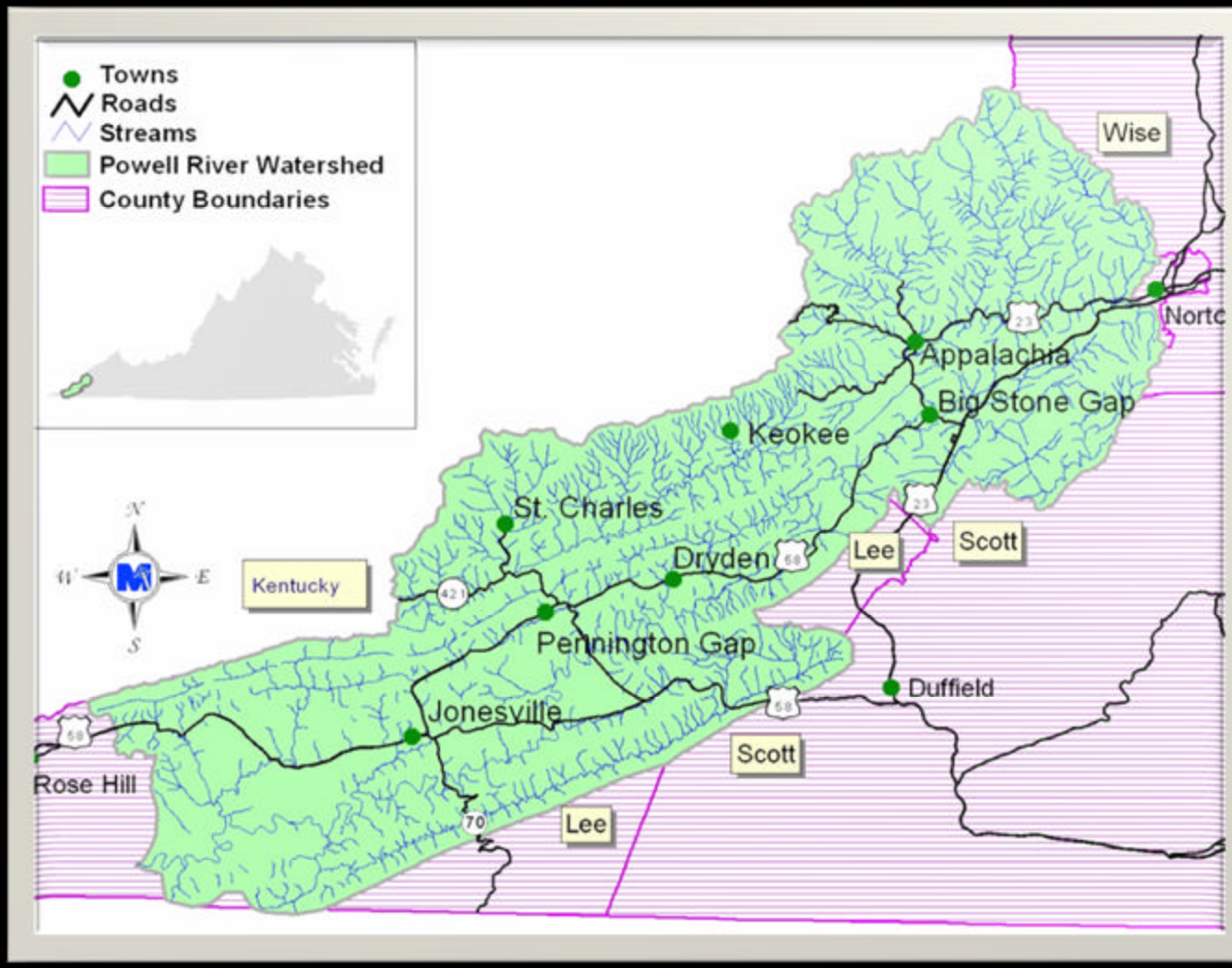
Powell River and Tributaries TMDL First TAC Meeting

October 21, 2008

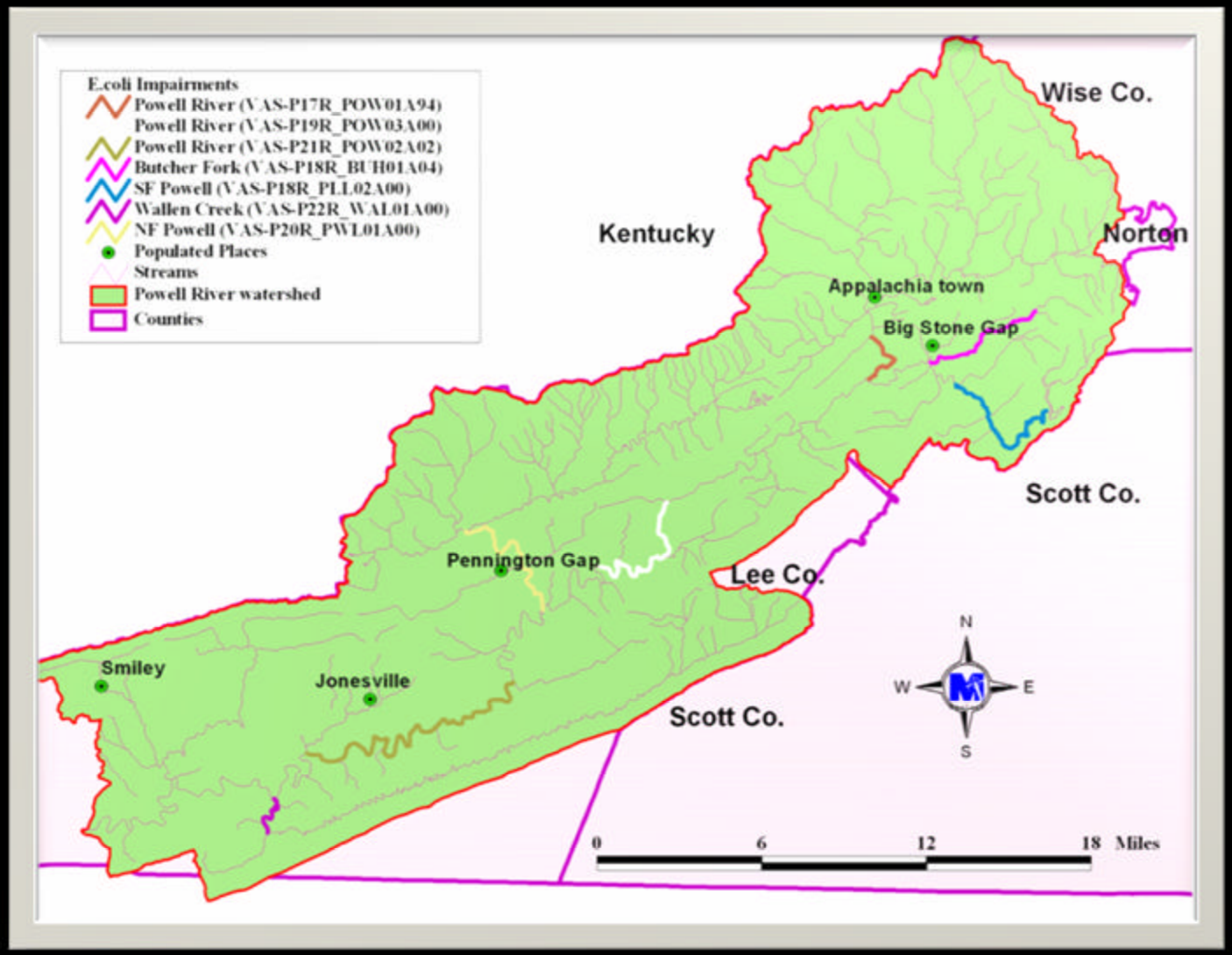
Location of Study Area



E.coli Impairments

Stream Name Impairment Id	Initial Listing Year	Impairment Location
Butcher Fork VAS-P18R_BUH01A04	2004	Headwaters to South Fork Powell River conf.
South Fork Powell River VAS-P18R_PLL02A00	2004	Big Cherry Reservoir to Beaverdam Creek;
North Fork Powell River VAS-P20R_PWL01A00	2004	Straight Creek conf. to Powell River conf.
Wallen Creek VAS-P22_WAL01A00	2006	Lone Branch to Powell River
Powell River at BSG VAS-P17R_POW01A94	1996	Roaring Branch conf. to Dakota St. in Big Stone Gap, VA
Powell River at PWS VAS-P19R_POW03A00	2004	Poor Valley Creek conf. to Public Water Supply
Powell River at Town Branch VAS-P21R_POW02A02	2006	Station Creek conf. to Town Branch conf.

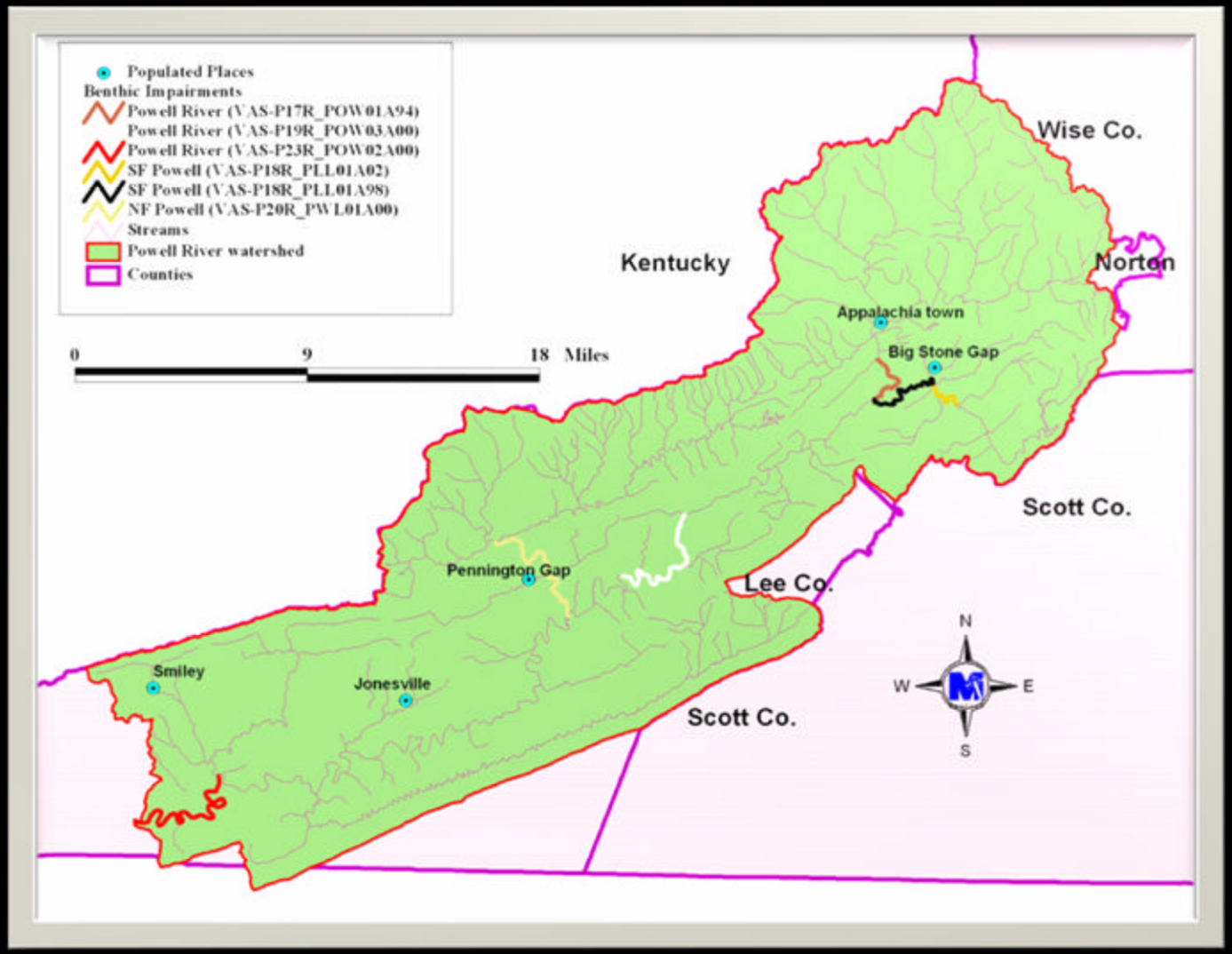
E. coli Impairments



Benthic Impairments

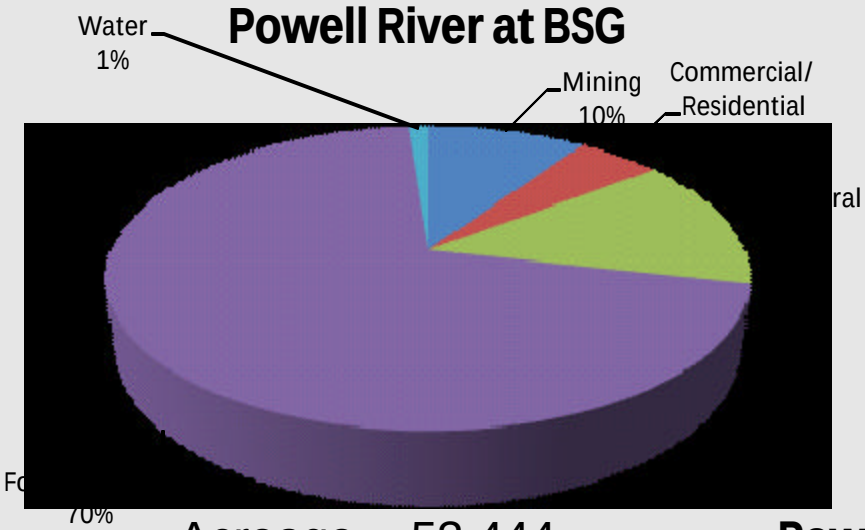
Stream Name Impairment Id	Initial Listing Year	Impairment Location
South Fork Powell River VAS-P18R_PLL01A02	1998	Beaverdam Creek to Butcher Fork;
South Fork Powell River VAS-P18R_PLL01A98	1998	Butcher Fork to the Powell River
North Fork Powell River VAS-P20R_PWL01A00	1996	Straight Creek conf. to Powell River conf.
Powell River at BSG VAS-P17R_POW01A94	1996	Roaring Branch conf. to Dakota St. in Big Stone Gap, VA
Powell River at PWS VAS-P19R_POW03A00	2004	Poor Valley Creek conf. to Public Water Supply
Powell River at Yellow Creek VAS-P23R_POW02A00	2002	Hardy Creek conf. to Yellow Creek conf.

Benthic Impairments



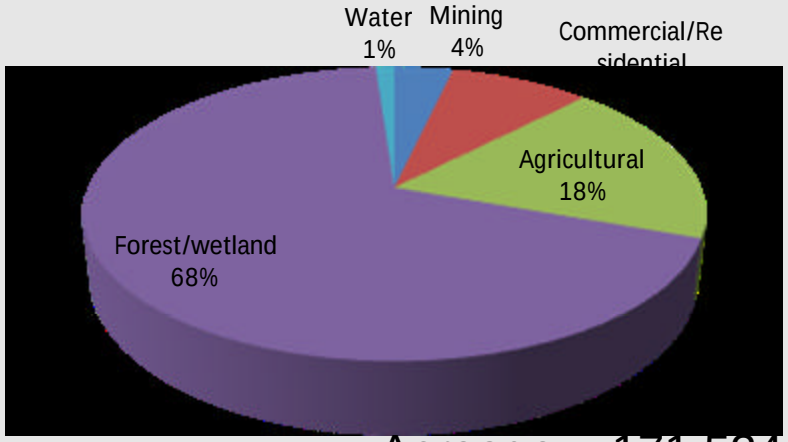
Land Use

Powell River at BSG



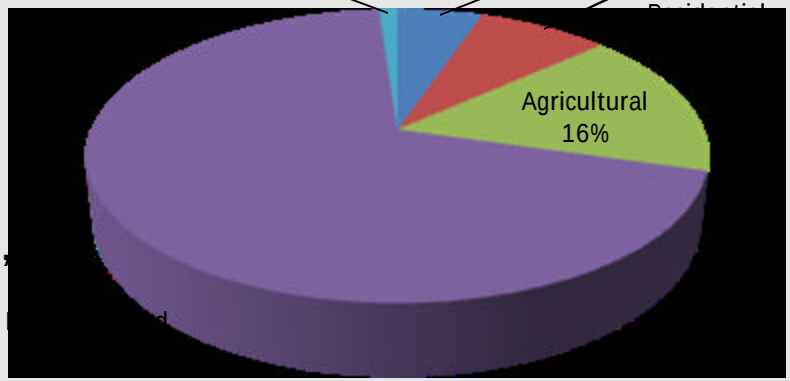
Acreage = 53,444

Powell River at Town Branch



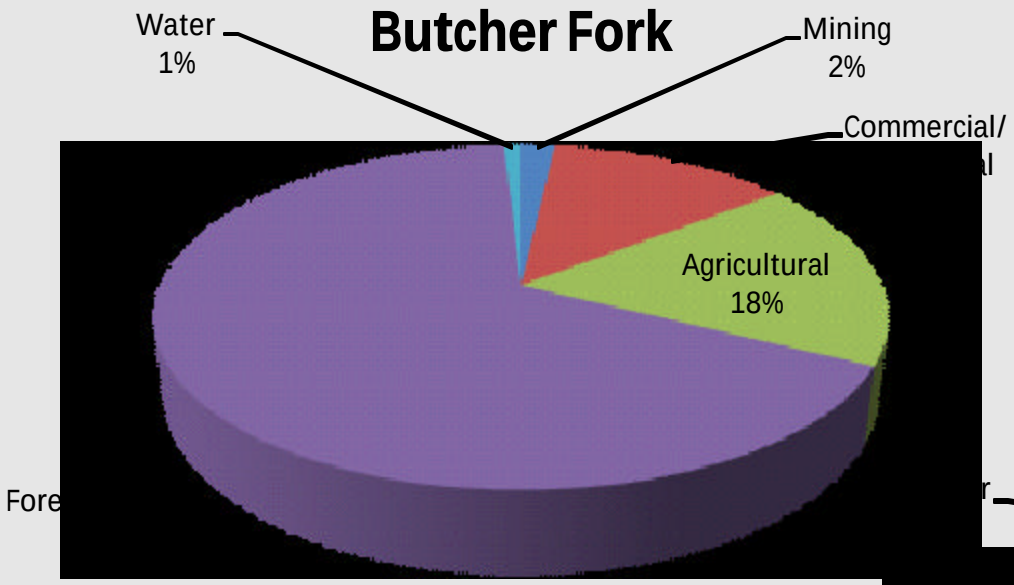
Acreage = 171,524

Powell River at PWS



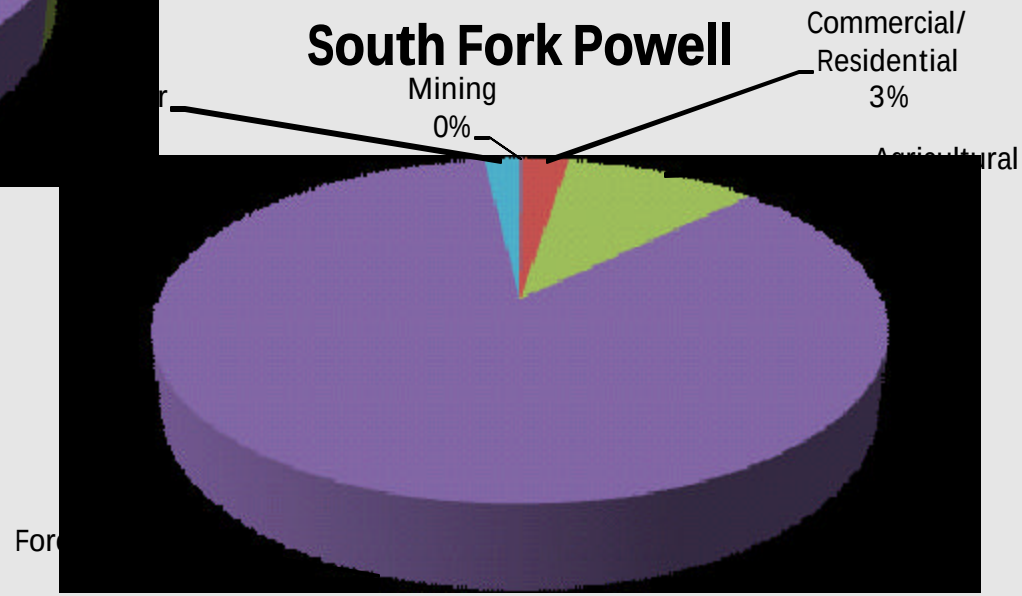
Acreage = 105,

Land Use

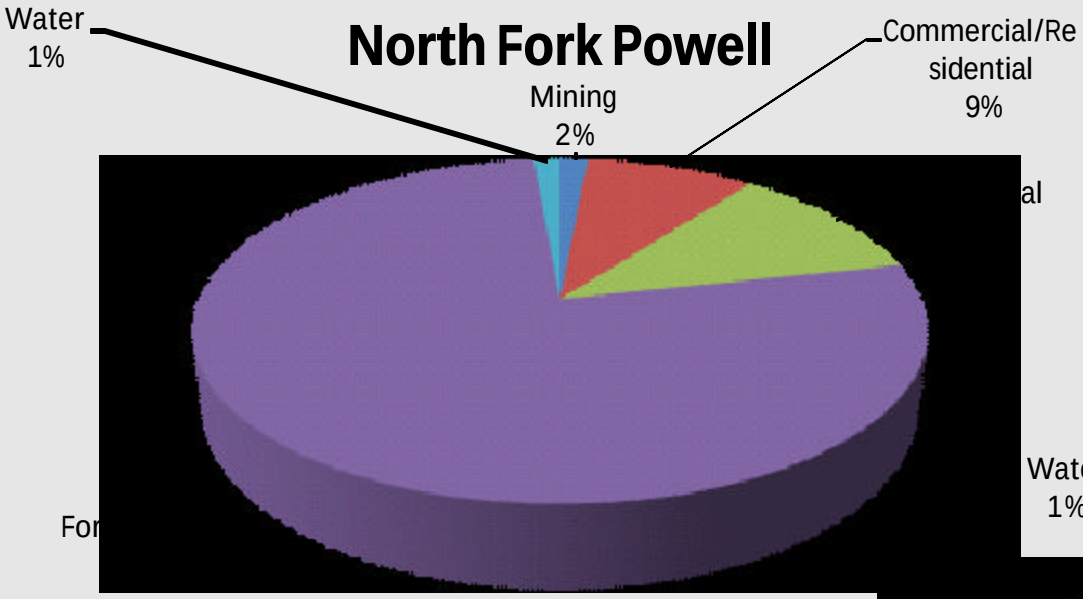


Acreage = 5,427

Acreage = 8,374

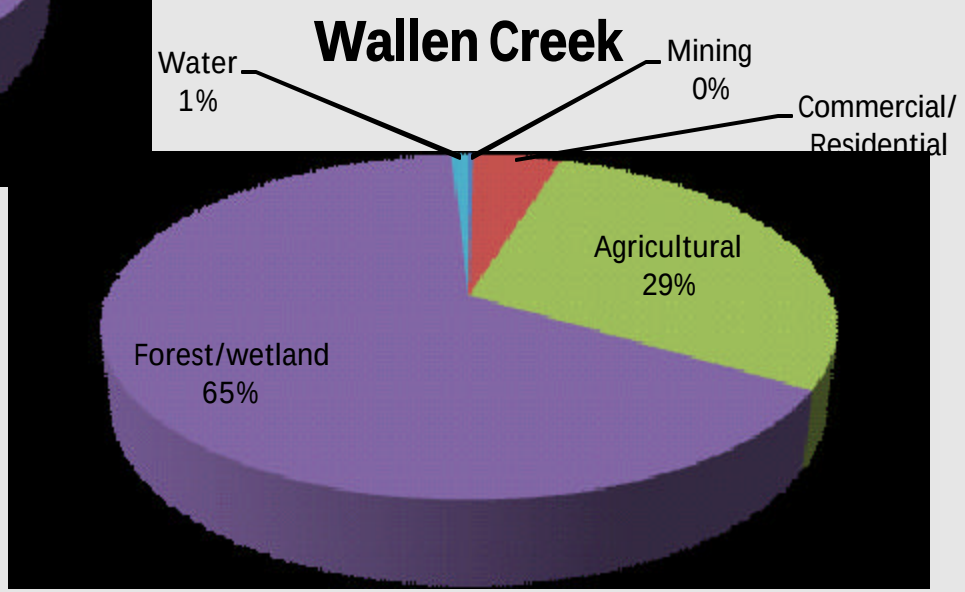


Land Use



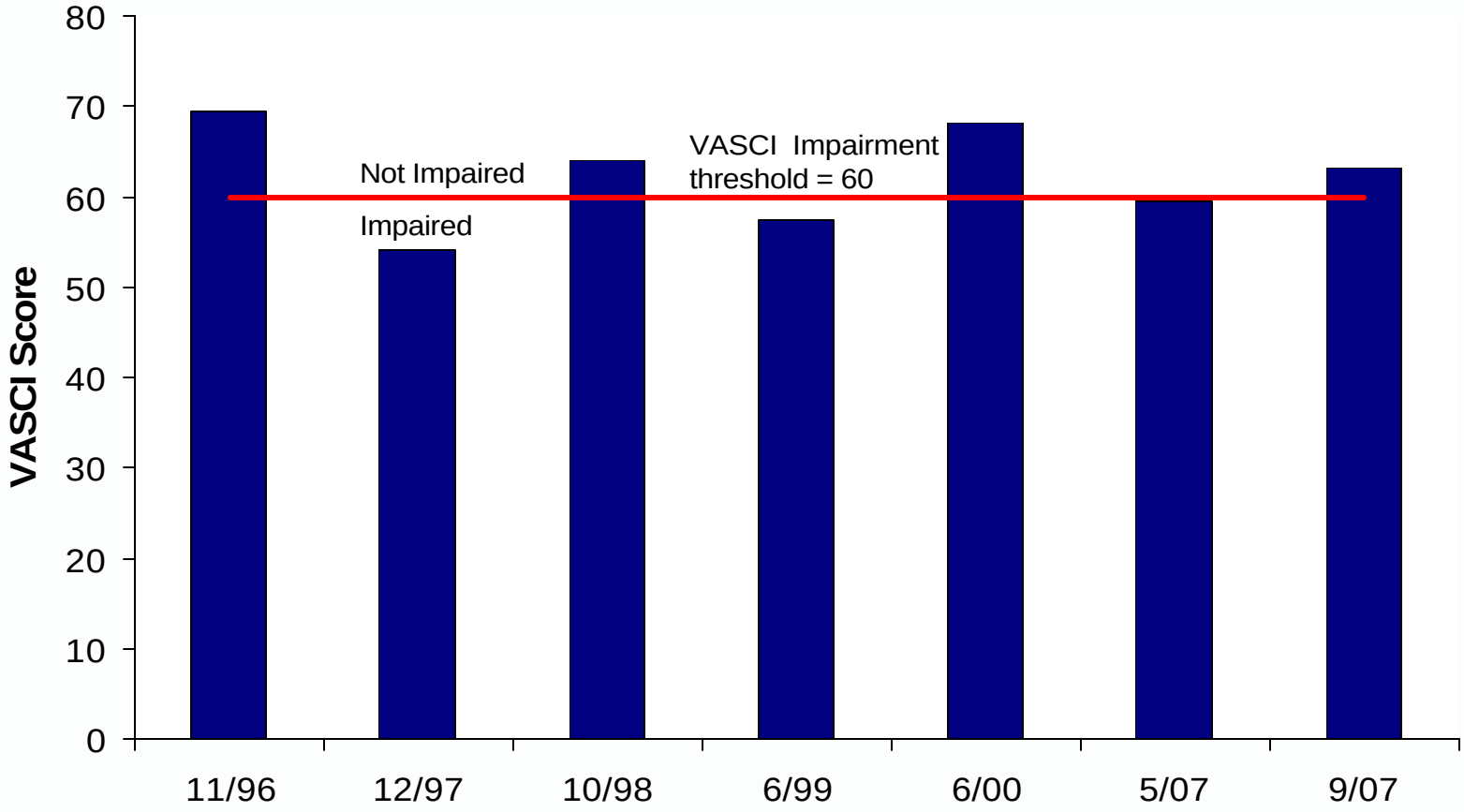
Acreage = 40,000

Acreage = 30,442

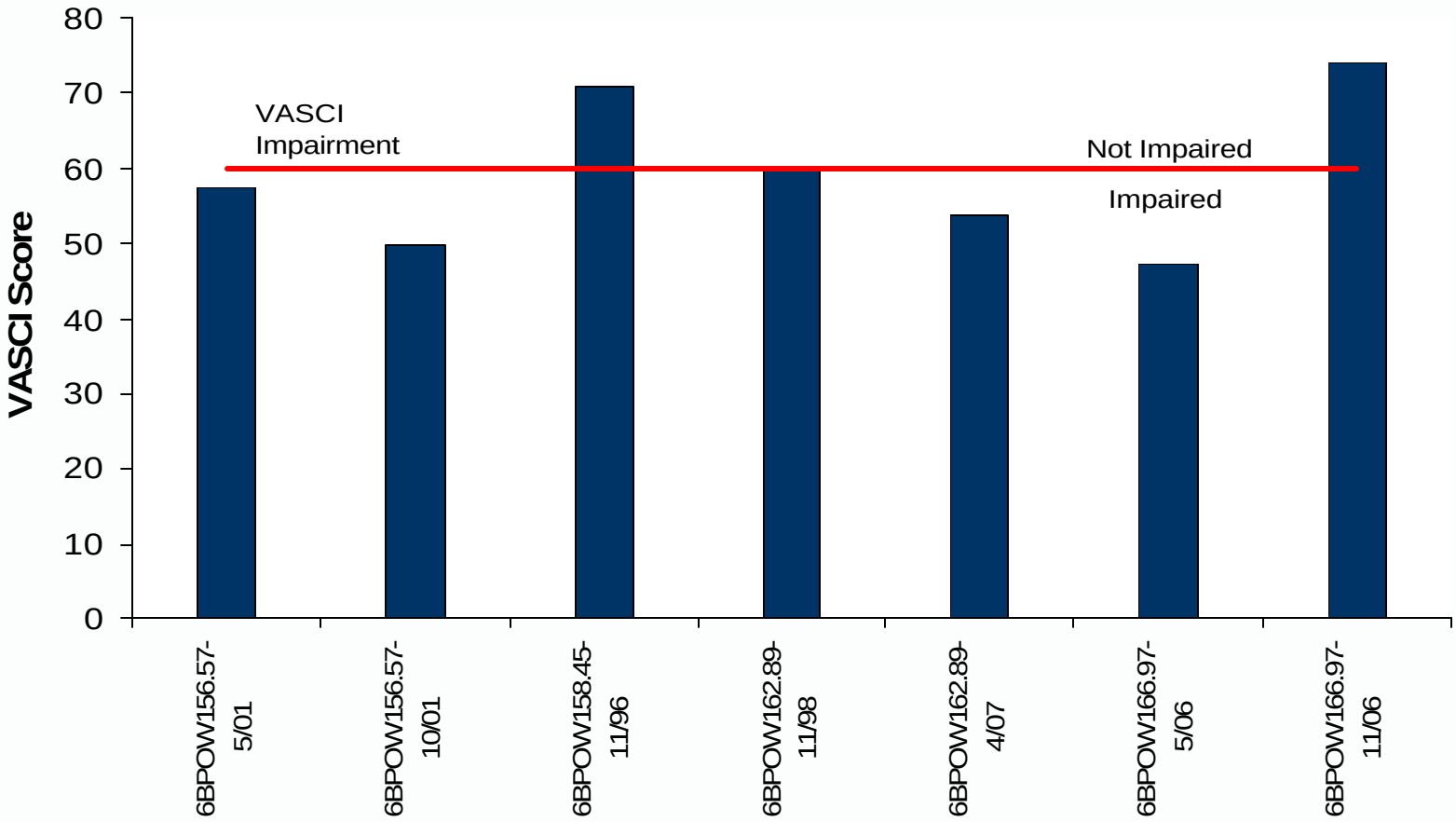


Biological Monitoring Scores

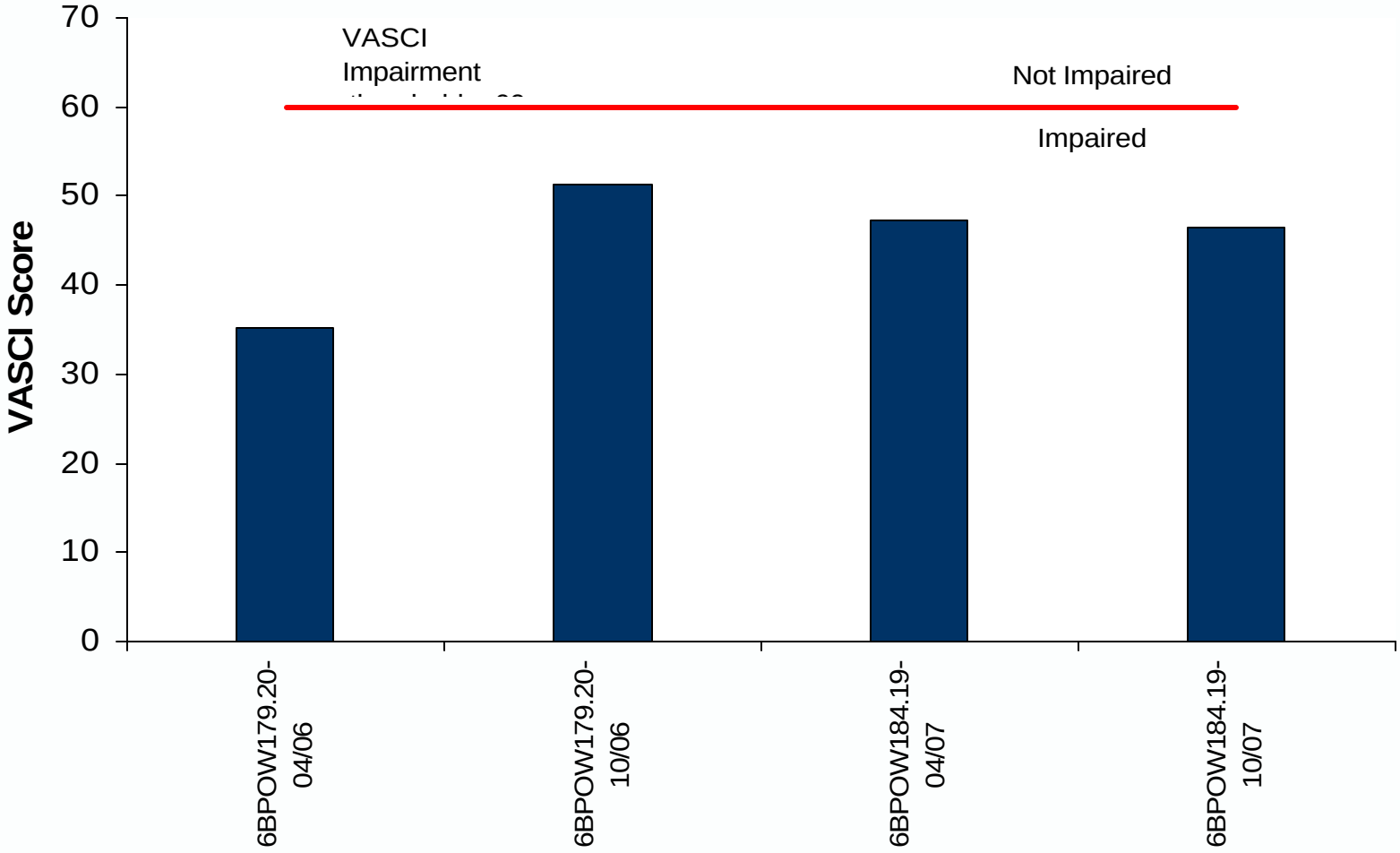
What Are Biological Monitoring Scores in the Powell River at River Mile 120.12 near the State Line?



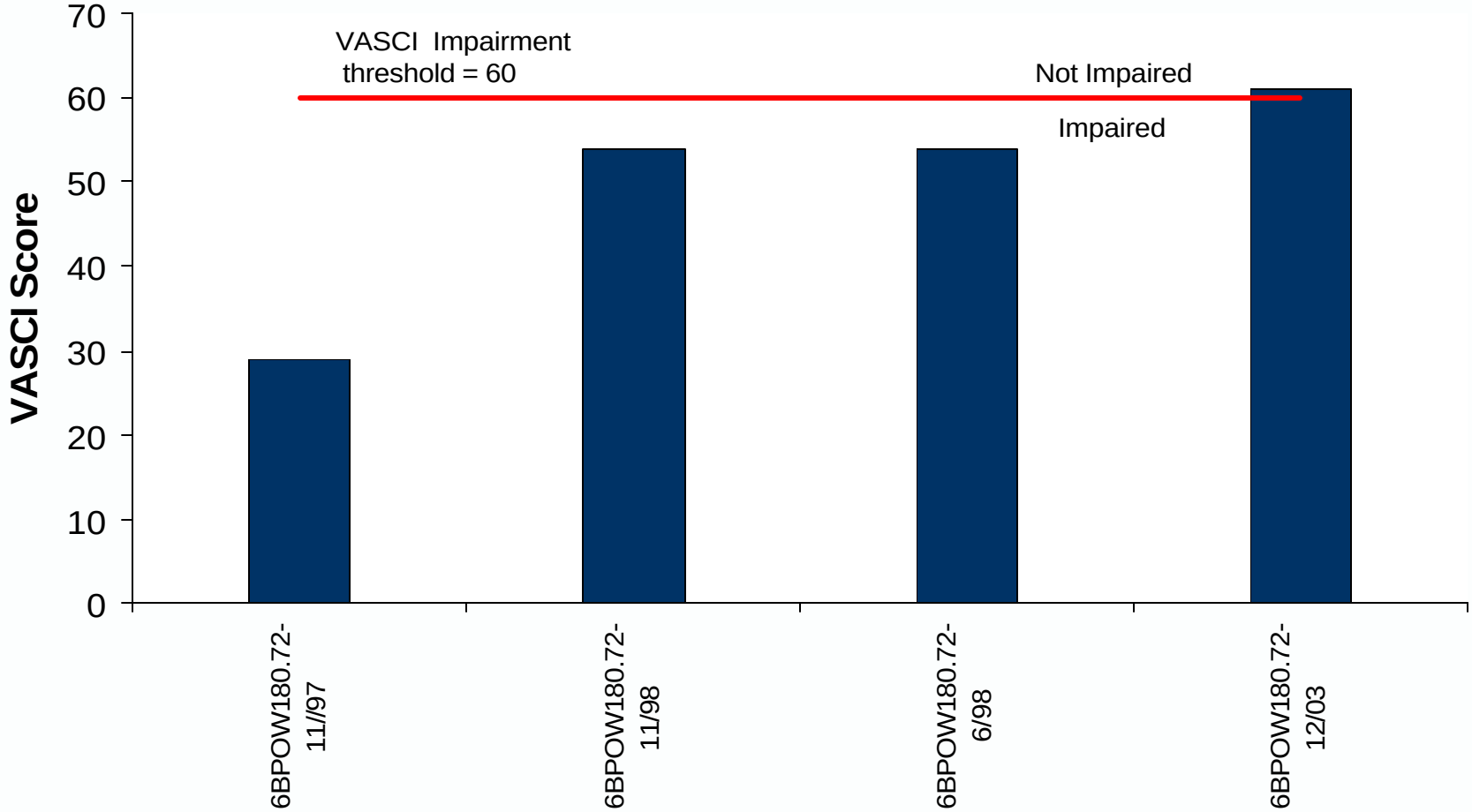
What Are Biological Monitoring Scores in the Powell River at the Rt 642 Bridge, NF Powell R , Rt 743 Bridge and Rt 58 Bridge?



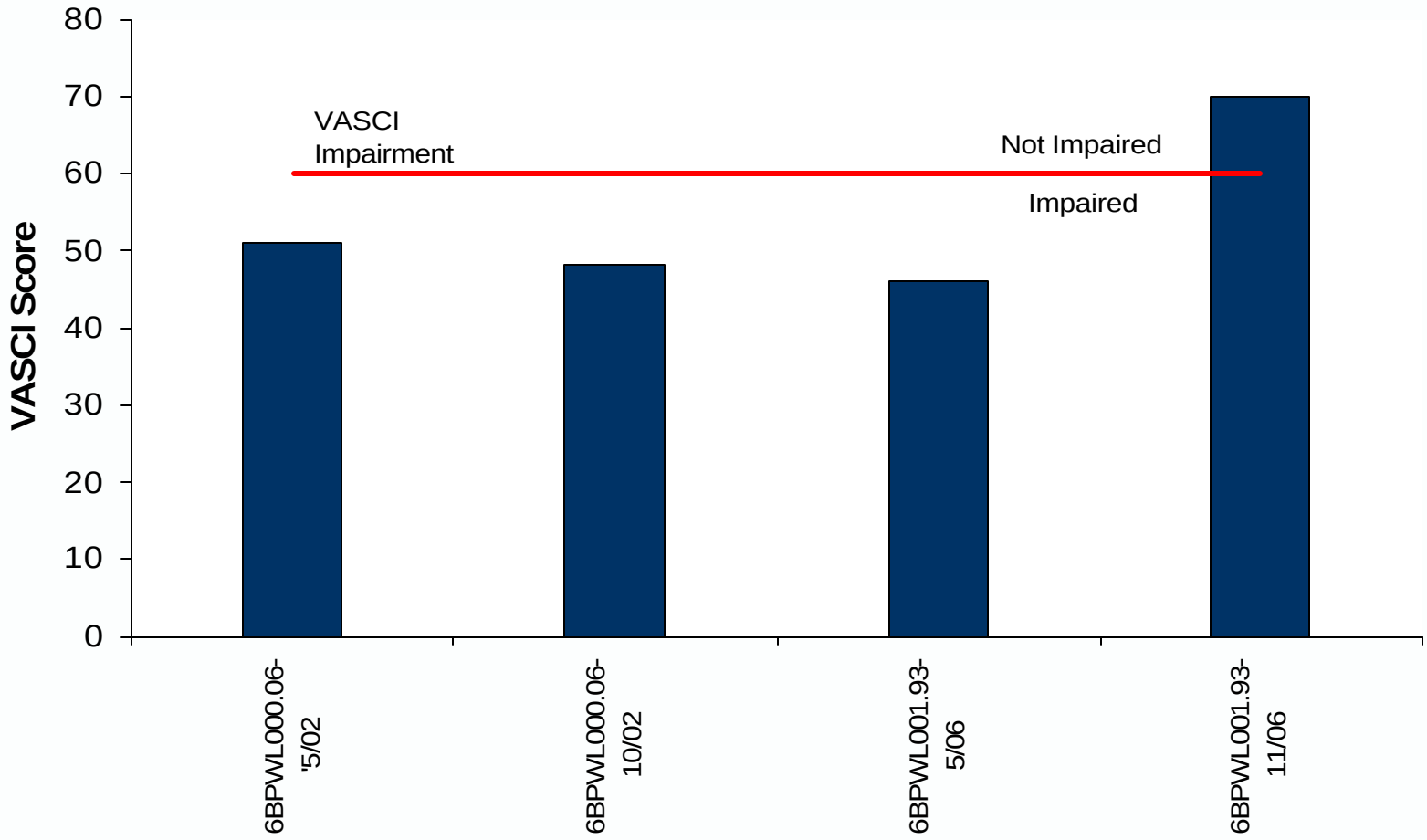
What Are Biological Monitoring Scores in the Powell River at Big Stone Gap, and Rt 58/23 Intersection?



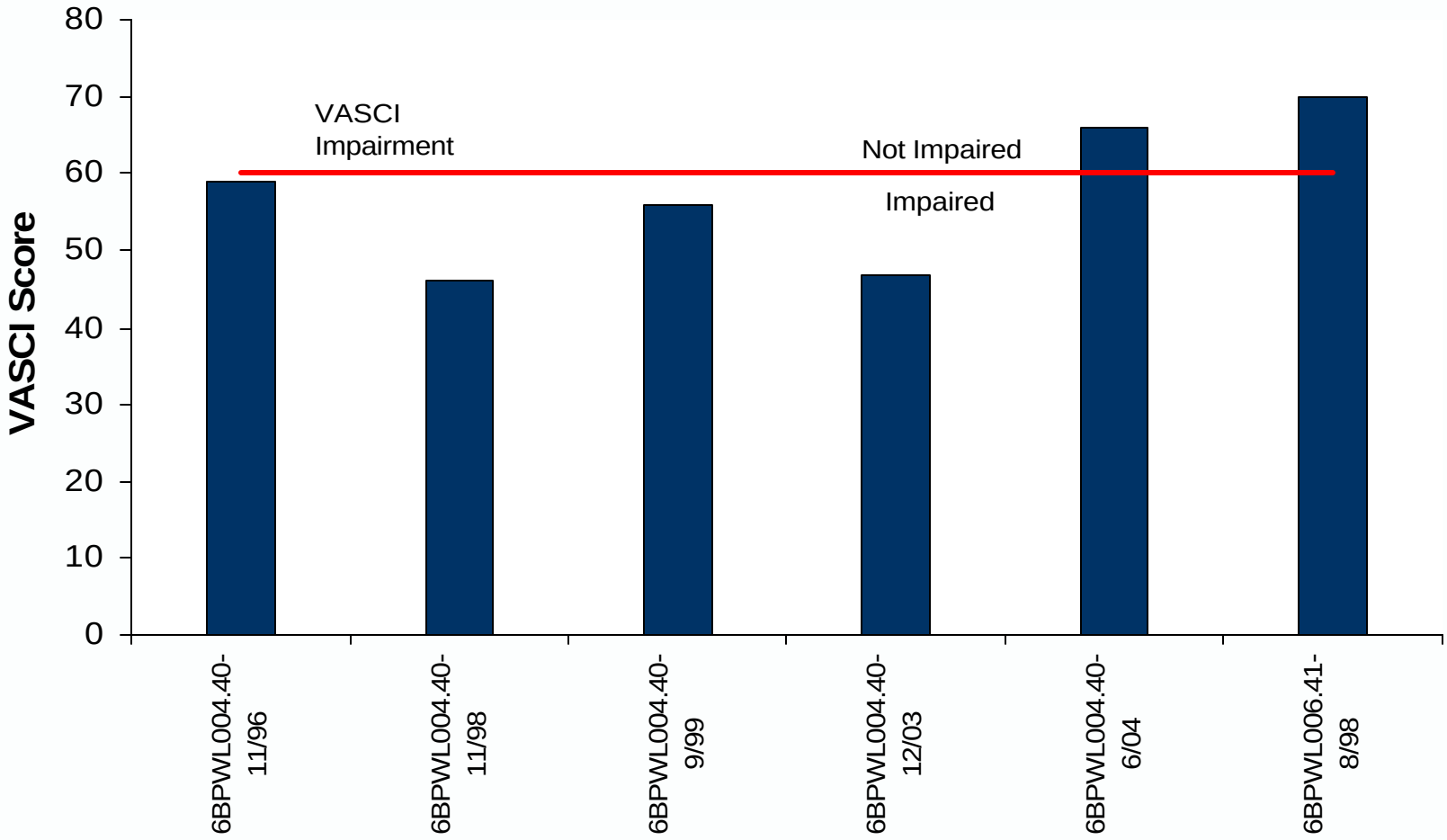
What Are Biological Monitoring Scores in the Powell River at the Rt 23 Bridge?



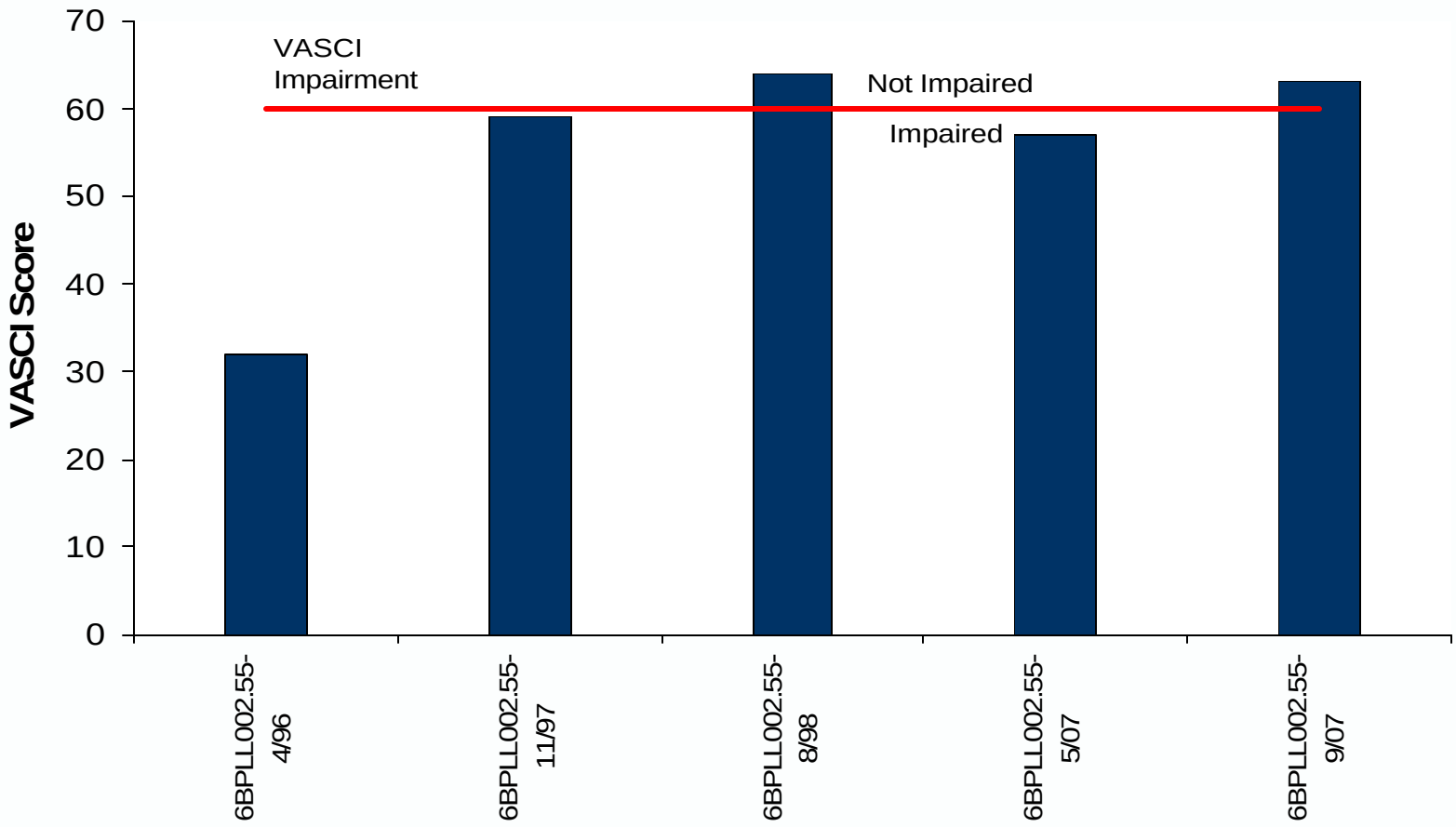
What Are Biological Monitoring Scores in the NF Powell River at Woodway and Pennington Gap?



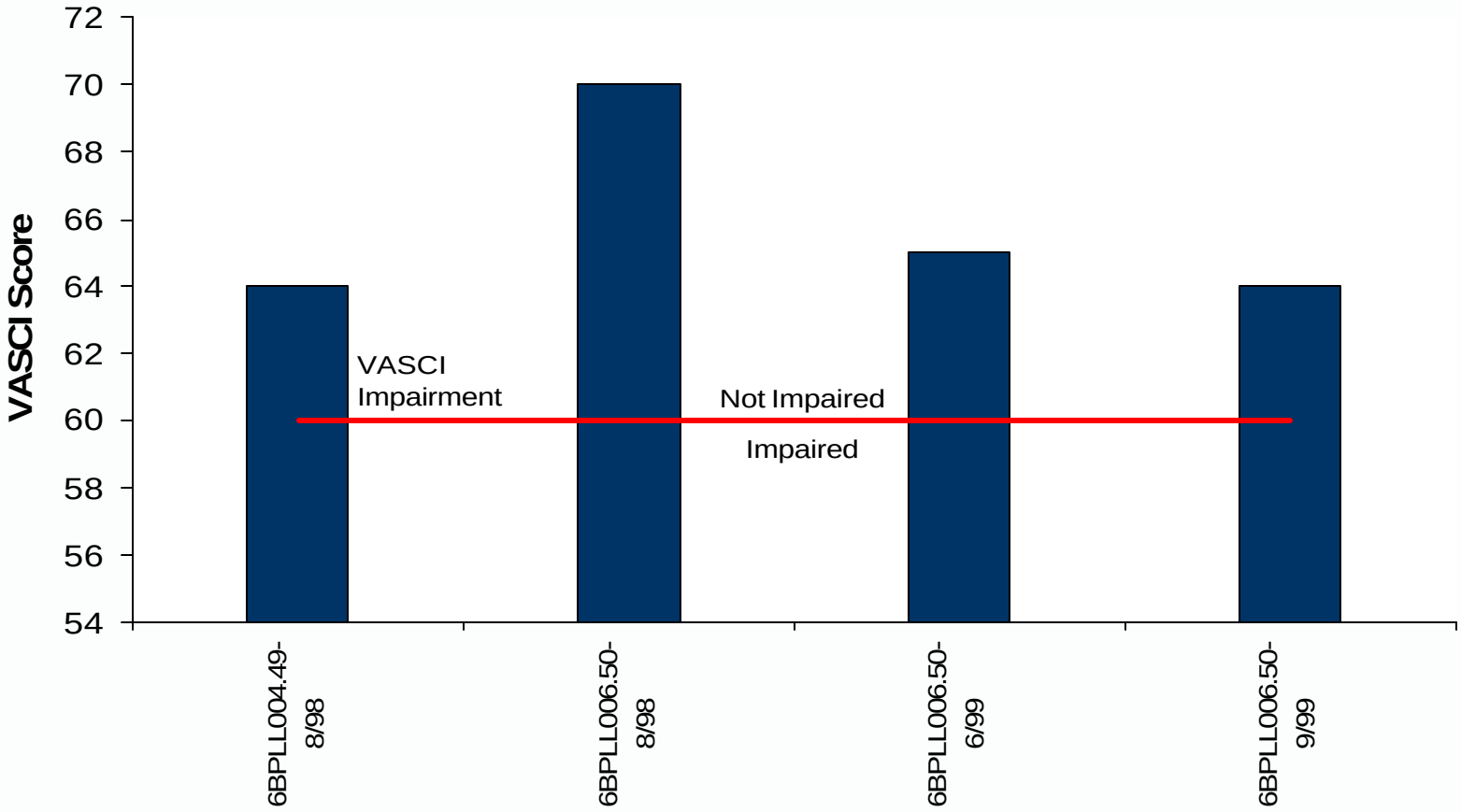
What Are Biological Monitoring Scores in the NF Powell River at Leeman Field and Rt 606?



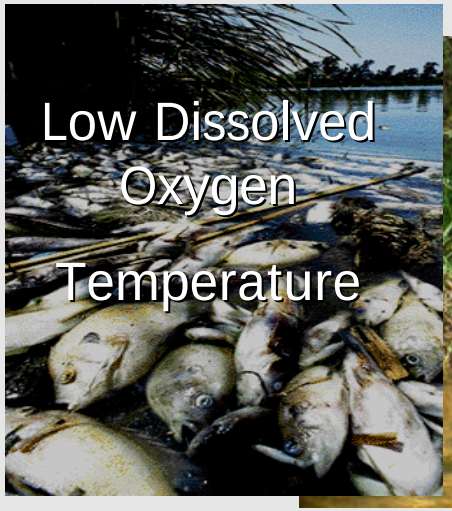
What Are Biological Monitoring Scores in the SF Powell River at Rt 613?

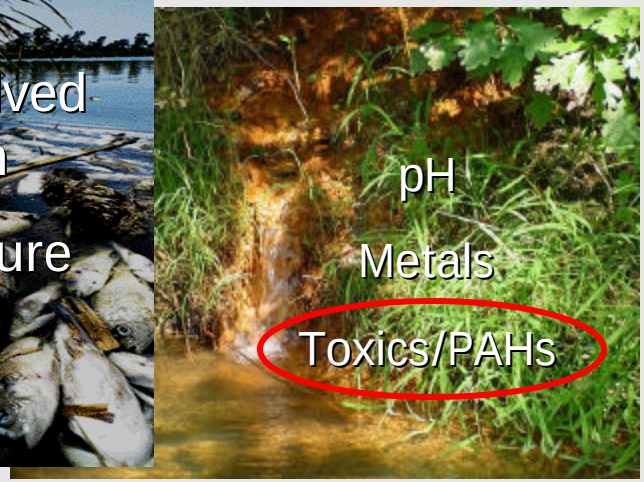


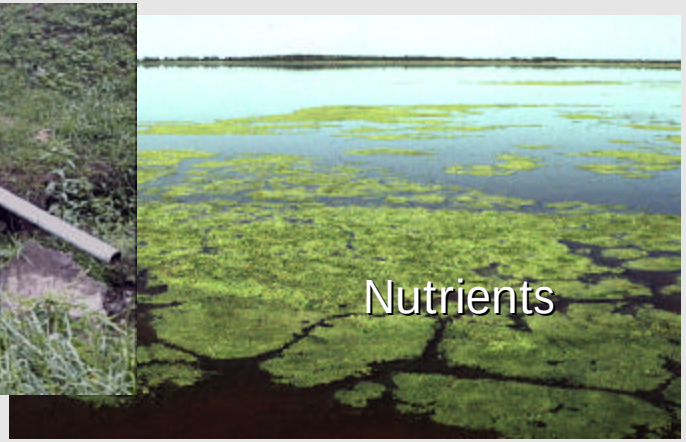
What Are Biological Monitoring Scores in the SF Powell River at East Stone Gap and Rt 616?

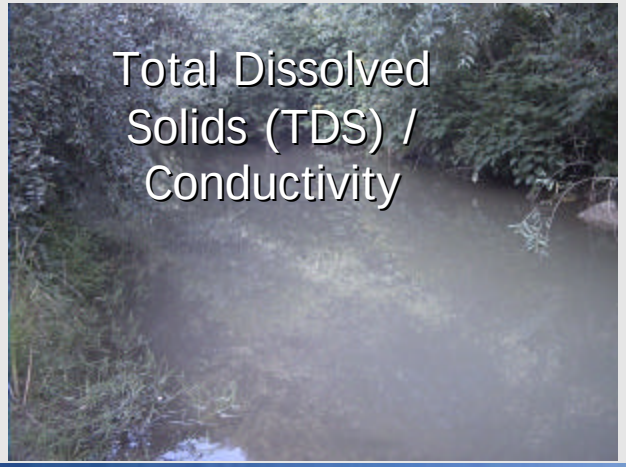


NF, SF and Powell Rivers: What is harming the Aquatic Life?





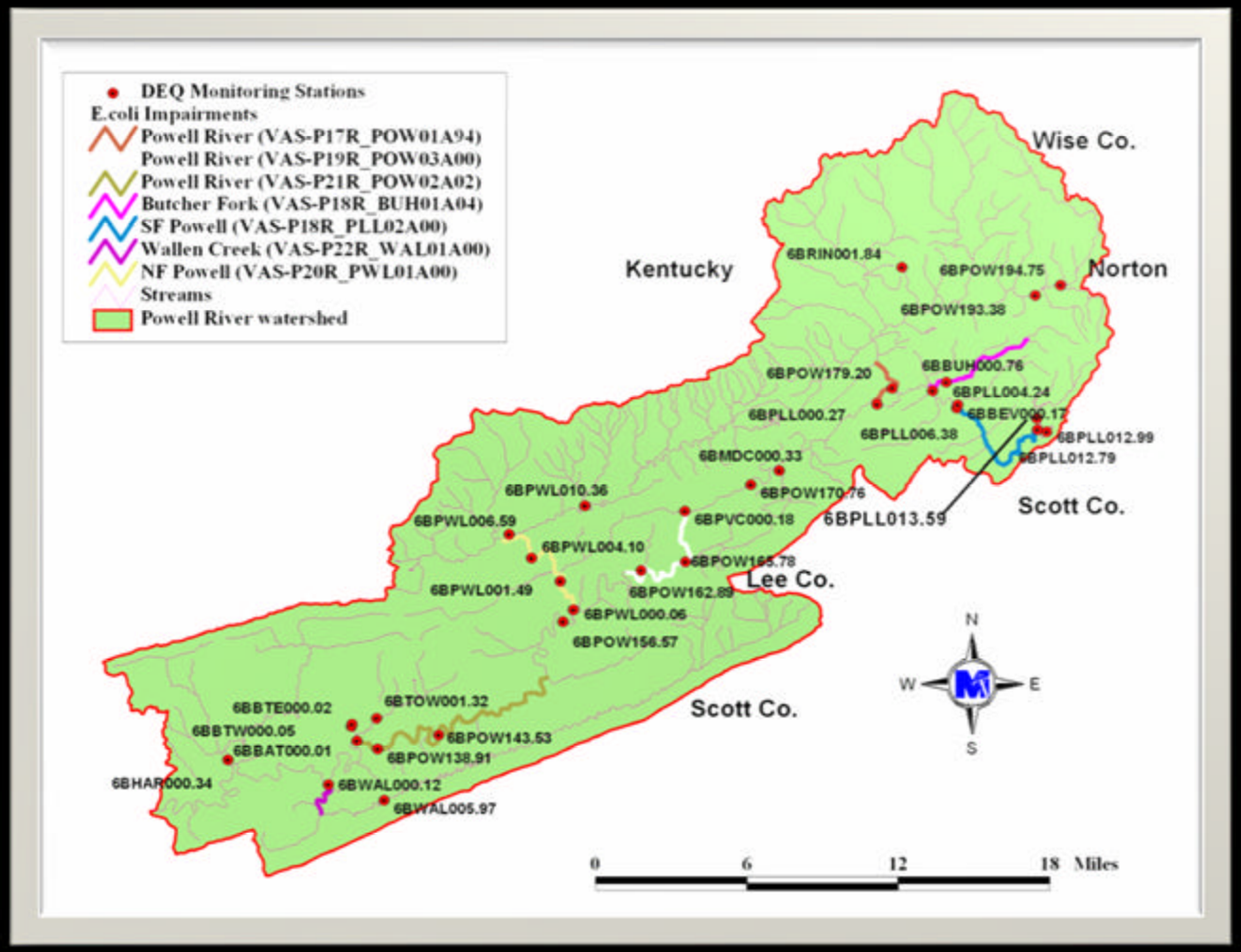




North Fork, South Fork and Powell Rivers Probable Stressors

Stream	Stressor(s)
Powell River	Sediment (TSS) & Polycyclic Aromatic Hydrocarbons (PAHs)
North Fork Powell River	Sediment (TSS) & Polycyclic Aromatic Hydrocarbons (PAHs)
South Fork Powell River	Sediment (TSS)

Bacteria Data
DEQ Monitoring Station Locations



Water Quality Data Description -Fecal Coliform -

Stream	VADEQ Station	Count (#)	Maximum (cfu/100mL)	Median (cfu/100mL)	Standard Deviation	Violations[2] %
Batie Creek, East Fork	6BBTE000.02	5	4,500	670	1,793	60%
Batie Creek, West Fork	6BBTW000.05	5	1,400	100	604	40%
Butcher Fork	6BBUH000.76	12	3,900	300	1,144	42%
North Fork Powell River	6BPWL001.49	148	22,800	1,150	4,057	67%
North Fork Powell River	6BPWL004.10	12	1,000	275	313	25%
Powell River	6BPOW138.91	107	1,800	50	218	6%
Powell River	6BPOW143.53	136	20,000	100	2,356	29%
Powell River	6BPOW165.78	95	6,000	100	728	9%
Powell River	6BPOW179.20	179	12,000	600	2,438	60%
Powell River	6BPOW193.38	12	3,800	750	1,152	67%
Roaring Fork	6BRIN001.84	12	400	100	100	0%
South Fork Powell River	6BPLL000.27	12	4,700	100	1,310	8%
South Fork Powell River	6BPLL004.24	12	600	300	164	8%
South Fork Powell River	6BPLL006.38	28	5,200	100	1,000	29%
South Fork Powell River	6BPLL012.79	8	1,700	100	566	13%
South Fork Powell River	6BPLL012.99	7	100	100	0	0%
South Fork Powell River	6BPLL013.59	7	100	100	0	0%

Water Quality Data Analysis
- *E.coli* -

Stream	VADEQ Station	Count (#)	Maximum (cfu/100mL)	Median (cfu/100mL)	Standard Deviation	Violations[1] %
Hardy Creek	6BHAR000.34	11	580	150	186	36%
Mud Creek	6BMDC000.33	6	1,000	100	379	33%
North Fork Powell River	6BPWL001.49	11	880	100	256	18%
North Fork Powell River	6BPWL004.10	12	420	115	118	17%
North Fork Powell River	6BPWL006.59	12	300	88	82	8%
North Fork Powell River	6BPWL010.36	12	75	25	16	0%
Poor Valley Creek	6BPVC000.18	6	350	38	128	17%
Powell River	6BPOW138.91	40	620	25	138	13%
Powell River	6BPOW165.78	6	75	25	20	0%
Powell River	6BPOW179.20	2	150	88	88	0%
Powell River	6BPOW193.38	2	300	200	141	50%
Powell River	6BPOW194.75	2	100	63	53	0%
Roaring Fork	6BRIN001.84	2	300	163	194	50%
South Fork Powell River	6BPLL012.79	7	25	25	0	0%
South Fork Powell River	6BPLL012.99	7	25	25	0	0%
South Fork Powell River	6BPLL013.59	7	25	25	0	0%
Town Branch	6BTOW001.32	11	1,600	180	481	36%
Wallen Creek	6BWAL000.12	11	480	100	166	27%

Water Quality Data Analysis
- Enterococci -

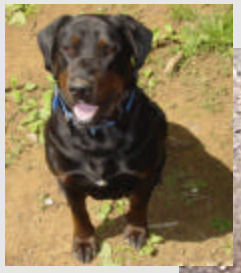
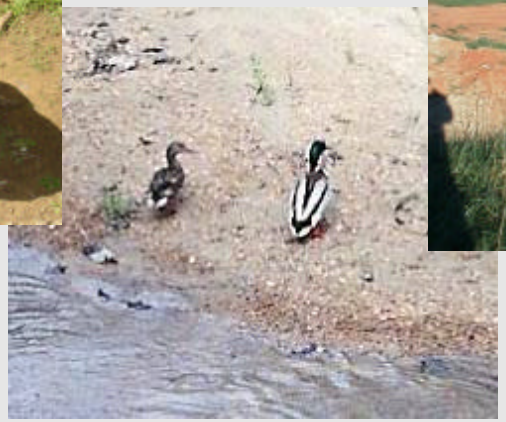
Stream	VADEQ Station	Count (#)	Maximum (cfu/100mL)	Median (cfu/100mL)	Standard Deviation
North Fork Powell River	6BPWL004.10	12	800	150	237
Powell River	6BPOW138.91	15	800	30	208

Pollutant Source Assessment

- Bacteria -

Source Assessment

- Permitted discharges
  - Wastewater treatment facilities
  - Other Permitted Discharges
- Human
  - Biosolids
  - Failed Septic Systems
  - Straight Pipes
  - Overflows
- Pets
- Livestock
- Wildlife

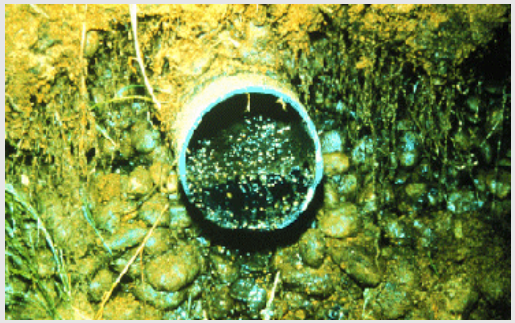
Permitted Discharges – VPDES

Permit Number	Facility Name	Type	Design Flow (MGD)	Receiving Waterbody
VA0020940	Big Stone Gap Regional WWTP	Municipal	2	Powell River
VA0022012	Norfolk Southern Raiway Co - Andover Yard	Industrial	0.065	Callahan Creek
VA0029599	Pennington Gap STP	Municipal	0.6	Powell River
VA0052311	Big Stone Gap Water Treatment Plant	Industrial	0.049	South Fork Powell Riv
VA0052337	Appalachia WTP	Industrial	0.049	Ben's Branch
VA0053023	Pennington Gap Water Plant	Industrial	0.135	Powell River
VA0060798	Wise County Public Schools	Municipal	0.012	Mill Branch
VA0063941	Dot Mobile Home Park STP	Municipal	0.0049	Station Creek
VA0070751	Jonesville Water Plant	Industrial	0.34	Fleenortown Creek
VA0075515	Lee County Public Service Authority - Cross Cr	Municipal	0.03	Powell River
VA0088111	Lee County Public Service Authority-Rose Hill	Municipal	0.06	Martin Creek
VA0089397	Lee County PSA - Hickory Flats WWTP	Municipal	0.8	Powell River

Human Source

Population, housing units, and onsite treatment system based on U.S. Census

- Septic Systems
  - Failure to soil surface throughout year
  - Lateral movement continuously to stream



- Straight Pipes
  - Direct continuous input into stream

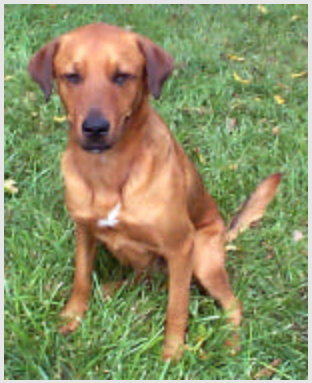
- Biosolids
  - Land-applied

Human Source (2008)

Impairment	Human Population	Housing Units (HU)	HU on Sewer	HU on Septic	HU on "Other"	Failing Septic Systems
Butcher Fork	845	394	39	340	15	76
South Fork Powell River	550	201	0	187	14	44
Powell River at BSG	6,196	3,133	1,741	1,255	137	805
Powell River at PWS	7,919	3,971	2,279	1,532	160	955
Powell River at Town Branch	26,319	13,056	5,399	6,910	747	2,727
North Fork Powell River	5,415	2,917	1,100	1,455	362	740
Wallen Creek	1,227	570	28	493	49	94

Pet Sources

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



Pet Source (2008)

Impairment	Dog Population	Cat Population
Butcher Fork	211	236
South Fork Powell River	108	121
Powell River at BSG	1,678	1,878
Powell River at PWS	2,126	2,380
Powell River at Town Branch	6,987	7,823
North Fork Powell River	1,562	1,751
Wallen Creek	306	343

Livestock Sources

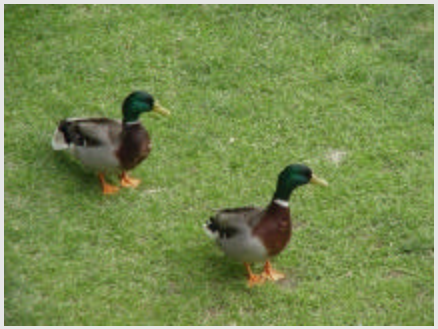
- Population
  - Virginia Agricultural Statistics
  - Consultation with SWCD, NRCS, VADCR, and VCE
  - Watershed visits
- Distribution of waste
  - Pastured
  - Confined, waste collected, spread
  - Direct deposition to the stream
- Seasonal varying applications

Livestock Population (2008)

Impairment	Beef	Other Cattle	Sheep	Horse	Hog	Goat	Dairy Milker	Dairy Dry	Dairy Calf
Butcher Fork	114	69	3	35	2	3			
SF Powell	68	41	3	21	2	3			
Powell BSG	117	74	16	41	16	16			
Powell PWS	125	90	17	43	17	17			
Powell Town Branch	2,095	3,418	199	447	57	199	60	30	30
NF Powell	185	362	147	38	13	147			
Wallen Creek	608	1,208	13	107	9	13			

Wildlife Source

- 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 Population (2008)

Impairment	Muskrat	Raccoon	Goose	Deer	Duck	Turkey	Beaver
Butcher Fork	1,745	91	96	52	121	15	80
SF Powell River	10,461	665	575	384	726	112	143
Powell River at BSG	16,283	889	895	482	1,130	145	764
Powell River at PWS	31,433	1,722	1,727	964	2,182	283	837
Powell River at Town Branch	49,803	2,829	2,737	1,606	3,457	469	2,121
NF Powell River	2,870	139	158	81	199	25	374
Wallen Creek	7,142	360	392	211	496	64	514

How do we Determine the TMDLs?

+

Watershed data

TMDL

And then:

- Conduct the Analyses
- Public Meeting 2 (Date?)
- Public Review
- Submit to EPA
- State Approval
- Implementation Plan Development
- Implementation

We appreciate that you're taking the time to come to the meeting

We appreciate your feedback

Contact Information

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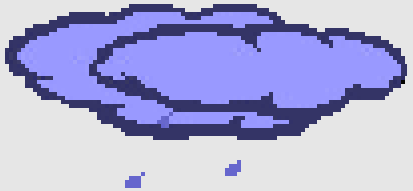
MapTech, Inc.
Mohammad Alsmadi, PhD
Environmental Scientist
malsmadi@maptech-inc.com
(540) 961-7864

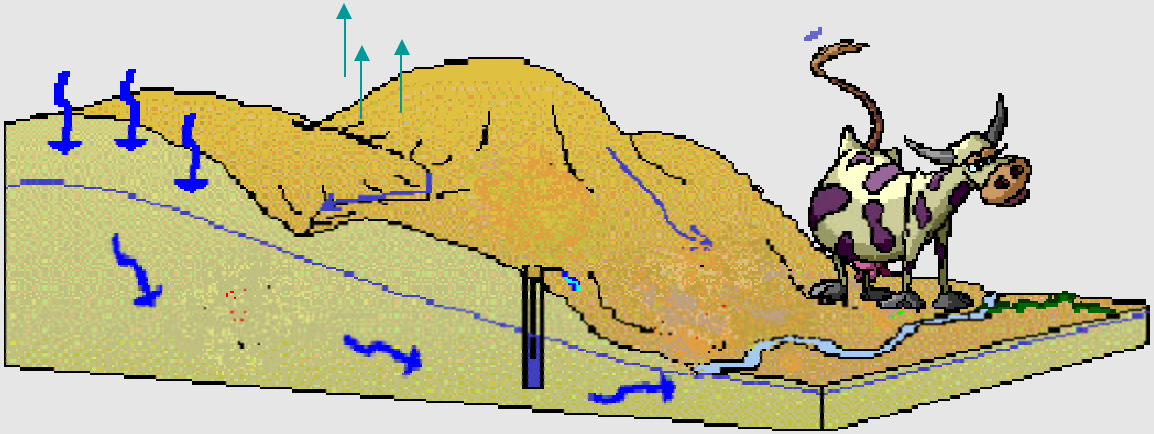
Appendix A

Modeling

Modeling - Bacteria

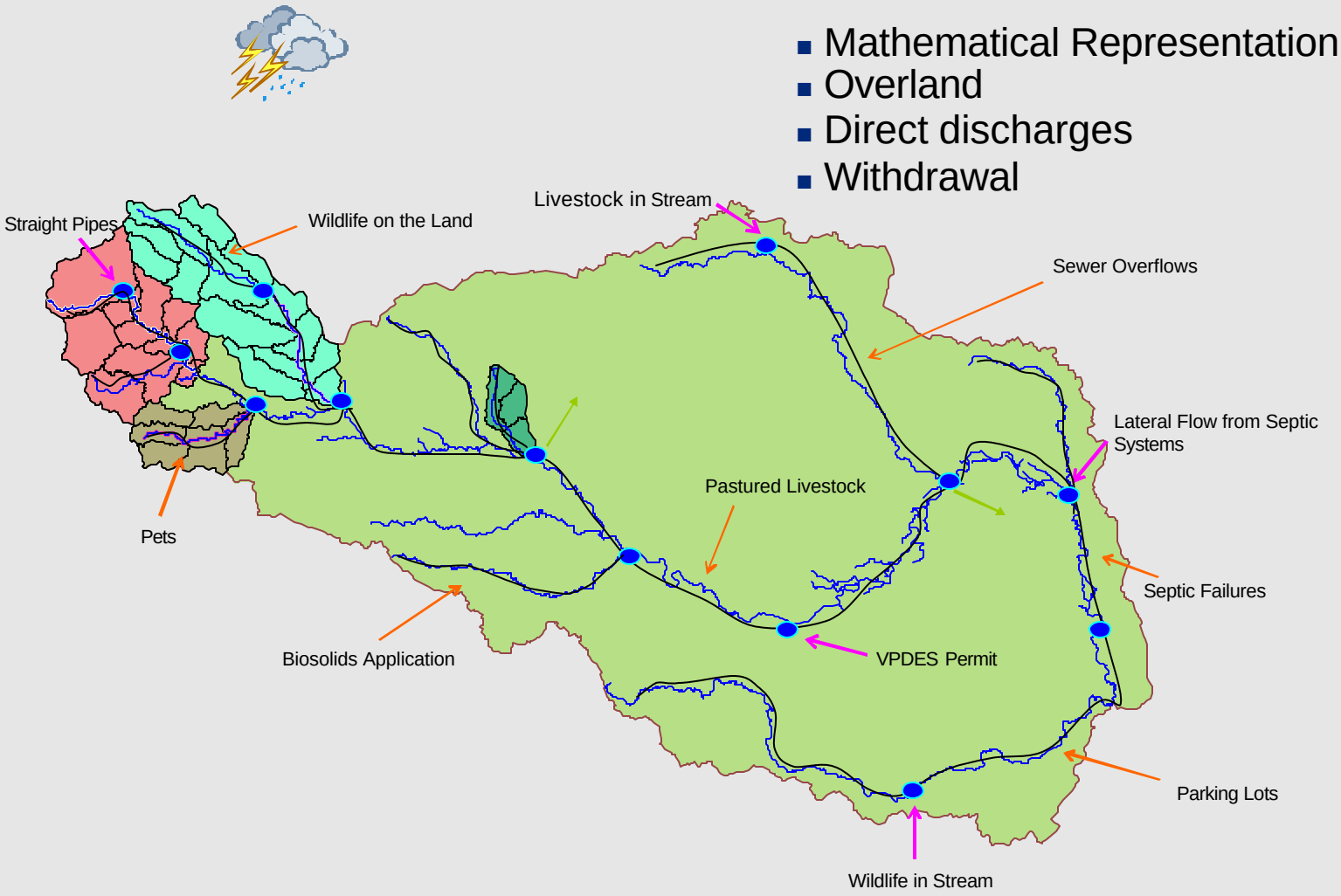
- Rainfall-Runoff-Water Quality
  - Hydrologic Simulation Program – Fortran (HSPF)
    - Watershed-based
    - Continuous time interval
    - Land-applied, direct loads





Conceptual Model

- Mathematical Representation
- Overland
- Direct discharges
- Withdrawal



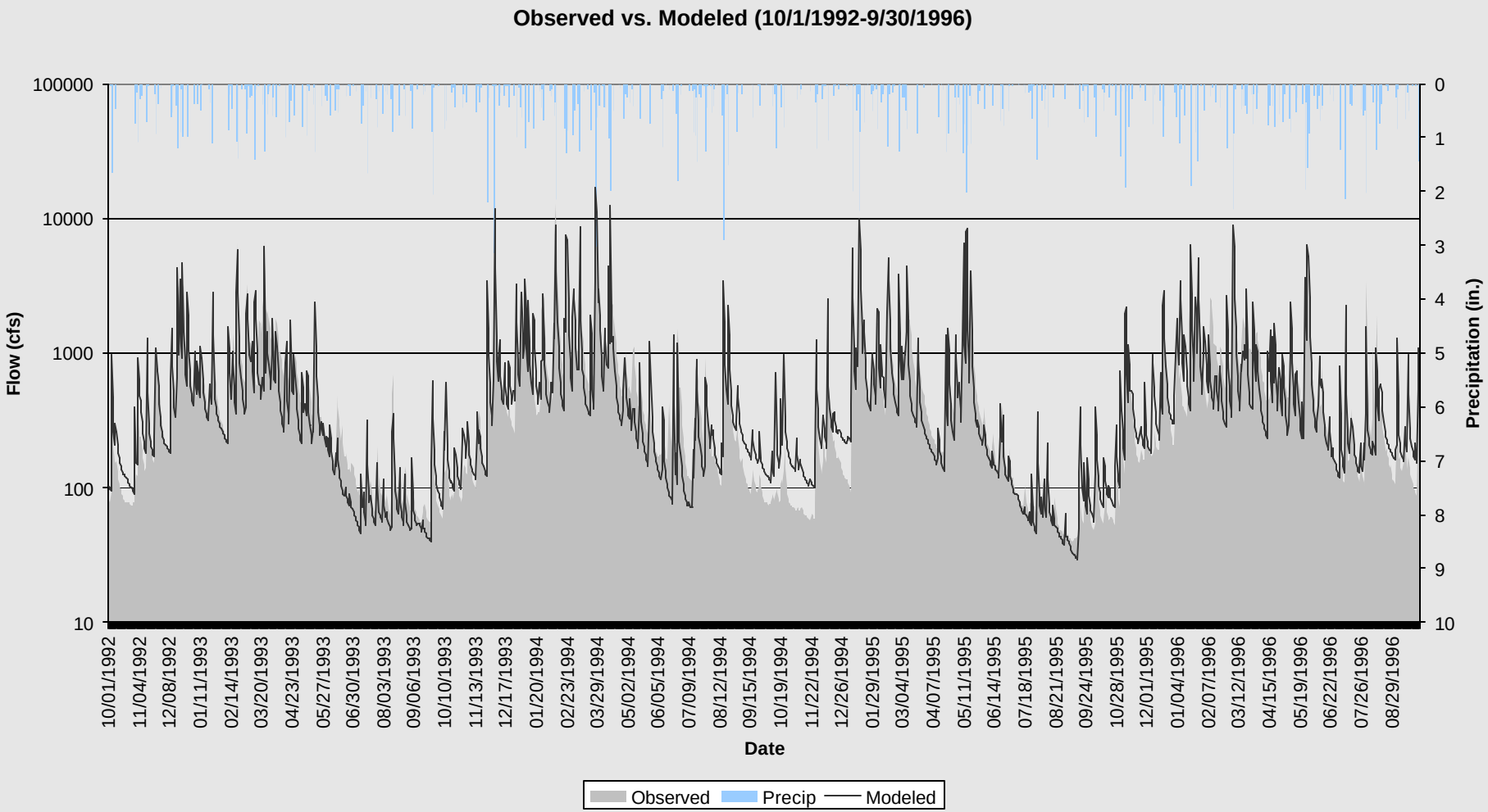
Modeling – Sediment and PAH's

- Rainfall-Runoff-Water Quality
  - Generalized Watershed Loading Function (GWLF)
    - Watershed-based
    - Daily Flow and Sediment output
    - PAH's are modeled as a function of sediment

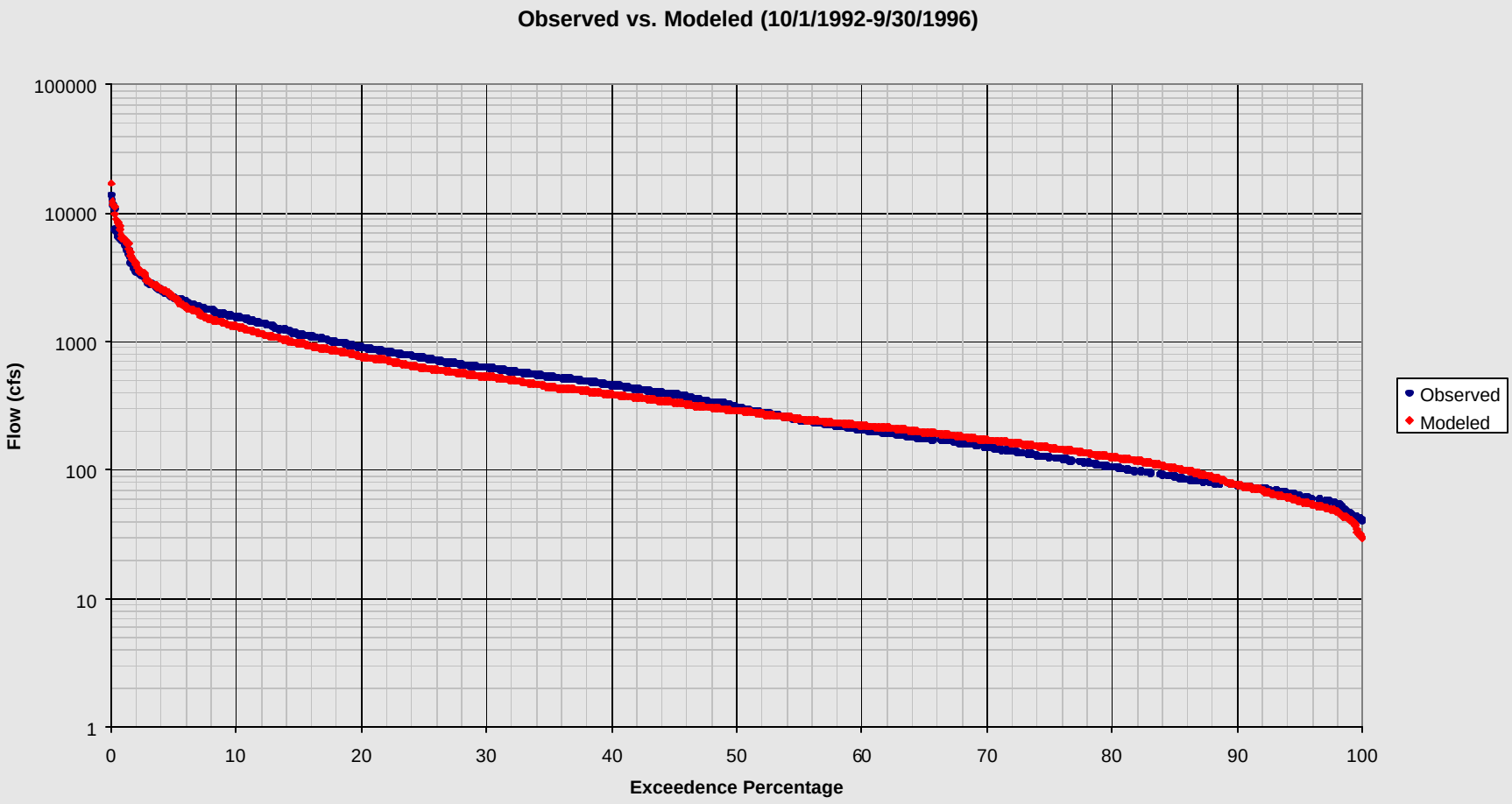
Hydrologic Modeling Components

- Climatic data
- Land use
- Topography
- Soils
- Stream channel characteristics
- Point source discharge/withdrawal
- Flow data

Hydrologic Calibration



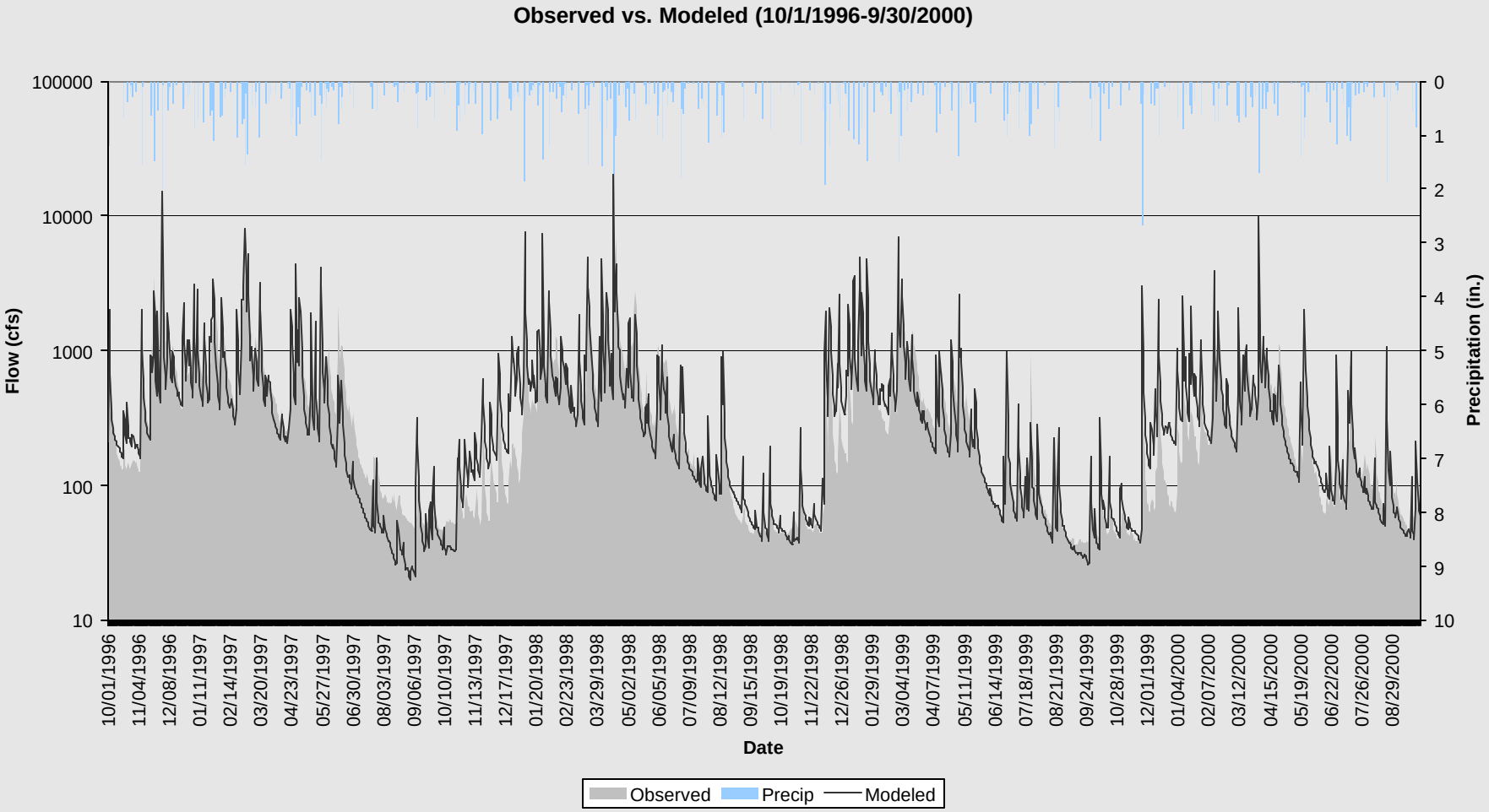
Hydrologic Calibration



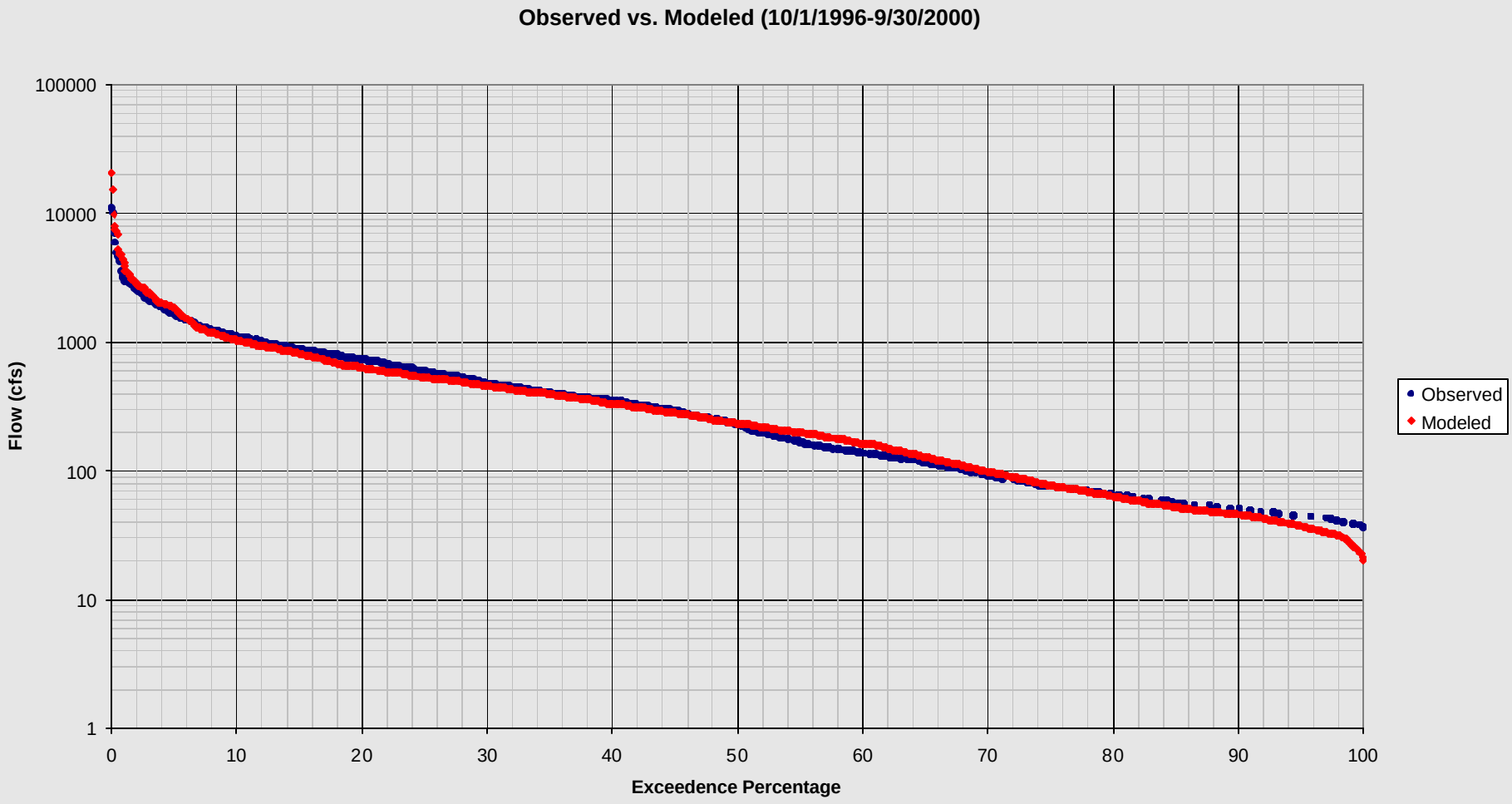
Hydrologic Calibration

	Observed	Modeled	Error	Target
Total In-stream Flow:	517.13	493.94	-4.48%	10.00%
Upper 10% Flow Values:	235.49	244.05	3.63%	15.00%
Lower 50% Flow Values:	55.54	59.75	7.58%	10.00%
Winter Flow Volume	273.01	243.56	-10.79%	30.00%
Spring Flow Volume	131.42	120.42	-8.37%	30.00%
Summer Flow Volume	39.98	40.82	2.10%	30.00%
Fall Flow Volume	72.72	89.15	22.59%	30.00%
Total Storm Volume	473.25	455.22	-3.81%	20.00%
Winter Storm Volume	262.13	233.95	-10.75%	50.00%
Spring Storm Volume	120.45	110.73	-8.07%	50.00%
Summer Storm Volume	29.03	31.19	7.44%	50.00%
Fall Storm Volume	61.64	79.35	28.73%	50.00%

Hydrologic Validation



Hydrologic Validation



Hydrologic Validation

	Observed	Modeled	Error	Target
Total In-stream Flow:	373.60	386.77	3.53%	10.00%
Upper 10% Flow Values:	164.96	188.94	14.54%	15.00%
Lower 50% Flow Values:	36.44	38.85	6.62%	10.00%
Winter Flow Volume	168.36	180.79	7.38%	30.00%
Spring Flow Volume	126.40	113.42	-10.27%	30.00%
Summer Flow Volume	22.10	19.91	-9.90%	30.00%
Fall Flow Volume	56.74	72.65	28.04%	30.00%
Total Storm Volume	341.39	361.55	5.90%	20.00%
Winter Storm Volume	160.40	174.53	8.81%	50.00%
Spring Storm Volume	118.36	107.11	-9.51%	50.00%
Summer Storm Volume	14.00	13.63	-2.71%	50.00%
Fall Storm Volume	48.62	66.27	36.30%	50.00%

Water Quality Modeling Components

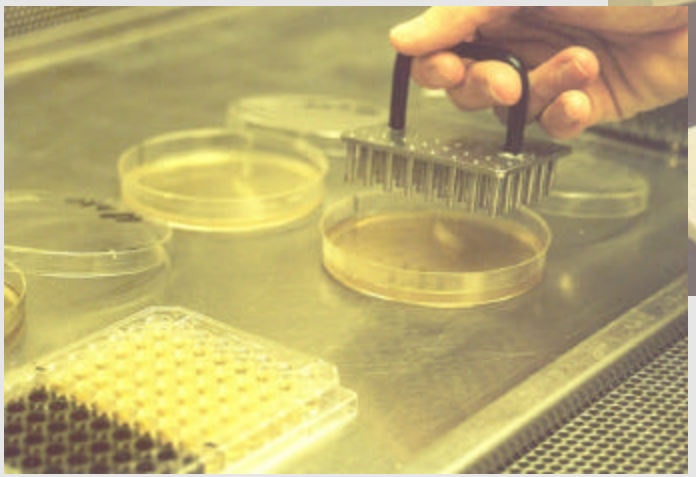
- Sources
  - Fecal production
  - FC densities
  - FC distribution
- Delivery Mechanisms
  - Direct
  - Land-applied
- Temporal Variation

Appendix B

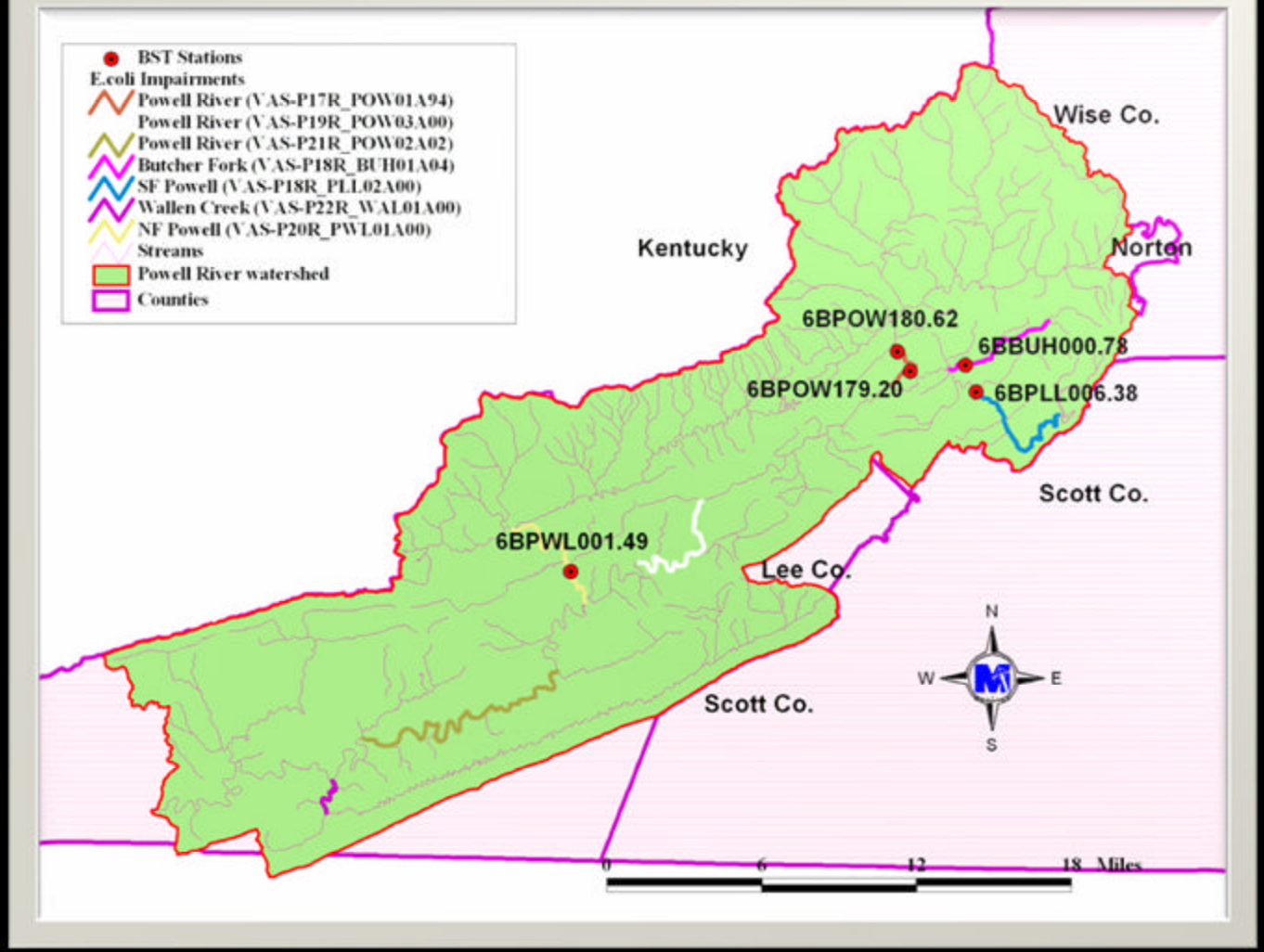
Bacterial Source Tracking

Bacterial Source Tracking

- Antibiotic Resistance Analysis (ARA)
  - Differentiates the sources of bacteria based on bacterial resistance to antibiotics



Bacterial Source Tracking Stations



Bacterial Source Tracking Results - 6BPOW179.20

Date	Number of Isolates	E. coli[1] (cfu/100 ml)	Percent Isolates classified as:			
			Wildlife	Human	Livestock	Pet
7/21/2003	24	210	**17%**	4%	**46%**	**33%**
8/20/2003	24	610	**12%**	**55%**	8%	**25%**
9/17/2003	24	2,000	**51%**	**12%**	**25%**	12%
10/15/2003	24	670	**84%**	4%	8%	4%
11/17/2003	24	460	**29%**	0%	**71%**	0%
12/16/2003	24	156	**17%**	**37%**	**17%**	**29%**
1/12/2004	24	134	**12%**	**71%**	0%	**17%**
2/17/2004	24	158	0%	**75%**	**21%**	4%
3/17/2004	24	580	**80%**	8%	8%	4%
4/20/2004	10	130	**20%**	20%	10%	**50%**
5/12/2004	1	1	**100%**	0%	0%	0%
6/21/2004	24	290	0%	**71%**	8%	**21%**

Bacterial Source Tracking Results - 6BPOW180.62

Date	Number of Isolates	E. coli[1] (cfu/100 ml)	Percent Isolates classified as:			
			Wildlife	Human	Livestock	Pet
7/21/2003	24	270	**12%**	8%	**59%**	**21%**
8/20/2003	24	200	**12%**	**59%**	12%	**17%**
9/17/2003	16	190	**19%**	**25%**	**50%**	6%
10/15/2003	24	1,600	**67%**	8%	**25%**	0%
11/17/2003	24	320	**12%**	0%	**88%**	0%
12/16/2003	24	138	4%	**71%**	8%	**17%**
1/12/2004	24	170	**50%**	**38%**	4%	8%
2/17/2004	24	610	**29%**	**25%**	**17%**	**29%**
3/17/2004	24	154	**54%**	**25%**	**21%**	0%
4/20/2004	24	300	**50%**	**25%**	**25%**	0%
5/12/2004	24	360	**25%**	**29%**	0%	**46%**
6/21/2004	24	460	4%	**63%**	12%	**21%**

Bacterial Source Tracking Results - 6BPWL001.49

Date	Number of Isolates	E. coli[1] (cfu/100 ml)	Percent Isolates classified as[2]:			
			Wildlife	Human	Livestock	Pet
7/21/2003	24	250	**38%**	**33%**	12%	**17%**
8/20/2003	24	320	**51%**	**12%**	**33%**	4%
9/17/2003	20	180	**35%**	**20%**	**45%**	0%
10/15/2003	24	1700	**12%**	**29%**	**47%**	12%
11/17/2003	24	480	**25%**	0%	**63%**	12%
12/16/2003	24	48	**42%**	**21%**	**25%**	12%
1/12/2004	13	20	**38%**	**47%**	15%	0%
2/17/2004	24	120	8%	**46%**	**25%**	**21%**
3/17/2004	24	126	8%	**58%**	**17%**	**17%**
4/20/2004	24	540	**59%**	**25%**	12%	4%
5/12/2004	24	120	**12%**	0%	**42%**	**46%**
6/21/2004	23	250	4%	**57%**	**17%**	**22%**

Bacterial Source Tracking

Data from two stations will be available at the end of the year

6BPLL006.38 on SF Powell River

6BBUH000.76 on Butcher Fork