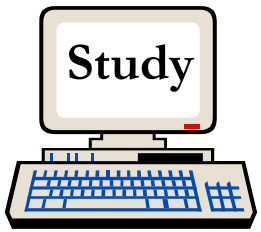


http://www.deq.state.va.us/tmdl/implans/ipguide.pdf

TMDL Process

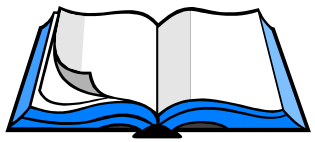
Total
Maximum
Daily
Load

Study



- What will it take to fix the problem?

Clean-up Plan



- How can those fixes be implemented?

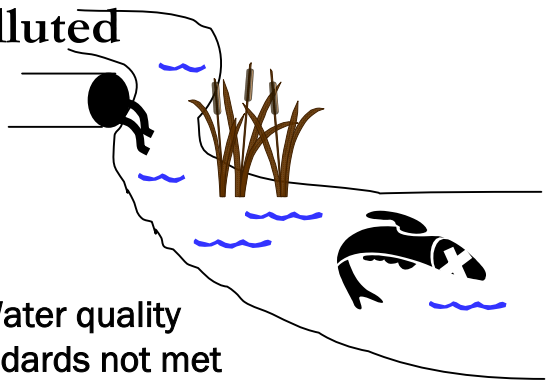
Implementation

Monitoring

Clean

Water quality standards met

Polluted

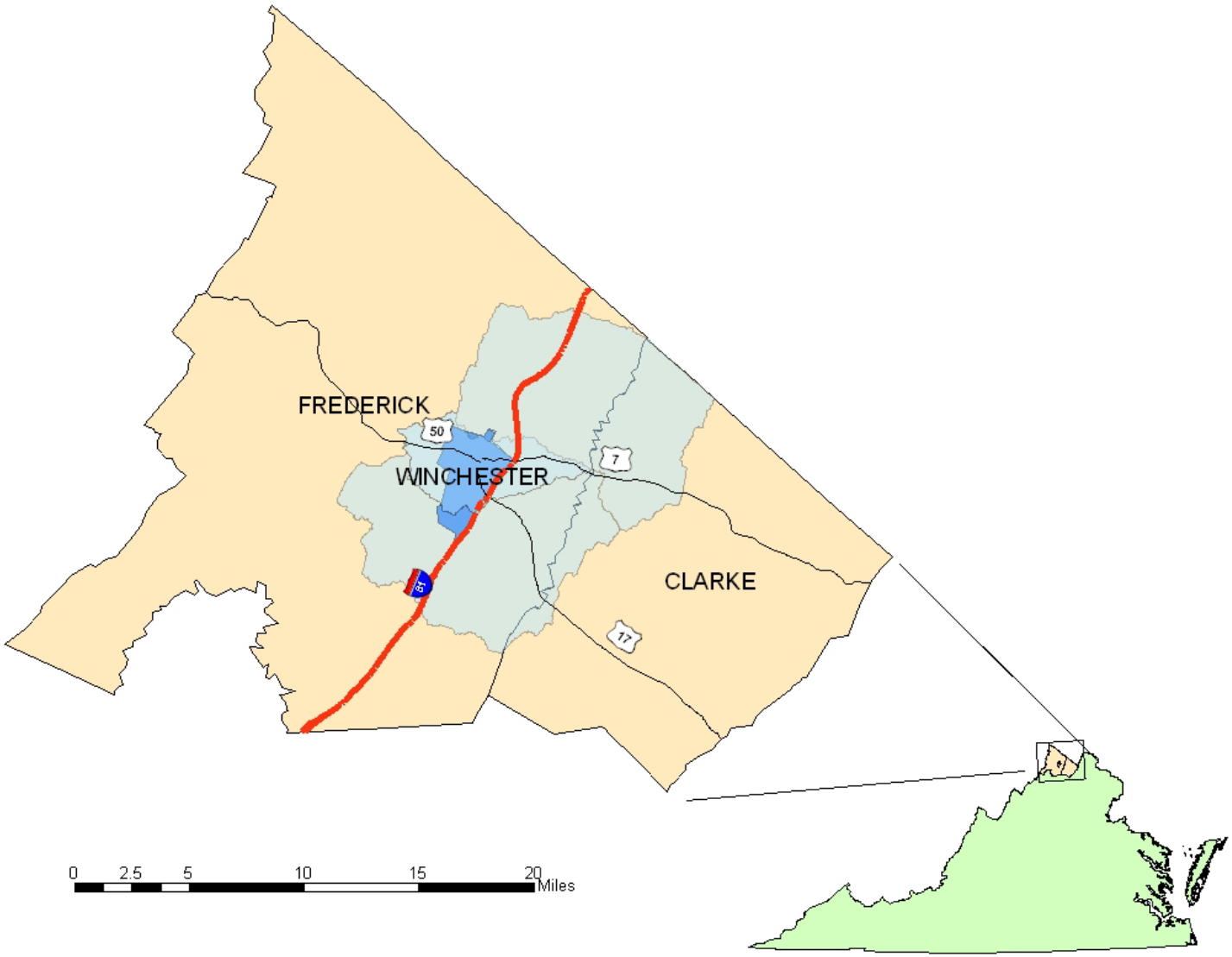


Water quality standards not met

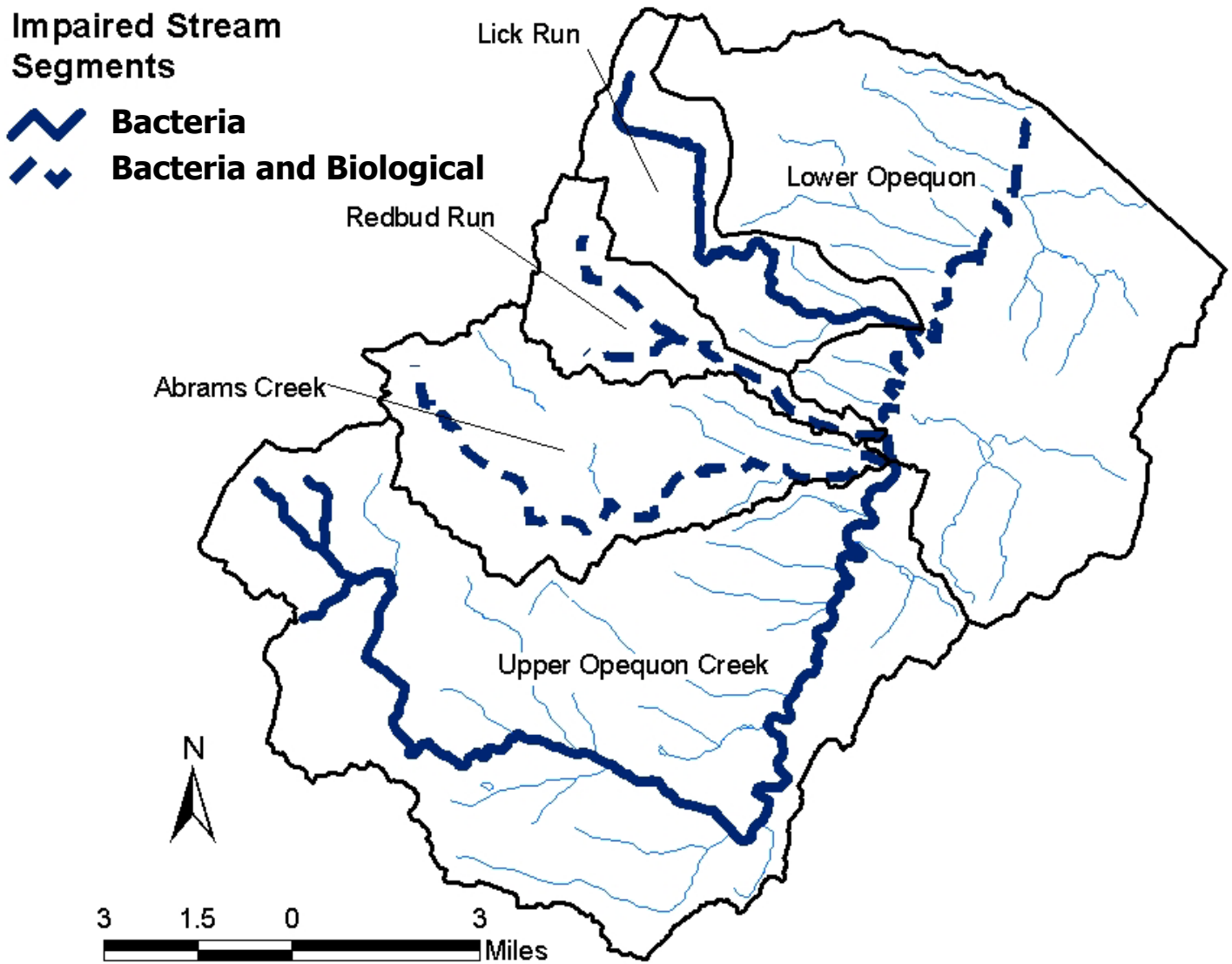
The Process

Graphic adapted from Dr. Robert Brent, Virginia DEQ

Opequon Creek Case Study

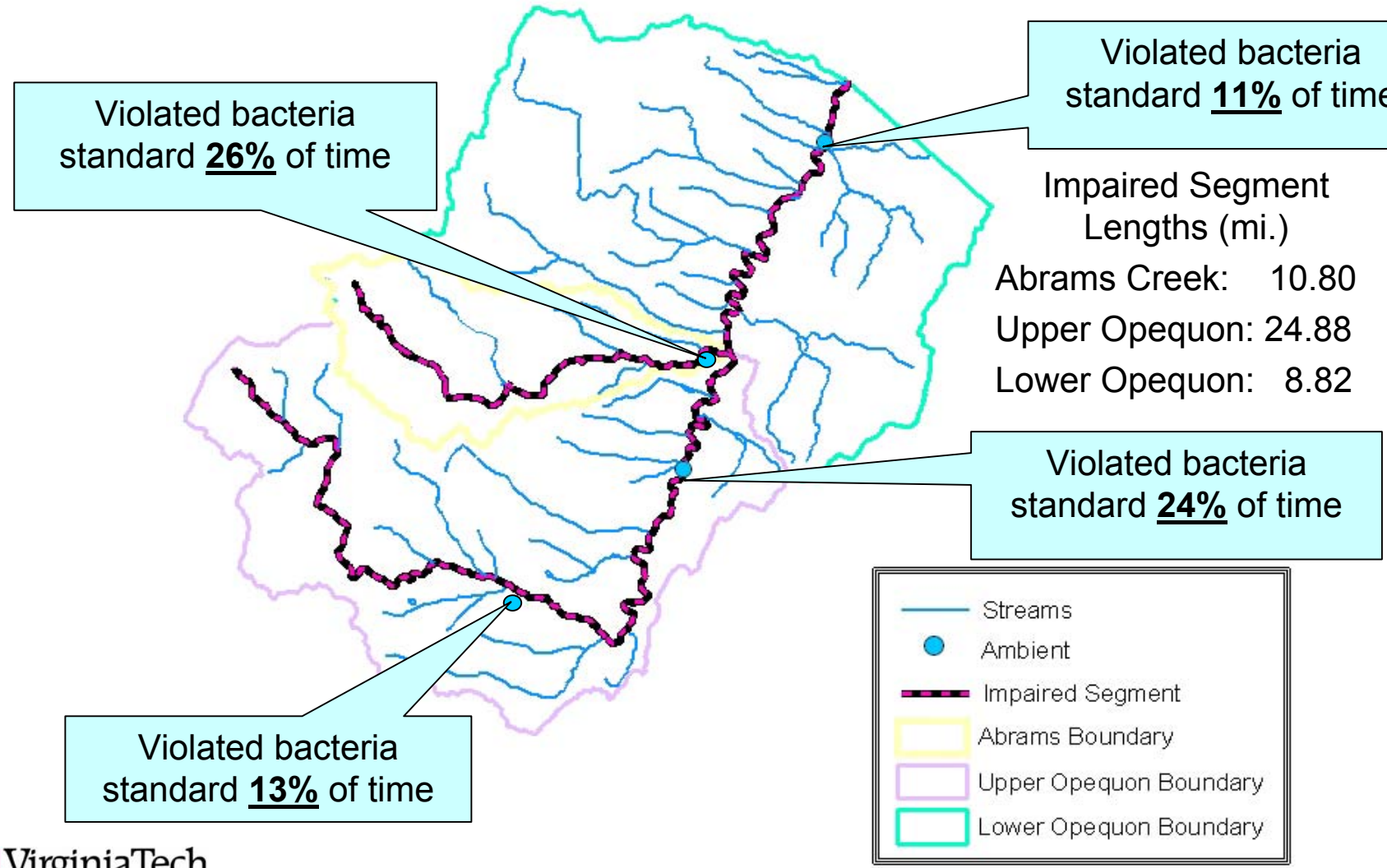


Opequon Creek Impairments

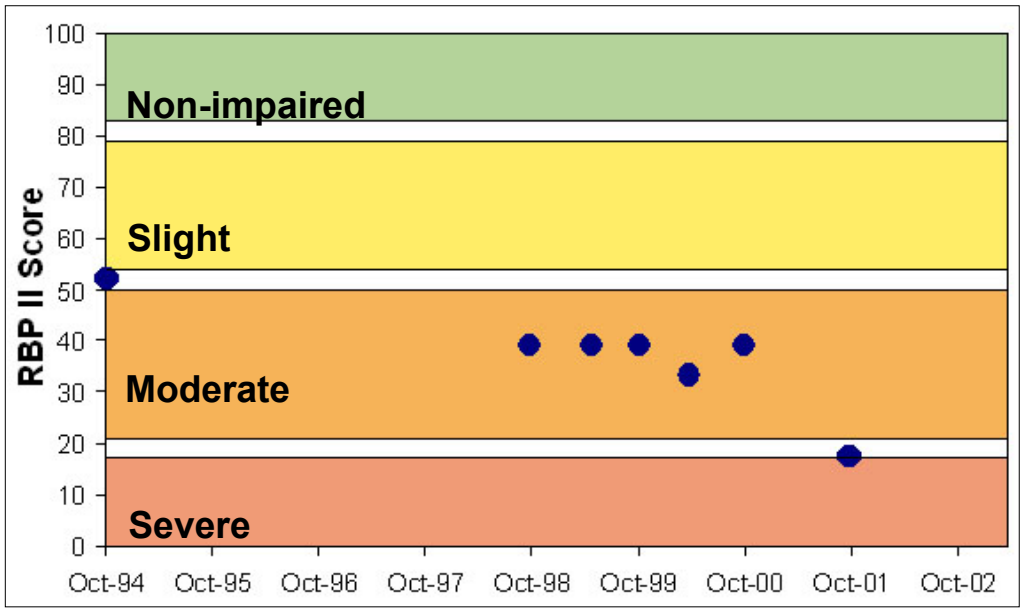


Bacteria Impairment

More than 10% of the time, the stream is not meeting the State's bacteria standard for primary contact recreation

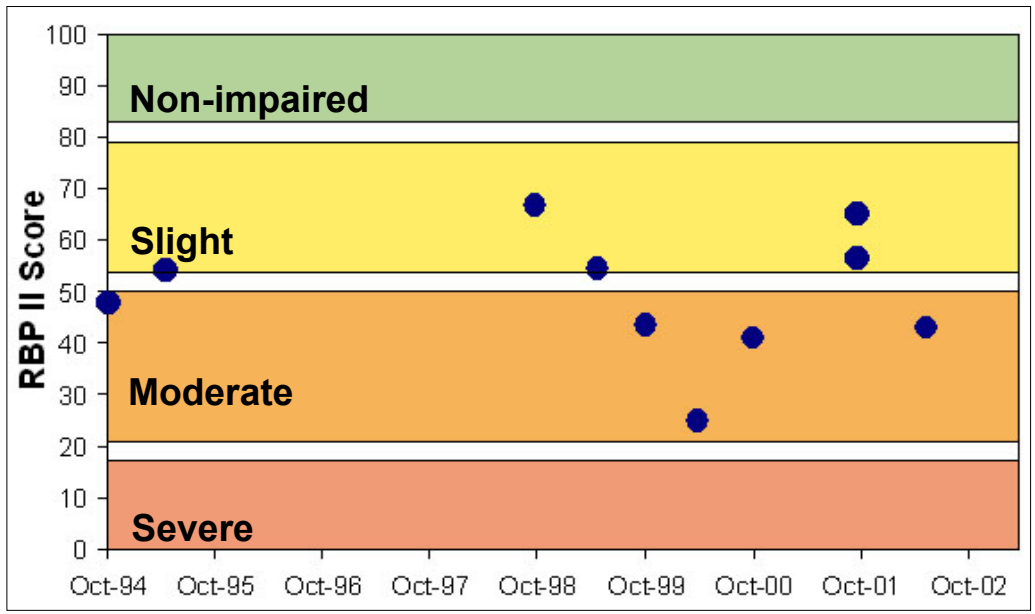


RPB II Assessment



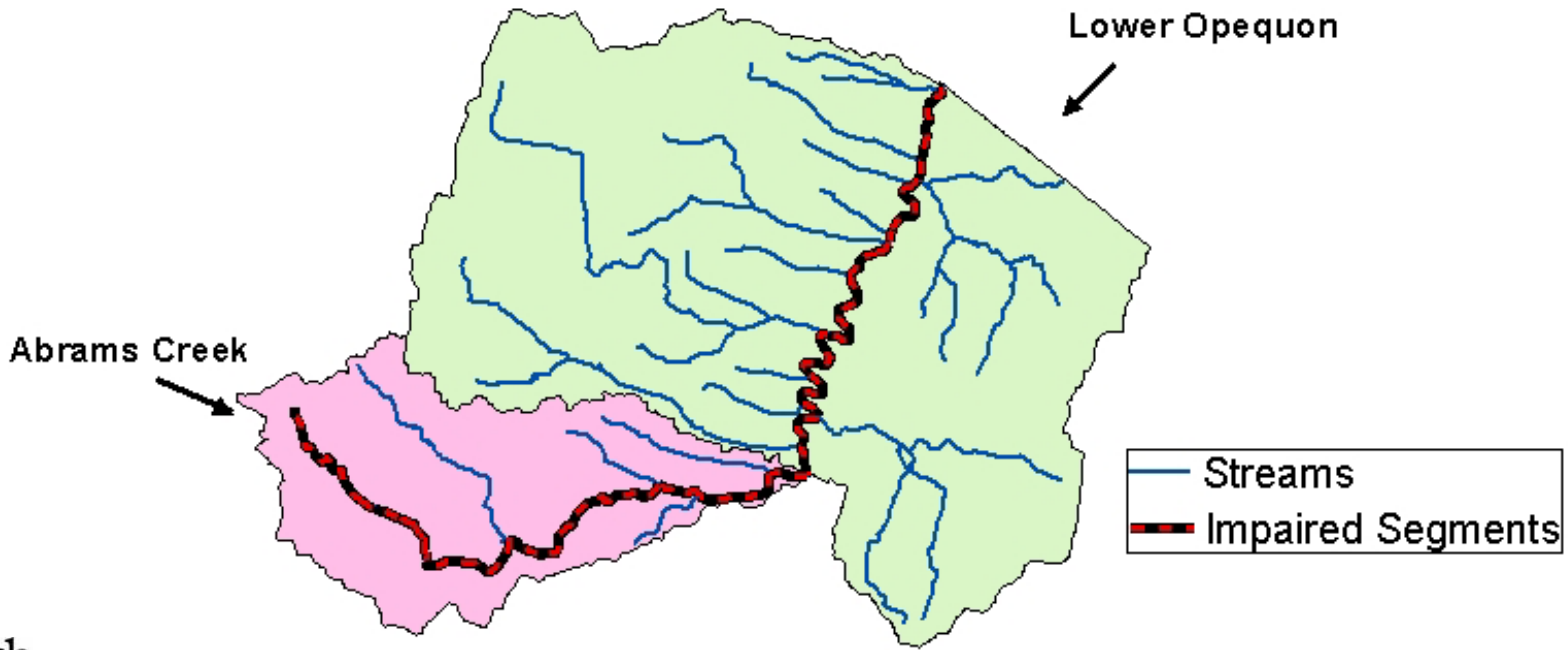
Abrams Creek

Lower Opequon Creek



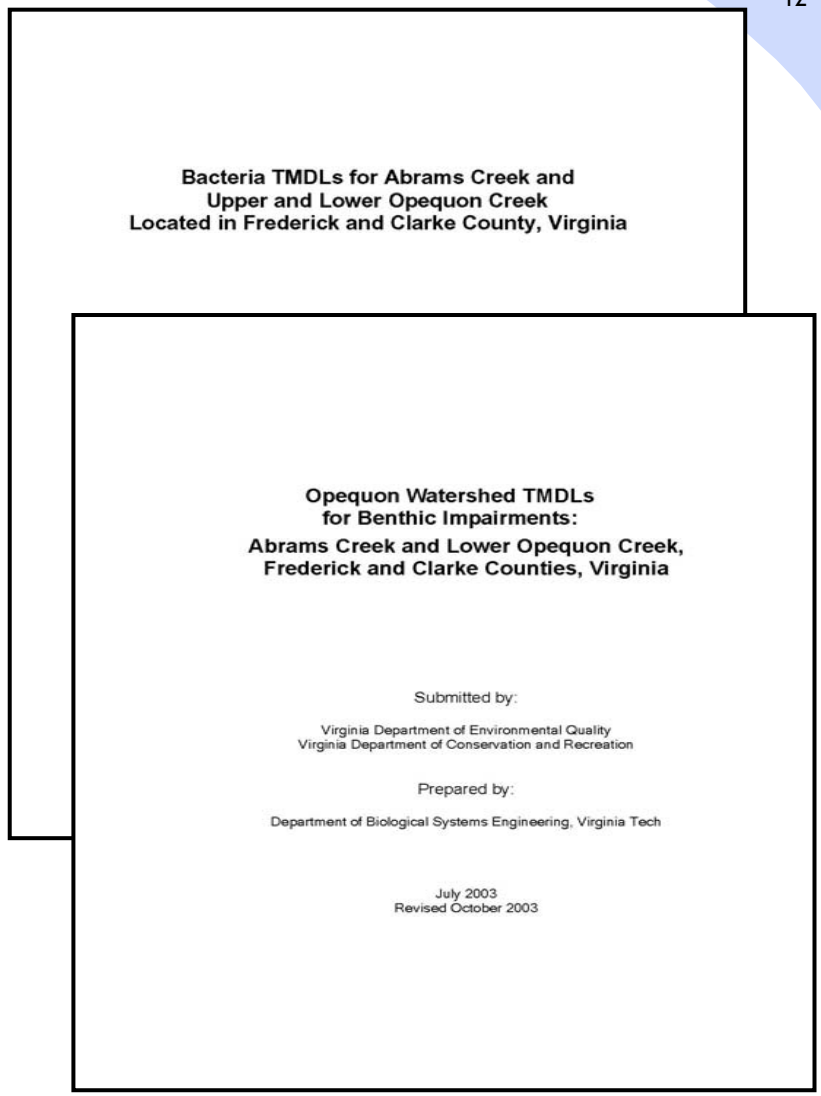
Biological Impairment

Sediment was determined to be the **most likely stressor** causing the biological impairment. Impaired streams do not support a diverse, balanced, and healthy assemblage of living things (evidenced primarily by benthic macroinvertebrate community). TMDL developed using Reference Watershed approach.



TMDL Studies

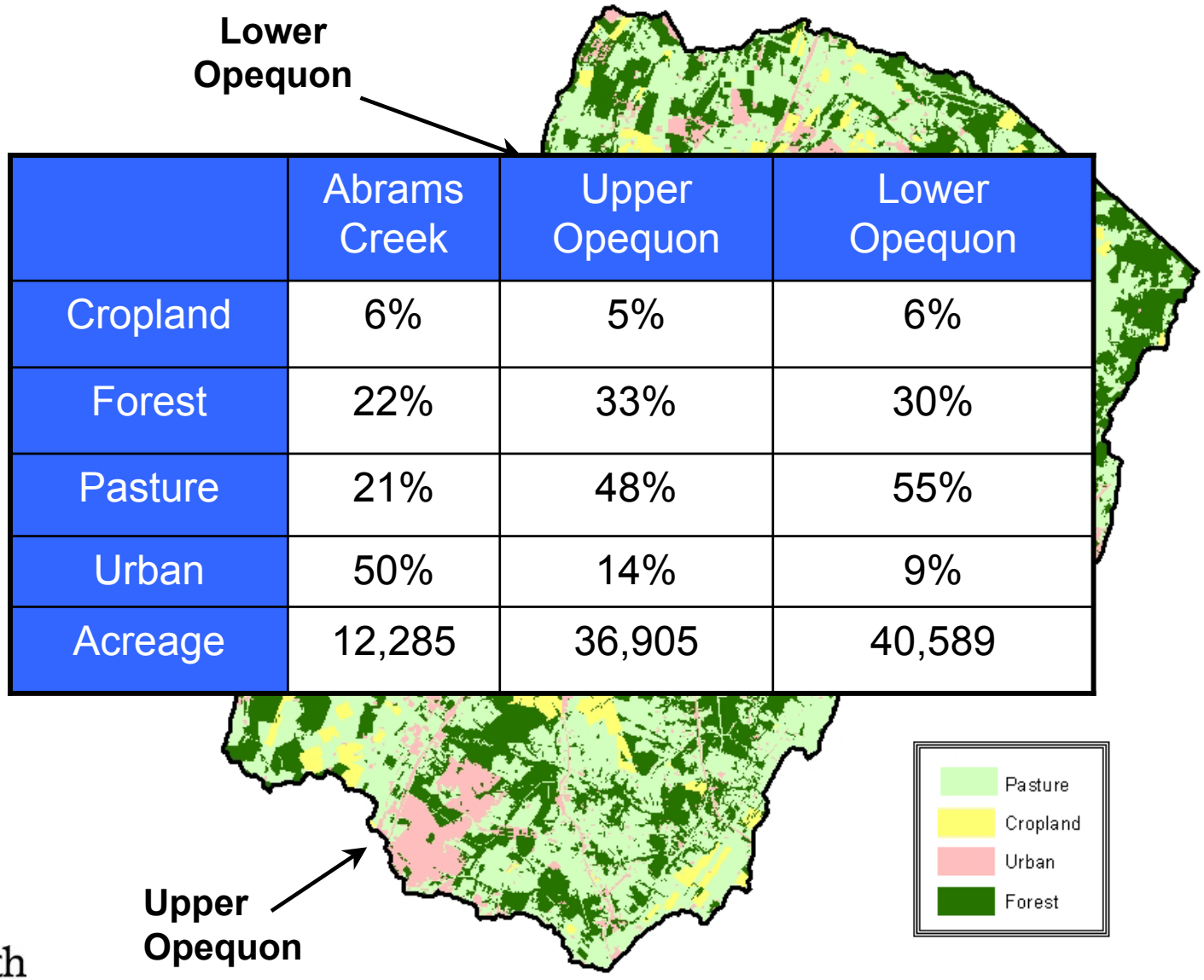
- Completed in 2004
- Provided information on:
  - Landuses in the area
  - Sources of bacteria and sediment in the watershed
  - Reductions in those sources necessary to meet water quality standards



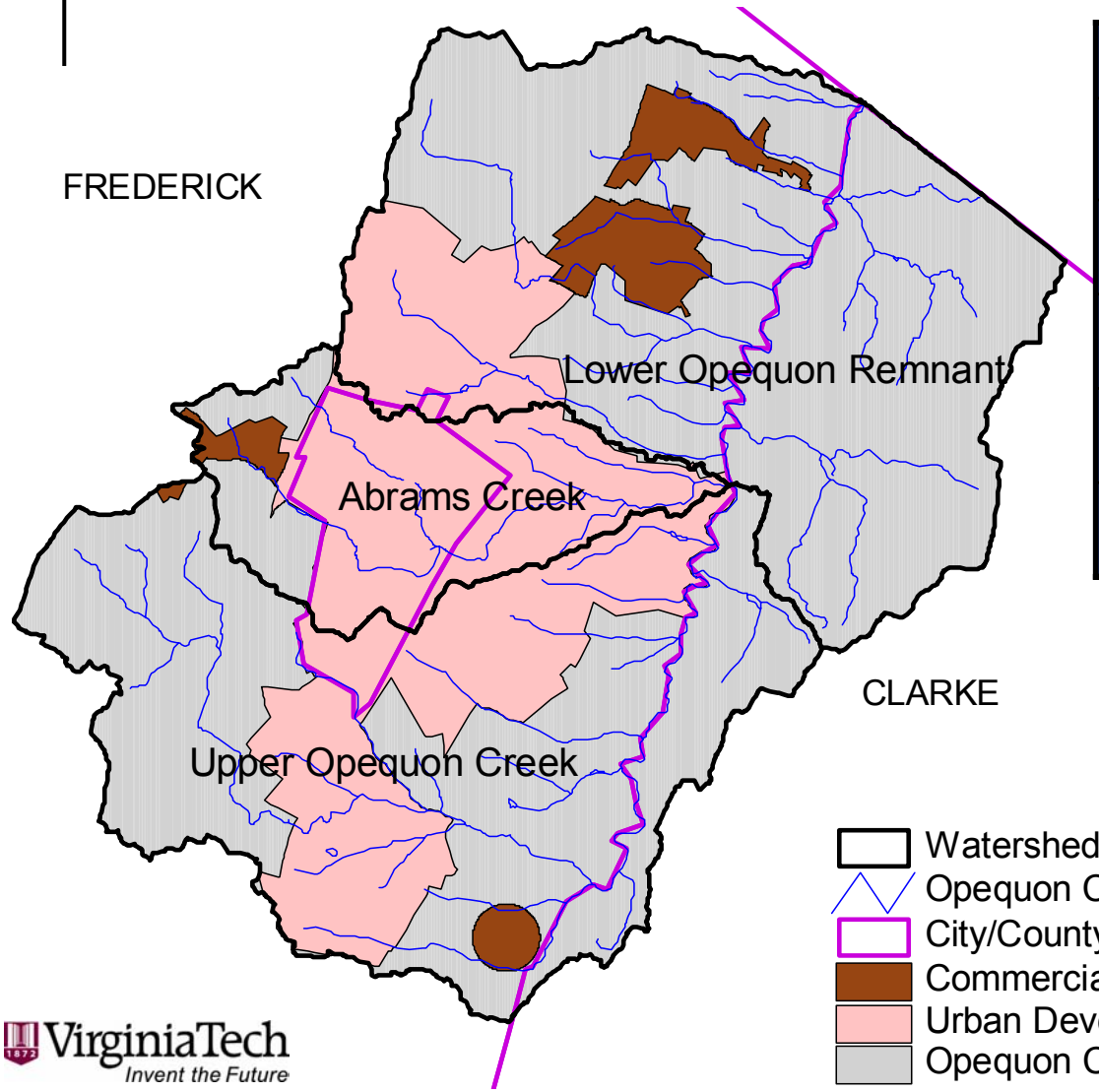
www.tmdl.bse.vt.edu

Major Land Uses

	Abrams Creek	Upper Opequon	Lower Opequon
Cropland	6%	5%	6%
Forest	22%	33%	30%
Pasture	21%	48%	55%
Urban	50%	14%	9%
Acreage	12,285	36,905	40,589



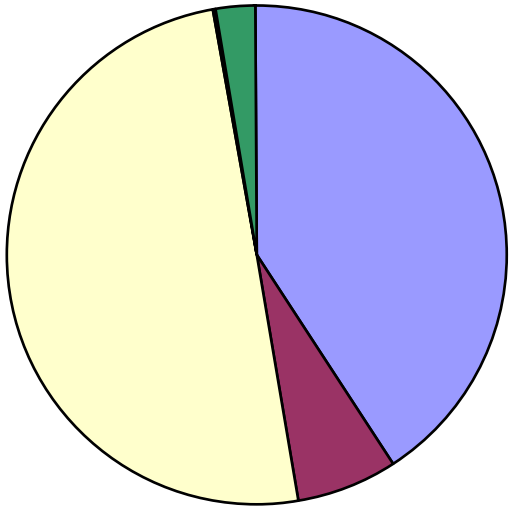
Estimating Future Land Use Changes



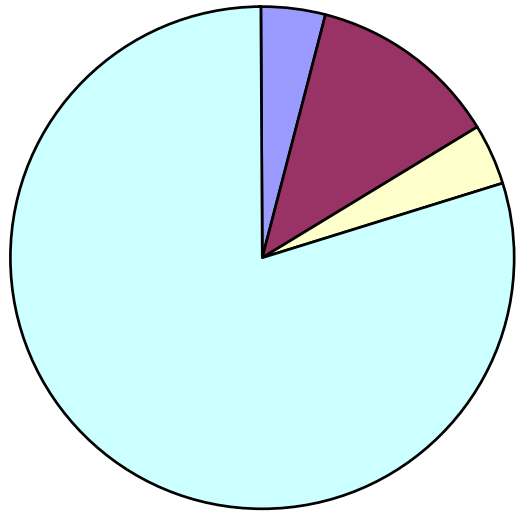
	Land Use Category		
% Build-Out	Agriculture (%)	Urban (%)	Forest (%)
Existing 0%	56.5	16.9	26.6
Future 25%	53.3	22.1	24.6
Future 50%	50.0	27.3	22.6
Future 100%	43.6	37.7	18.6

Sources of Bacteria

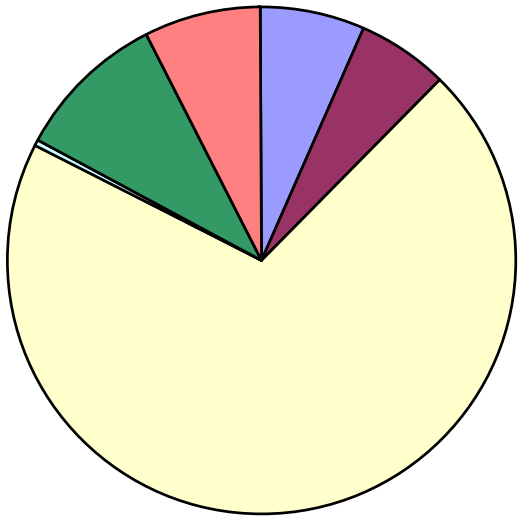
Upper Opequon



Abrams

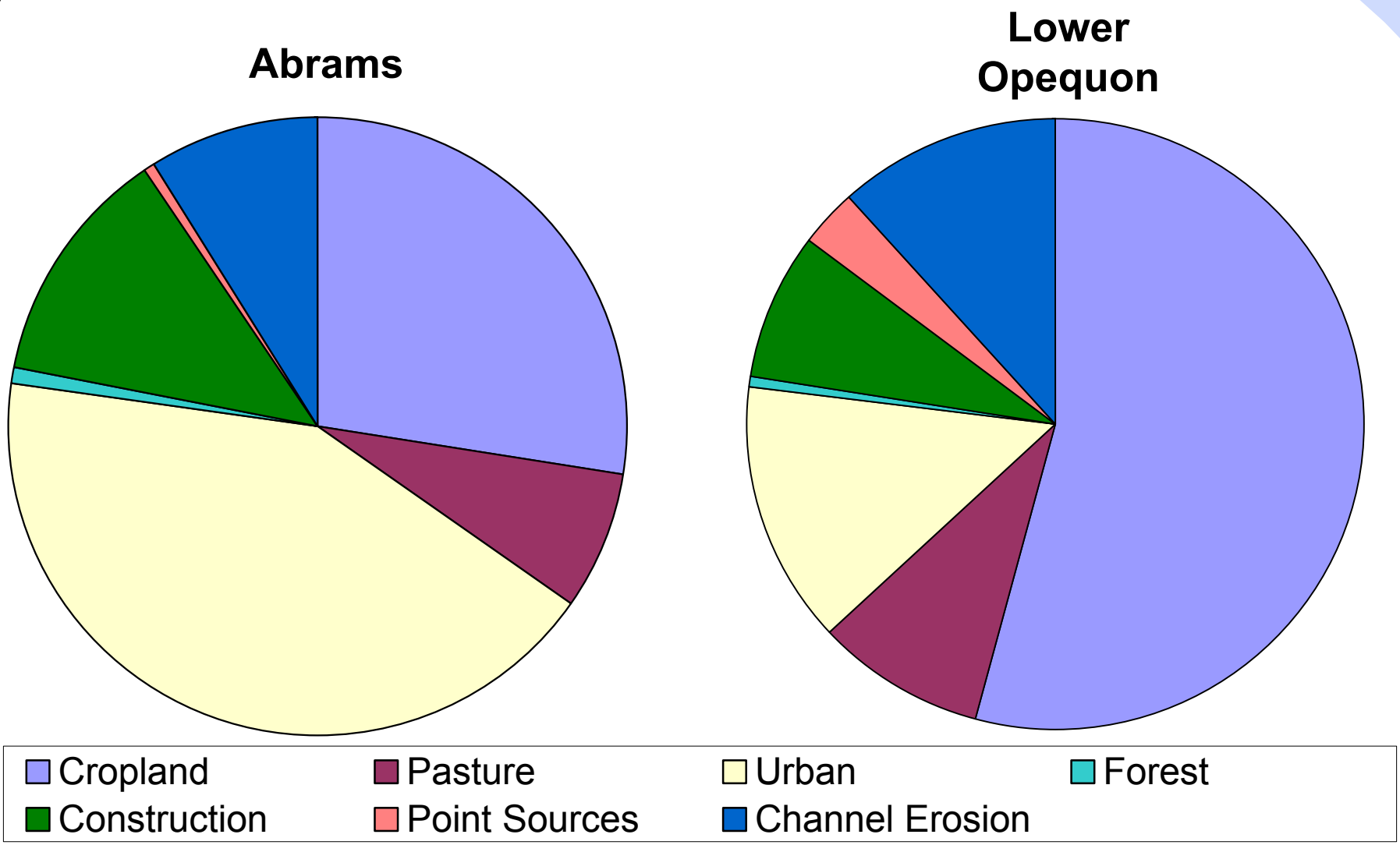


Lower Opequon



- Cattle in stream
- Wildlife in stream
- Runoff from cropland, pasture, residential
- Runoff from urban areas
- Point sources
- Upstream loadings

Sources of Sediment



Summary of TMDL studies

- Bacteria loads from urban and residential areas must be reduced
- Nearly all livestock must be excluded from streams
- Bacteria from pasture and cropland must be reduced
- All straight pipes in the area need to be eliminated
- Failing septic systems must be repaired/replaced
- Sediment loads from urban areas and channel erosion must be reduced

Required Bacteria Load Reductions (%)

Source	Abrams Creek	Upper Opequon	Lower Opequon
Cattle in-stream (Direct Deposit)	30	100	0
Wildlife in-stream (Direct Deposit)	0	100	0
Residential Pervious Land Uses	96	90	80
Impervious Land Uses	96	90	80

Required Sediment Reductions (%)

Source	Abrams Creek	Lower Opequon Creek
Agricultural Areas	10	15
Urban Areas	25	15
Channel Erosion	55	35
Municipal Storm Sewer System (MS4)	25	15
Point Sources	0	0
Total	22	17

TMDL Implementation Plan Outline

1. Executive Summary
2. Introduction
3. State and Federal Requirements for TMDL Implementation Plans
4. **Review of the TMDL Study**
5. **Public Participation**
6. **Implementation Actions**
7. **Measurable Goals and Milestones**
8. Stakeholders Roles and Responsibilities
9. Integration with Other Watershed Plans
10. Potential Funding Sources
11. References

Appendix A – Working Group Reports and Meeting Summaries

Appendix B – Additional Implementation Actions Suggested by Working Groups

Appendix C – Glossary

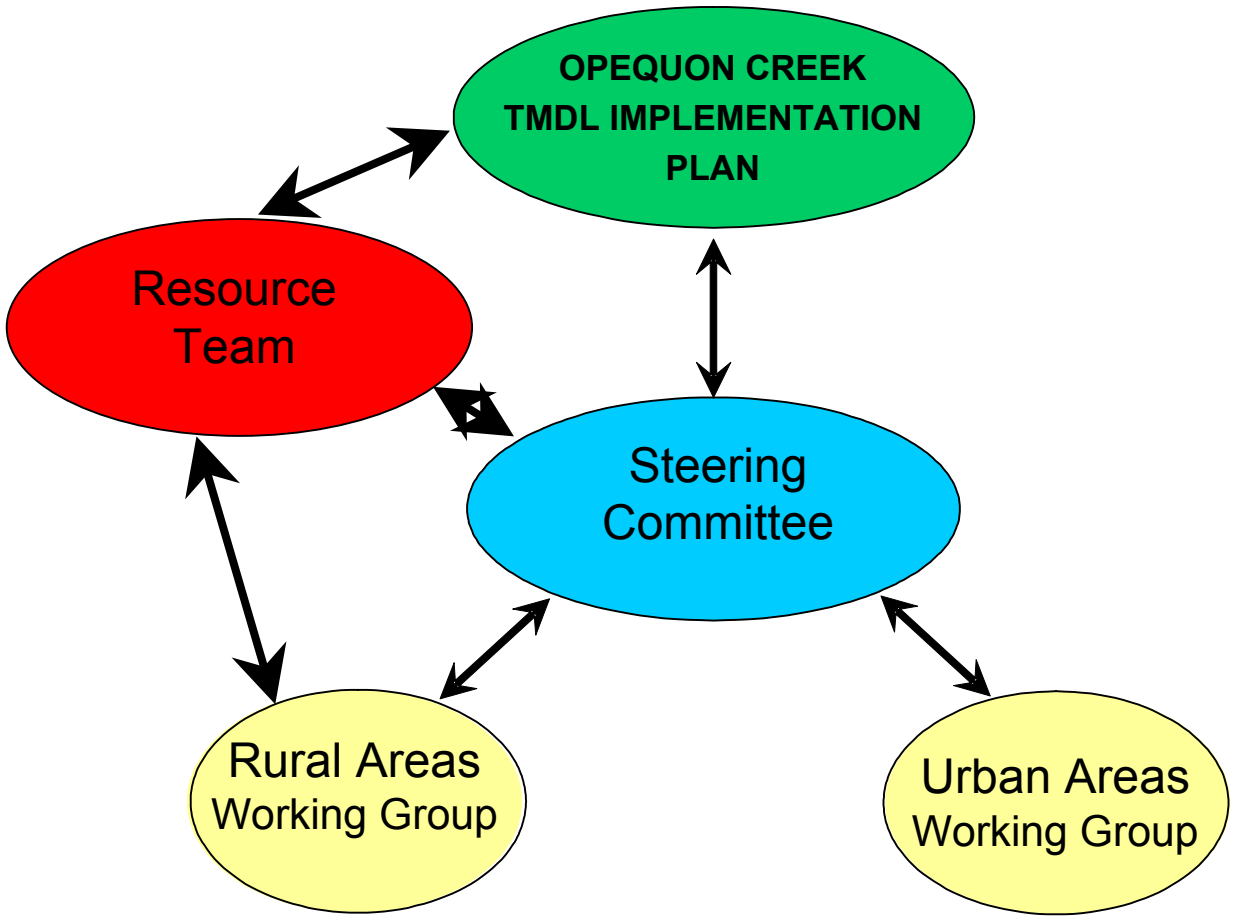
Public Participation

- Public Meetings
  - Informational
  - Solicit public participation
  - Provide a forum for public comment
- Steering Committee
  - Direct the overall process
  - Review output from Working Groups
  - Coordinate transition to implementation
- Working Groups
  - Address “community” issues/concerns

DEQ Virginia Department of Environmental Quality

DCR

Public participation



TMDL IP Development Timeline

March 22, 2005	Initial interest meeting for stakeholders
May 11, 2005	Steering Committee Meeting
June 13, 2005	First Public Meeting
July 7, 2005	Working Groups meeting
August 4, 2005	Working Groups meeting
September 15, 2005	Steering Committee Meeting
November 15, 2005	Steering Committee Meeting
January 24, 2006	Steering Committee Meeting
April 2006	Complete Draft of Implementation Plan
April 21, 2006	Steering Committee Meeting
May 10, 2006	Final Public Meeting
July 2006	Plan approval by EPA and State Water Control Board

Needs Assessment

- Identification of practices
  - Stakeholder input
  - Implementation matrix
- Quantification of practices
  - Spatial Analysis
    - GIS
    - BMP Database
    - Modeling – HSPF and GWLF
- Technical Assistance and Education/Outreach

Prioritize Corrective Actions – Implementation Matrix

Biological Systems Engineering
Center for TMDL and Watershed Studies

Opequon Implementation Planning Matrix (with 9/15/05 steering committee input)												
Problem	**Implementation Practice**	**High Priority (# of votes)**	**Lead Agency/ Organization**	**Target Parcels/ Locations/ Audiences**	**Integration with Other Programs**	**Extent**	**Units**	**Cost /Unit**	**Tech. Assist. (person-hours)**	**Potential Cost-Share Source/Tax Credit/Loan**	**Cost-Share Rate**	**Notes**
1. Livestock access to streams												
	Fencing with off-stream watering (SL-6 Grazing Land Protection)	15		Abrams		58600 (11.1 mi.)	linear ft	$1.78		CREP Ag BMP Cost-Share (SL-6 Grazing Land Protection) Tax Credit Loan	CREP: 50% of installation costs; $10/ac/yr sign-up incentive payment; one-time 40% installation costs; $70-100/ac/yr federal rental plus $5/ac/yr state rental; tax credit 25% ($17,500 max); cost share 75%	does not include chargers and gates
		15		Upper Opequon		461,400 (87.4 mi.)	linear ft					
		15		Lower Opequon		393400 (67.6 mi.)	linear ft					
	Permanent fencing (Stream protection DCR WP-2T)									Ag BMP Costshare Tax Credit CREP	Cost share $75 Tax Credit 25% ($17,500 max); one-time $0.50 per linear ft maintenance payment;	
	Off-stream water system (SL-6B Alternative Water System)	15					system	$6,000		Tax Credit Ag BMP Loan	25% ($17,500 max)	
	Stream crossing and hardened access (WP-2B)	15								Tax Credit Ag BMP Loan	25% ($17,500 max)	
	Information to farmers about cost-share	11										
	Increase cost-share for fencing/off-stream watering to 100%	10										
	Maintenance of stream exclusion fencing (WP-2D)									Tax Credit		
2. Lack of streamside buffer/forest												
	Establish riparian buffers	15					acre	$550		Ag BMP Cost-Share CREP		
	Permanent preservation of streamside buffers from	15					acre					
	Permanent easements on riparian buffers											
	Incorporate stream buffers into development	15										
	Increase awareness of CREP	8										
3. Agricultural runoff												
	Establish riparian buffers	15					acre	$550		Ag BMP Cost-Share CREP		
	Cover crops	9					acre			Ag BMP Cost-Share Tax Credit (SL-8B Small grain Cover Crop for Nutrient	SL-8B Cost-share $20 /ac; Tax credit 25% ($17,500 max)	
	Vegetative buffers	9		livestock auction			acre	$100				

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Corrective Actions Categorized

TMDL Implementation Plan for Opequon Creek
Submitted for Review
July 5, 2006

Problem	Implementation Action[1]	Type of Practice		
		Primary	Policy	Education
6. Enforcement of E&S Regulations at Construction Sites	Document City's street sweeping and inlet clean-out activities; document expansion, if needed	X		
	Offer E&S educational programs that target developers			X
	Add 1 or 2 additional E&S inspectors; 1 for large projects, 1 for single family homes	X		
	Pass more uniform E&S ordinances among jurisdictions		X	
	Pass ordinances to facilitate establishment of vegetation in a timely manner following construction		X	
	Pass ordinances to reduce land stripping, possibly through tree protection		X	
	Modify E&S ordinances to apply to large tracts zoned RA (Rural Area) so that the ordinances apply when development takes place prior to the rezoning process		X	
7. Stream bank erosion	Stream restoration - geomorphology and riparian areas (Abrams)	X		
8. Stream channel modifications	Re-establish riparian forest buffers	X		
9. Failing septic systems	Increase public awareness of costshare money to repair failing systems			X
	Integrate maintenance fees with property taxes; maybe through ordinance that requires regular maintenance of septic systems		X	
	Map straight pipes, sinkholes, wells, and septic systems	X		
	Target high-risk areas for money to repair failing systems - older houses, karst areas		X	
	Septic tank pumpout (state cost share practice, RB-1)	X		
	Connect malfunctioning system to public sewer (RB-2)	X		
	Repair failing system (RB-3)	X		
	Septic tank installation/replacement (RB-4)	X		
	Install alternative on-site waste treatment systems: sand filters, elevated sand mounds, constructed wetlands, peat filters, vault privies, incinerator toilets, composting toilets (RB-5)	X		
10. Improper pet waste disposal	Develop City/County ordinance to address this source		X	
	Develop and execute education program			X
11. Excessive resident waterfowl population	Encourage City and Shenandoah University to utilize USDA nuisance wildlife control program	X		
12. Exfiltration from municipal sewer collection system	Integrate with city/county sewer maintenance and rehabilitation programs	X		
13. Watershed Management	Inventory watershed to determine priority locations for practices identified above	X		
	Develop and implement comprehensive monitoring program	X		

[1]State cost-share practices numbers are given in parentheses, where appropriate.

Residential Practices

- Replace ALL straight pipes
- Repair/replace failing septic systems

How?

- Connection of Septic System to Sewer Line (RB-2)
- Septic System Repair (RB-3)
- Septic System Installation/ Replacement (RB-4)
- Alternative Waste Treatment Systems (RB-5)

Bioretention

Underdrain Stone Layer

Sand Layer

Engineered Soil

Plants & Mulch

Agricultural Practices

- Grazing Land Protection Systems (SL-6)
  - Rotational grazing
  - Off-stream water source
  - Stream exclusion fencing
- Stream Protection Fence (WP-2T)
- Pasture Land Management

Photos: Virginia Department of Conservation and Recreation

Quantification of Agricultural Practices

Watershed	No. of SL-6 systems	WP-2T fencing (linear ft)	WP-2D fencing maintenance (linear ft)	Pasture management (acres)	Rural riparian buffer zones (linear ft)	Cover crop (acres)	Loafing lot management (no.)
Abrams	0	0	0	0	0	0	0
Upper Opequon	22	32,208	32,208	7,726		1,866	1
Lower Opequon	0	0	0	10,323	105,790	0	1
Total	22	32,208	32,208	18,049		1,866	2

Quantification of Residential/ Urban Practices

Watershed	Septic systems repaired/ replaced	Acres treated by infiltration basins (rain gardens)	Pet waste education program	Goose waste clean-up	Riparian buffer zones (linear ft)	Improved erosion and sediment control efficiency
Abrams	44	1,652 (2,066)	1	1	35,980	1
Upper Opequon	350	637 (797)	1	1	27,300	1
Lower Opequon	372	0	1	1	105,790	1
Total	766	2,289 (2,863)	1	1	169,070	1

Cost Estimates- Agricultural

Practice	Estimated units needed	Average cost ($)/unit	Total cost ($)
SL-6 grazing land protection (linear ft)	55,282	17	939,794
WP-2T fencing (linear ft)	32,208	3.50	112,728
WP-2T fencing maintenance (linear ft)	32,208	0.50	16,104
Pasture management (acres)	18,049	85	1,534,165
Rural riparian buffer zones (acres)	85	750	63,750
Cover crop (acres)	1,866	27	50,382
Loafing lot management (no.)	2	50,000	100,000
Staff years	5	50,000	250,000
Total			3,066,923

Cost Estimates- Urban/Residential

Practice	Estimated units needed	Average cost ($)/unit	Total cost ($)
Septic systems repaired/ replaced	766	6,707	5,137,600
Acres treated by infiltration basins (rain gardens)	2,289 (2,863)	14,520 (19,239)	33,236,280 (55,081,257)
Pet waste education program	Annual materials (11years)	3,820	42,020
Goose waste clean-up sweeper	1	15,000	15,000
Urban buffer zones (acres)	51	750	38,250
Improved erosion and sediment control efficiency	Staff member	Included next line	Included next line
Staff years	44 (4 for 11 years)	50,000	2,200,000
Total			40,669,150 (62,514,127)

Assessing Benefits of Implementation

- Contingent valuation survey asked stakeholders about
  - use of and knowledge about creeks,
  - local environmental quality,
  - benefits that would accrue from cleaning up creeks,
  - willingness to implement various BMPs with or without cost share program support (riparian landowners), and
  - trust in various institutions acting in the sphere of water quality protection.

Assessing Benefits of Implementation cont.

- Contingent valuation survey
  - allowed for stakeholder participation beyond working groups and steering committee,
  - permitted estimation of stakeholders willingness -to-pay for water quality improvement, and
  - provided an outlet for additional WQ issues not necessarily related to TMDLs,
  - The results from the contingent valuation survey are useful to stakeholders as well as policy makers

Implementation Milestones – Residential/Urban

Action	Unit	Watershed	Years				Total
			1-5 (Phase 1)	6-7	8-9	10-11	
			Units implemented or impacted(#)				
Repair/replace failing septic systems	system	Abrams	0	10	10	24	44
		Upper Opequon	175	50	50	75	350
		Lower Opequon	74	50	124	124	372
Infiltration basin/trench (Rain garden/bioretention)	acres treated	Abrams	149 (186)	501 (627)	501 (627)	501 (627)	1,652 (2,066)
		Upper Opequon	0 (0)	212 (266)	212 (266)	213 (265)	637 (797)
Pet waste education program	program	All	1	1	1	1	1
Geese and duck waste clean-up	sweeper/ vacuum	All	1	1	1	1	1
Enhanced E&S efficiency	E&S inspector	Abrams	1	1	1	1	1

Implementation Milestones - Agricultural

Action	Unit	Watershed	Years				Total
			1-5 (Stage 1)	6-7	8-9	10-11	
			Units implemented or impacted (#)				
Loafing lot management	system	Upper Opequon	1	0	0	0	1
		Lower Opequon	1	0	0	0	1
Pasture management	acres	Upper Opequon	7809	0	0	0	7809
		Lower Opequon	10,323	0	0	0	10,323
SL-6 Grazing Land Protection	linear ft	Upper Opequon	13,820	13,820	13,820	13,820	55,280
WP-2T (fencing)	linear ft	Upper Opequon	8,253	7,895	7,895	7,895	32,208
WP-2D (maintenance)	linear ft	Upper Opequon	8,253	7,895	7,895	7,895	32,208

Water Quality Milestones

Milestone 1: Less than 10.5% violations of the instantaneous *E. coli* bacteria criterion (235/100 mL) at each watershed outlet and meet sediment TMDL- achieved in 5 years

Milestone 2: 0% violations of the instantaneous *E. coli* bacteria criterion (235/100 mL) at each watershed outlet – achieved in 11 years

	Water Quality Milestones							
	% Violations of Bacteria Standard						Sediment Reduction (%)	
	Abrams		Upper Opequon		Lower Opequon		Abrams	Lower Opequon
Time	Geo	Inst	Geo	Inst	Geo	Inst		
Existing	na	22	na	14	na	12	0	0
5 years	1	9	3	10	3	9	>22%	>17%
11 years	0	0	0	2	0	3	>22%	>17%

Progress to date

- Established Opequon Creek TMDL Implementation Action Team
- State NPS oversight agency has allocated section 319 funds to watershed for agricultural BMP implementation
- Virginia Tech, West Virginia University and local partners obtained EPA targeted watershed grant that builds on implementation planning efforts


Thanks