APPENDIX A

Land Use Distribution in the North Fork Forked Deer River Watershed

Table A-1. MRLC Land Use Distribution of North Fork Forked Deer River Subwatersheds

Land Use	HUC-12 Subwatershed (08010204____) or Drainage Area (DA)					
	0201		0203		0204	
	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	28	0.1	0	0.0
Deciduous Forest	3193	7.8	974	2.2	738	2.4
Evergreen Forest	322	0.8	56	0.1	85	0.3
High Intensity Commercial/Industrial/Transp.	261	0.6	47	0.1	24	0.1
High Intensity Residential	262	0.6	60	0.1	0	0.0
Low Intensity Residential	1344	3.3	193	0.4	27	0.1
Mixed Forest	1722	4.2	737	1.7	822	2.7
Open Water	523	1.3	1599	3.6	174	0.6
Other Grasses (Urban/recreation; e.g. parks)	93	0.2	4	0.0*	0	0.0
Pasture/Hay	12951	31.8	9468	21.3	14557	47.4
Row Crops	17665	43.4	22050	49.5	13896	45.2
Small Grains	348	0.9	32	0.1	0	0.0
Transitional	21	0.1	27	0.1	6	0.0
Woody Wetlands	2034	5.0	9259	20.8	389	1.3
Total	40740	100.0	44534	100.0	30720	100.0

* <0.05

Table A-1. MRLC Land Use Distribution of North Fork Forked Deer River Subwatersheds (Cont.)

Land Use	HUC-12 Subwatershed (08010204__) or Drainage Area (DA)							
	0306		0402		0403		0404	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Bare Rock/Sand/Clay	0	0.0	0	0.0	18	0.0*	0	0.0
Deciduous Forest	758	4.0	1117	10.4	1518	3.4	4204	10.0
Evergreen Forest	25	0.1	66	0.6	139	0.3	320	0.8
High Intensity Commercial/Industrial/Transportatio	91	0.5	430	4.0	345	0.8	958	2.3
High Intensity Residential	33	0.2	564	5.3	56	0.1	554	1.3
Low Intensity Residential	120	0.6	1207	11.3	220	0.5	1391	3.3
Mixed Forest	244	1.3	603	5.6	741	1.7	2666	6.3
Open Water	28	0.1	298	2.8	375	0.8	186	0.4
Other Grasses (Urban/recreational; e.g. parks law	54	0.3	164	1.5	53	0.1	186	0.4
Pasture/Hay	6389	33.4	1889	17.6	8898	20.1	13713	32.6
Row Crops	11338	59.3	4145	38.7	30256	68.3	17831	42.4
Small Grains	0	0.0	0	0.0	69	0.2	0	0.0
Transitional	0	0.0	40	0.4	101	0.2	69	0.2
Woody Wetlands	36	0.2	201	1.9	1534	3.5	0	0.0
Total	19118	100.0	10724	100.0	44323	100.0	42078	100.0

* <0.05

Table A-1. MRLC Land Use Distribution of North Fork Forked Deer River Subwatersheds (Cont.)

Land Use	HUC-12 Subwatershed (08010204____) or Drainage Area (DA)							
	Dry Creek DA		Beech Creek DA		Davis Creek DA		Tucker Creek DA	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Deciduous Forest	1422	33.8	583	6.8	416	2.6	70	2.3
Evergreen Forest	284	6.7	72	0.8	42	0.3	2	0.1
High Intensity Commercial/Industrial/Transp.	2	0.0*	2	0.0*	15	0.1	20	0.7
High Intensity Residential	0	0.0	0	0.0	0	0.0	0	0.0
Low Intensity Residential	3	0.1	0	0.0	8	0.1	22	0.7
Mixed Forest	359	8.5	332	3.9	457	2.9	33	1.1
Open Water	3	0.1	30	0.4	62	0.4	2	0.1
Other Grasses (Urban/recreation; e.g. parks)	0	0.0	0	0.0	0	0.0	1	0.0*
Pasture/Hay	743	17.7	2716	31.7	7349	46.5	573	18.9
Row Crops	1359	32.3	4744	55.4	7453	47.2	2242	74.0
Small Grains	0	0.0	55	0.6	0	0.0	64	2.1
Transitional	1	0.0*	6	0.1	2	0.0*	0	0.0
Woody Wetlands	35	0.8	22	0.3	0	0.0	0	0.0
Total	4211	100.0	8563	100.0	15806	100.0	3029	100.0

* <0.05

Table A-1. MRLC Land Use Distribution of North Fork Forked Deer River Subwatersheds (Cont.)

Land Use	HUC-12 Subwatershed (08010204____) or Drainage Area (DA)							
	Jones Creek DA		Light Creek DA		Bethel Branch DA		Harris Creek DA	
	[acres]	[%]	[acres]	[%]	[acres]	[%]	[acres]	[%]
Deciduous Forest	592	6.2	869	7.4	592	4.6	167	3.4
Evergreen Forest	73	0.8	45	0.4	23	0.2	5	0.1
High Intensity Commercial/Industrial/Transp.	206	2.2	123	1.1	11	0.1	80	1.6
High Intensity Residential	66	0.7	8	0.1	7	0.1	29	0.6
Low Intensity Residential	170	1.8	64	0.5	47	0.4	107	2.2
Mixed Forest	255	2.7	424	3.6	194	1.5	48	1.0
Open Water	48	0.5	6	0.1	46	0.4	5	0.1
Other Grasses (Urban/recreation; e.g. parks)	49	0.5	3	0.0*	0	0.0	57	1.1
Pasture/Hay	3607	38.0	3930	33.7	4143	32.5	1587	32.1
Row Crops	4419	46.6	6200	53.1	7443	58.4	2862	57.9
Transitional	6	0.1	2	0.0*	2	0.0*	0	0.0
Woody Wetlands	0	0.0	0	0.0	246	1.9	0	0.0
Total	9490	100.0	11674	100.0	12754	100.0	4948	100.0

* <0.05

APPENDIX B

Water Quality Monitoring Data

There are a number of water quality monitoring stations that provide data for waterbodies identified as impaired for E. coli in the North Fork Forked Deer River watershed. The location of these monitoring stations is shown in Figure 5. Monitoring data recorded at these stations for E. coli are tabulated in Table B-1.

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed

Monitoring Station	Date	E. Coli [CFU/100 mL]
BEECH001.8CK	6/16/1999	206.3
	8/12/1999	131.3
	11/12/2002	**1233**
	1/14/2003	13.4
	3/11/2003	14.8
BETHE001.8DY	6/15/1999	80.8
	8/11/1999	36.4
	7/11/2002	**>2419.2**
	8/8/2002	20
	9/5/2002	86.5
	9/12/2002	61.3
	9/19/2002	139.6
	9/26/2002	**1299.7**
	10/3/2002	37.9
	10/10/2002	**>2419.2**
	10/17/2002	111.2
	10/24/2002	116.9
	11/7/2002	**>2419.2**
	1/9/2003	79.8
	2/13/2003	201.4
	3/6/2003	238.2
	4/3/2003	146.7
	4/10/2003	**1732.9**
	4/16/2003	103.9
	4/24/2003	**1483**
	5/15/2003	131.3
	5/22/2003	387.3
	5/29/2003	74.9
	6/5/2003	203.5

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
BETHE004.2GI	7/11/2002	**>2419.2**
	8/8/2002	30
	9/5/2002	178.2
	9/12/2002	344.8
	9/19/2002	101.7
	9/26/2002	**>2419.2**
	10/3/2002	64.4
	10/10/2002	**>2419.2**
	10/17/2002	387.3
	10/24/2002	111.2
	11/7/2002	**>2419.2**
	1/9/2003	148.3
	2/13/2003	166.9
	3/6/2003	218.7
	4/3/2003	106.7
	4/10/2003	**1986.3**
	4/16/2003	67
	4/24/2003	776
	5/15/2003	218.7
	5/22/2003	488.4
	5/29/2003	143.9
	6/5/2003	248.9
BETHE006.1GI	7/11/2002	**>2419.2**
	8/8/2002	560
	9/5/2002	328.2
	9/12/2002	547.5
	9/19/2002	**980.4**
	9/26/2002	**9804**
	10/3/2002	**1119.9**
	10/10/2002	**>24192**
	10/17/2002	547.5
	11/7/2002	**>2419.2**
	1/9/2003	**1413.6**
	2/13/2003	770.1
	3/6/2003	410.6
	4/3/2003	**1119.9**
	4/10/2003	155.1
	4/16/2003	142.1

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
BETHE006.1GI	4/24/2003	**6867**
	5/15/2003	517.2
	5/22/2003	387.3
	5/29/2003	686.7
	6/5/2003	**>2419.2**
BUCK001.2GI	4/14/1998	**1413.6**
	4/15/1998	579.4
	4/16/1998	**4366**
	7/21/1998	38.8
	7/22/1998	167.8
	7/23/1998	44.8
	7/9/2002	177.7
	8/6/2002	91
	9/3/2002	307.6
	9/10/2002	140.1
	9/17/2002	**1299.7**
	9/24/2002	69.7
	10/1/2002	209.8
	10/8/2002	290.9
	10/15/2002	74.3
	12/22/2002	131.3
	11/5/2002	**>2419.2**
	12/3/2002	57.3
	1/7/2003	65
	2/4/2003	**5475**
	3/4/2003	51.2
	4/1/2003	55.4
	4/8/2003	**980.4**
	4/15/2003	117.8
	4/22/2003	**>2419.2**
	5/13/2003	65.7
	5/20/2003	78.9
	5/27/2003	123.6
	6/3/2003	185

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
BUCK007.7GI	10/1/2002	**1413.6**
	10/15/2002	613.1
	10/22/2002	172.3
	11/5/2002	**>24192**
	1/7/2003	93.3
	2/4/2003	**1785**
	3/4/2003	25.9
	4/1/2003	65
	4/8/2003	613.1
	4/15/2003	488.4
	4/22/2003	**>2419.2**
	5/13/2003	410.6
	5/20/2003	10.7
	5/27/2003	235.9
	6/3/2003	461.1
DAVIS000.9GI	7/9/2002	58.6
	8/6/2002	201.2
	9/3/2002	36.4
	9/10/2002	488.4
	9/17/2002	648.8
	9/24/2002	73.8
	10/1/2002	172.3
	10/8/2002	122.3
	10/22/2002	54.6
	11/5/2002	**>2419.2**
	12/3/2002	131.3
	1/7/2003	88.2
	2/4/2003	**5172**
	3/4/2003	30.1
	4/1/2003	95.9
	4/8/2003	290.9
	4/15/2003	161.6
	4/22/2003	261.3
	5/13/2003	189.2
	5/20/2003	261.3
	5/27/2003	93.3
	6/3/2003	344.8
	7/9/2002	58.6

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
DAVIS002.5GI	7/9/2002	164.8
	8/6/2002	275.5
	9/3/2002	178.5
	9/10/2002	122.3
	9/17/2002	**>2419.2**
	9/24/2002	216
	10/1/2002	90.6
	10/8/2002	579.4
	10/15/2002	172.3
	10/22/2002	387.3
	11/5/2002	**8164**
	12/3/2002	57.3
	1/7/2003	142.1
	2/4/2003	**2282**
	3/4/2003	80.9
	4/1/2003	193.5
	4/8/2003	387.3
	4/15/2003	155.3
	4/22/2003	111.2
	5/13/2003	135.4
	5/20/2003	261.3
	5/27/2003	**1553.1**
	6/3/2003	**1413.6**
DOAKV002.0DY	4/20/1999	**980.4**
	4/21/1999	816.2
	7/11/2002	**>2419.2**
	8/8/2002	**1130**
	9/5/2002	41.3
	9/12/2002	**1299.7**
	9/19/2002	206.3
	9/26/2002	74
	10/3/2002	70.6
	10/10/2002	**>2419.2**
	10/17/2002	40.8
	10/24/2002	48
	12/24/2002	58.6
	11/7/2002	**>2419.2**
	1/9/2003	166.9

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
DOAKV002.0DY	2/13/2003	365.4
	3/6/2003	160.7
	4/3/2003	613.1
	4/10/2003	**1986.3**
	4/16/2003	410.6
	4/24/2003	910
	5/15/2003	90.9
	5/22/2003	161.6
	5/29/2003	95.9
	6/5/2003	103.9
DOAKV005.4DY	7/11/2002	**>2419.2**
	8/8/2002	475
	9/5/2002	770.1
	9/12/2002	160.7
	9/19/2002	344.8
	9/26/2002	**1986.3**
	10/3/2002	275.5
	10/10/2002	**>2419.2**
	10/17/2002	613.1
	10/24/2002	686.7
	11/7/2002	**1986.3**
	1/9/2003	344.8
	2/13/2003	727
	3/6/2003	228.2
	4/3/2003	686.7
	4/10/2003	**1299.7**
	4/16/2003	228.2
	4/24/2003	**9208**
	5/15/2003	435.2
	5/22/2003	410.6
	5/29/2003	727
	6/5/2003	191.8

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
DRY000.3MN	6/17/1999	**>2419.2**
	12/10/2002	121
	2/11/2003	62
	6/10/2003	344.8
HARRI001.9DY	7/11/2002	**>2419.2**
	10/10/2002	**>2419.2**
	10/17/2002	68.3
	10/24/2002	218.7
	11/7/2002	**>2419.2**
	1/9/2003	**1299.7**
	2/13/2003	105
	3/6/2003	290.9
	4/3/2003	613.1
	4/10/2003	**1553.1**
	4/16/2003	435.2
	4/24/2003	**>24192**
	5/15/2003	547.5
	5/22/2003	172.6
	5/29/2003	344.8
	6/5/2003	148.3
JONES003.8DY	7/17/2002	128.1
	8/14/2002	**>24192**
	11/13/2002	**>2419.2**
	12/11/2002	148
	1/15/2003	116.9
	2/12/2003	933
	3/12/2003	131.7
	6/11/2003	**>2419.2**
LEWIS000.3DY	7/17/2002	579.4
	8/14/2002	**>24192**
	11/13/2002	105.8
	12/11/2002	495
	1/15/2003	74.2
	2/12/2003	**5475**
	3/12/2003	118.6
	6/11/2003	**>2419.2**

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
LEWIS002.5DY	7/17/2002	8.5
	8/14/2002	**>24192**
	11/13/2002	25.9
	12/11/2002	201
	1/15/2003	35
	2/12/2003	663
	3/12/2003	50.4
	6/11/2003	**>2419.2**
LEWIS007.9DY	8/14/2002	**12033**
	11/13/2002	22.8
	12/11/2002	364
	1/15/2003	152.9
	2/12/2003	**12033**
	3/12/2003	44.8
	6/11/2003	**>2419.2**
LIGHT002.2DY	7/17/2002	**>2419.2**
	8/14/2002	**>24192**
	11/13/2002	52
	12/11/2002	243
	1/15/2003	45.7
	2/12/2003	470
	3/12/2003	387.5
	6/11/2003	**>2419.2**
MFFDE014.6CK	6/16/1999	**1986.2**
	8/11/1999	41.1
	7/16/2002	**517.2**
	11/12/2002	**1153**
	1/14/2003	30.9
	3/11/2003	14.2
MFFDE021.5GI	4/14/1998	34.5
	4/15/1998	**>2419.2**
	4/16/1998	86
	7/21/1998	**>2419.2**
	7/22/1998	**1732.9**
	7/23/1998	143.9
	7/16/2002	328.2

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
MFFDE021.5GI	11/12/2002	**1467**
	1/14/2003	93.4
	3/11/2003	33.6
NFFDE007.3DY	4/14/1998	**1119.9**
	4/15/1998	206.3
	4/16/1998	613.1
	7/21/1998	37.3
	7/22/1998	63.1
	7/23/1998	46.4
	9/28/1998	58.1
	12/16/1998	648.8
	3/24/1999	27.2
	6/9/1999	98.4
	9/28/1999	57.8
	12/1/1999	29.5
	3/30/2000	117.4
	6/20/2000	410.6
	9/6/2000	12.1
	12/14/2000	1
	3/13/2001	**>2419.2**
	6/27/2001	30.1
	9/12/2001	74.8
	12/17/2001	**1732.9**
	3/12/2002	**1842**
	6/18/2002	240
	9/24/2002	547.5
	12/16/2002	157.6
	3/25/2003	129.1
	6/19/2003	686.7
	9/16/2003	195.6
	12/11/2003	**>2419.2**
	3/18/2004	240
	6/8/2004	86.5
	9/27/2004	120
	12/15/2004	65.7

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
POND001.1DY	6/15/1999	**1413.6**
	7/10/2002	410.6
	8/7/2002	61.8
	9/4/2002	14.3
	9/11/2002	22.6
	9/18/2002	123.6
	9/25/2002	103.4
	10/2/2002	59.4
	10/9/2002	517.2
	10/16/2002	51.2
	10/23/2002	95.9
	11/6/2002	**>2419.2**
	12/4/2002	186
	1/8/2003	52.1
	2/5/2003	839
	3/5/2003	24.6
	4/2/2003	69.7
	4/9/2003	613.1
	4/16/2003	51.2
	4/23/2003	246
	5/14/2003	41
	5/21/2003	74
	5/28/2003	178.2
	6/4/2003	195.1
POND007.4DY	7/10/2002	107.1
	8/7/2002	**>2419.2**
	9/4/2002	307.6
	9/18/2002	45.5
	9/25/2002	163.1
	10/2/2002	275.5
	10/9/2002	38.4
	10/16/2002	184.2
	10/23/2002	39.3
	11/6/2002	**>2419.2**
	12/4/2002	325.5
	1/8/2003	68.9
	2/5/2003	909
	3/5/2003	178.9

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
POND007.4DY	4/2/2003	114.5
	4/9/2003	547.5
	4/16/2003	155.3
	4/23/2003	520
	5/14/2003	146
	5/21/2003	933
	5/28/2003	43.5
	6/4/2003	77.6
POND011.3DY	8/7/2002	**1203.3**
	9/4/2002	6.3
	9/18/2002	137.1
	9/25/2002	89.1
	10/2/2002	547.5
	10/9/2002	52.9
	10/16/2002	190.4
	10/23/2002	65.7
	11/6/2002	**>2419.2**
	12/4/2002	307.6
	1/8/2003	111.9
	2/5/2003	452
	3/5/2003	13.5
	4/2/2003	32.7
	4/9/2003	166.9
	4/16/2003	38.2
	4/23/2003	422
	5/14/2003	218
	5/21/2003	**1860**
	5/28/2003	40.8
	6/4/2003	153.9
POND012.9CK	8/7/2002	41
	9/4/2002	18.9
	9/11/2002	**>2419.2**
	9/18/2002	**1607**
	9/25/2002	248
	10/2/2002	613.1
	10/9/2002	67.6
	10/16/2002	275.5

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
POND012.9CK	10/23/2002	135.4
	11/2/2002	**>2419.2**
	12/4/2002	260.2
	1/8/2003	75.4
	2/5/2003	728
	3/5/2003	24.9
	4/2/2003	40.4
	4/9/2003	156.5
	4/16/2003	20.1
	4/23/2003	359
	5/14/2003	296
	5/21/2003	**3255**
	5/28/2003	66.9
	6/4/2003	290.9
POND014.9CK	8/7/2002	91.2
	10/2/2002	**1413.6**
	10/9/2002	816.4
	10/16/2002	218.7
	11/6/2002	**>2419.2**
	12/4/2002	48.8
	1/8/2003	44.8
	2/5/2003	**1497**
	3/5/2003	30.5
	4/2/2003	38.8
	4/9/2003	166.4
	4/16/2003	166.9
	4/23/2003	**1354**
	5/14/2003	146
	5/21/2003	**4884**
	5/28/2003	42.2
	6/4/2003	111.2
TUCKE000.4CK	9/18/2002	**1119.9**
	10/9/2002	261.3
	10/16/2002	275.5
	10/23/2002	58.3
	11/6/2002	**>2419.2**
	12/4/2002	**1413.6**

Table B-1. Water Quality Monitoring Data – North Fork Forked Deer River Watershed (Cont.)

Monitoring Station	Date	E. Coli [CFU/100 mL]
TUCKE000.4CK	1/8/2003	33.1
	2/5/2003	**1664**
	3/5/2003	206.3
	4/2/2003	84.2
	4/9/2003	272.3
	4/16/2003	93.3
	4/23/2003	408
	5/14/2003	256
	5/21/2003	**4884**
	5/28/2003	387.3
	6/4/2003	131.3

APPENDIX C

Load Duration Curve Development and Determination of Required Load Reductions

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS) that takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma \text{ WLAs} + \Sigma \text{ LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.

C.1 Development of TMDLs

E. coli TMDLs, WLAs, and LAs were developed for impaired subwatersheds in the North Fork Forked Deer River watershed using Load Duration Curves (LDCs) to determine the reduction in pollutant loading required to decrease existing, instream E. coli concentrations to target levels. TMDLs are expressed as required percent reductions in pollutant loading.

C.1.1 Development of Flow Duration Curves

A flow duration curve is a cumulative frequency graph, constructed from historic flow data at a particular location, that represents the percentage of time a particular flow rate is equaled or exceeded. Flow duration curves are developed for a waterbody from daily discharges of flow over a period of record. In general, there is a higher level of confidence that curves derived from data over a long period of record correctly represent the entire range of flow. The preferred method of flow duration curve computation uses daily mean data from U.S. Geological Survey (USGS) continuous-record stations located on the waterbody of interest. For ungaged streams, alternative methods must be used to estimate daily mean flow. These include: 1) regression equations (using drainage area as the independent variable) developed from continuous record stations in the same ecoregion; 2) drainage area extrapolation of data from a nearby continuous-record station of similar size and topography; and 3) calculation of daily mean flow using a dynamic computer model, such as the Loading Simulation Program C++ (LSPC).

Flow duration curves for impaired waterbodies in the North Fork Forked Deer River Watershed were derived from LSPC hydrologic simulations based on parameters derived from calibration at USGS Stations 07028960, Middle Fork Forked Deer River near Fairview, and 07029100, North Fork Forked Deer River at Dyersburg (see Appendix D for details of calibration). The data used, in each case, included the period of record from 1/1/95 – 12/31/04. For example, a flow-duration curve for North Fork Forked Deer River at mile 7.3 was constructed using simulated daily mean flow for the period from 1/1/95 through 12/31/04 (mile 7.3 corresponds to the location of monitoring station NFFDE007.3DY). This flow duration curve is shown in Figure C-1 and represents the cumulative distribution of daily discharges arranged to show percentage of time specific flows were exceeded during the period of record (the highest daily mean flow during this period is exceeded 0% of the time and the lowest daily mean flow is equaled or exceeded 100% of the time). Flow duration curves for other impaired waterbodies were derived using a similar procedure.

C.1.2 Development of Load Duration Curves and Determination of Required Load Reductions

When a water quality target concentration is applied to the flow duration curve, the resulting load duration curve (LDC) represents the allowable pollutant loading in a waterbody over the entire range of flow. Pollutant monitoring data, plotted on the LDC, provides a visual depiction of stream water quality as well as the frequency and magnitude of any exceedances. Load duration curve intervals can be grouped into several broad categories or zones, in order to provide additional insight about conditions and patterns associated with the impairment. For example, the duration curve could be divided into five zones: high flows (exceeded 0-10% of the time), moist conditions (10-40%), median or mid-range flows (40-60%), dry conditions (60-90%), and low flows (90-100%). Impairments observed in the low flow zone typically indicate the influence of point sources, while those further left on the LDC (representing zones of higher flow) generally reflect potential nonpoint source contributions (Stiles, 2003).

E. coli load duration curves for impaired waterbodies in the North Fork Forked Deer River Watershed were developed from the flow duration curves developed in Section C.1.1, E. coli target concentrations, and available water quality monitoring data. Load duration curves and required load reductions were developed using the following procedure (North Fork Forked Deer River at mile 7.3 [NFFD 7.3] is shown as an example):

1. A target load duration curve (LDC) was generated for NFFD River at mile 7.3 by applying the E. coli target concentration of 941 CFU/100 mL to each of the ranked flows used to generate the flow duration curve (ref.: Section C.1.1) and plotting the results. The E. coli target maximum load corresponding to each ranked daily mean flow is:

   $(\text{Target Load})_{\text{NFFD 7.3}}$ = (941 CFU/100 mL) x (Q) x (UCF)

   where: Q = daily mean flow
   UCF = the required unit conversion factor

2. Daily loads were calculated for each of the water quality samples collected at monitoring station NFFDE007.3DY (ref.: Table B-1) by multiplying the sample concentration by the daily mean flow for the sampling date and the required unit conversion factor. NFFDE007.3DY was selected for LDC analysis because it has numerous sampling points, well distributed across the full range of flow conditions, and multiple exceedances of the target concentration.

   Note: In order to be consistent for all analyses, the derived daily mean flow was used to compute sampling data loads, even if measured ("instantaneous") flow data was available for some sampling dates.

   Example (12/17/01 sampling event):
   Modeled Flow = 3323.93 cfs
   Concentration = 1732.9 CFU/100 mL
   Daily Load = 1.409×10^{14}

3. Using the flow duration curves developed in C.1.1, the "percent of days the flow was exceeded" (PDFE) was determined for each sampling event. Each sample load was then plotted on the load duration curves developed in Step 1 according to the PDFE. The resulting E. coli load duration curve for NFFD River at mile 7.3 is shown in Figure C-2.

4. For cases where the existing load exceeded the target maximum load at a particular PDFE, the reduction required to reduce the sample load to the target load was calculated.

Example (7/12/01 sampling event):
Target Concentration = 941 CFU/100 mL
Measured Concentration = 1732.9 CFU/100 mL
Reduction to Target = 45.7%

5. The 90th percentile value for all of the E. coli sampling data at NFFDE007.3DY monitoring site was determined. If the 90th percentile value exceeded the target maximum E. coli concentration, the reduction required to reduce the 90th percentile value to the target maximum concentration was calculated (Table C-1).

   Example: Target Concentration = 941 CFU/100 mL
   90th Percentile Concentration = 1672 CFU/100 mL
   Reduction to Target = 43.7%

6. For cases where five or more samples were collected over a period of not more than 30 consecutive days, the geometric mean E. coli concentration was determined and compared to the target geometric mean E. coli concentration of 126 CFU/100mL. If the sample geometric mean exceeded the target geometric mean concentration, the reduction required to reduce the sample geometric mean value to the target geometric mean concentration was calculated.

   Example: Insufficient monitoring data were available for NFFD River at Mile 7.3
   Sufficient data were available for Pond Creek at Mile 12.9
   Sampling Period = 9/11/02 – 10/9/02
   Geometric Mean Concentration > 525 CFU/100 mL
   Target Concentration = 126 CFU/100 mL
   Reduction to Target > 76.0%

   Note: One sample value, dated 9/11/02, in the above example was equal to >2419.2. Therefore, the geometric mean and reduction to target were expressed as greater than (>) their respective calculated values.

7. The load reductions required to meet the target maximum (Step 5) and target 30-day geometric mean concentrations (Step 6) of E. coli were compared and the load reduction of the greatest magnitude selected as the TMDL for NFFD River at mile 7.3.

Load duration curves, required load reductions, and TMDLs of other impaired waterbodies were derived in a similar manner and are shown in Figures C-1 through C-16 and Tables C-1 through C-15. Note that Figures C-4, C-5, C-10, and C-13 present E. coli samples on load duration curves for geometric mean analyses. The target lines represent 30-day geometric mean targets rather than daily maximum targets as in the standard load duration curve methodology. Individual samples cannot be compared to corresponding target values. Rather, the geometric mean of all samples is compared to the target concentration. The figures are presented for descriptive purposes.

C.2 Development of WLAs and LAs

As previously discussed, a TMDL can be expressed as the sum of all point source loads (WLAs), nonpoint source loads (LAs), and an appropriate margin of safety (MOS) that takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

Expanding the terms:

$$TMDL = [\Sigma WLAs]_{WWTF} + [\Sigma WLAs]_{MS4} + [\Sigma WLAs]_{CAFO} + [\Sigma LAs]_{DS} + [\Sigma LAs]_{SW} + MOS$$

For E. coli TMDLs in each impaired subwatershed, WLA terms include:

- $[\Sigma WLAs]_{WWTF}$ is the allowable load associated with discharges of NPDES permitted WWTFs located in impaired subwatersheds. Since NPDES permits for these facilities specify that treated wastewater must meet instream water quality standards at the point of discharge, no additional load reduction is required. WLAs for WWTFs are calculated from the facility design flow and the Monthly Average permit limit.

- $[\Sigma WLAs]_{CAFO}$ is the allowable load for all CAFOs in an impaired subwatershed. All wastewater discharges from a CAFO to waters of the state of Tennessee are prohibited, except when either chronic or catastrophic rainfall events cause an overflow of process wastewater from a facility properly designed, constructed, maintained, and operated to contain:
  - All process wastewater resulting from the operation of the CAFO (such as wash water, parlor water, watering system overflow, etc.); plus,
  - All runoff from a 25-year, 24-hour rainfall event for the existing CAFO or new dairy or cattle CAFOs; or all runoff from a 100-year, 24-hour rainfall event for a new swine or poultry CAFO.

  Therefore, a WLA of zero has been assigned to this class of facilities.

- $[\Sigma WLAs]_{MS4}$ is the required load reduction for discharges from MS4s. E. coli loading from MS4s is the result of buildup/wash-off processes associated with storm events.

LA terms include:

- $[\Sigma LAs]_{DS}$ is the allowable E. coli load from "other direct sources". These sources include leaking septic systems, illicit discharges, and animals access to streams. The LA specified for all sources of this type is zero CFU/day (or to the maximum extent feasible).

- $[\Sigma LAs]_{SW}$ represents the required reduction in E. coli loading from nonpoint sources indirectly going to surface waters from all land use areas (except areas covered by a MS4 permit) as a result of the buildup/wash-off processes associated with storm events (i.e., precipitation induced).

Since WWTFs discharge must comply with instream water quality criteria (TMDL target) at the point of discharge, $[WLAs]_{CAFO} = 0$, and $[LAs]_{DS} = 0$, the expression relating TMDLs to precipitation-based point and nonpoint sources may be simplified to:

$$TMDL - MOS = [WLAs]_{MS4} + [\Sigma LAs]_{SW}$$

WLAs for MS4s and LAs for precipitation-based nonpoint sources are equal and expressed as the percent reduction in loading required to decrease instream E. coli concentrations to TMDL target values minus MOS. As stated in Section 8.4, an explicit MOS, equal to 10% of the E. coli water quality targets (ref.: Section 5.0), was utilized for determination of the WLAs and LAs:

Instantaneous Maximum (lake, reservoir, State Scenic River, Tier II, and Tier III):

Target – MOS = (487 CFU/100 ml) – 0.1(487 CFU/100 ml)

Target – MOS = 438 CFU/100 ml

Instantaneous Maximum (other):

Target – MOS = (941 CFU/100 ml) – 0.1(941 CFU/100 ml)

Target – MOS = 847 CFU/100 ml

30-Day Geometric Mean:

Target – MOS = (126 CFU/100 ml) – 0.1(126 CFU/100 ml)

Target – MOS = 113 CFU/100 ml

C.2.1 Development of WLAs for MS4s and LAs for Precipitation-Based Nonpoint Sources

WLAs for MS4s and LAs for precipitation-based nonpoint sources were developed using methods similar to those described in Section C.1.2 (again, using NFFD River at mile 7.3 as an example):

8. An allocation LDC was generated for NFFD River at mile 7.3 by applying the E. coli "target – MOS" concentration of 847 CFU/100 mL to each of the ranked flows used to generate the flow duration curve (ref.: Section C.1.1) and plotting the results on the target LDC developed in Step 1. The E. coli target maximum allocated load corresponding to each ranked daily mean flow is:

   $(\text{Target Load – MOS})_{\text{NFFD 7.3}}$ = (847 CFU/100 mL) x (Q) x (UCF)

   where: Q = daily mean flow
   UCF = the required unit conversion factor

9. For cases where the existing load exceeded the "target maximum load – MOS" at a particular PDFE, the reduction required to reduce the sample load to the "target – MOS" load was calculated.

   Example – 12/17/01 sampling event:
   Target Concentration – MOS = 847 CFU/100 mL
   Measured Concentration = 1732.9 CFU/100 mL
   Reduction to Target – MOS = 51.1%

10. If the 90th percentile value for all of the E. coli sampling data at NFFDE007.3DY monitoring site (calculated in Step 5) exceeded the "target maximum – MOS" E. coli concentration, the reduction required to reduce the 90th percentile value to the "target maximum – MOS" concentration was calculated (Table C-5).

    Example: Target Concentration – MOS = 847 CFU/100 mL
    90th Percentile Concentration = 1672 CFU/100 mL
    Reduction to Target – MOS = 49.3%

11. For cases where five or more samples were collected over a period of not more than 30 consecutive days, the geometric mean E. coli concentration was determined and compared to the "target geometric mean E. coli concentration – MOS" of 113 CFU/100 mL. If the sample geometric mean exceeded the "target geometric mean – MOS" concentration, the reduction required to reduce the sample geometric mean value to the "target geometric mean – MOS" concentration was calculated.

    Example: Insufficient monitoring data were available for NFFD River at Mile 7.3
    Sufficient data were available for Pond Creek at Mile 12.9
    Sampling Period = 9/11/02 – 10/9/02
    Geometric Mean Concentration > 525 CFU/100 mL
    Target Concentration – MOS = 113 CFU/100 mL
    Reduction to Target – MOS = 78.5%

    Note: One sample value, dated 9/11/02, in the above example was equal to >2419.2. Therefore, the geometric mean and reduction to "target – MOS" were expressed as greater than (>) their respective calculated values.

12. The load reductions required to meet the "target maximum – MOS" (Step 10) and "target 30-day geometric mean – MOS" concentrations (Step 11) of E. coli were compared and the load reduction of the greatest magnitude selected as the WLA for MS4s and/or LA for precipitation-based nonpoint sources for NFFD River at mile 7.3.

Load duration curves, required load reductions, WLAs for MS4s, and LAs for precipitation-based nonpoint sources of other impaired waterbodies were derived in a similar manner and are shown in Figures C-2 through C-16 and Tables C-1 through C-15. For waterbodies with multiple water quality monitoring stations and/or sufficient data for calculating 90th percentile and geometric mean reductions, only results for the most protective (largest percent) reductions are presented. TMDLs, WLAs, & LAs for impaired subwatersheds in the North Fork Forked Deer River Watershed are summarized in Table C-16.

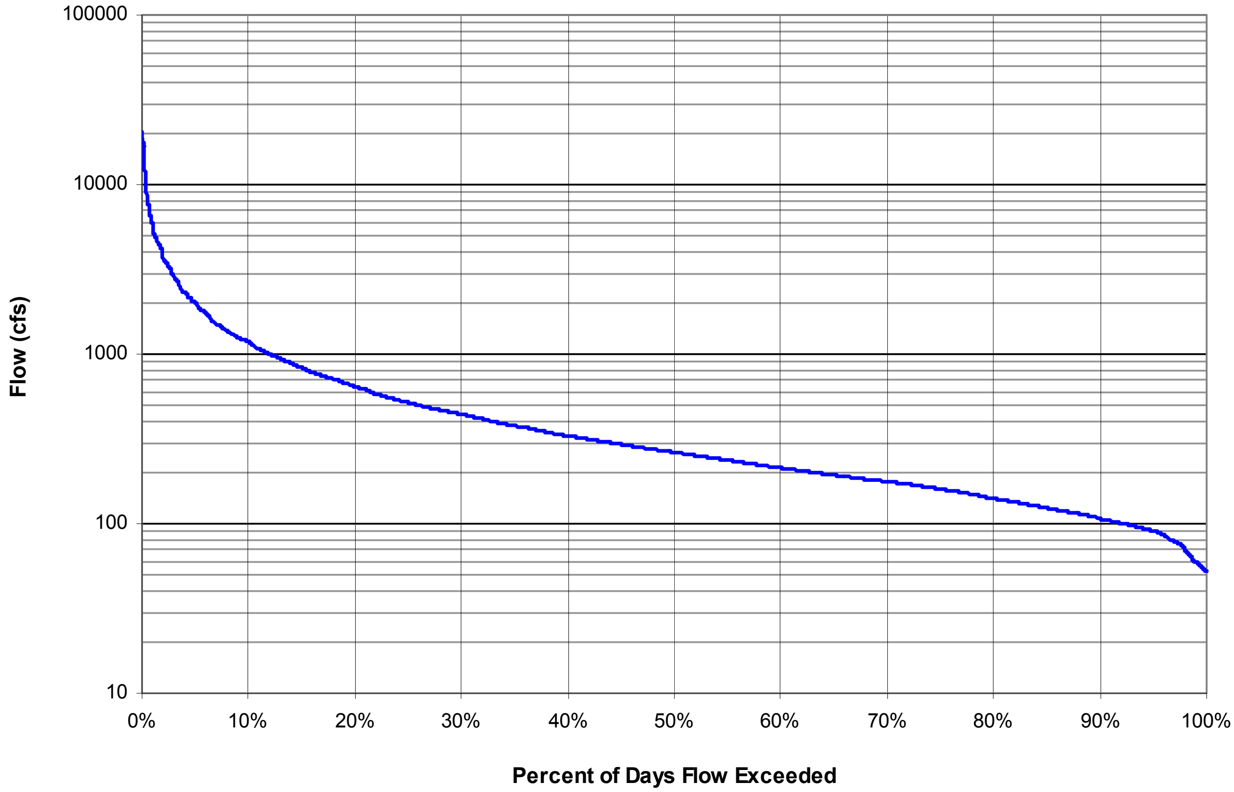

Figure C-1. Flow Duration Curve for North Fork Forked Deer River at Mile 7.3

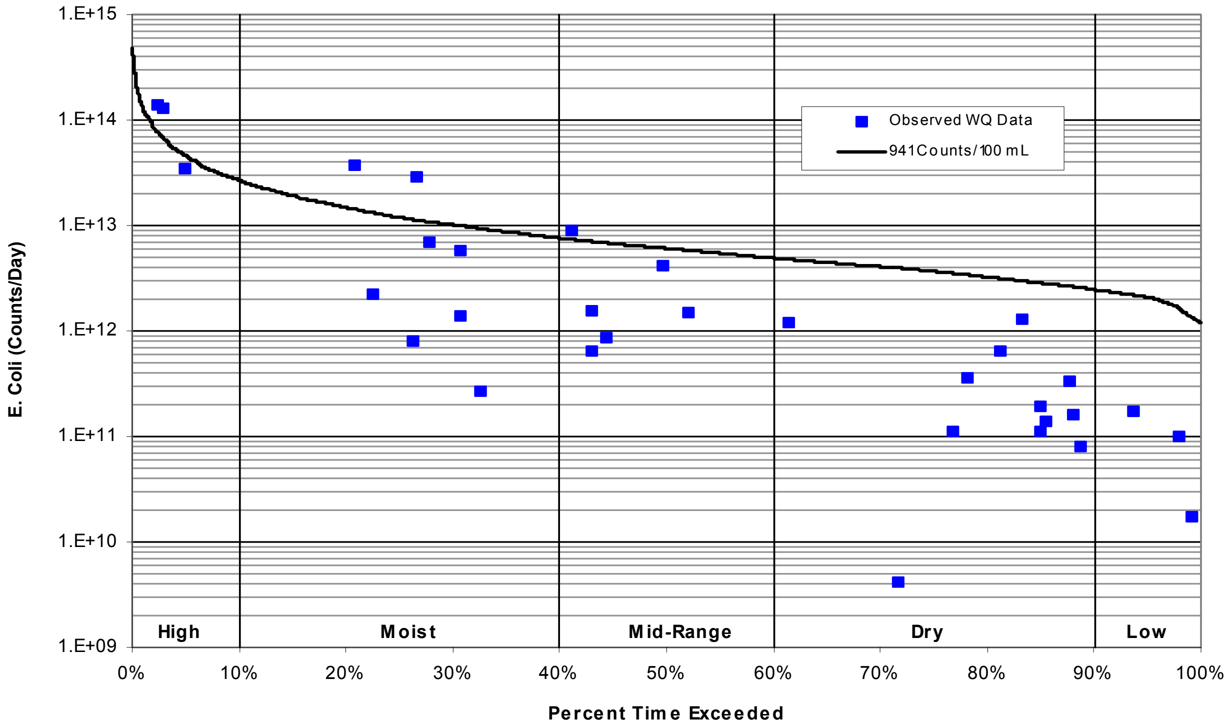

Figure C-2. E. Coli Load Duration Curve for North Fork Forked Deer River at Mile 7.3

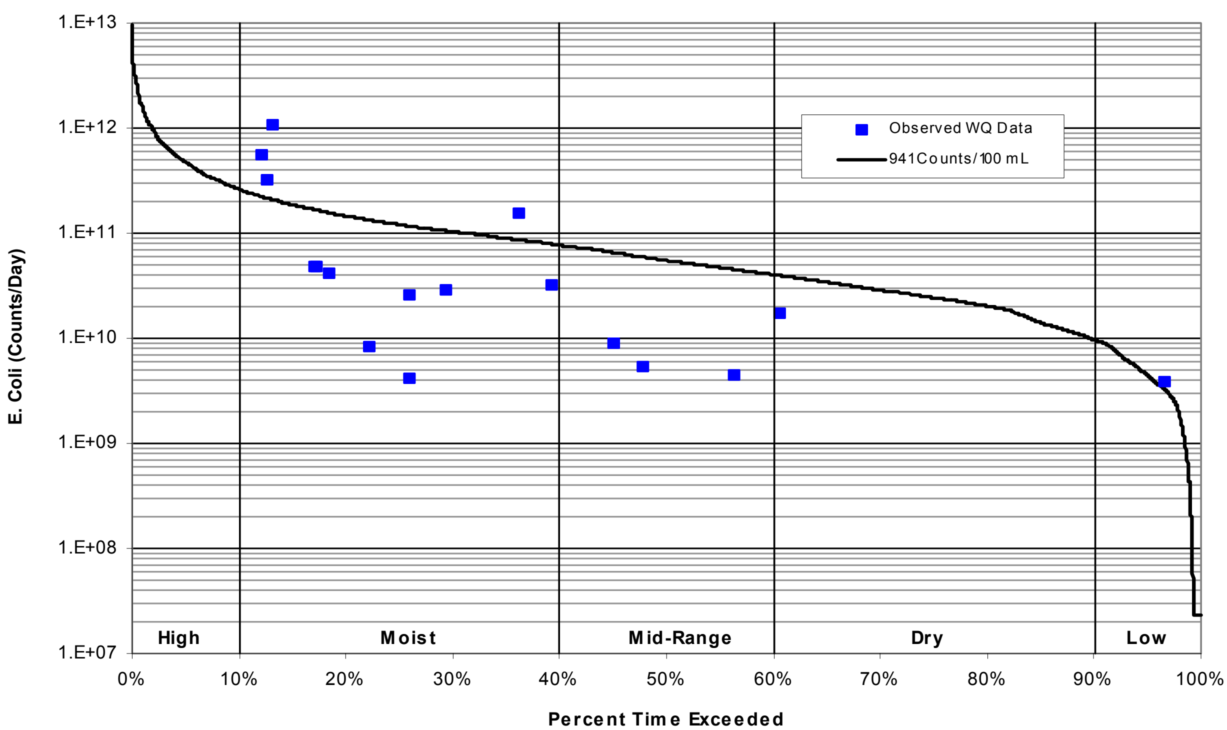

Figure C-3. E. Coli Load Duration Curve for Tucker Creek at Mile 0.4

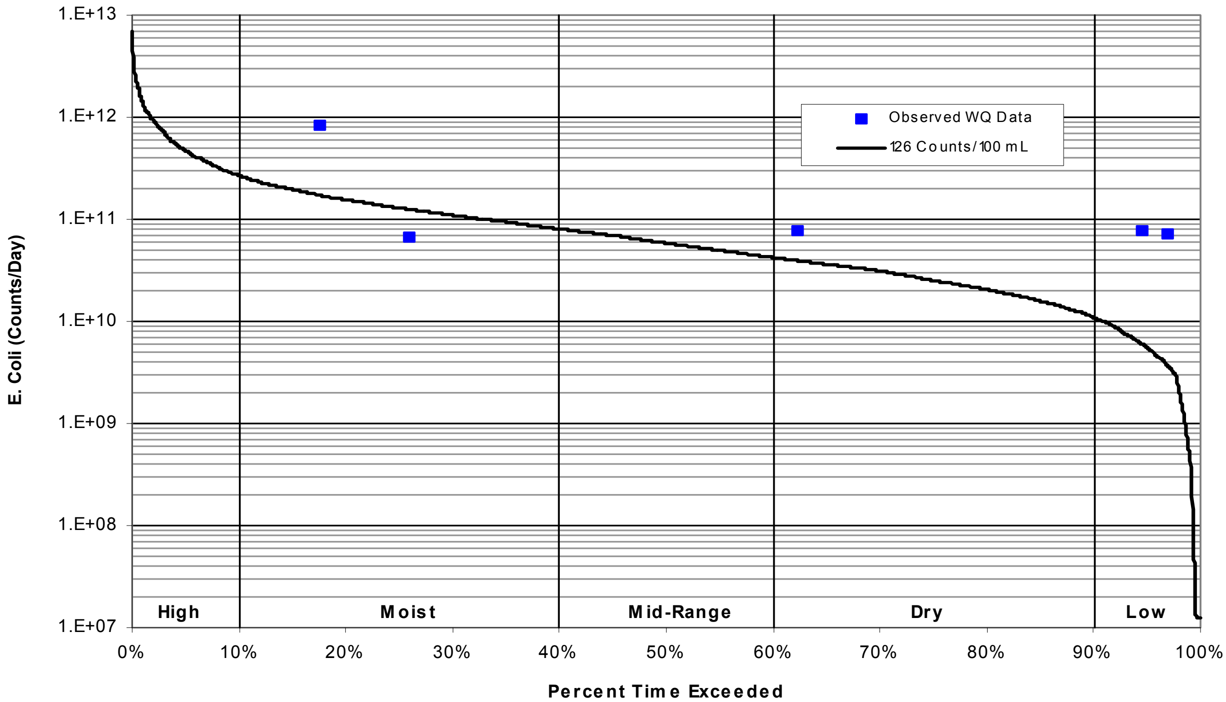

Figure C-4. E. Coli Load Duration Curve for Pond Creek at Mile 12.9 (Geometric Mean data [9/11/02-10/9/02])

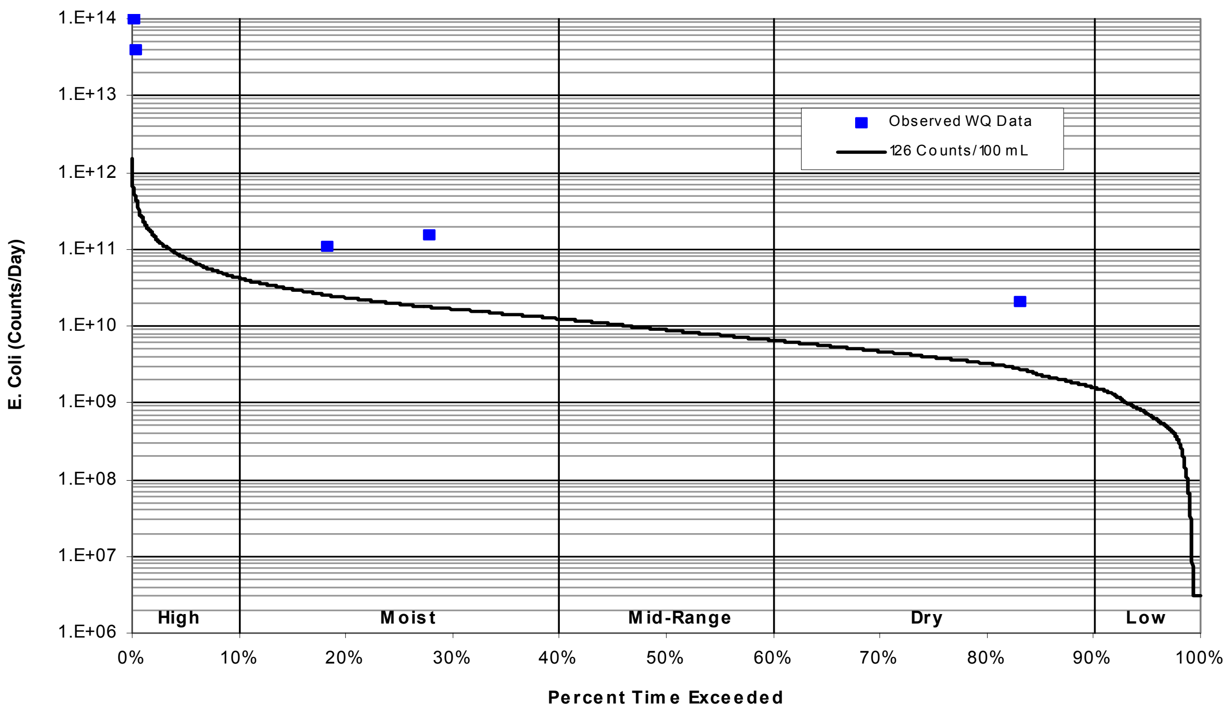

Figure C-5. E. Coli Load Duration Curve for Bethel Branch at Mile 6.1 (Geometric Mean data [9/19/02-10/17/02])

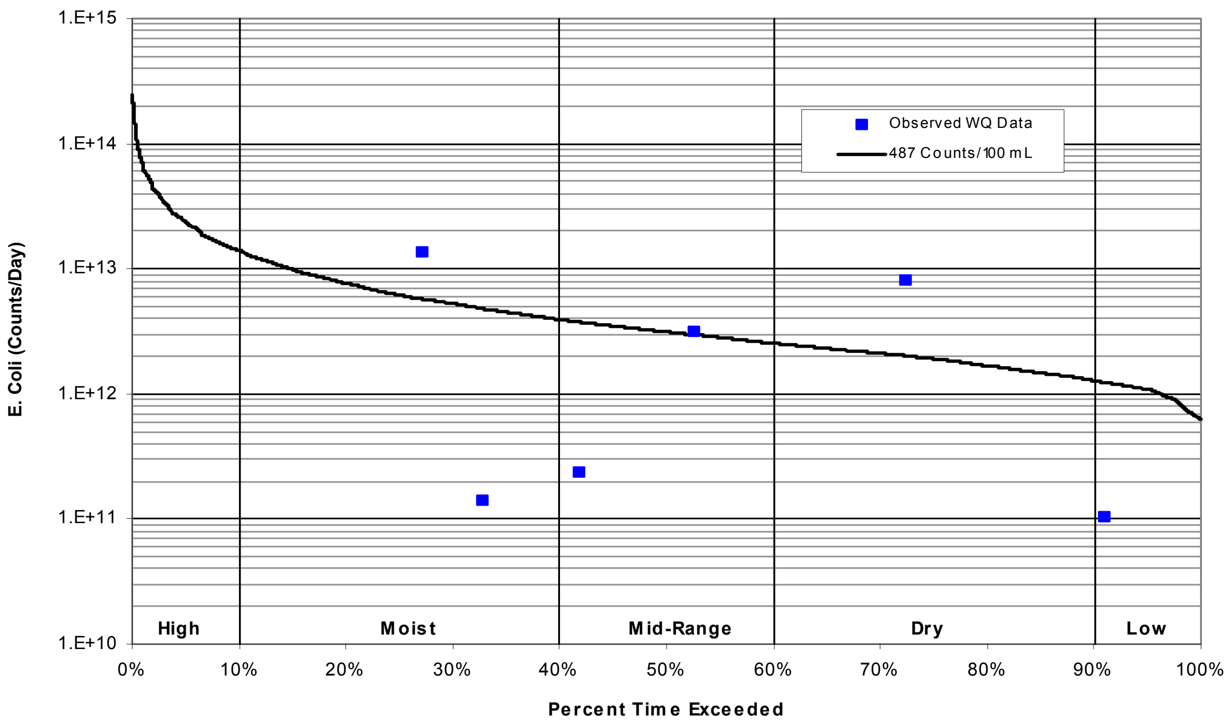

Figure C-6. E. Coli Load Duration Curve for Middle Fork Forked Deer River at Mile 14.6

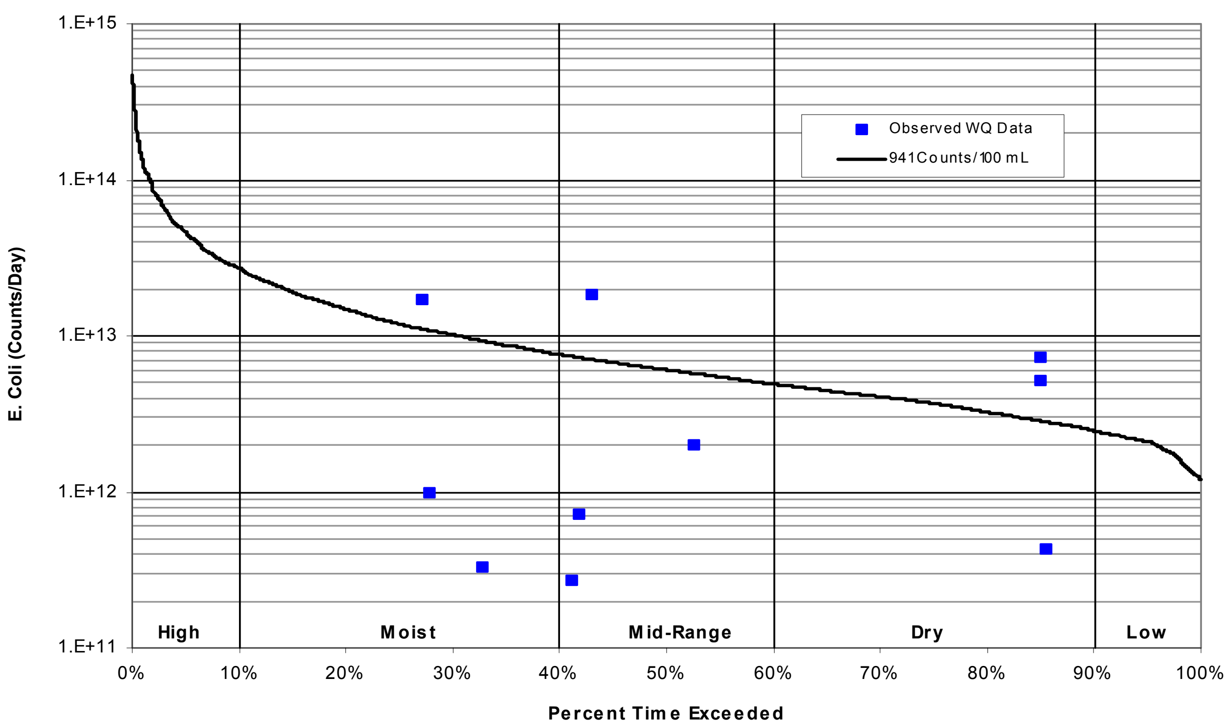

Figure C-7. E. Coli Load Duration Curve for Middle Fork Forked Deer River at Mile 21.5

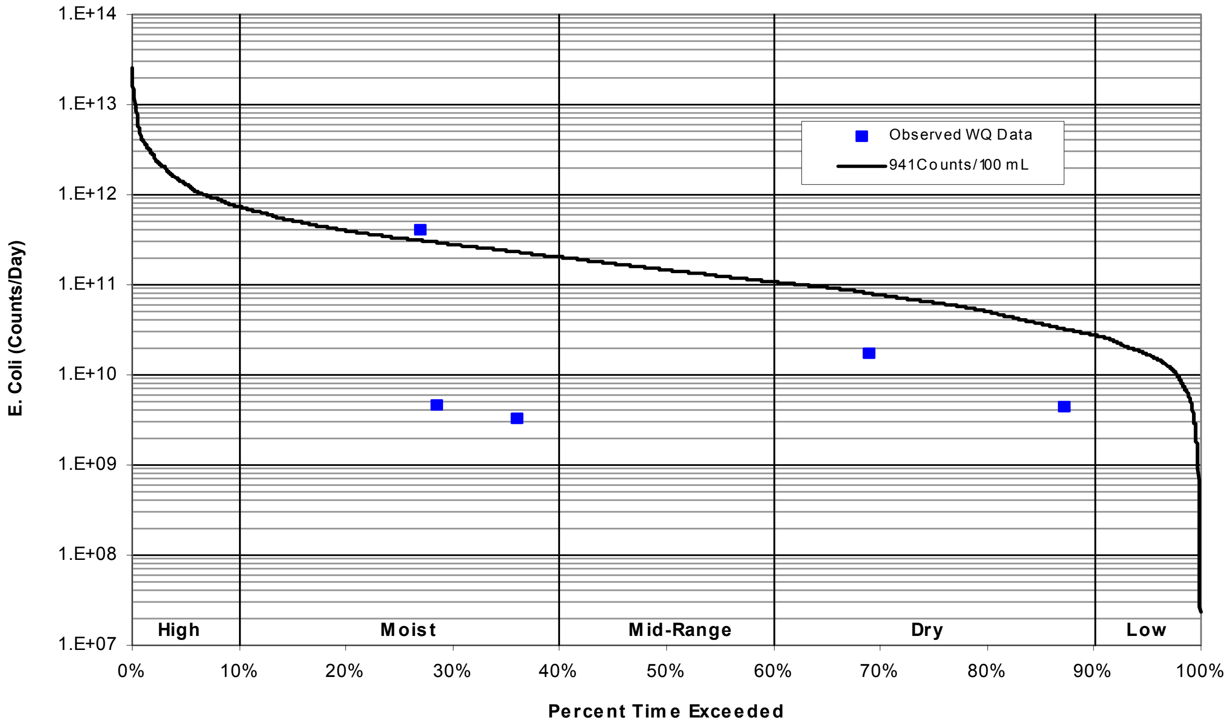

Figure C-8. E. Coli Load Duration Curve for Beech Creek at Mile 1.8

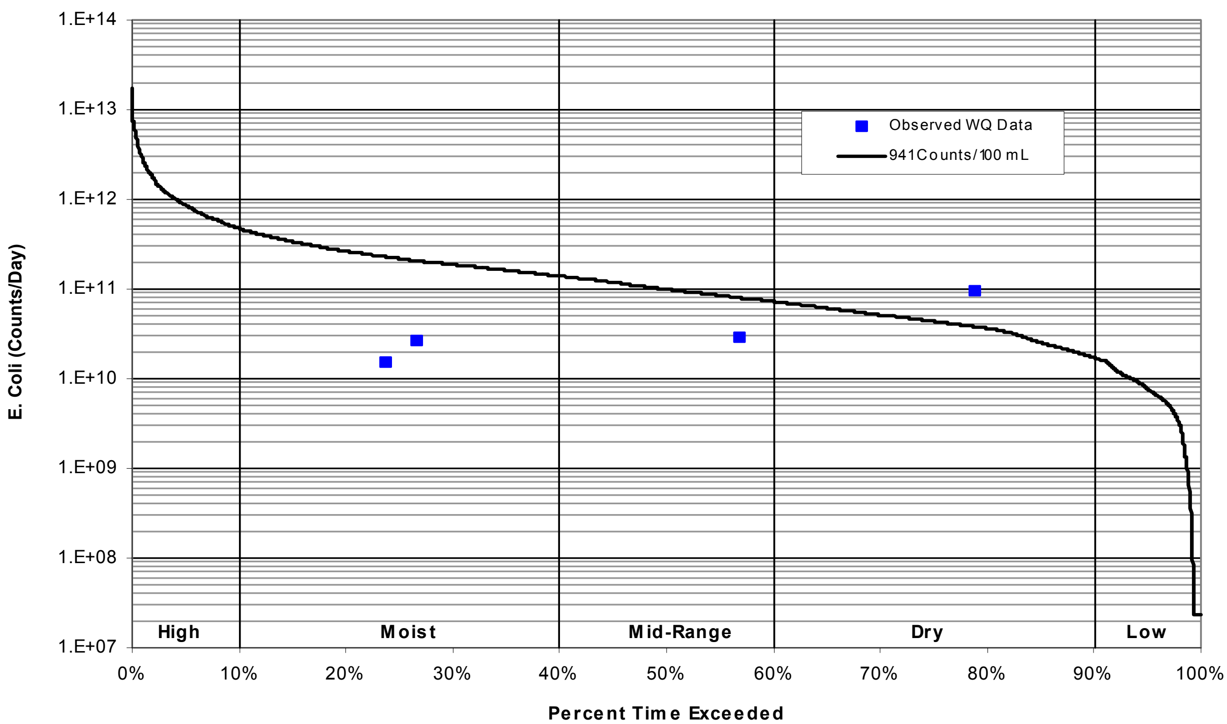

Figure C-9. E. Coli Load Duration Curve for Dry Creek at Mile 0.3

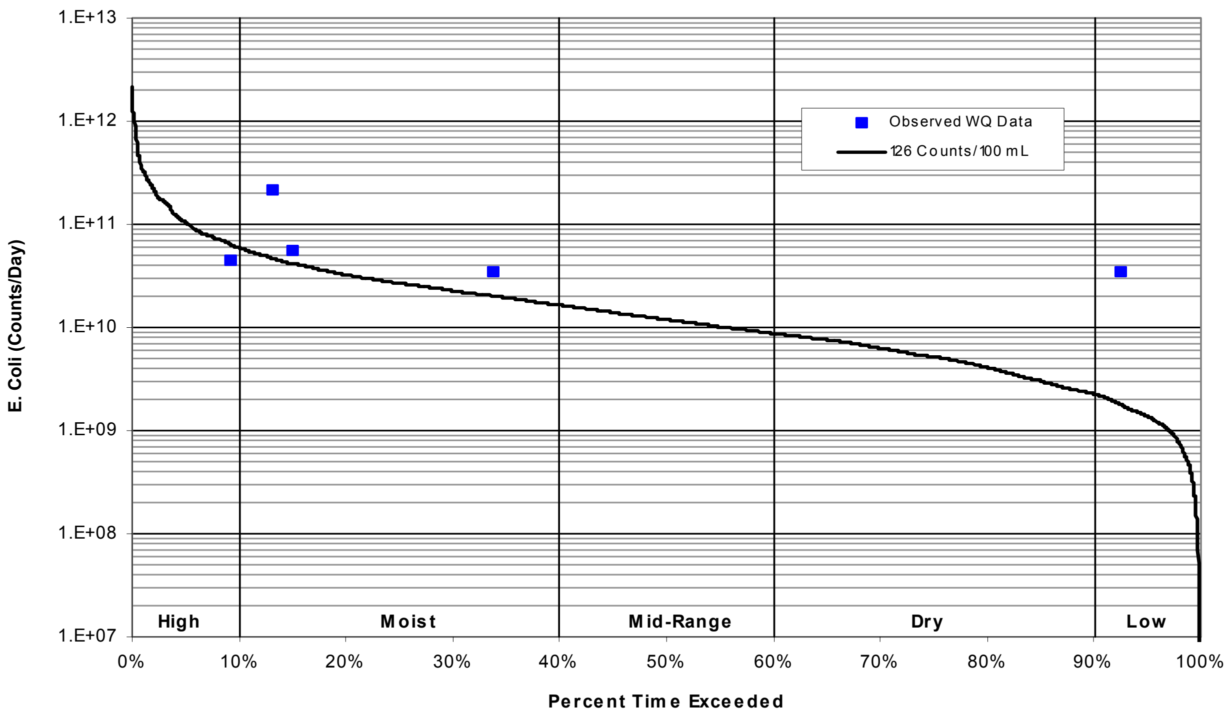

Figure C-10. E. Coli Load Duration Curve for Davis Creek at Mile 2.5 (Geometric Mean data [9/17/02-10/15/02])

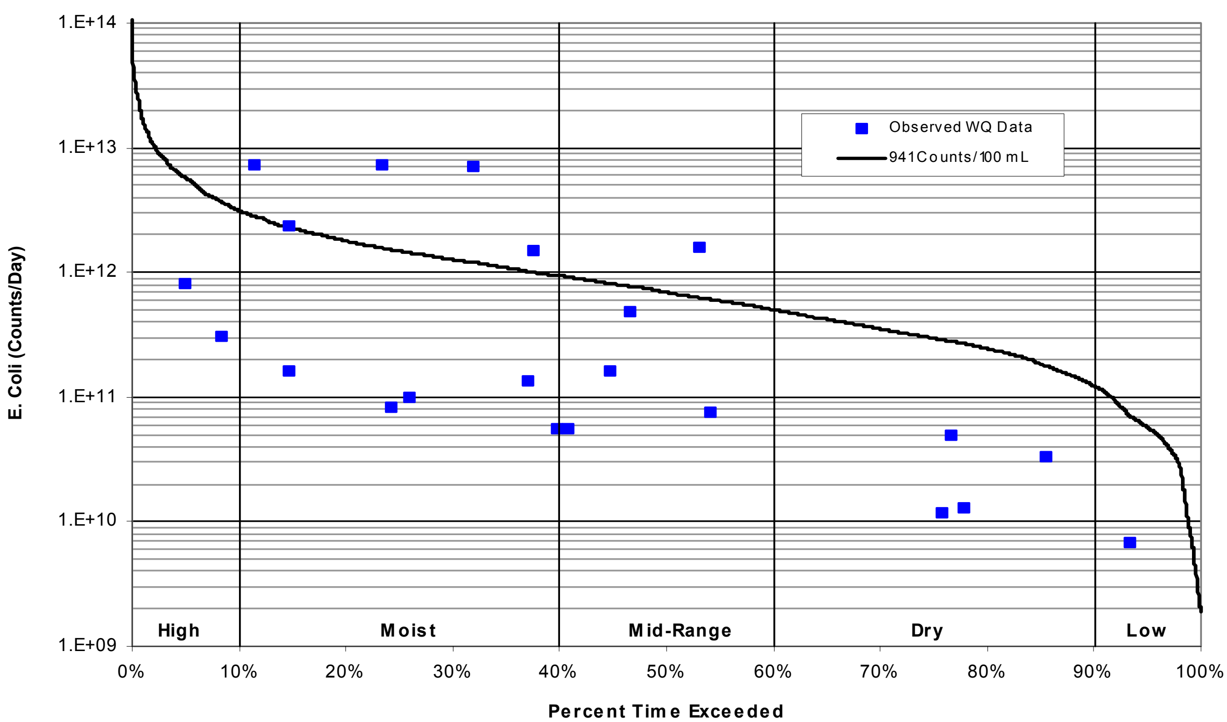

Figure C-11. E. Coli Load Duration Curve for Buck Creek at Mile 1.2

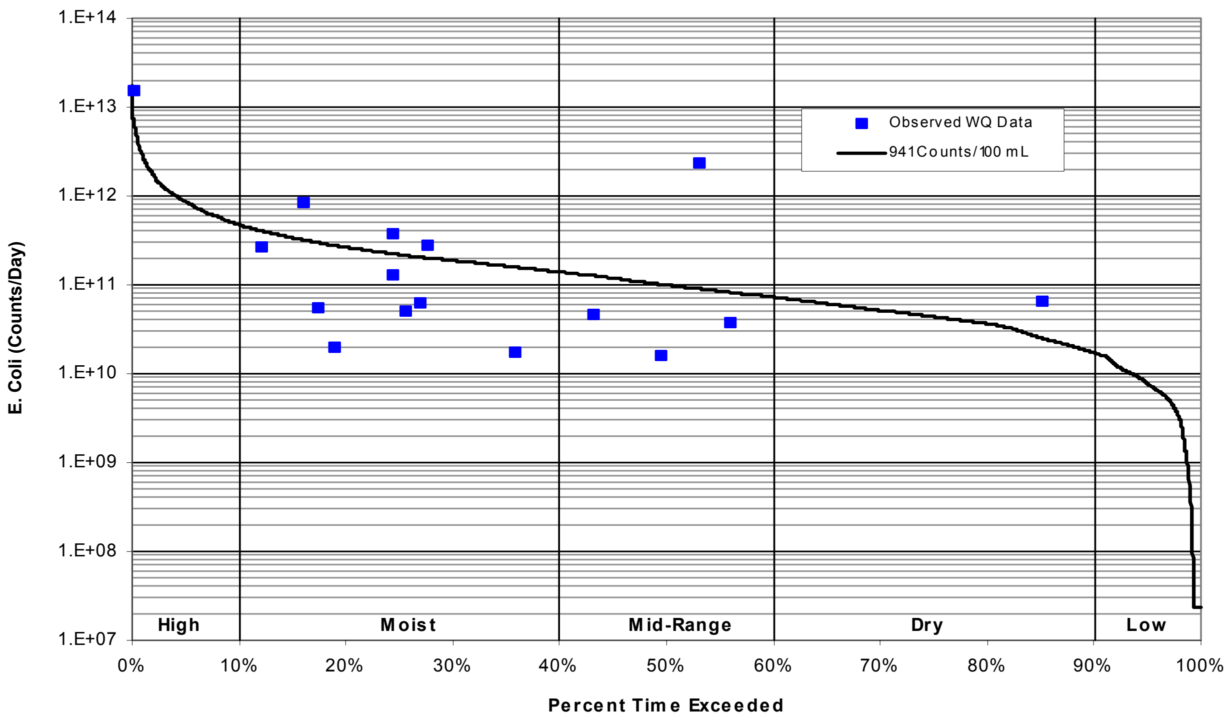

Figure C-12. E. Coli Load Duration Curve for Harris Creek at Mile 1.9

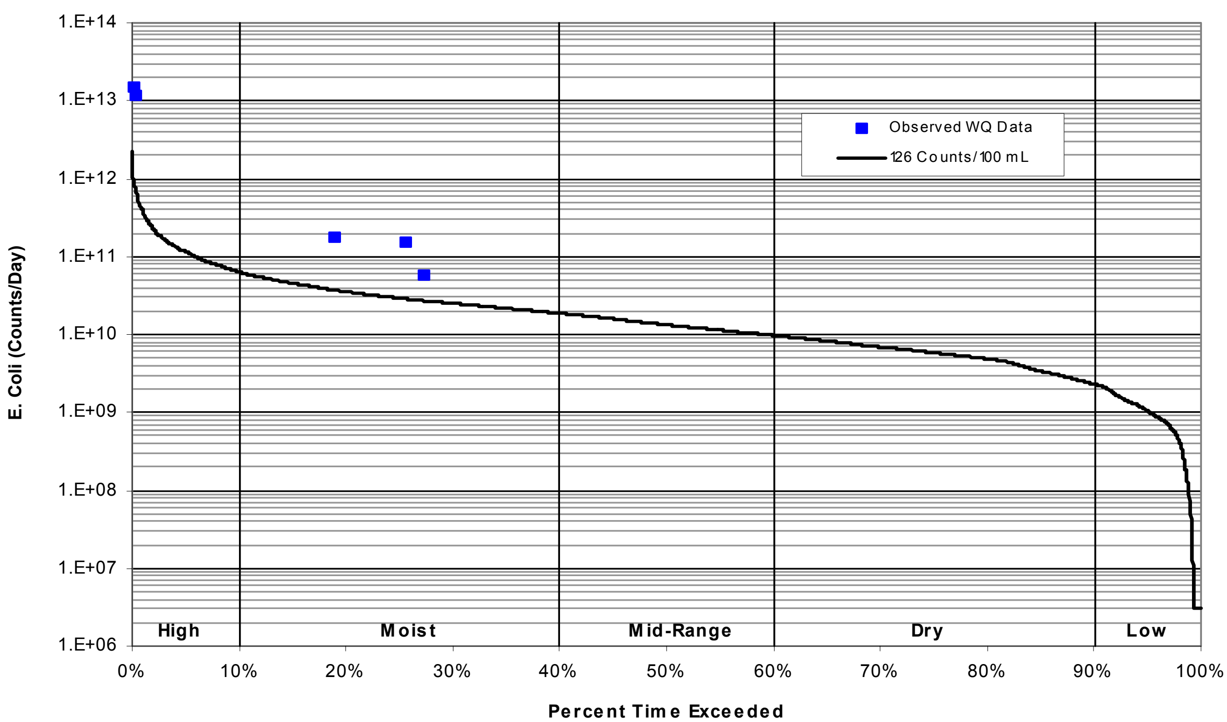

Figure C-13. E. Coli Load Duration Curve for Doakville Creek at Mile 5.4 (Geometric Mean data [9/26/02-10/24/02])

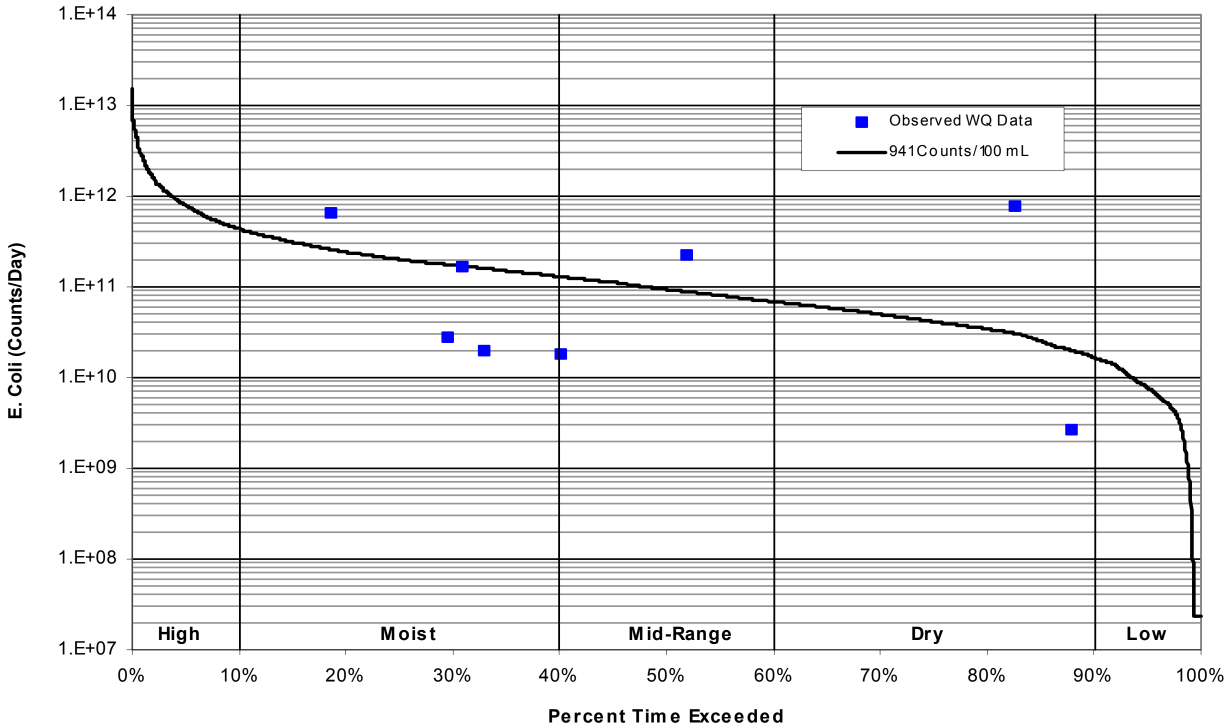

Figure C-14. E. Coli Load Duration Curve for Jones Creek at Mile 3.8

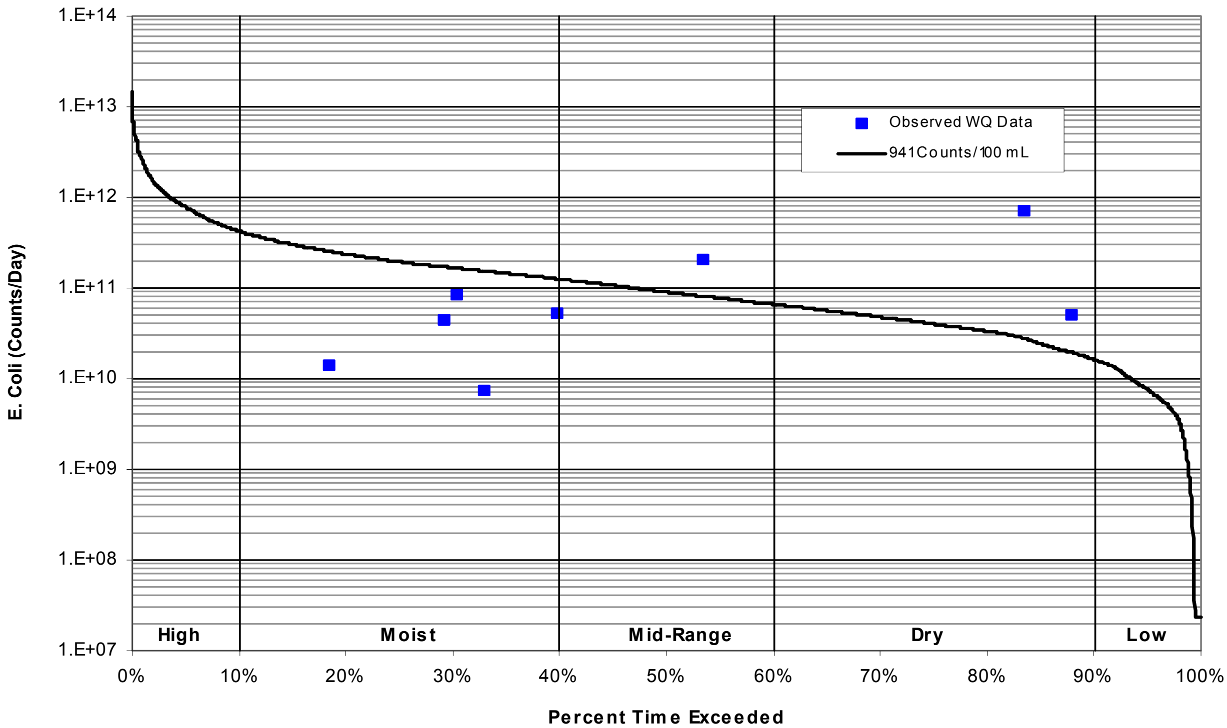

Figure C-15. E. Coli Load Duration Curve for Light Creek at Mile 2.2

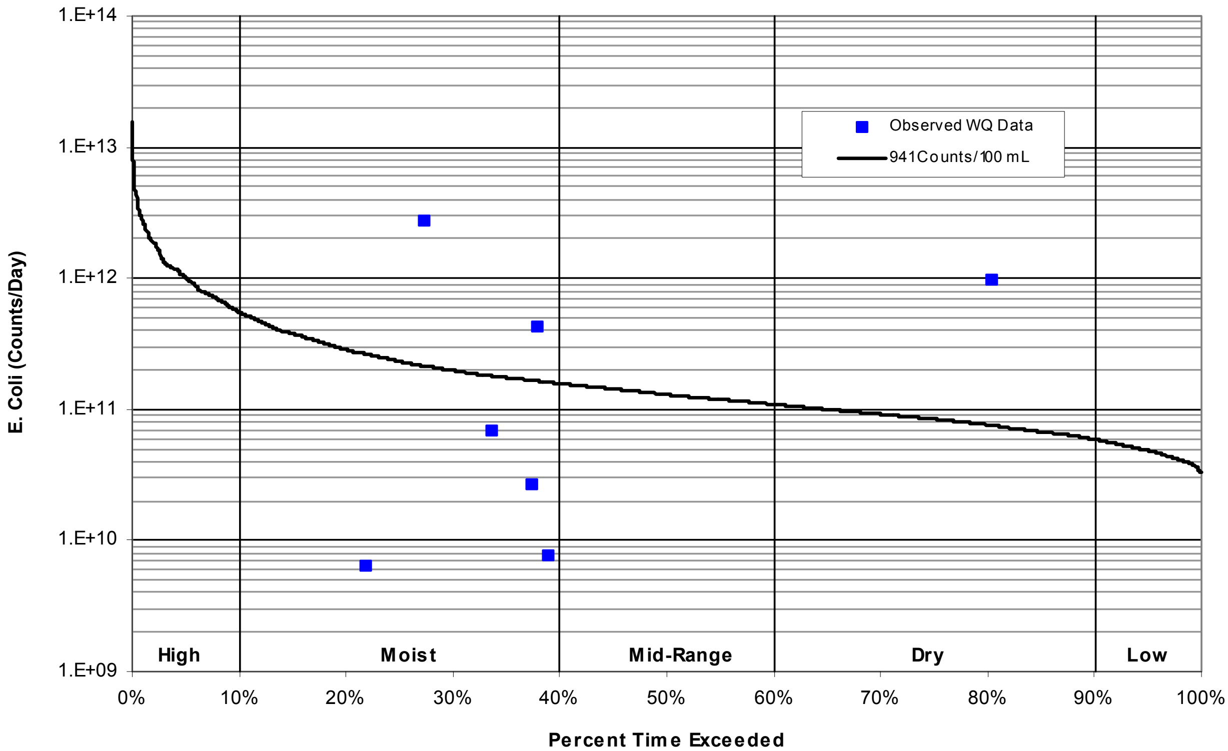

Figure C-16. E. Coli Load Duration Curve for Lewis Creek at Mile 7.9

Table C-1. Required Load Reduction for North Fork Forked Deer River at Mile 7.3 – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli	
			Sample Conc.	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[%]
2.436%	3323.93	12/17/01	**1732.9**	**45.7**
2.984%	2872.62	3/12/02	**1842**	**48.9**
4.900%	2033.83	6/19/03	686.7	**NR**
20.805%	622.926	12/11/03	**>2419.2**	**>61.1**
22.475%	572.941	12/16/02	157.6	**NR**
26.198%	494.525	12/15/04	65.7	**NR**
26.608%	488.884	3/13/01	**>2419.2**	**>61.1**
27.895%	470.349	4/16/98	613.1	**NR**
30.632%	435.008	3/25/03	129.1	**NR**
30.687%	434.029	9/24/02	547.5	**NR**
32.549%	407.64	3/24/99	27.2	**NR**
41.117%	321.678	4/14/98	**1119.9**	**16.0**
42.924%	307.139	4/15/98	206.3	**NR**
43.060%	306.448	6/8/04	86.5	**NR**
44.402%	297.049	3/30/00	117.4	**NR**
49.630%	265.986	12/16/98	648.8	**NR**
52.012%	252.482	3/18/04	240	**NR**
61.484%	207.416	6/18/02	240	**NR**
71.612%	172.132	12/14/00	1	**NR**
76.759%	153.793	6/27/01	30.1	**NR**
78.073%	148.866	6/9/99	98.4	**NR**
81.303%	136.645	9/16/03	195.6	**NR**
83.301%	129.279	6/20/00	410.6	**NR**
84.971%	123.828	7/21/98	37.3	**NR**
85.026%	123.428	7/22/98	63.1	**NR**
85.491%	121.988	7/23/98	46.4	**NR**
87.791%	115.359	9/27/04	120	**NR**
88.037%	114.707	9/28/98	58.1	**NR**
88.749%	112.503	12/1/99	29.5	**NR**
93.759%	95.139	9/12/01	74.8	**NR**
98.002%	70.049	9/28/99	57.8	**NR**
99.206%	58.1306	9/6/00	12.1	**NR**
	90th Percentile (all)		**>1672**	**>43.7**

Table C-2. Required Load Reduction for Tucker Creek at Mile 0.4 – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli	
			Sample Conc.	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[%]
12.154%	9.58474	11/6/02	**>2419.2**	**>61.1**
12.675%	9.33134	12/4/02	**1413.6**	**33.4**
13.085%	9.13689	5/21/03	**4884**	**80.7**
17.137%	7.24335	4/9/03	272.3	**NR**
17.273%	7.18524	10/16/02	275.5	**NR**
18.423%	6.7421	5/14/03	256	**NR**
22.174%	5.80669	10/23/02	58.3	**NR**
25.869%	5.04313	1/8/03	33.1	**NR**
25.897%	5.04054	3/5/03	206.3	**NR**
29.318%	4.59068	10/9/02	261.3	**NR**
36.217%	3.74764	2/5/03	**1664**	**43.4**
39.201%	3.42443	5/28/03	387.3	**NR**
45.031%	2.83478	6/4/03	131.3	**NR**
47.796%	2.56964	4/2/03	84.2	**NR**
56.255%	1.9696	4/16/03	93.3	**NR**
60.553%	1.72286	4/23/03	408	**NR**
96.606%	0.142073	9/18/02	**1119.9**	**16.0**
	90th Percentile (all)		**>1966**	**>52.1**

Table C-3. Required Load Reduction for Pond Creek at Mile 12.9 (Geometric Mean data) – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli		
			Sample Conc.	Geometric Mean	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[CFU/100 mL]	[%]
94.689%	1.87011	9/4/02	18.9		
96.879%	1.21349	9/11/02	**>2419.2**		
94.498%	1.94958	9/18/02	1607		
62.332%	12.7313	9/25/02	248		
17.629%	55.6127	10/2/02	613.1	**>407**	
25.897%	40.6544	10/9/02	67.6	**>525**	**>76.0**
18.505%	53.2771	10/16/02	275.5	**>340**	
26.745%	39.2931	10/23/02	135.4	**>207**	

Table C-4. Required Load Reduction for Bethel Branch at Mile 6.1 (Geometric Mean data) – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli		
			Sample Conc.	Geometric Mean	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[CFU/100 mL]	[%]
9/5/02	0.137191	97.317%	328.2		
9/12/02	0.084319	98.193%	547.5		
9/19/02	0.882611	83.082%	**980.4**		
9/26/02	159.547	0.301%	**9804**		
10/3/02	5.72007	27.868%	**1119.9**	**1141**	
10/10/02	170.41	0.246%	**>24192**	**>2697**	
10/17/02	8.19165	18.259%	547.5	**>2697**	**>95.3**

Table C-5. Required Load Reduction for Middle Fork Forked Deer River at Mile 14.6 – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli	
			Sample Conc.	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[%]
27.074%	481.19	11/12/02	**1153**	**57.8**
32.685%	404.111	3/11/03	14.2	**NR**
41.774%	316.33	1/14/03	30.9	**NR**
52.532%	249.222	7/16/02	**517.2**	**5.8**
72.434%	169.495	6/16/99	**1986.2**	**75.5**
90.884%	103.999	8/11/99	41.1	**NR**
	90th Percentile (all)		**1570**	**69.0**

Table C-6. Required Load Reduction for Middle Fork Forked Deer River at Mile 21.5 – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli	
			Sample Conc.	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[%]
27.074%	481.19	11/12/02	**1467**	**35.9**
27.895%	470.349	4/16/98	86	**NR**
32.685%	404.111	3/11/03	33.6	**NR**
41.117%	321.678	4/14/98	34.5	**NR**
41.774%	316.33	1/14/03	93.4	**NR**
42.924%	307.139	4/15/98	**>2419.2**	**61.1**
52.532%	249.222	7/16/02	328.2	**NR**
84.971%	123.828	7/21/98	**>2419.2**	**61.1**
85.026%	123.428	7/22/98	**1732.9**	**45.7**
85.491%	121.988	7/23/98	143.9	**NR**
	90th Percentile (all)		**>2419**	**>61.1**

Table C-7. Required Load Reduction for Beech Creek at Mile 1.8 – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli	
			Sample Conc.	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[%]
27.046%	13.5416	11/12/02	1233	**23.7**
28.442%	12.9533	3/11/03	14.8	**NR**
36.053%	10.0707	1/14/03	13.4	**NR**
68.957%	3.50937	6/16/99	206.3	**NR**
87.189%	1.40163	8/12/99	131.3	**NR**
	90th Percentile (all)		822	0.0

Table C-8. Required Load Reduction for Dry Creek at Mile 0.3 – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli	
			Sample Conc.	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[%]
23.707%	9.96847	2/11/03	62	**NR**
26.554%	9.02441	12/10/02	121	**NR**
56.748%	3.47822	6/10/03	344.8	**NR**
78.839%	1.65049	6/17/99	**>2419.2**	**>61.1**
	90th Percentile (all)		**>1797**	**>47.6**

Table C-9. Required Load Reduction for Davis Creek at Mile 2.5 (Geometric Mean data) – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli		
			Sample Conc.	Geometric Mean	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[CFU/100 mL]	[%]
92.445%	0.586019	9/3/02	178.5		
94.799%	0.45554	9/10/02	122.3		
92.417%	0.586237	9/17/02	**>2419.2**		
33.780%	6.55197	9/24/02	216		
9.225%	20.5578	10/1/02	90.6	**>253**	
13.195%	15.1851	10/8/02	579.4	**>320**	
15.083%	13.4337	10/15/02	172.3	**>343**	**>63.3**
30.003%	7.32744	10/22/02	387.3	**>238**	

Table C-10. Required Load Reduction for Buck Creek at Mile 1.2 – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli	
			Sample Conc.	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[%]
4.955%	250.68	12/22/02	131.3	**NR**
8.295%	159.858	5/20/03	78.9	**NR**
11.361%	123.293	11/5/02	**>2419.2**	**>61.1**
14.645%	99.8208	4/8/03	**980.4**	**4.0**
14.755%	98.9797	5/13/03	65.7	**NR**
23.460%	67.9828	4/16/98	**4366**	**78.4**
24.199%	66.2296	3/4/03	51.2	**NR**
25.979%	62.3679	1/7/03	65	**NR**
31.946%	52.1864	2/4/03	**5475**	**82.8**
37.011%	44.1717	5/27/03	123.6	**NR**
37.613%	43.3141	4/14/98	**1413.6**	**33.4**
39.776%	41.0636	4/1/03	55.4	**NR**
40.816%	39.9617	12/3/02	57.3	**NR**
44.703%	35.3249	6/3/03	185	**NR**
46.510%	33.7135	4/15/98	579.4	**NR**
53.134%	27.1765	4/22/03	**>2419.2**	**>61.1**
54.093%	26.5087	4/15/03	117.8	**NR**
75.801%	12.5127	7/21/98	38.8	**NR**
76.649%	12.1336	7/22/98	167.8	**NR**
77.854%	11.6801	7/23/98	44.8	**NR**
85.464%	7.71736	7/9/02	177.7	**NR**
93.375%	3.06065	8/6/02	91	**NR**
	90th Percentile (all)		**>2419**	**>61.1**

Table C-11. Required Load Reduction for Harris Creek at Mile 1.9 – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli	
			Sample Conc.	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[%]
0.246%	255.466	10/10/02	**>2419.2**	**61.1**
12.045%	17.6132	4/3/03	613.1	**NR**
15.959%	13.9845	11/7/02	**>2419.2**	**61.1**
17.410%	13.027	5/22/03	172.6	**NR**
18.861%	12.0397	10/17/02	68.3	**NR**
24.391%	9.71739	4/10/03	**1553.1**	**39.4**
24.446%	9.70658	5/15/03	547.5	**NR**
25.650%	9.28601	10/24/02	218.7	**NR**
26.937%	8.88608	3/6/03	290.9	**NR**
27.676%	8.67491	1/9/03	**1299.7**	**27.6**
35.806%	6.85817	2/13/03	105	**NR**
43.252%	5.51869	5/29/03	344.8	**NR**
49.411%	4.41255	6/5/03	148.3	**NR**
53.134%	3.91825	4/24/03	**>24192**	**96.1**
56.009%	3.56926	4/16/03	435.2	**NR**
85.108%	1.08725	7/11/02	**>2419.2**	**61.1**
	90th Percentile (all)		**>2419.2**	**>61.1**

Table C-12. Required Load Reduction for Doakville Creek at Mile 5.4 (Geometric Mean data) – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli		
			Sample Conc.	Geometric Mean	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[CFU/100 mL]	[%]
97.126%	0.212865	9/5/02	770.1		
98.002%	0.131725	9/12/02	160.7		
93.540%	0.429784	9/19/02	344.8		
0.301%	236.214	9/26/02	**1986.3**		
27.375%	8.76698	10/3/02	275.5	**472**	
0.246%	255.466	10/10/02	**>2419.2**	**>593**	
18.861%	12.0397	10/17/02	613.1	**>775**	
25.650%	9.28601	10/24/02	686.7	**>890**	**>85.8**

Table C-13. Required Load Reduction for Jones Creek at Mile 3.8 – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli	
			Sample Conc.	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[%]
18.615%	11.1814	11/13/02	**>2419.2**	**61.1**
29.537%	7.63581	12/11/02	148	**NR**
30.851%	7.31475	2/12/03	933	**NR**
32.904%	6.9207	1/15/03	116.9	**NR**
40.159%	5.59872	3/12/03	131.7	**NR**
51.848%	3.85907	6/11/03	**>2419.2**	**61.1**
82.590%	1.3302	8/14/02	**>24192**	**96.1**
87.955%	0.859942	7/17/02	128.1	**NR**
	90th Percentile (all)		**>8951**	**>89.5**

Table C-14. Required Load Reduction for Light Creek at Mile 2.2 – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli	
			Sample Conc.	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[%]
18.423%	10.969	11/13/02	52	**NR**
29.264%	7.45145	12/11/02	243	**NR**
30.386%	7.19158	2/12/03	470	**NR**
33.014%	6.69423	1/15/03	45.7	**NR**
39.721%	5.46212	3/12/03	387.5	**NR**
53.490%	3.52035	6/11/03	**>2419.2**	**>61.1**
83.520%	1.20397	8/14/02	**>24192**	**>96.1**
87.955%	0.842024	7/17/02	**>2419.2**	**>61.1**
	90th Percentile (all)		**>8951**	**>89.5**

Table C-15. Required Load Reduction for Lewis Creek at Mile 7.9 – E. Coli Analysis

PDFE	Flow	Sample Date	E. Coli	
			Sample Conc.	Required Load Reduction
[%]	[cfs]		[CFU/100 ml]	[%]
21.900%	11.5358	11/13/02	22.8	**NR**
27.375%	9.28272	2/12/03	**12033**	**92.2**
33.616%	7.8045	12/11/02	364	**NR**
37.339%	7.24453	1/15/03	152.9	**NR**
37.914%	7.15184	6/11/03	**>2419.2**	**>61.1**
38.982%	6.99936	3/12/03	44.8	**NR**
80.290%	3.30217	8/14/02	**12033**	**92.2**
	90th Percentile (all)		**12033**	**92.2**

Table C-16. TMDLs, WLAs, & LAs for North Fork Forked Deer River Watershed

HUC-12 Subwatershed (08010204__)	Impaired Waterbody Name	Impaired Waterbody ID	TMDL	WLAs[a]				LAs[e]
				WWTFs[b]		Leaking Collection Systems[c]	MS4s[d]	
				Monthly Avg.	Daily Max.			
			[% Red.]	[CFU/day]	[CFU /day]	[CFU /day]	[% Red.]	[% Red.]
0103	Dry Creek	TN08010204014 – 0100	>47.6	NA	NA	NA	NA	>52.9
0201	MFFD River	TN08010204010 – 1000	>61.1	1.240×10^{10}	9.263×10^{10}	0	NA	>65.0
	Beech Creek	TN08010204010 – 1100	*	NA	NA	NA	NA	*
0203	MFFD River	TN08010204007 – 1000	69.0	1.908×10^{9}	1.425×10^{10}	0	NA	72.1
0204	Davis Creek	TN08010204017 – 0100	>63.2	NA	NA	NA	NA	>67.0
	Buck Creek	TN08010204017 – 1000	>61.1	NA	NA	NA	NA	>65.0
0305	Bethel Branch	TN08010204004 – 0100	>95.3	NA	NA	NA	NA	>95.8
0306	Harris Creek	TN08010204022 – 0100	>61.1	NA	NA	0	NA	>65.0
	Doakville Creek	TN08010204022 – 1000	>85.8	NA	NA	NA	NA	>87.3
0402	NFFD River	TN08010204001 – 1000	>43.7	4.507×10^{10}	3.366×10^{11}	0	>49.3	>49.3
0403	Tucker Creek	TN08010204003 – 0100	>52.1	NA	NA	NA	NA	>56.9
	Pond Creek	TN08010204003 – 1000	>76.0	NA	NA	0	NA	>78.5
0404	Jones Creek	TN08010204023 – 0200	>89.5	NA	NA	0	>90.5	>90.5
	Light Creek	TN08010204023 – 0210	>89.5	NA	NA	0	>90.5	>90.5
	Lewis Creek	TN08010204023 – 1000	92.2	NA	NA	0	93.0	93.0

Note: *NA = Not applicable.*

* *Insufficient data available to calculate TMDL and LA.*

a. *There are no CAFOs in impaired subwatersheds of the North Fork Forked Deer River watershed. All current and future CAFOs are and will be assigned waste load allocations (WLAs) of zero.*

b. *WLAs for WWTFs expressed as E. coli loads (CFU/day). Future WWTFs must meet instream water quality standards at the point of discharge as specified in their NPDES permits.*

c. *The objective for leaking collection systems is a WLA of zero. It is recognized, however, that a WLA of 0 CFU/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in E. coli loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality standard for E. coli.*

d. *Applies to any MS4 discharge loading in the subwatershed.*

e. *The load allocations (LAs) listed apply to precipitation induced nonpoint sources only. The objective for all other nonpoint sources (leaking septic systems, illicit discharges, and animals access to streams) is a LA of zero. It is recognized, however, that for leaking septic systems a LA of 0 CFU/day may not be practical. For these sources, the LA is interpreted to mean a reduction in E. coli loading to the maximum extent feasible, consistent with the requirement that these sources not contribute to a violation of the water quality standard for E. coli.*

APPENDIX D

Hydrodynamic Modeling Methodology

D.1 Model Selection

The Loading Simulation Program C++ (LSPC) was selected for flow simulation of E. coli-impaired waters in the North Fork Forked Deer River watershed. LSPC is a watershed model capable of performing flow routing through stream reaches. LSPC is a dynamic watershed model based on the Hydrologic Simulation Program - Fortran (HSPF).

D.2 Model Set Up

The impaired waterbodies were delineated into subwatersheds in order to facilitate model hydrologic calibration. Boundaries were constructed so that subwatershed "pour points" coincided with HUC-12 delineations, 303(d)-listed waterbodies, USGS monitoring stations (see Section C.1), and water quality monitoring stations. Watershed delineation was based on the National Hydrography Dataset (NHD) stream coverage and Digital Elevation Model (DEM) data. This discretization facilitates simulation of daily flows at water quality monitoring stations.

Several computer-based tools were utilized to generate input data for the LSPC model. The Watershed Characterization System (WCS), a geographic information system (GIS) tool, was used to display, analyze, and compile available information to support water quality model simulations for selected subwatersheds. This information includes land use categories, point source dischargers, soil types and characteristics, population data (human and livestock), and stream characteristics.

An important factor influencing model results is the precipitation data contained in the meteorological data files used in these simulations. Weather data from the Jackson Experiment Station meteorological station was available for the time period from January 1970 through December 2004. Meteorological data for a selected 11-year period was used for all simulations. The first year of this period was used for model stabilization with simulation data from the subsequent 10-year period (1/1/95 – 12/31/04) used for TMDL analyses.

D.3 Model Calibration

Hydrologic calibration of the watershed model involves comparison of simulated streamflow to historic streamflow data from USGS stream gaging stations for the same period of time. USGS continuous record stations located in the North Fork Forked Deer River watershed with sufficiently long and recent historical records were selected as the basis of the hydrology calibration. Two USGS stations were selected due to the transition in Level III ecoregions at the approximate midpoint of the watershed coinciding with one of the USGS stations and the dissimilarity in hydrologic characteristics between the two regions. The other USGS station is located near the mouth of the North Fork Forked Deer River. The calibration involved comparison of simulated and observed hydrographs until statistical stream volumes and flows were within acceptable ranges as reported in the literature (Lumb, et al., 1994).

Initial values for hydrologic variables were taken from an EPA developed default data set. During the calibration process, model parameters were adjusted within reasonable constraints until acceptable agreement was achieved between simulated and observed streamflow. Model parameters adjusted include: evapotranspiration, infiltration, upper and lower zone storage, groundwater storage, recession, losses to the deep groundwater system, and interflow discharge.

The results of the hydrologic calibrations for Middle Fork Forked Deer River near Fairview, USGS Station 07028960, and North Fork Forked Deer River at Dyersburg, USGS Station 07029100, are shown in Tables D-1 and D-2 and Figures D-1 and D-2, respectively.

Table D-1. Hydrologic Calibration Summary: Middle Fork Forked Deer River near Fairview (USGS 07028960)

Simulation Name:	**MFFDR08 (calibration)**	**Simulation Period:**	
	MFFD River near Fairview	**Watershed Area (ac):**	135040.00
Period for Flow Analysis	(USGS 07028960)		
Begin Date:	**10/01/97**	**Baseflow PERCENTILE:**	2.5
End Date:	**09/30/04**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**145.38**	Total Observed In-stream Flow:	**148.15**
Total of highest 10% flows:	**77.93**	Total of Observed highest 10% flows:	**79.42**
Total of lowest 50% flows:	**19.64**	Total of Observed Lowest 50% flows:	**20.11**
Simulated Summer Flow Volume (months 7-9):	**17.48**	Observed Summer Flow Volume (7-9):	**18.20**
Simulated Fall Flow Volume (months 10-12):	**35.58**	Observed Fall Flow Volume (10-12):	**36.36**
Simulated Winter Flow Volume (months 1-3):	**53.74**	Observed Winter Flow Volume (1-3):	**53.54**
Simulated Spring Flow Volume (months 4-6):	**38.58**	Observed Spring Flow Volume (4-6):	**40.05**
Total Simulated Storm Volume:	**125.53**	Total Observed Storm Volume:	**123.86**
Simulated Summer Storm Volume (7-9):	**12.50**	Observed Summer Storm Volume (7-9):	**12.12**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**-1.87**	10	
Error in 50% lowest flows:	**-2.33**	10	
Error in 10% highest flows:	**-1.87**	15	
Seasonal volume error - Summer:	**-3.98**	30	
Seasonal volume error - Fall:	**-2.13**	30	
Seasonal volume error - Winter:	**0.38**	30	
Seasonal volume error - Spring:	**-3.69**	30	
Error in storm volumes:	**1.35**	20	
Error in summer storm volumes:	**3.12**	50	

Table D-2. Hydrologic Calibration Summary: North Fork Forked Deer River at Dyersburg (USGS 07029100)

Simulation Name:	**NFFDR12 (calibration)**	**Simulation Period:**	
	NFFD River at Dyersburg	**Watershed Area (ac):**	600960.00
Period for Flow Analysis	(USGS 07029100)		
Begin Date:	**10/01/80**	**Baseflow PERCENTILE:**	2.5
End Date:	**09/30/85**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**99.95**	Total Observed In-stream Flow:	**101.07**
Total of highest 10% flows:	**51.10**	Total of Observed highest 10% flows:	**45.89**
Total of lowest 50% flows:	**11.39**	Total of Observed Lowest 50% flows:	**11.01**
Simulated Summer Flow Volume (months 7-9):	**6.11**	Observed Summer Flow Volume (7-9):	**10.99**
Simulated Fall Flow Volume (months 10-12):	**31.63**	Observed Fall Flow Volume (10-12):	**26.39**
Simulated Winter Flow Volume (months 1-3):	**28.85**	Observed Winter Flow Volume (1-3):	**30.39**
Simulated Spring Flow Volume (months 4-6):	**33.37**	Observed Spring Flow Volume (4-6):	**33.30**
Total Simulated Storm Volume:	**90.43**	Total Observed Storm Volume:	**91.31**
Simulated Summer Storm Volume (7-9):	**3.71**	Observed Summer Storm Volume (7-9):	**8.54**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**-1.11**	10	
Error in 50% lowest flows:	**3.40**	10	
Error in 10% highest flows:	**11.35**	15	
Seasonal volume error - Summer:	**-44.43**	30	
Seasonal volume error - Fall:	**19.83**	30	
Seasonal volume error - Winter:	**-5.09**	30	
Seasonal volume error - Spring:	**0.22**	30	
Error in storm volumes:	**-0.96**	20	
Error in summer storm volumes:	**-56.57**	50	

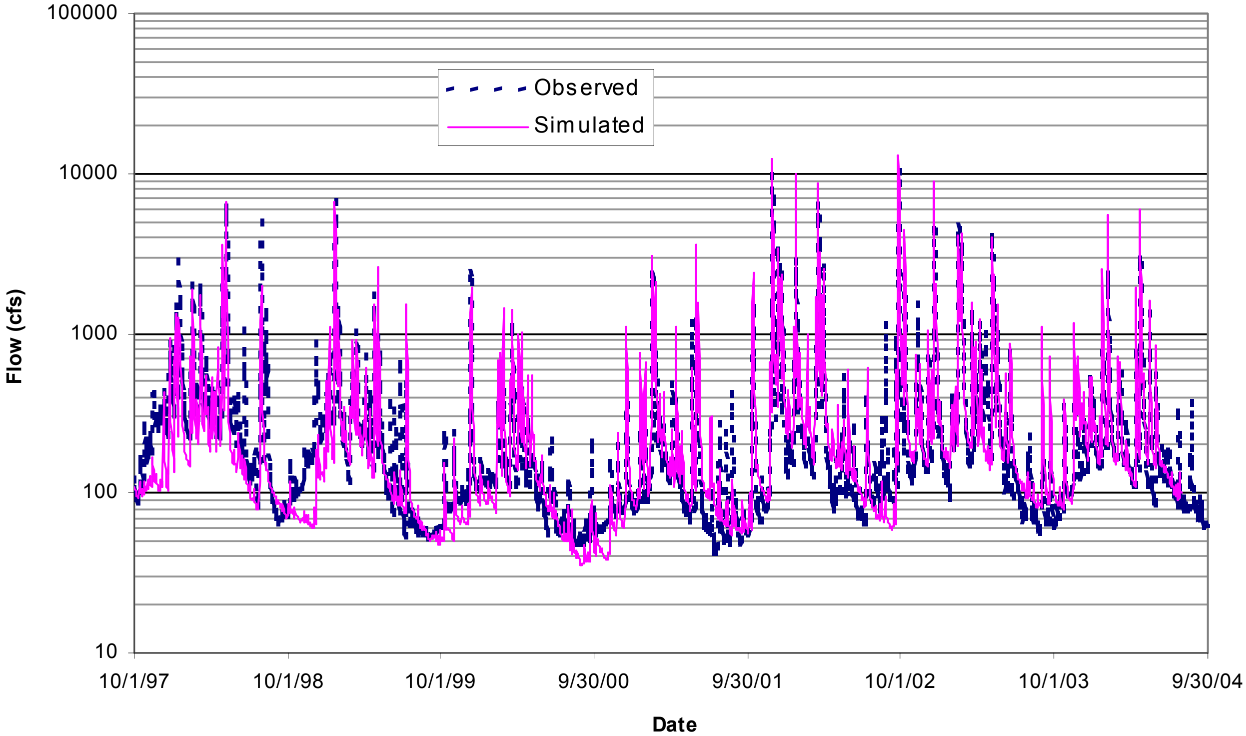

Figure D-1. Hydrologic Calibration: North Fork Forked Deer River near Fairview (USGS 07028960)

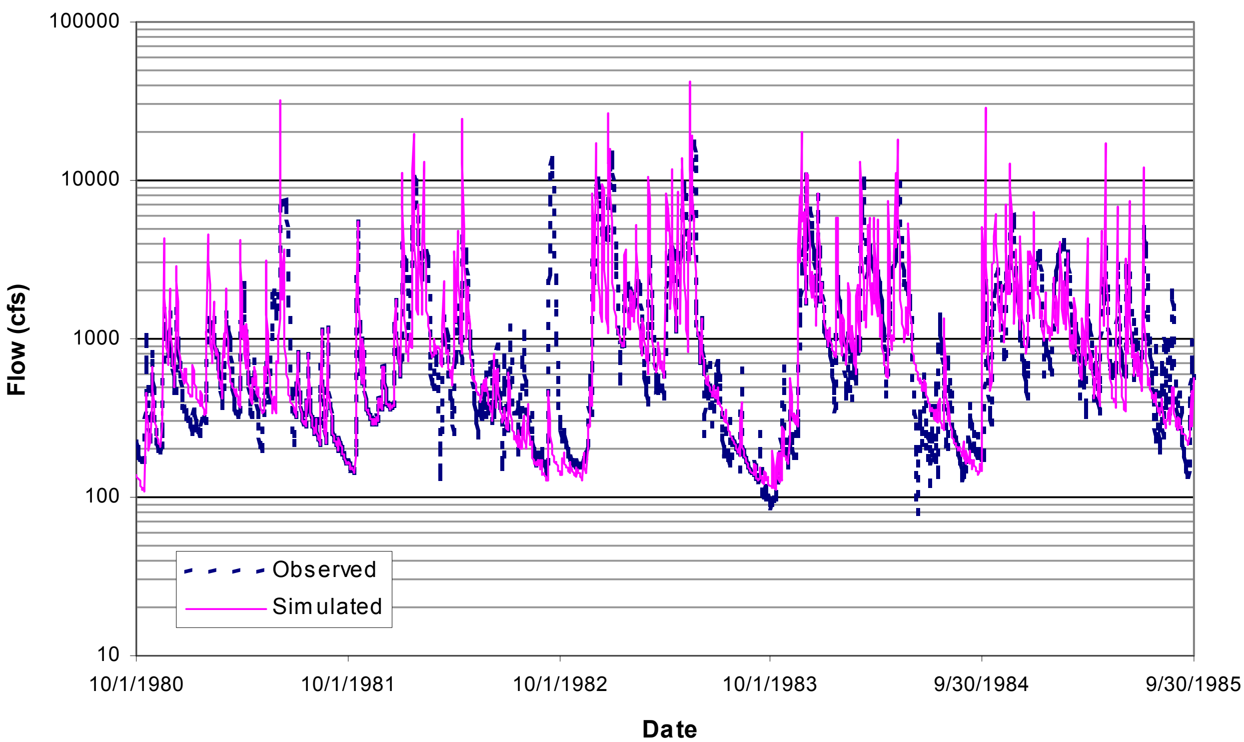

Figure D-2. Hydrologic Calibration: North Fork Forked Deer River at Dyersburg (USGS 07029100)

APPENDIX E

Public Notice of Proposed Total Maximum Daily Loads (TMDLs) for E. Coli in the North Fork Forked Deer River Watershed (HUC 08010204)

DIVISION OF WATER POLLUTION CONTROL

PUBLIC NOTICE OF AVAILABILITY OF PROPOSED TOTAL MAXIMUM DAILY LOAD (TMDL) FOR E. COLI IN THE NORTH FORK FORKED DEER RIVER WATERSHED (HUC 08010204), TENNESSEE

Announcement is hereby given of the availability of Tennessee's proposed total maximum daily load (TMDL) for E. coli in the North Fork Forked Deer (NFFD) River watershed, located in western Tennessee. Section 303(d) of the Clean Water Act requires states to develop TMDLs for waters on their impaired waters list. TMDLs must determine the allowable pollutant load that the water can assimilate, allocate that load among the various point and nonpoint sources, include a margin of safety, and address seasonality.

A number of waterbodies are listed on Tennessee's Final Version Year 2004 303(d) list as not supporting designated use classifications due, in part, to discharge of E. coli from pasture grazing, discharges from MS4 areas, and undetermined fecal/pathogen sources. The TMDL utilizes Tennessee's general water quality criteria, recently collected site specific water quality data, continuous flow data from two USGS discharge monitoring stations located in the watershed, a calibrated hydrologic model, and load duration curves to establish allowable loadings of E. coli which will result in reduced in-stream concentrations and attainment of water quality standards. The TMDL requires reductions of E. coli loading on the order of 44-95% for the listed waterbodies.

The proposed NFFD River E. coli TMDL document can be downloaded from the following website:

http://www.state.tn.us/environment/wpc/tmdl/

Technical questions regarding this TMDL should be directed to the following members of the Division of Water Pollution Control staff:

Dennis M. Borders, P.E., Watershed Management Section
Telephone: 615-532-0706

Sherry H. Wang, Ph.D., Watershed Management Section
Telephone: 615-532-0656

Persons wishing to comment on the proposed TMDL are invited to submit their comments in writing no later than July 24, 2006 to:

Division of Water Pollution Control
Watershed Management Section
7th Floor L & C Annex
401 Church Street
Nashville, TN 37243-1534

All comments received prior to that date will be considered when revising the TMDL for final submittal to the U.S. Environmental Protection Agency.

The TMDL and supporting information are on file at the Division of Water Pollution Control, 7th Floor L & C Annex, 401 Church Street, Nashville, Tennessee. They may be inspected during normal office hours. Copies of the information on file are available on request.

APPENDIX F

Public Comments Received

From: kathy krone <kkrone@stategazette.com>
To: <Dennis.Borders@state.tn.us>
Date: 7/5/2006 5:47:46 PM
Subject: North Fork Forked Deer TMDL

Dennis,

My name is Kathy Krone. I am a reporter for the State Gazette in Dyersburg, TN.

I got the TDEC notice abut the proposed TMDL for E. coli in the North Fork Forked Deer River. I'm trying to read through the document. I'm not sure I understand everything.

Table 2 shows that 15 waterbodies within the watershed are impaired by E. coli (and sometimes other things).

Table 3, on the other hand, lists 26 monitoring stations and all of them appear to have exceeded the water quality maximum target at least once (if I'm reading the chart correctly).

If I'm interpreting it correctly, Table 7 appears to indicate that the proposed TMDL limits will require significant reductions. For example, Dry Creek will need a reduction of greater than 47.6 percent.

You apparently hope to implement these reductions through:
· Maintaining current municipal and industrial wastewater treatment facilities at current levels.
· Implementation of municipal storm sewer regulations, such as those Dyersburg is following now.
· Regulating animal feeding operations.
· Relying upon citizen-led measures to lower nonpoint sources. (How realistic is that?)
· Encouraging farmers to use BMPs.

How much do you expect those measures to reduce E. coli?

Will you develop TMDLs for the other items impairing waterbodies within the watershed, such as phosphates, siltation, habitat alterations and nitrates?

Perhaps we could talk about this. My phone number is (731) 285-4091. I have a meeting at 11 a.m. Thursday and another at 4 p.m. Thursday.

Thanks,
Kathy Krone
State Gazette
Dyersburg, TN

The following follow-up message from Kathy Krone was forwarded to the Division of Water Pollution Control by Tisha Calabrese-Benton, TDEC's Public Information Officer:

From:	Sherry Wang
To:	Borders, Dennis
Date:	7/12/2006 12:20:11 PM
Subject:	Fwd: Follow-up Reporter Question

>>> Tisha Calabrese 07/12/06 9:40 AM >>>
Hi Sherry,

Please see Kathy Krone's follow-up questions in bold below. Could you please help me answer these?

One more quick question before I sit down and really absorb this information: Looking at the methods proposed for reducing E. coli levels, I'm not sure I understand how you intend to get as much of a decrease as is needed (such as a 47.6 percent decrease on Dry Creek). The wastewater treatment facilities will remain fairly unchanged. No concentrated animal feeding operations were reported in the watershed. Farmers reportedly have been using BMPs for years. And, citizen-led environmental measures don't happen very often in this part of the country.

Which of these measures is expected to have the biggest impact in the North Fork Forked Deer watershed? Is that enough to bring the total down to the proposed levels?

Thanks!
Tisha

Tisha Calabrese-Benton
Deputy Communications Director
Tennessee Dept. of Environment and Conservation
865.594.5442 - Knoxville Office
865.594.6105 - Knoxville Fax
865.599.3685 - Mobile
Tisha.Calabrese@state.tn.us

APPENDIX G

Responsiveness Summary

Reponses to Kathy Krone's comments

Note: responses (**bolded**) follow each individual comment.

Table 2 shows that 15 waterbodies within the watershed are impaired by E. coli (and sometimes other things). **Yes, there are 15 waterbody segments on the 2004 303(d) list identified as not supporting designated uses due in part to E. Coli. The TMDL addresses all 15 waterbodies.**

Table 3, on the other hand, lists 26 monitoring stations and all of them appear to have exceeded the water quality maximum target at least once (if I'm reading the chart correctly). **Water quality assessment is based on monitored data. Many waterbodies have multiple water quality monitoring stations located on a single (303(d)) waterbody segment. All data are evaluated for TMDL analysis. For example, Lewis Creek (TN08010204023 - 1000) has three (3) water quality monitoring stations. The required load reduction is based on the most protective (highest calculated percent reduction) of the three stations.**

If I'm interpreting it correctly, Table 7 appears to indicate that the proposed TMDL limits will require significant reductions. For example, Dry Creek will need a reduction of greater than 47.6 percent. **Yes, that is correct.**

You apparently hope to implement these reductions through:

• Maintaining current municipal and industrial wastewater treatment facilities at current levels. **Yes, at current permit limits for E. Coli.**

• Implementation of municipal storm sewer regulations, such as those Dyersburg is following now. **According to the Small MS4 General NPDES Permit, Section 4.1.2, "You must develop and fully implement your program in five years from the permit issuance date (February 27, 2003)."**

• Regulating animal feeding operations. **The Clean Water Act exempts discharges associated with normal farming operations. Animal Feeding Operations (AFOs) are agricultural operations where animals are kept and raised in confined situations. AFOs that meet the regulatory definition of a concentrated animal feeding operation (CAFO) have the potential of being regulated under the NPDES permitting program. A CAFO that either meets the large (Class I) CAFO size criteria, the medium (Class II) criteria or has otherwise been designated as a CAFO by the Director of the Division of Water Pollution Control is required to be covered by NPDES permits and in compliance with the requirements of those permits no later than April 2006. As of February 2006, there were no Class I, Class II, or other designated CAFOs located in the drainage areas of 303(d) listed waterbodies in the North Fork Forked Deer River watershed.**

• Relying upon citizen-led measures to lower nonpoint sources. (How realistic is that?) **In watersheds with dedicated and proactive watershed groups, these citizen-led, local organizations have the potential to be a major driving force in affecting change and facilitating long-term effort for pollutant load reduction from nonpoint sources. Examples of watersheds with active watershed groups in eastern Tennessee are the Little**

River and Lower Clinch River watersheds; in middle Tennessee, the Harpeth River and Stones River watersheds; and in western Tennessee, the Wolf River and Hatchie River watersheds.

• Encouraging farmers to use BMPs. **The Tennessee Department of Agricultural (TDA) Nonpoint Source Program for Tennessee provides funding for watershed restoration (i.e., BMP implementation) under Section 319 of the Clean Water Act. According to TDA's Nonpoint Source Program Request for Proposals FY 2006 website (http://state.tn.us/agriculture/nps/319-RFPF.pdf), "The highest priority for funding are projects that target waters of the state assessed as impaired from nonpoint source pollution and published in the 303(d) List." In addition, the Natural Resources Conservation Service (NRCS), an agency of the U. S. Department of Agriculture, provides technical assistance, information, and advice to citizens in their efforts to conserve soil, water, plant, animal, and air resources on private land. The local NRCS has an extensive history of conservation practices with partnerships in the North Fork Forked Deer River watershed.**

How much do you expect those measures to reduce E. coli? **TMDL implementation is an adaptive and iterative process. Implementation of a combination of appropriately selected, properly designed BMPs, including proper installation and routine maintenance, should achieve adequate efficiency of pollutant removal. Tennessee's Watershed Approach (five-year watershed cycle) provides the opportunity for additional stream monitoring to revisit and evaluate the effectiveness of corrective measures, track progress over time, and to apply additional measures in an iterative process. We believe if all stakeholders fulfill their respective responsibilities, the water quality of all impaired waterbodies in the North Fork Forked Deer River watershed should be significantly improved and ultimately restored.**

Will you develop TMDLs for the other items impairing waterbodies within the watershed, such as phosphates, siltation, habitat alterations and nitrates? **The state of Tennessee must develop TMDLs for all pollutants on all waterbodies on the 303(d) list. TMDLs for nutrients and sediment in the North Fork Forked Deer River watershed will be developed within the next five years.**

Reponses to Kathy Krone's follow-up comments

One more quick question before I sit down and really absorb this information: Looking at the methods proposed for reducing E. coli levels, I'm not sure I understand how you intend to get as much of a decrease as is needed (such as a 47.6 percent decrease on Dry Creek). The wastewater treatment facilities will remain fairly unchanged. No concentrated animal feeding operations were reported in the watershed. Farmers reportedly have been using BMPs for years. **TDA's Nonpoint Source Program prioritizes funding to projects that target waters on the state's 303(d) list. This is a relatively recent prioritization. Those represented in Figure 14 (TMDL document) are from TDA's database as of September 2002, the latest information provided to TDEC.** And, citizen-led environmental measures don't happen very often in this part of the country.

Which of these measures is expected to have the biggest impact in the North Fork Forked Deer watershed? **See Section 9.3 and Table 8 (TMDL document). Implementation of corrective measures should be targeted to the types of strategies that will address exceedances occurring under the appropriate flow conditions for a given waterbody.** Is that enough to bring the total down to the proposed levels? **If all sources are accurately identified and implementation strategies are comprehensive and appropriately selected, designed, installed, and maintained, then the water quality of impaired waterbodies should be restored to meet their designated uses.**