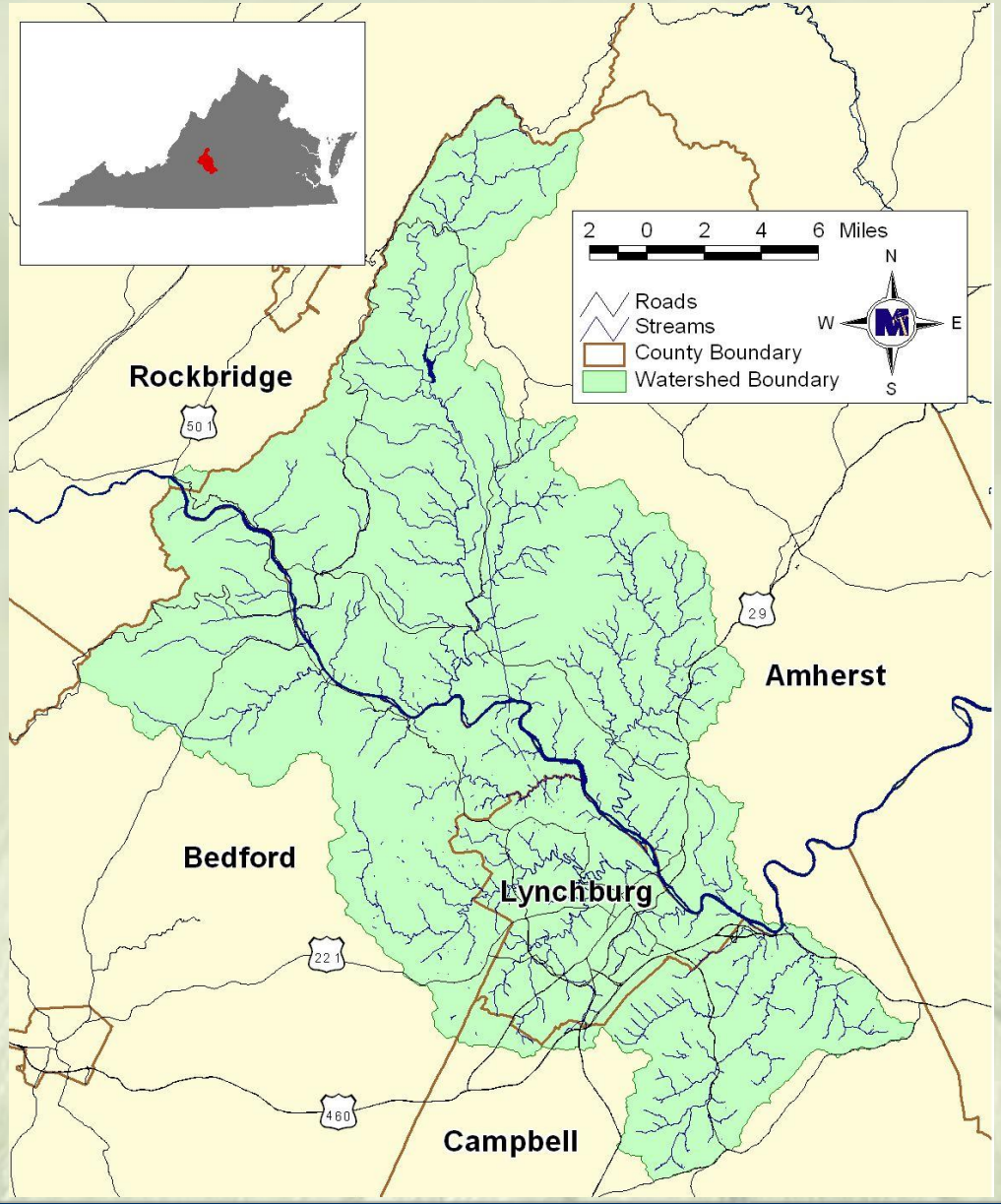
James River and Tributaries Lynchburg, VA Bacterial TMDL Revision

March 4, 2014

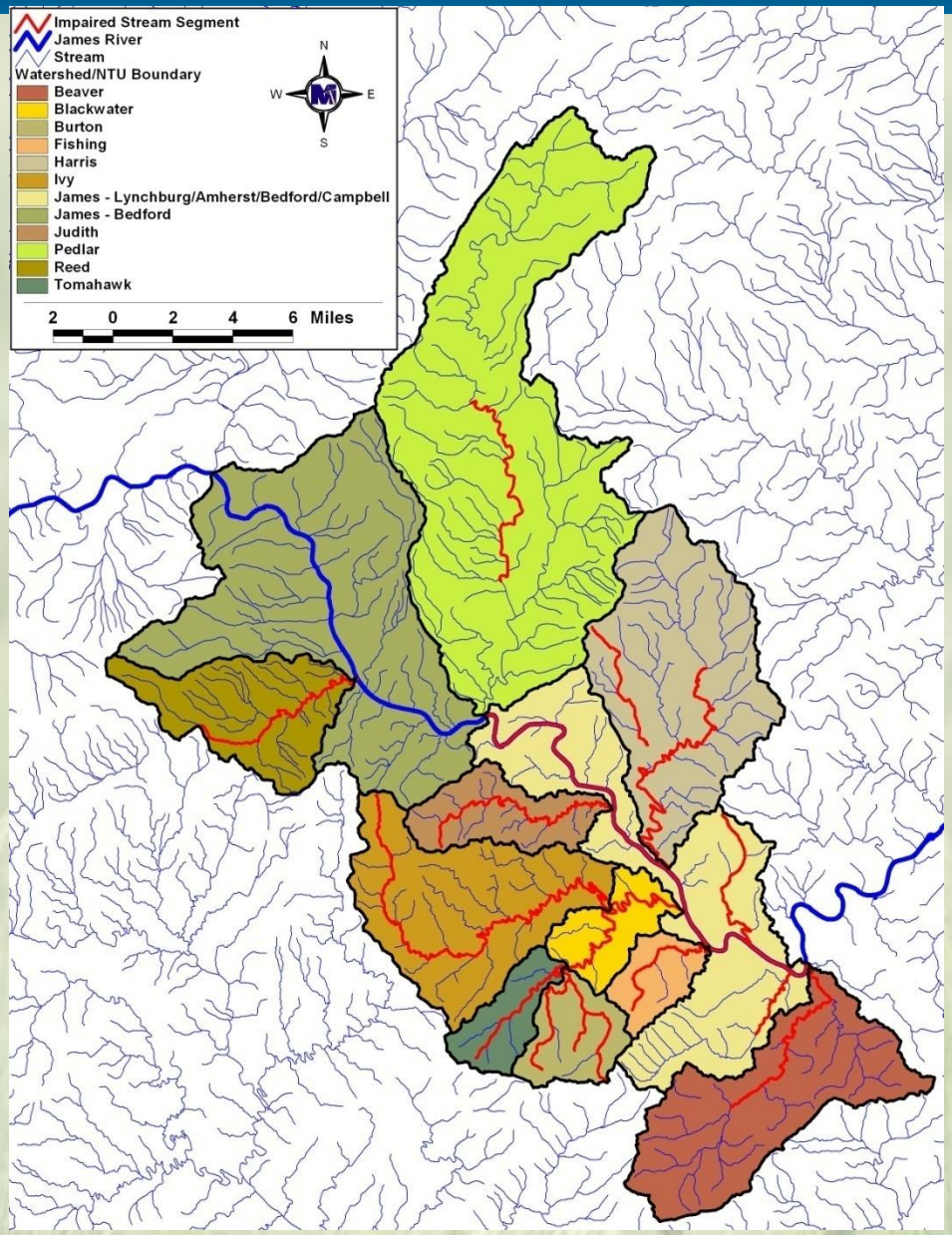
Bacteria Impairment

- Fecal Bacteria in James River and tributaries
  - What are Fecal Bacteria?
    - Bacteria associated with feces from warm blooded animals (fecal coliform, *E. coli*)
  - Why should we care?
    - Pathogens (including some strains of *E. coli)*
    - Parasites
  - Water Quality Standard
    - Swimming & Fishing Use
    - Instantaneous: 235 cfu/100 ml *E. coli*
    - Monthly Geometric Mean: 126 cfu/100 ml *E. coli*

Project Area



Impaired Watersheds



E.coli Impairments

Impairment ID	Initial Listing Year	2010 River Miles	2012 Listing Violation%	Impairment Location Description
James River VAC-H03R_JMS01A00	1996	3.84	25	James River mainstem from the Business Route 29 bridge downstream to the mouth of Williams Run.
James River VAC-H03R_JMS04A02	1996	4.11	25	James River mainstem from Reusens dam downstream to Business Route 29.
James River VAC-H05R_JMS04A00	1996	2.58	25	James River mainstem from the upper watershed boundary at the confluence of Williams Run downstream to the mouth of Archer Creek.
Ivy Creek VAC-H03R_IVA01A00	1998	20.8	21, 17, 17 & 19*	Ivy Creek mainstem from its headwaters downstream to its confluence with Blackwater Creek.
Fishing Creek VAC-H03R_FSG01A00	1996	5.44	42	Fishing Creek mainstem from its confluence with the James River upstream to its headwaters.

* Multiple monitoring stations

E.coli Impairments

Stream Name Impairment ID	Initial Listing Year	2010 River Miles	2012 Listing Violation%	Impairment Location Description
Blackwater Creek VAC-H03R_BKW01A00	1996	10.3	33 & 20*	Blackwater Creek mainstem from the confluence of Tomahawk and Burton Creeks downstream to the Blackwater Creek confluence on the James River.
Tomahawk Creek VAC-H03R_THK01A06	2006	5.89	33 & 20*	Tomahawk Creek from its headwaters to its confluence with Burton Creek.
Burton Creek VAC-H03R_BUN01A06	2006	3.45	42	Burton Creek from its headwaters to the confluence with Tomahawk Creek.
Burton Creek X-Trib VAC-H03R_XXA01A08	2008	3.43	33	Burton Creek Unnamed Tributary from its headwaters to its mouth on Burton Creek.
Judith Creek VAC-H03R_JTH01A06	2006	10.54	11 & 22*	Judith Creek from its headwaters to the confluence with the James River.
Beaver Creek VAC-H05R_BCR01A00	2004	8.5	13	Beaver Creek mainstem from its mouth on the James River upstream to an unnamed tributaries mouth at the Rt. 501 Bridge.

* Multiple monitoring stations

E.coli Impairments

Stream Name Impairment ID	Initial Listing Year	2010 River Miles	2012 Listing Violation%	Impairment Location Description
Dreaming Creek VAC-H03R_DMG01A08	2008	4.69	25	Dreaming Creek from its headwaters to its mouth on
Opossum Creek VAC-H05R_OPP01A00	2010	3.04	13	Opossum Creek mainstem from its mouth on the James River upstream to the Rt. 660 crossing.
Pedlar River VAC-H02R_POL02A00	2006	2.46	13	Pedlar River mainstem from the Little Cedar Creek mouth upstream to the mouth of an unnamed tributary located just downstream of the Rt. 610 crossing and upstream of the Little Dancing Creek mouth.
Pedlar River VAC-H02R_POL03A02	2006	7	13	Pedlar River mainstem from an unnamed tributary's confluence with the Pedlar River, just downstream of the Rt. 610 crossing upstream to the mouth of Enchanted Creek.
Williams Run VAC-H03R_WLM01A02	2006	6.37	13	Williams Run from its confluence with the James River upstream to it headwaters.
Graham Creek VAC-H04R_GRA02A02	2002	5.17	67	Graham Creek mainstem from the Graham Creek Reservoir backwaters upstream to its headwaters.

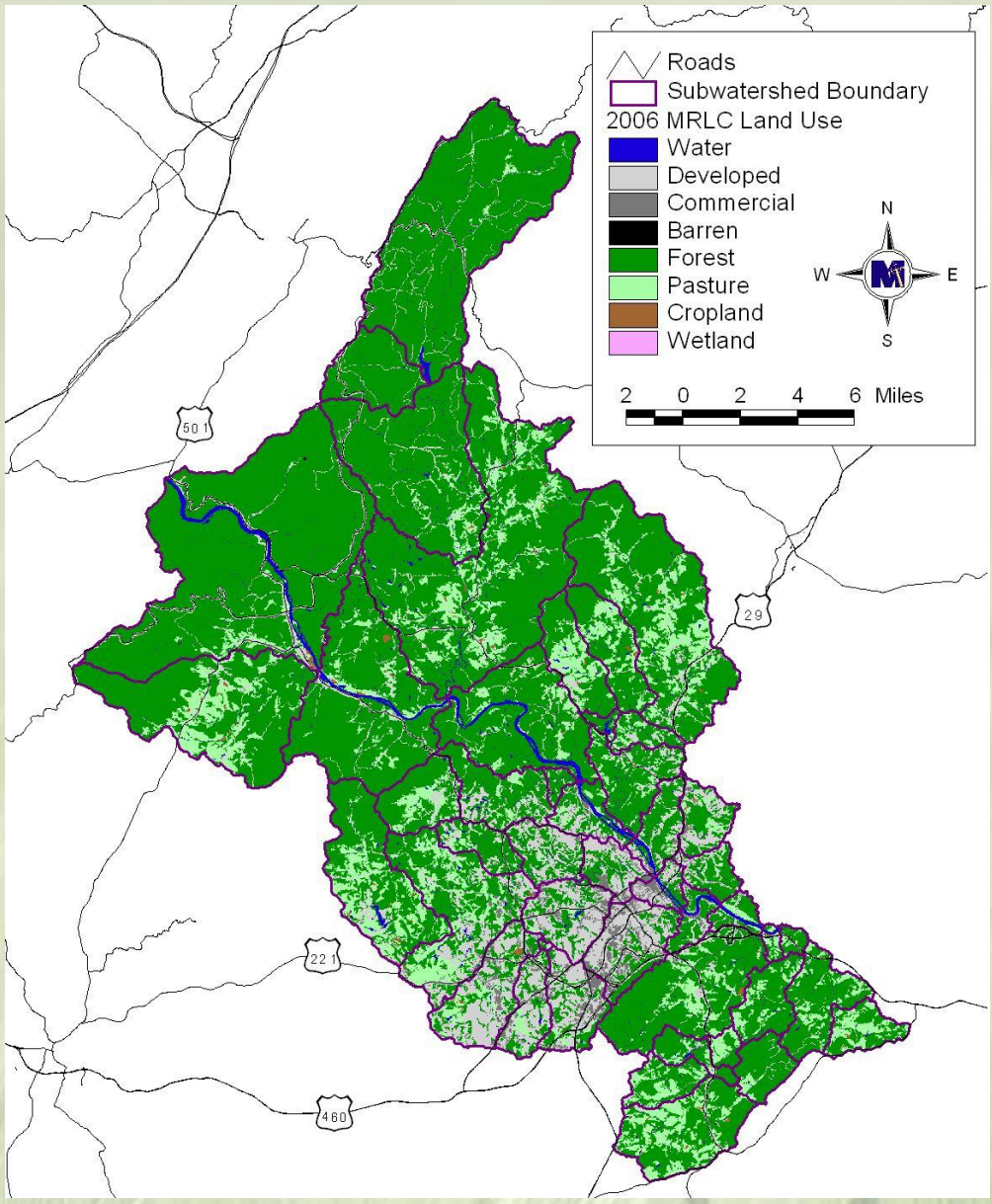
* Multiple monitoring stations

E.coli Impairments

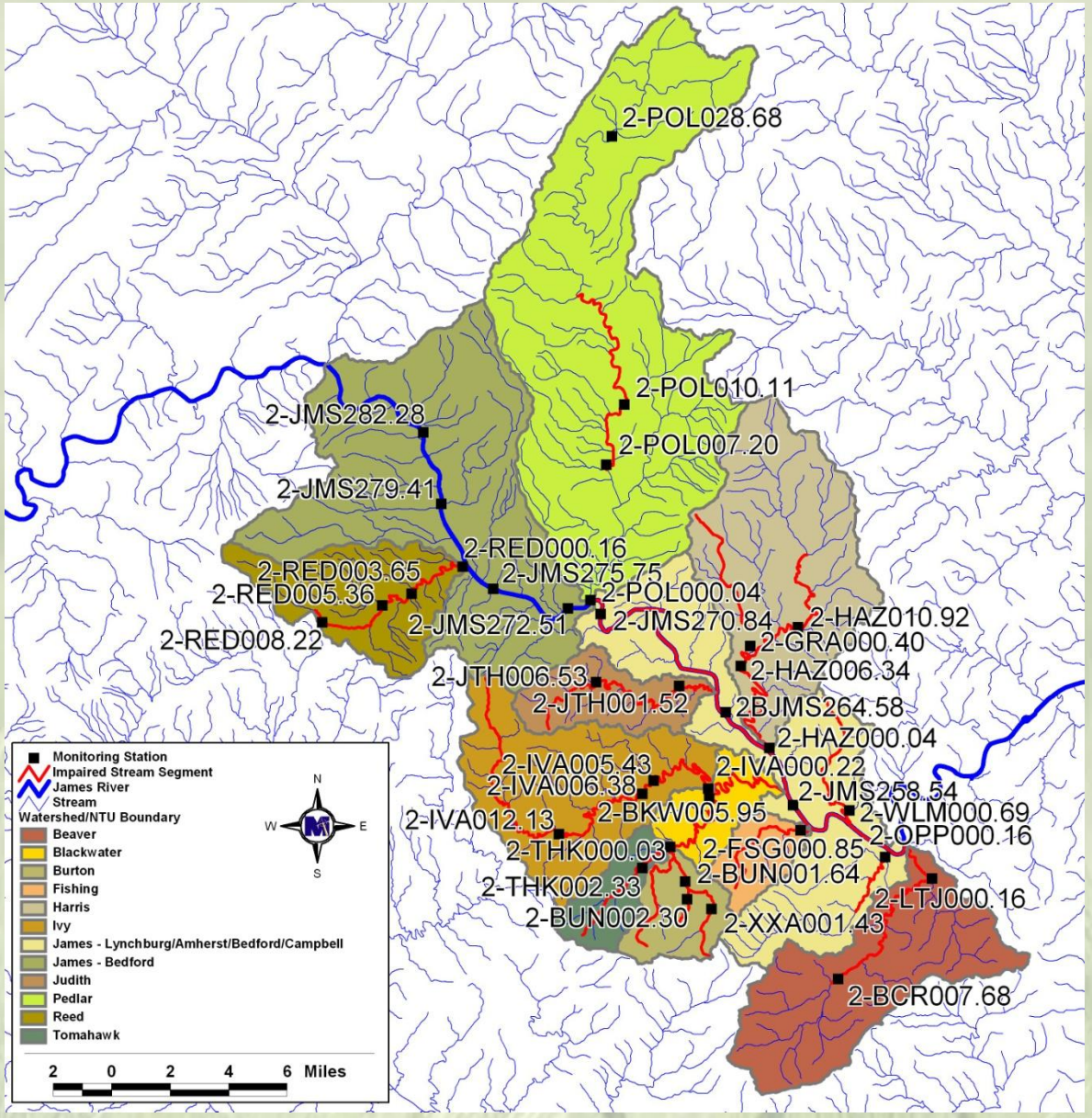
Stream Name Impairment ID	Initial Listing Year	2010 River Miles	2012 Listing Violation%	Impairment Location Description
Harris Creek VAC-H04R_HAZ02A08	2002	7.72	22	Harris Creek from its confluence with Falling Rock Creek to just upstream of the Amherst County USA secondary water intake.
Reed Creek VAW-H01R_RED01A00	2004	8.37	33, 100 & 17*	Reed Creek mainstem from its mouth on the James River upstream to the intersection of State Routes 638 and 764.

* Multiple monitoring stations

Land Use


Roads
Subwatershed Boundary
2006 MRLC Land Use
Water
Developed
Commercial
Barren
Forest
Pasture
Cropland
Wetland
N
W
E
S
2 0 2 4 6 Miles
501
29
221
460

DEQ Bacteria Monitoring Stations



Source Assessment

- Permitted Discharges
  - Wastewater Treatment Facilities
  - Other Permitted Discharges
- Human
  - ~~Biosolids~~
  - Failed Septic Systems
  - Straight Pipes
- Pets
- Livestock
- Wildlife

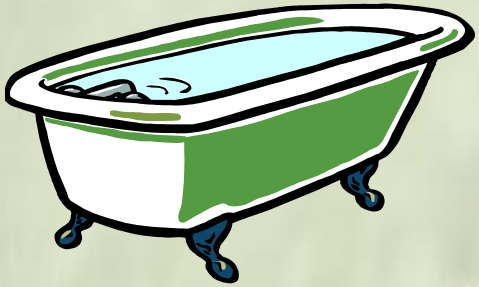
How many beaver equal a cow?

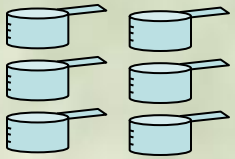
Fecal Bacteria Production Ratios

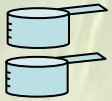
Source	Ratio to one Beef Cow	Source	Ratio to one Beef Cow
Beef Cattle	1	Goose	41
Goat	1.22	Horse	79
Sheep	1.22	Deer	95
Dairy Cattle*	1.31	Layers	243
Dairy Heifer	3	Raccoon	292
Dog	8	Wild Turkey	355
Mallard	14	Turkey	355
Wood Duck	14	Broilers	485
Human	22	Muskrat	1,320
		Beaver	165,000

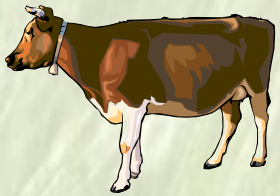
* Milked or Dry Cow

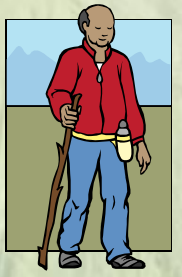
How much waste fouls a bathtub?











= 1 cup

= 1 Tbsp

= 1 tsp

Human Source Assessment

Population, housing units, and on-site treatment systems, based on U.S. Census

- Failing or Improperly Functioning Septic Systems
  - Effluent reaching ground surface throughout the year
  - Lateral movement continuously to stream
- Straight Pipes
  - Direct continuous input into stream

Human Source Assessment (2013)

Population	Housing Units	Housing Units with Sanitary Sewer	Housing Units with Septic Systems	Housing Units with Other
123,030	53,056	29,076	23,587	389

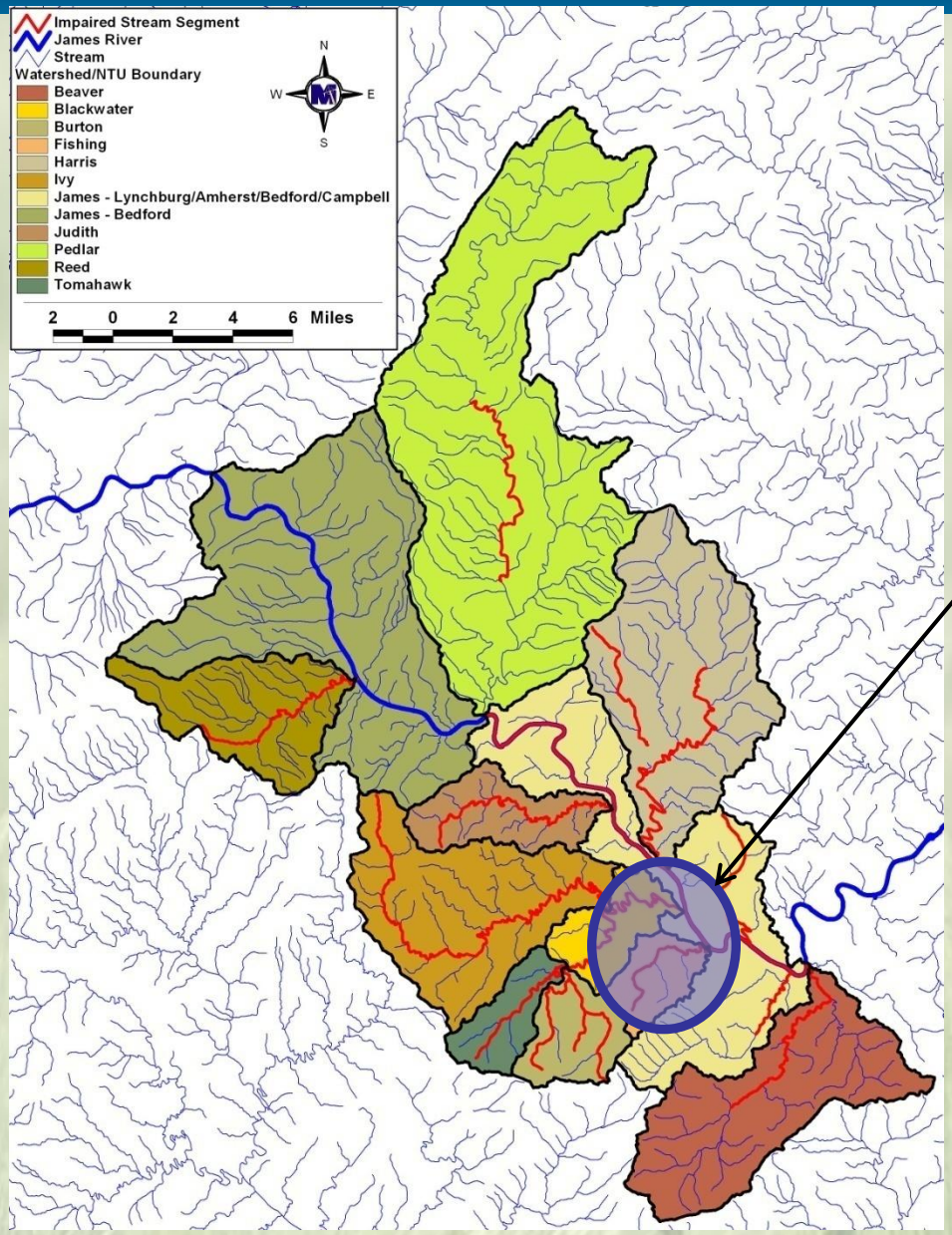
Permits in the Study Area (2013)

- 7 VPDES Permitted Discharges, permitted for control of fecal bacteria (includes permitted CSO discharges)
- 4 General Domestic Permits for single family homes
- 1 Animal Feeding Operation (AFO) permit (dairy operation)
- 4 MS4 permits (City of Lynchburg, VDOT, Central Virginia Community College, Central Virginia Training Center)

VPDES Permitted Discharges

Permit	Receiving Stream(s)	Facility Name	Design Flow, MGD
VA0063657	Judith Creek	Amherst Co. Service Authority	0.0015
VA0091162	James River	Boonsboro Country Club	0.015
VA0024970	James River	Lynchburg City Sewage Treatment Plant	22
VA0061042	Opossum Creek	Bennies Mobile Home Park Sewage Treatment Plant	0.035
VA0082546	Harris Creek, UT	Amherst Co. Service Authority Westbriar Subdivision	0.015
VA0062031	Tussocky Creek, UT	Evergreen Mobile Home Park	0.024
VA0027618	Harris Creek	US Department of Labor-Rescare, Inc.	0.04

Impaired Watersheds



Area impacted by CSO outfalls

Pet Source Assessment

- Population/household based on literature values, veterinarians, and animal control
- Translated to housing units based on U.S. Census
- Land-applied

Pet Source Assessment (2013)

Dog	Cat
26,326	29,485

Livestock Source Assessment

- Population
  - Virginia Agricultural Statistics
  - CAFO Permits
- Distribution of waste
  - Pastured
  - Confined, waste collected, spread
  - Direct deposition to the stream
- Seasonally varying applications

Livestock Source Assessment (2013)

Beef Cattle	Beef Calves	Dairy Cattle	Dairy Heifers	Dairy Calves	Sheep	Horse*
8,579	2,833	622	311	311	280	456

*Horse values include 36 donkeys and 11 llamas in the watershed

Wildlife Source Assessment

- Population
  - Animal densities from VDGIF biologists
  - Habitat from literature values
- Distribution of waste based on habitat
  - Land-applied
  - Direct deposition to the stream
- Seasonal variations based on migration patterns and food sources

Wildlife Source Assessment (2013)

Deer	Turkey	Beaver	Raccoon	Muskrat	Duck	Goose
9,051	2,129	2,750	18,840	13,413	279	140

How do we Determine the TMDLs?

+

Watershed data

TMDL

Total Maximum Daily Load (TMDL) Equation

TMDL = Sum of WLA + Sum of LA + MOS

Where:

TMDL	**=**	**Total Maximum Daily Load**
WLA	**=**	**Waste Load Allocation (point sources)**
LA	**=**	**Load Allocation (nonpoint sources)**
MOS	**=**	**Margin of Safety**

A TMDL is the maximum amount of a pollutant a water body can receive and still meet water quality standards.

Next Steps

- Model Completion
  - Verify Source Assessment with Stakeholders (TAC, Public Meetings)
  - Water Quality Calibration
  - Allocation
- TAC Meeting
- Public Meeting
- Public Review
- Submit to EPA
- State Approval

Contact Information

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  - James Kern
  - jkern@maptech-inc.com
  - (540) 961-7864

Extra Slides

Water Quality Data Analysis
- *E.coli* -

Stream	Station	Date	Count	Minimum	Maximum	Mean	Median	Standard Deviation	Violation %
Beaver Creek	2-BCR000.20	01/2007 - 12/2008	23	25	1,200	130	25	253	13.00%
Beaver Creek	2-BCR007.68	Apr-12	1	80	80	80	NA	NA	0.00%
James River	2BJMS264.58	Sep-10	1	10	10	10	NA	NA	0.00%
Blackwater Creek	2-BKW005.95	08/2003 - 12/2010	24	25	1,700	238	88	436	20.80%
Burtons Creek	2-BUN001.64	08/2003 - 12/2010	24	25	2000	235	75	430	20.80%
Burtons Creek	2-BUN002.30	01/2006 - 05/2006	5	25	50	35	25	14	0.00%
Harris Creek	2-HAZ000.04	02/2007 - 12/2008	11	25	300	57	25	82	9.10%
Harris Creek	2-HAZ010.92	07/2005 - 11/2012	21	25	2000	288	100	533	23.80%
Ivy Creek	2-IVA000.22	02/2007 - 12/2008	11	25	1300	184	50	382	18.20%
Ivy Creek	2-IVA005.43	02/2007 - 12/2008	11	25	450	118	25	149	18.20%
Ivy Creek	2-IVA006.38	01/2006 - 12/2006	12	25	300	125	88	96	16.70%

Water Quality Data Analysis
- *E.coli* -

Stream	Station	Date	Count	Minimum	Maximum	Mean	Median	Standard Deviation	Violation %
Ivy Creek	2-IVA012.13	08/2005 - 11/2012	33	25	480	156	120	129	27.3%
James River	2-JMS258.54	08/2003 - 05/2013	59	10	2000	290	75	436	30.5%
James River	2-JMS270.84	08/2003 - 05/2013	59	10	1225	113	25	251	11.9%
James River	2-JMS272.51	05/2006	1	10	10	10	NA	NA	0.0%
James River	2-JMS275.75	07/2003 - 05/2013	60	10	1750	118	25	301	10.0%
James River	2-JMS279.41	07/2004 - 06/2013	108	25	2000	54	25	197	2.8%
James River	2-JMS282.28	07/2003 - 11/2012	57	20	1225	105	25	202	12.3%
Judith Creek	2-JTH001.52	08/2003 - 12/2010	36	25	980	150	75	219	16.7%
Judith Creek	2-JTH006.53	08/2005 - 11/2012	21	25	850	284	200	262	47.6%
Little Beaver Creek	2-LTJ000.16	01/2007 - 12/2007	12	25	1500	230	75	416	25.0%
Opossum Creek	2-OPP000.16	01/2007 - 12/2008	23	25	1000	108	25	214	13.0%

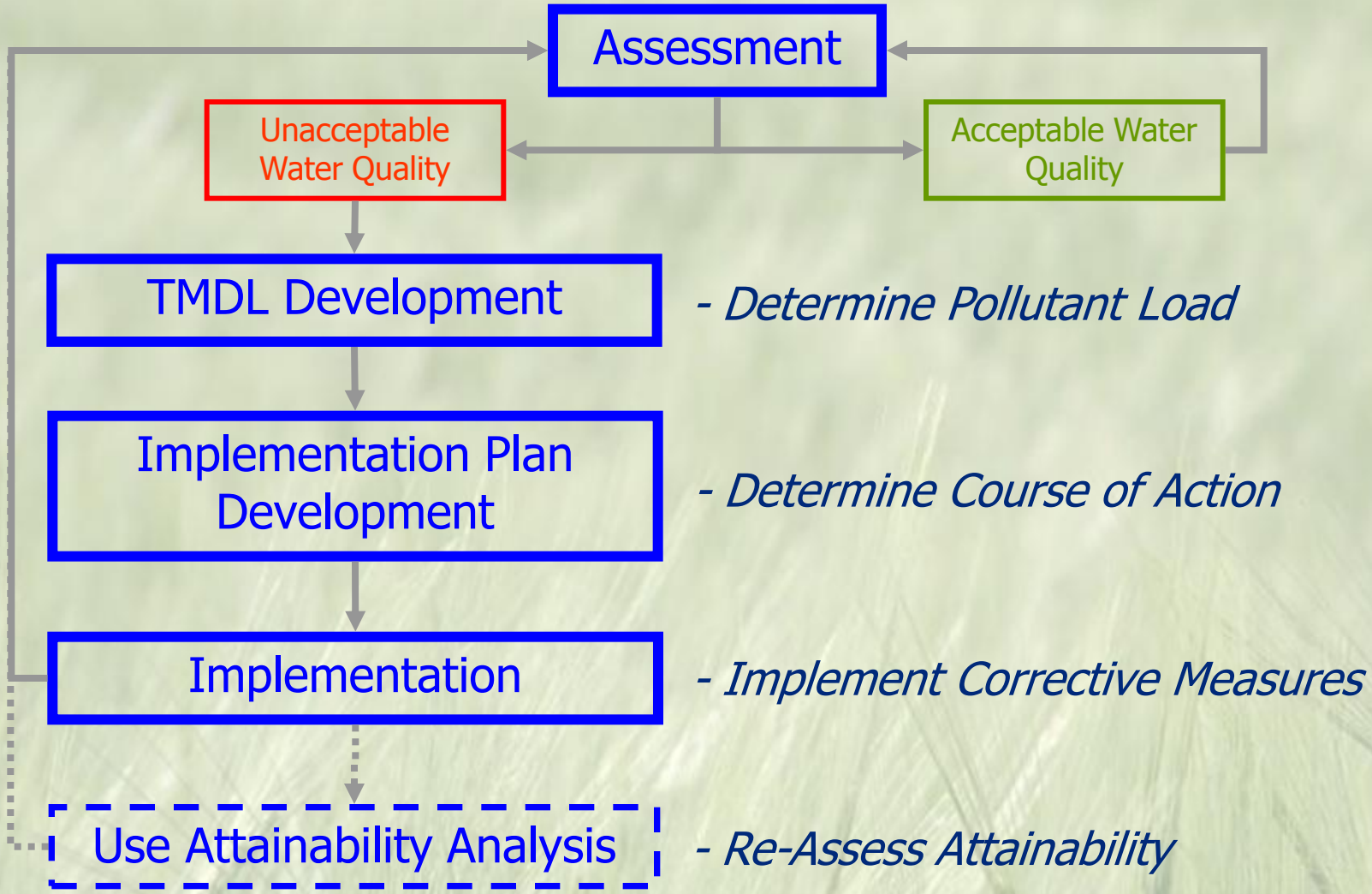
Water Quality Data Analysis
- *E.coli* -

Stream	Station	Date	Count	Minimum	Maximum	Mean	Median	Standard Deviation	Violation %
Pedlar River	2-POL000.04	02/2007 - 12/2008	11	25	97.5	44	42	24	0.0%
Pedlar River	2-POL007.20	01/2011 - 12/2011	12	25	625	135	25	195	25.0%
Pedlar River	2-POL008.53	08/2003 - 12/2011	35	25	2000	197	50	357	20.0%
Pedlar River	2-POL010.11	04/2002 - 12/2011	13	10	1475	176	25	399	15.4%
Pedlar River	2-POL028.68	01/2013 - 06/2013	6	25	325	88	25	120	16.7%
Reed Creek	2-RED000.16	08/2002 - 11/2012	38	25	2000	279	150	450	28.9%
Reed Creek	2-RED003.65	05/2004 - 05/2013	3	140	380	227	160	133	33.3%
Reed Creek	2-RED005.36	08/2002 - 05/2005	18	50	2000	453	295	454	66.7%
Reed Creek	2-RED008.22	08/2002 - 05/2005	18	10	1300	266	55	389	27.8%
Tomahawk Creek	2-THK000.03	03/2009	1	30	30	30	NA	NA	0.0%
Tomahawk Creek	2-THK002.33	08/2003 - 12/2010	24	25	950	183	100	224	16.7%

Water Quality Data Analysis
- *E.coli* -

Stream	Station	Date	Count	Minimum	Maximum	Mean	Median	Standard Deviation	Violation %
Williams Run	2-WLM000.69	04/2007 - 03/2008	2	10	10	10	10	0	0.0%
Williams Run	2-WLM002.69	08/2003 - 12/2010	24	25	580	176	87.5	168	29.2%
Burton Creek X-Trib	2-XXA001.43	01/2006 - 12/2006	12	25	2000	559	110	801	33.3%

TMDL Process



TMDL Modeling Completed to Date…

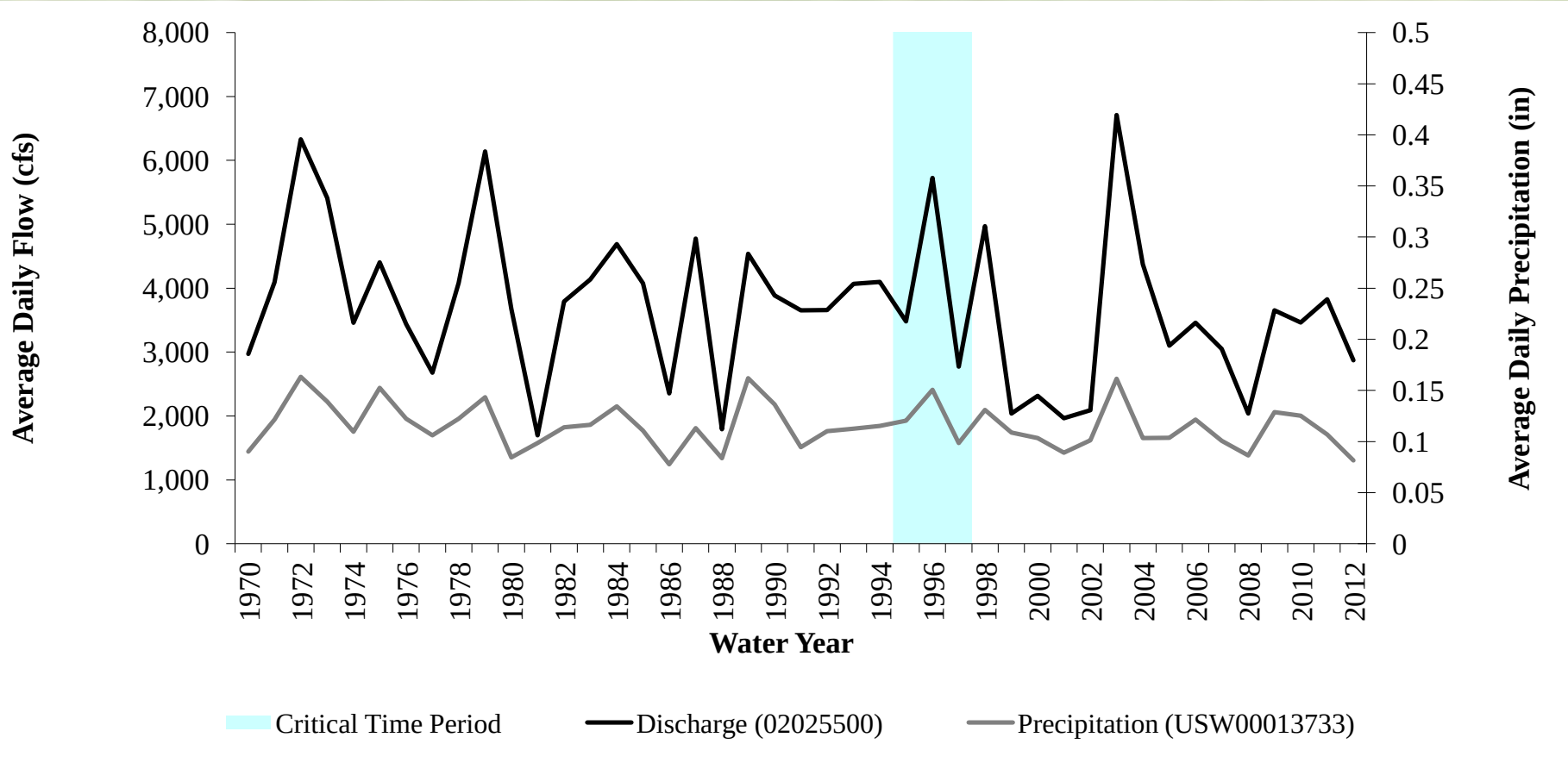
- Constructed New HSPF Model
- Hydrologic Calibration of Model (pending DEQ approval)
  - Include upstream watershed and impairments (above Holcomb Rock) in model directly
  - Include transfers (e.g. water from reservoir on Pedlar River to City of Lynchburg)
  - Incorporate results of CSO LTCP model (flow from outfalls)
  - Subtracted areas incorporated by CSO model from HSPF model (no double-counting of stormwater inputs)
- Identified Critical Time Period
- Performed Initial Source Assessment

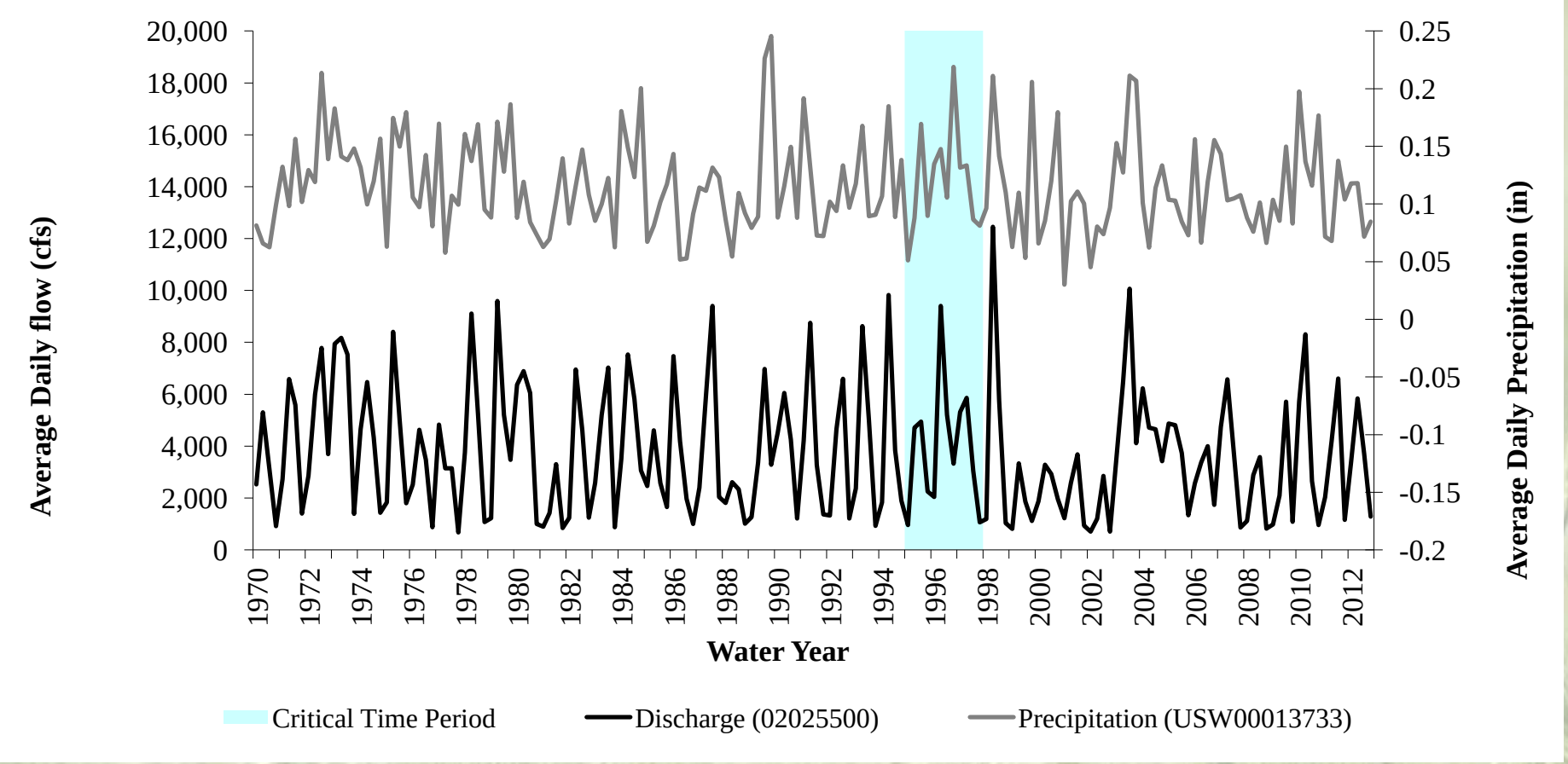
Critical Period

- Statistical analysis to determine representative modeling period
  - Full range of low and high flow and precipitation
  - Average flow and precipitation near the long-term average
  - Based on water years rather than calendar years
- **1 October 1994 to 30 September 1997** identified as critical time period for bacterial water quality modeling

Critical Period vs. Annual Historic Data

Critical Period: 1 October 1994 to 30 September 1997



Critical Period vs. Seasonal Historic Data

Critical Period: 1 October 1994 to 30 September 1997