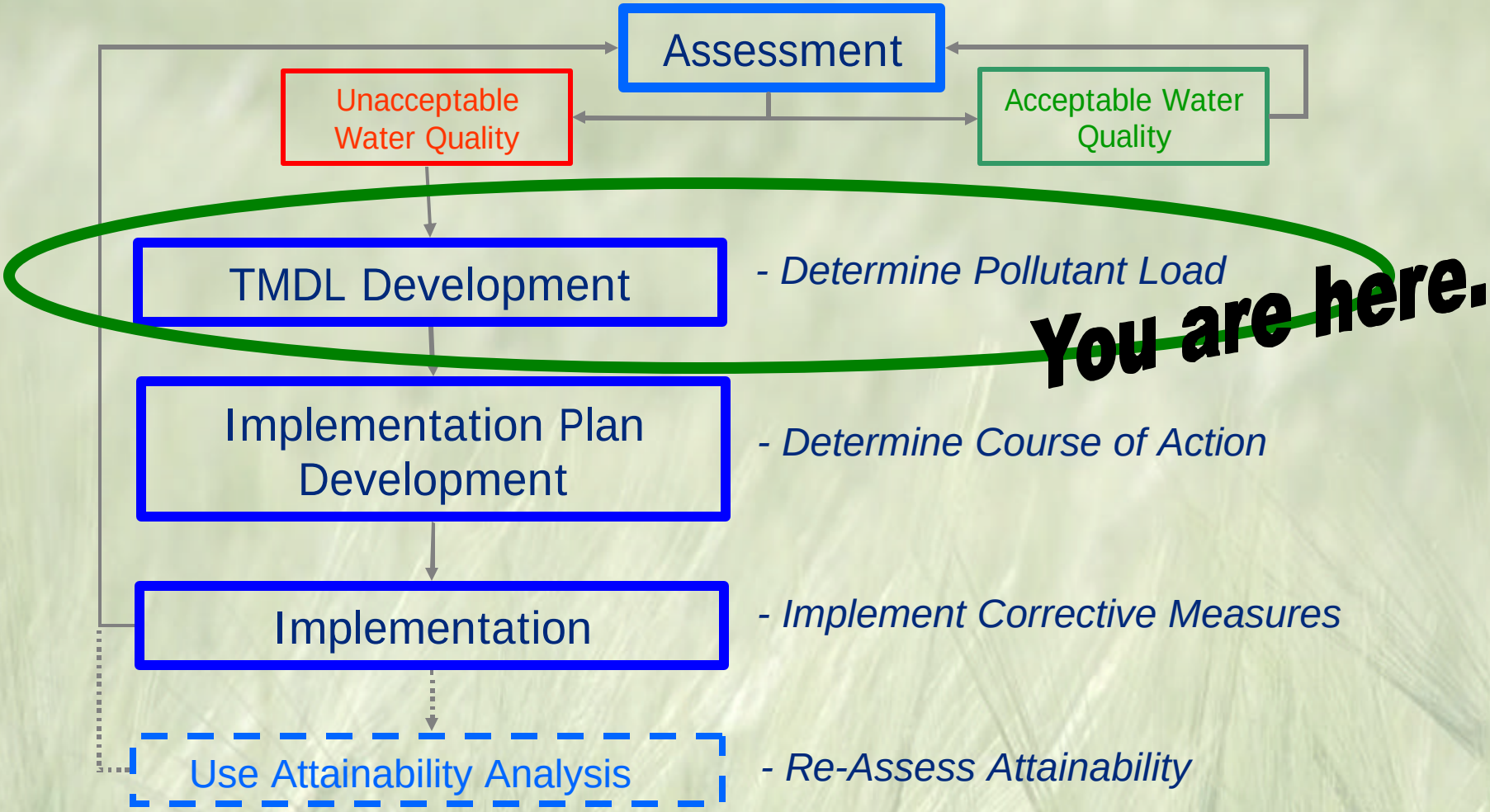
E. coli Bacterial TMDL Development and Source Assessment for

Fontaine Creek

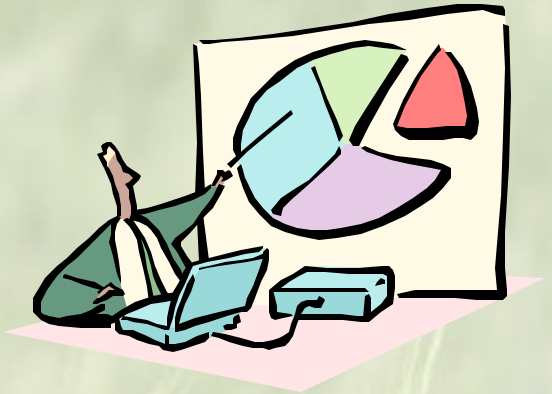
First Public Meeting

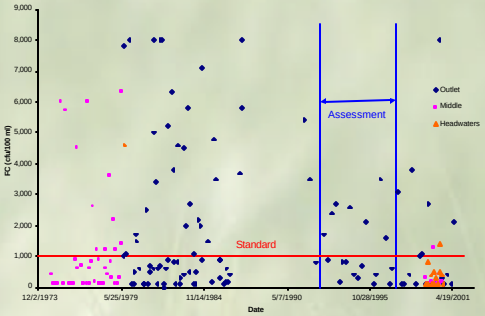
May 26, 2010

TMDL Process

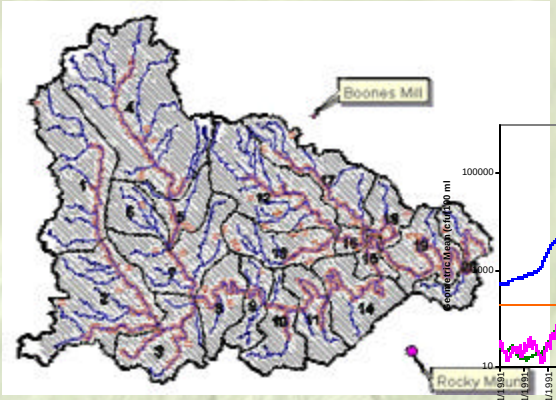


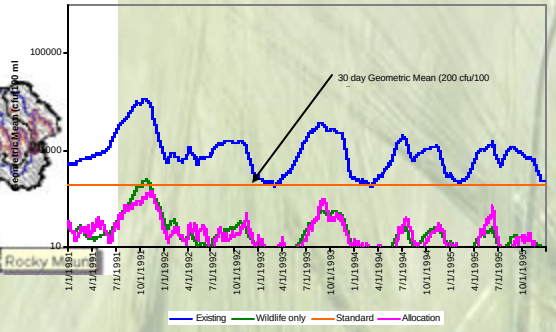
Major Components of the TMDL Report Development



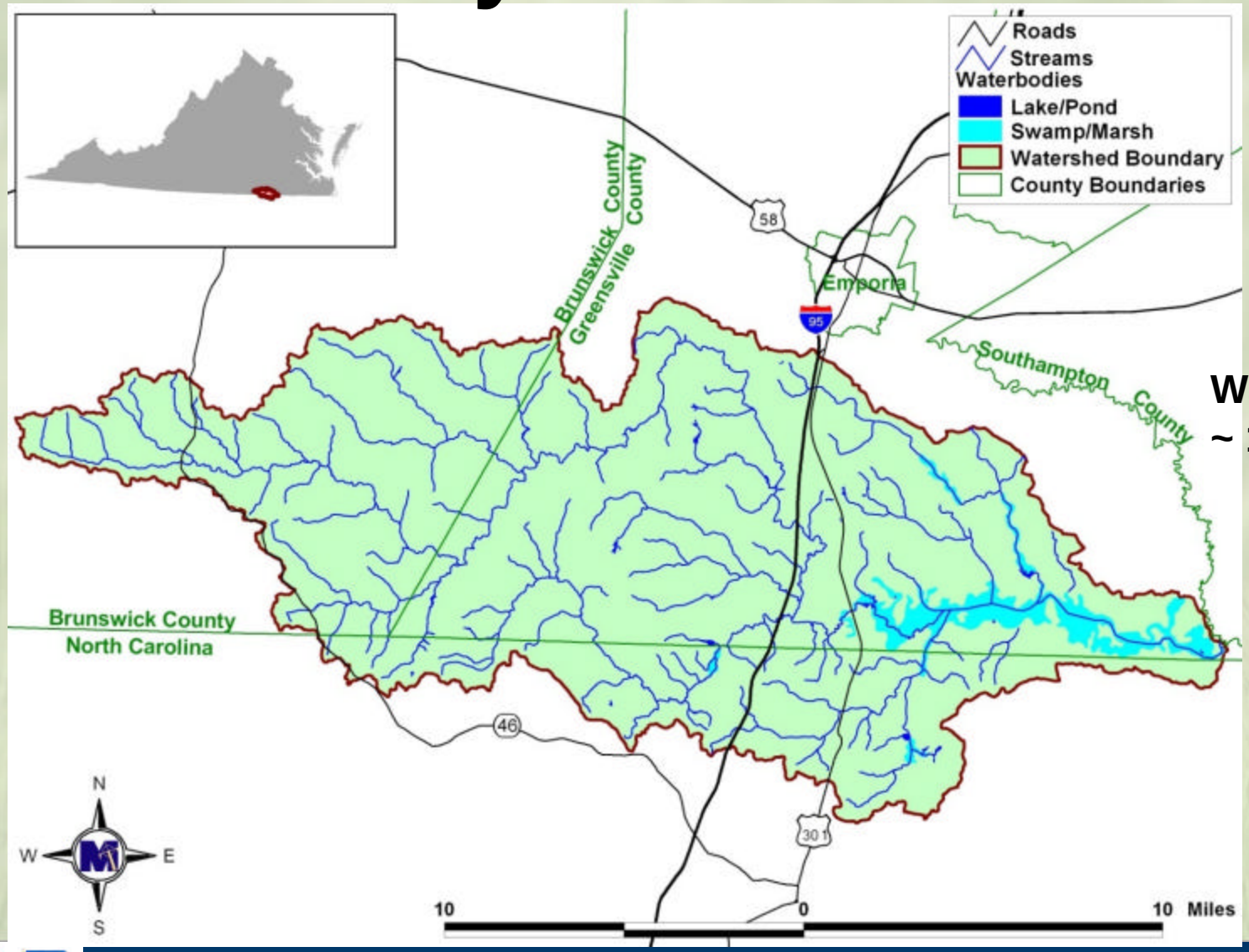


- Source Assessment
- Modeling
  - Hydrology
  - Water Quality
  - Load Allocation
- Public Participation



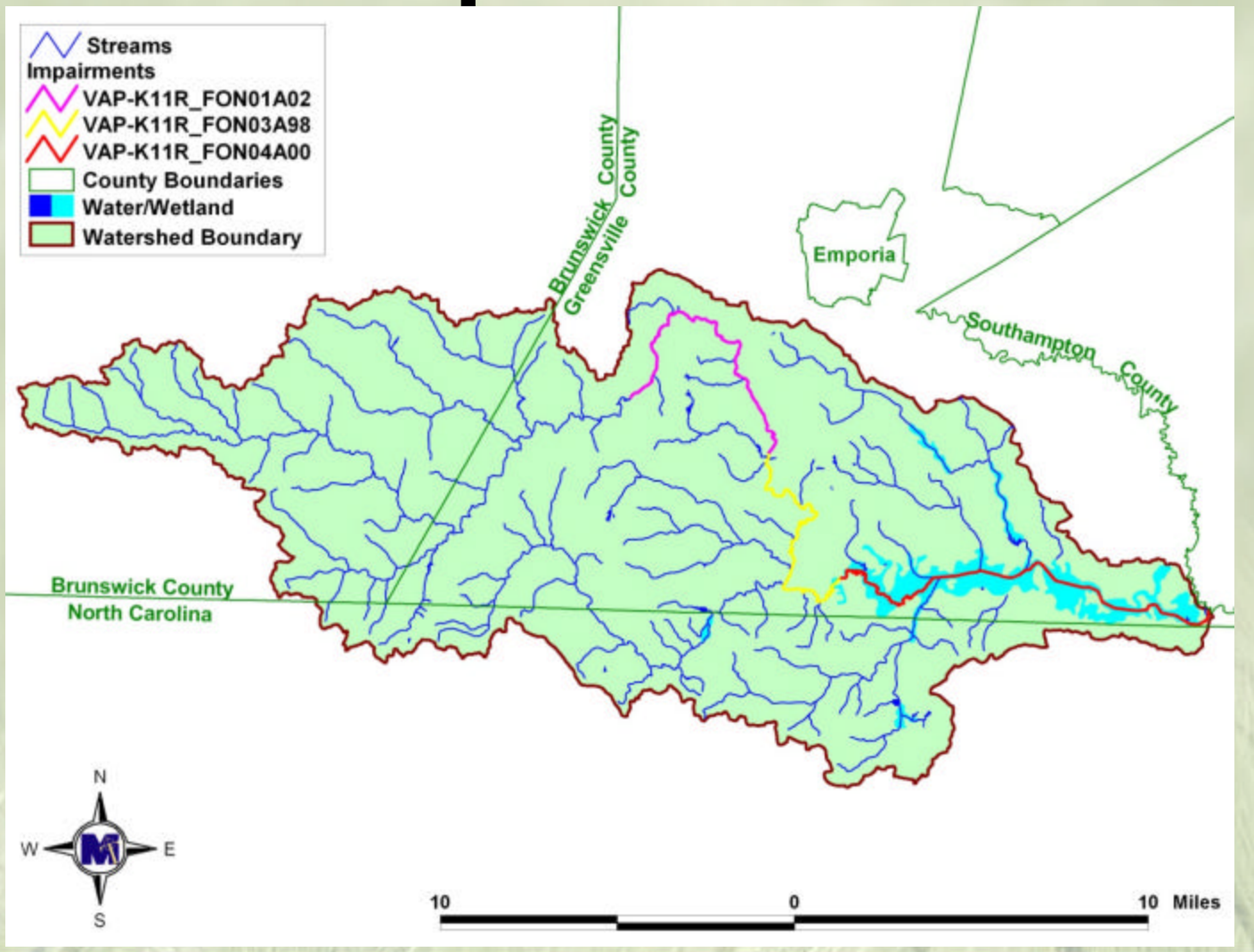


Study Area Location

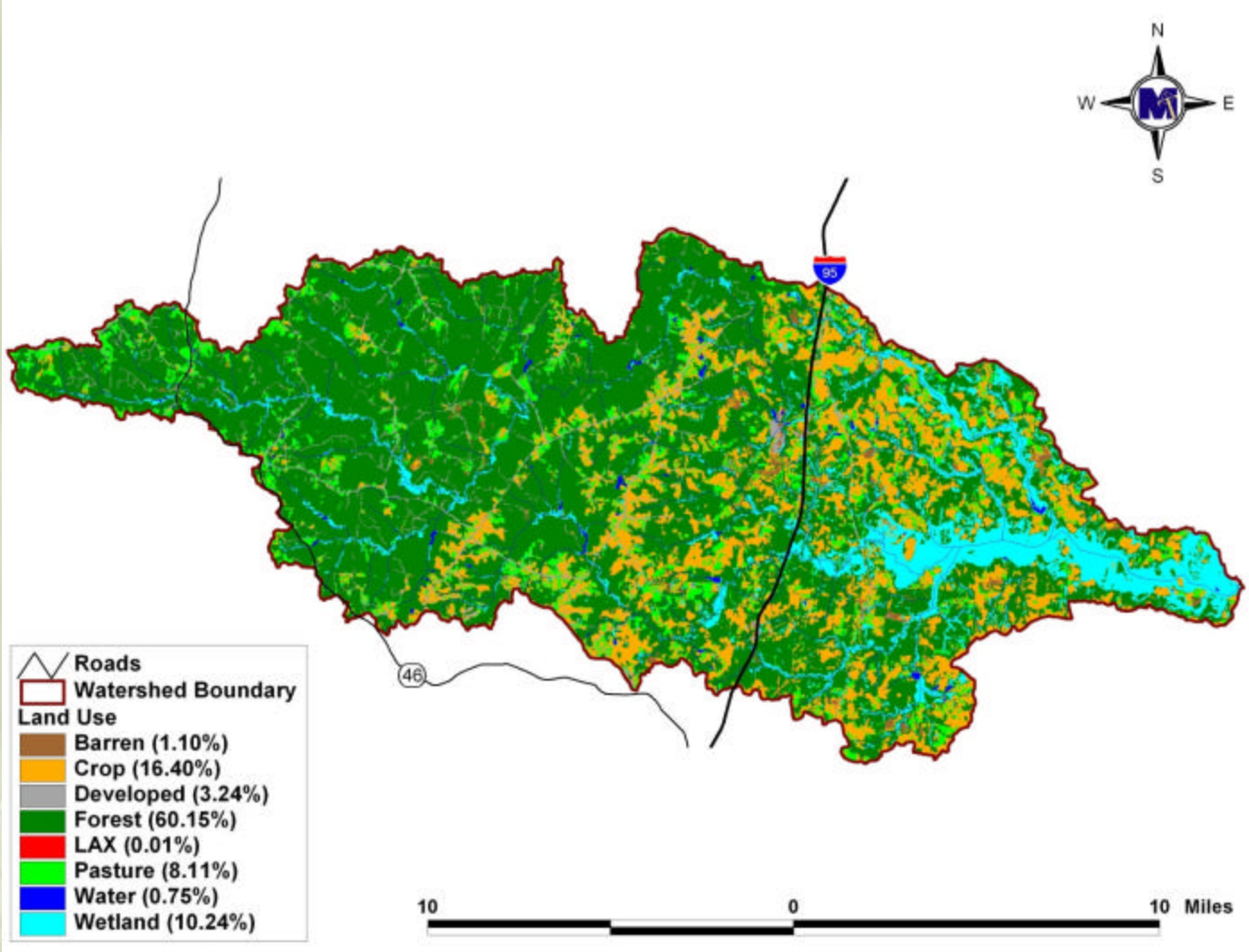


Watershed size ~ 154,000 acres

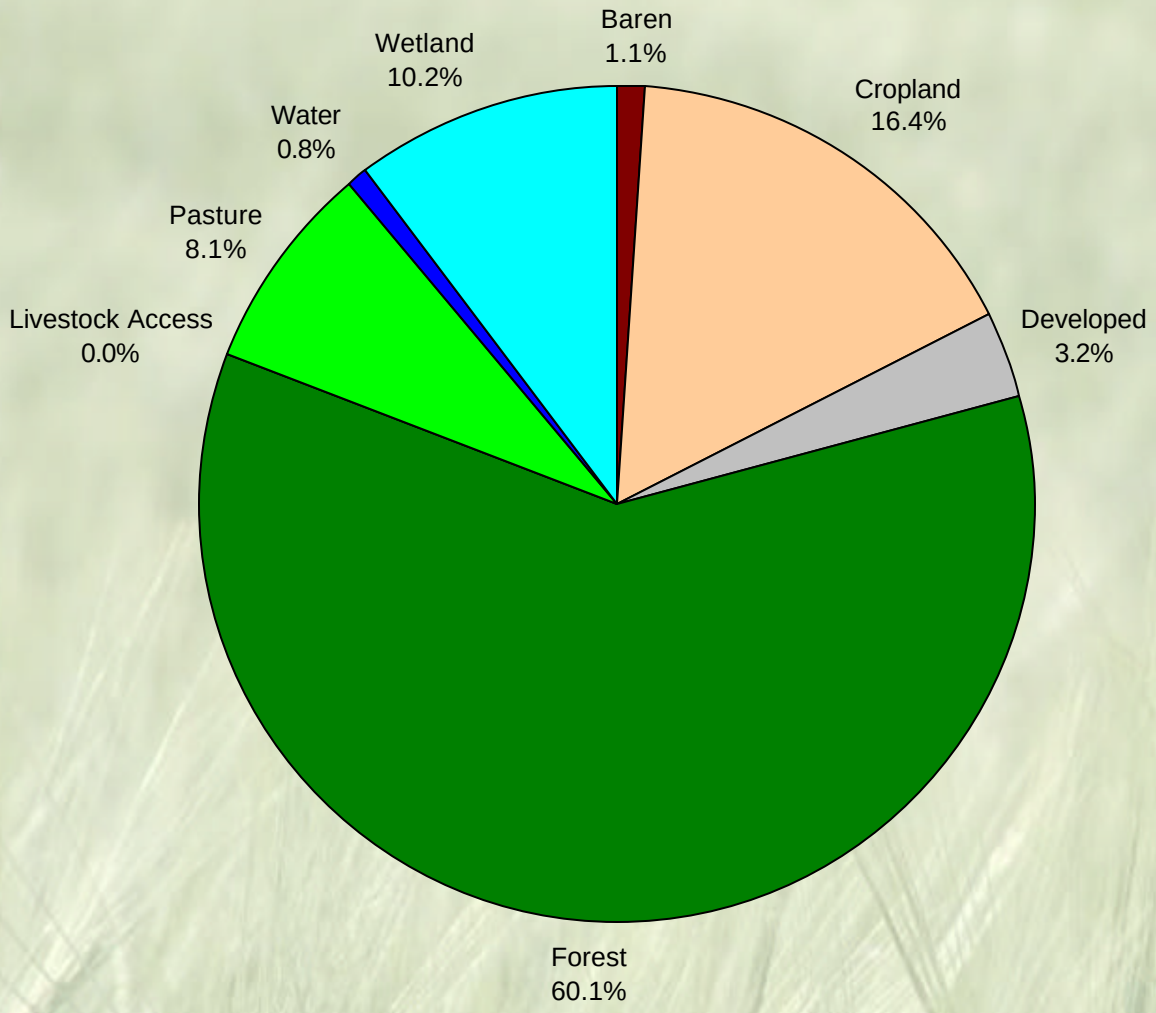
Impairments



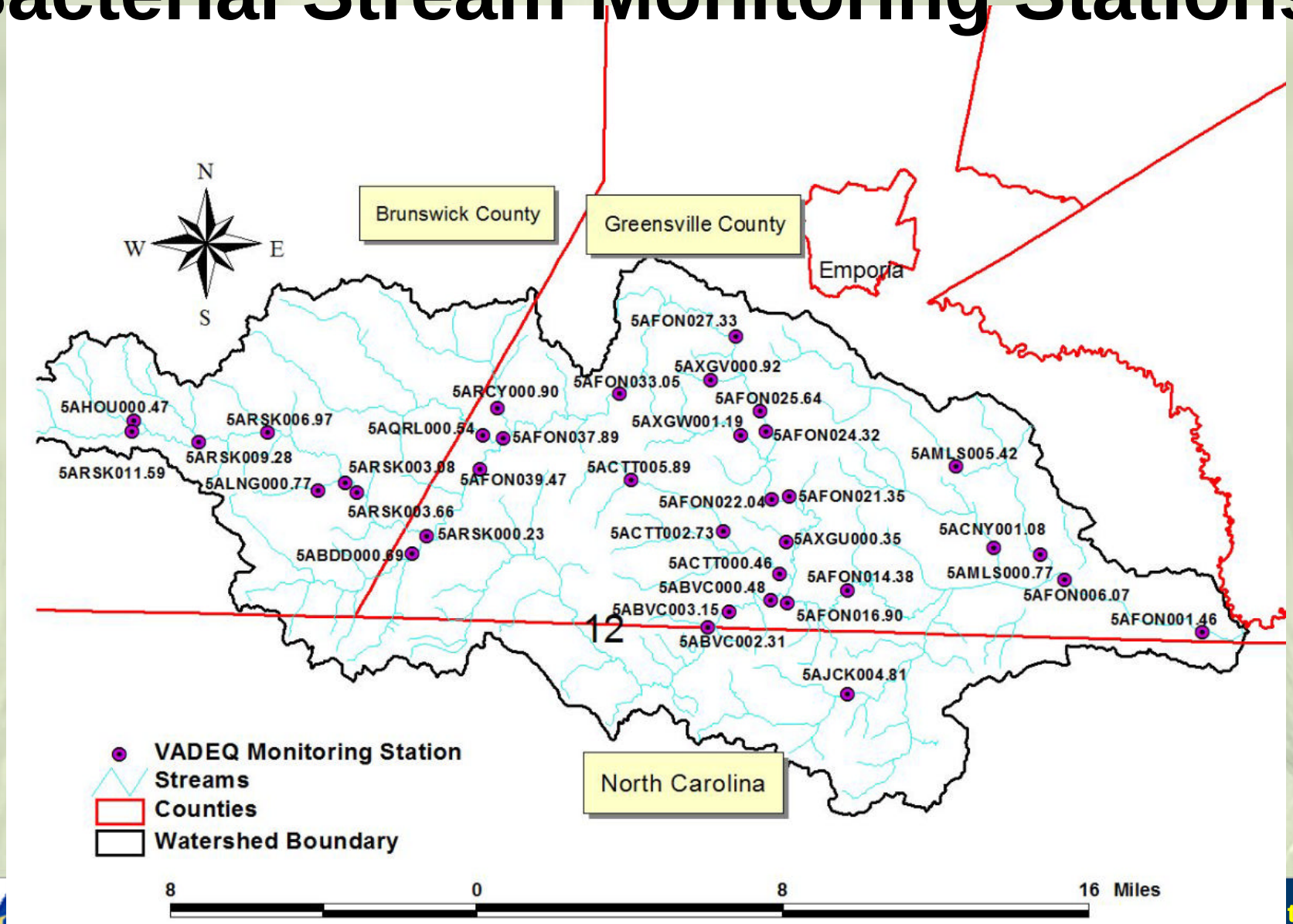
Watershed Land Uses



Watershed Land Uses



Bacterial Stream Monitoring Stations



Bacterial Data – *E.coli*

E. coli primary contact use single sample standard = 235 cfu/100mL

Station	Dates	Count	Minimum	Maximum	Mean	Median	Standard Deviation	Violation %
5ABDD000.69	01/07 – 12/07	11	2	100	30	15	36	0%
5ABVC000.48	01/07 – 12/07	12	1	300	48	21	84	8%
5ABVC002.31	01/07 – 11/07	11	4	1200	176	100	342	9%
5ACNY001.08	01/07 – 04/10	10	4	450	85	34	133	10%
5ACTT000.46	01/07 – 12/07	12	3	100	28	12	36	0%
5ACTT002.73	01/07 – 11/08	12	29	600	190	100	179	17%
5AFON001.46	01/07 – 06/07	6	22	600	128	34	231	17%
5AFON006.07	07/03 – 12/07	23	7	1100	165	53	268	17%
5AFON014.38	06/05 – 12/07	22	1	600	88	25	148	14%
5AFON016.90	03/07 – 03/07	1	10	10	10	10	NA	0%
5AFON021.35	01/07 – 12/07	12	1	140	45	29	45	0%

Bacterial Data – *E.coli*

E. coli primary contact use single sample standard = 235 cfu/100mL

Station	Dates	Count	Minimum	Maximum	Mean	Median	Standard Deviation	Violation %
5AFON022.04	01/07 – 12/07	12	8	800	103	32	222	8%
5AFON025.64	01/07 – 12/07	12	1	570	77	21	159	8%
5AFON027.33	01/07 – 12/07	12	2	250	55	29	69	8%
5AFON033.05	01/07 – 12/07	12	3	300	50	15	86	8%
5AFON037.89	08/03 – 12/07	31	4	380	96	75	84	10%
5AFON039.47	01/07 – 12/07	9	31	210	108	100	59	0%
5AHOU000.47	01/07 – 08/07	8	6	100	30	16	33	0%
5AJCK004.81	02/09 – 05/10	9	25	500	153	100	174	22%
5ALNG000.77	01/07 – 12/07	12	1	220	72	41	75	0%
5AMLS000.77	01/07 – 12/07	12	1	100	19	3	38	0%
5AMLS005.42	01/07 – 11/08	12	9	500	125	100	127	8%
5AQRL000.54	01/07 – 12/07	11	4	130	55	36	46	0%

Bacterial Data – *E.coli*

E. coli primary contact use single sample standard = 235 cfu/100mL

Station	Dates	Count	Minimum	Maximum	Mean	Median	Standard Deviation	Violation %
5ARCY000.90	01/07 – 12/07	11	1	230	45	8	72	0%
5ARSK000.23	01/07 – 12/07	10	16	400	81	25	122	10%
5ARSK003.08	05/05 – 12/07	22	11	1660	190	35	439	14%
5ARSK003.66	04/04 – 04/04	1	20	20	20	20	NA	0%
5ARSK006.97	01/07 – 12/07	12	5	100	50	40	37	0%
5ARSK009.28	01/07 – 12/07	12	12	252	106	68	75	8%
5ARSK011.59	01/07 – 12/07	10	12	4500	487	28	1410	10%
5AXGU000.35	01/07 – 12/07	12	1	100	31	18	36	0%
5AXGV000.92	01/07 – 11/07	7	1	280	69	36	98	14%
5AXGW001.19	01/07 – 12/07	9	10	330	91	17	114	11%

Bacterial Data – Fecal Coliform

Fecal Coliform primary contact use single sample standard = 400 cfu/100mL

Station	Dates	Count	Minimum	Maximum	Mean	Median	Standard Deviation	Violation %
5ABVC003.15	06/01 - 04/10	14	100	400	129	100	83	0%
5ACTT002.73	03/98 – 08/02	17	18	700	209	110	210	29%
5ACTT005.89	12/97 – 08/02	19	18	790	217	120	257	21%
5AFON006.07	08/94 – 03/01	34	20	1400	369	165	456	24%
5AFON016.90	03/07 – 03/07	1	25	25	25	25	NA	0%
5AFON022.04	08/90 – 03/00	44	18	1400	188	100	285	9%
5AFON024.32	04/03 – 04/03	1	25	25	25	25	NA	0%
5AFON025.64	12/97 – 08/02	24	18	3500	472	120	927	21%
5AFON027.33	12/97 – 08/02	20	18	16000	1164	112	3587	15%
5AFON037.89	05/01 – 06/03	13	100	600	177	100	188	15%
5ARSK003.08	08/94 – 11/06	45	18	3500	320	78	750	13%

Bacterial Source Assessment

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

[Human + Pet + Livestock = Controllable Loading]

Permits in the Study Areas (2009)

3 VPDES Permitted Discharges

Permit	Receiving Stream(s)	Facility Name	Outfall Number(s)	Permitted for FC Control
VA0028916	Fontaine Creek	Skippers Wastewater Treatment Facility	1	Y
VA0059072	Fontaine Creek	Georgia Pacific Wood Products LLC - Skippers	1	N
VA0092436	UT Fontaine Crk	Iluka Resources Inc - Brink Concentrator	001, 002	N

Permits in the Study Areas (2009)

2 Confined (?) Animal Feeding Operation (AFO):

Permit Number	Facility Name	Water Body	Type	Adjacent Receiving Stream
VPG100033	Smithfield Carrolls Farm 93	VAP-K11R	Swine	Cattail Creek
No longer operating. When did it stop operating?	?	VAP-K11R	Chicken	UT Fontaine Creek.

Permits in the Study Areas (2009)

1 Single Family Home permit.

Permit	Receiving Stream	Facility Name
VAG404256	UT Fontaine Creek	Private Residence

1 Virginia Pollution Abatement permit (VPA)

Permit	Receiving Stream	Facility Name
VPA00532	Fontaine Creek	Georgia Pacific Wood Products LLC - Skippers

Human Sources

Population, housing units, and # of onsite treatment systems based on 1990 and 2000 U.S. Census

Failing Septic Systems:

#s based on age of homes

Effluent reaching ground surface throughout the year

Lateral movement continuously to stream

Straight Pipes:

#s based on “other” category in 1990 census

Direct continuous input into stream

Biosolids:

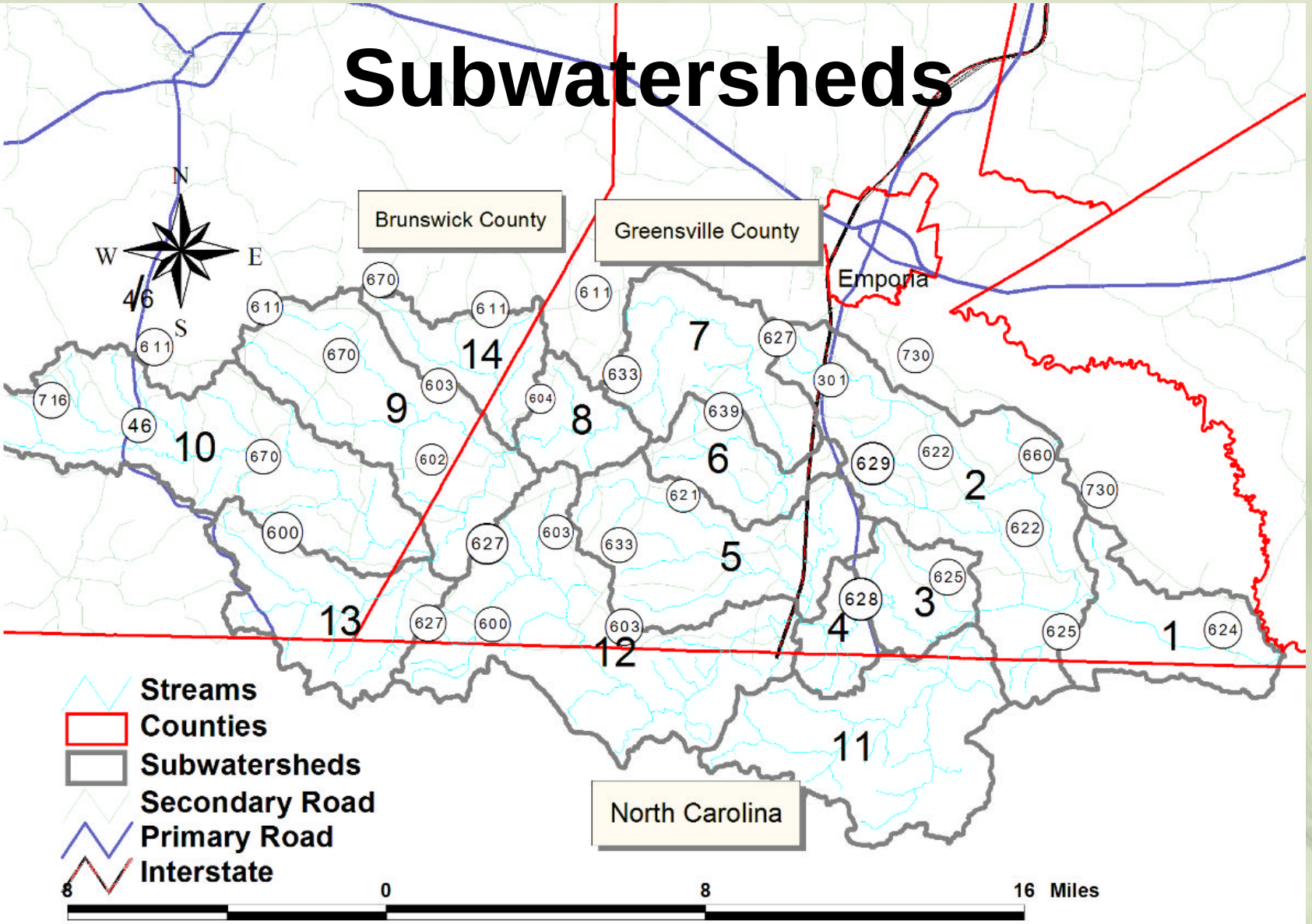
No biosolids were reported to have been applied within the study area within the last 10 years

Human Population Estimates (2009)

Sub-watershed	Population	Housing Units	Sewer	Septic	Straight Pipes	Failing Septics
1	100	55	14	37	4	16
2	1,054	594	102	442	51	156
3	811	364	6	332	26	90
4	207	101	2	92	7	24
5	1,181	629	74	521	35	110
6	703	404	69	301	33	90
7	341	195	58	110	27	59
8	257	171	35	117	19	49
9	266	197	14	152	30	88
10	1,240	613	4	594	16	124
11	786	372	30	329	14	55
12	2,379	1,231	257	908	65	192
13	714	502	51	434	17	143
14	101	75	5	58	12	33
total	10,140	5,503	721	4,427	356	1,229

- Failing septic and straight pipe numbers were deemed high by VDH and will be adjusted accordingly
- Current estimated septic system failure rate is 28%

Subwatersheds



Pet Sources

Population #s: based on literature values of animals per housing unit.

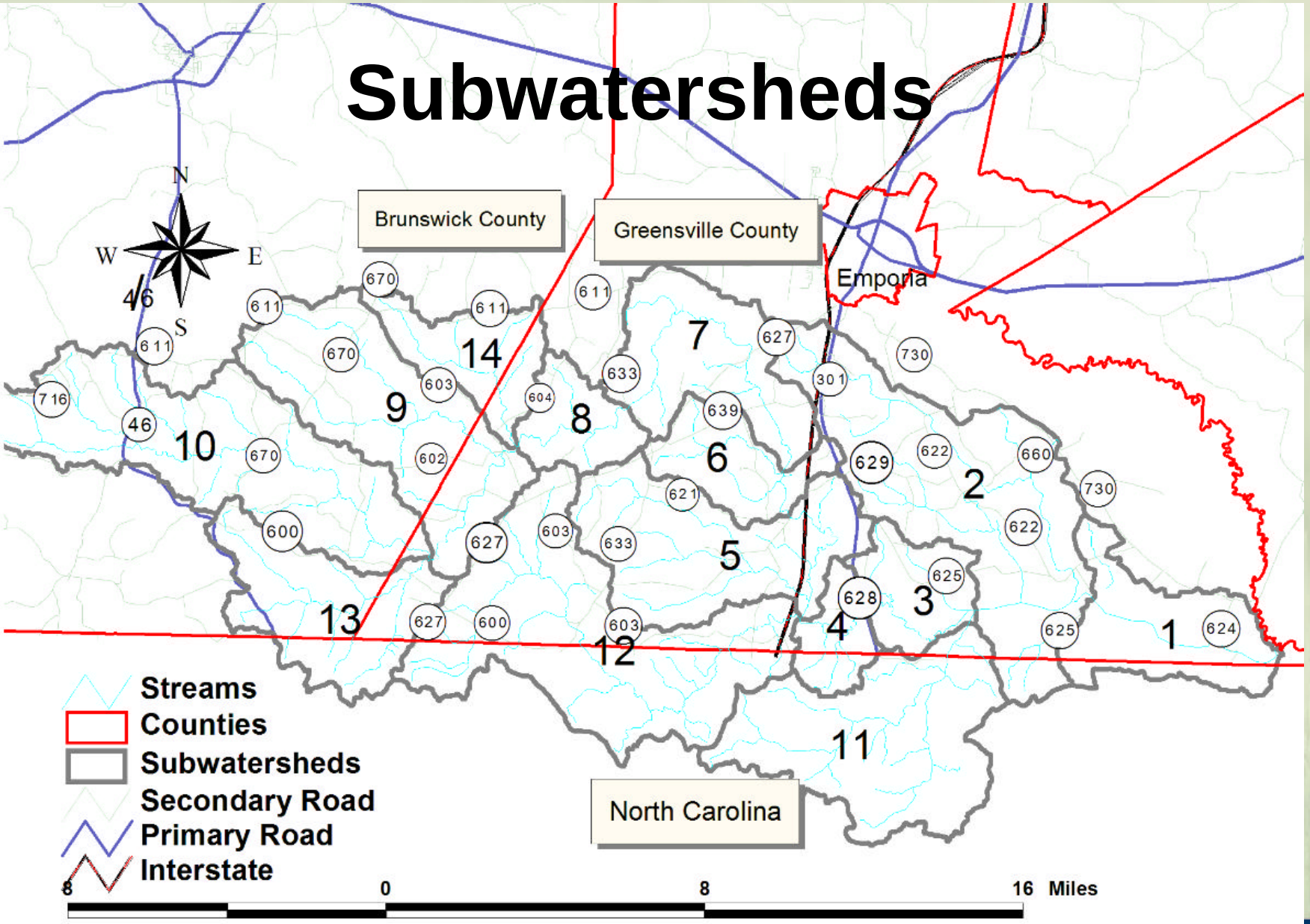
Housing unit #s: based on U.S. Census

Bacteria in model: Land-applied on Developed land use

Pet Population Estimates (2009)

Subwatershed	dogs	cats
1	26	29
2	292	327
3	177	198
4	49	55
5	308	345
6	200	224
7	98	110
8	85	95
9	94	105
10	300	335
11	177	199
12	605	677
13	203	227
14	36	40
total	2,650	2,966

Subwatersheds



Livestock Sources

Populations #s: Virginia Agricultural Statistics
Verified by local SWCD staff

Distribution of waste:
Pastured
Confined, waste collected, spread on cropland, pasture
Direct deposition to the stream

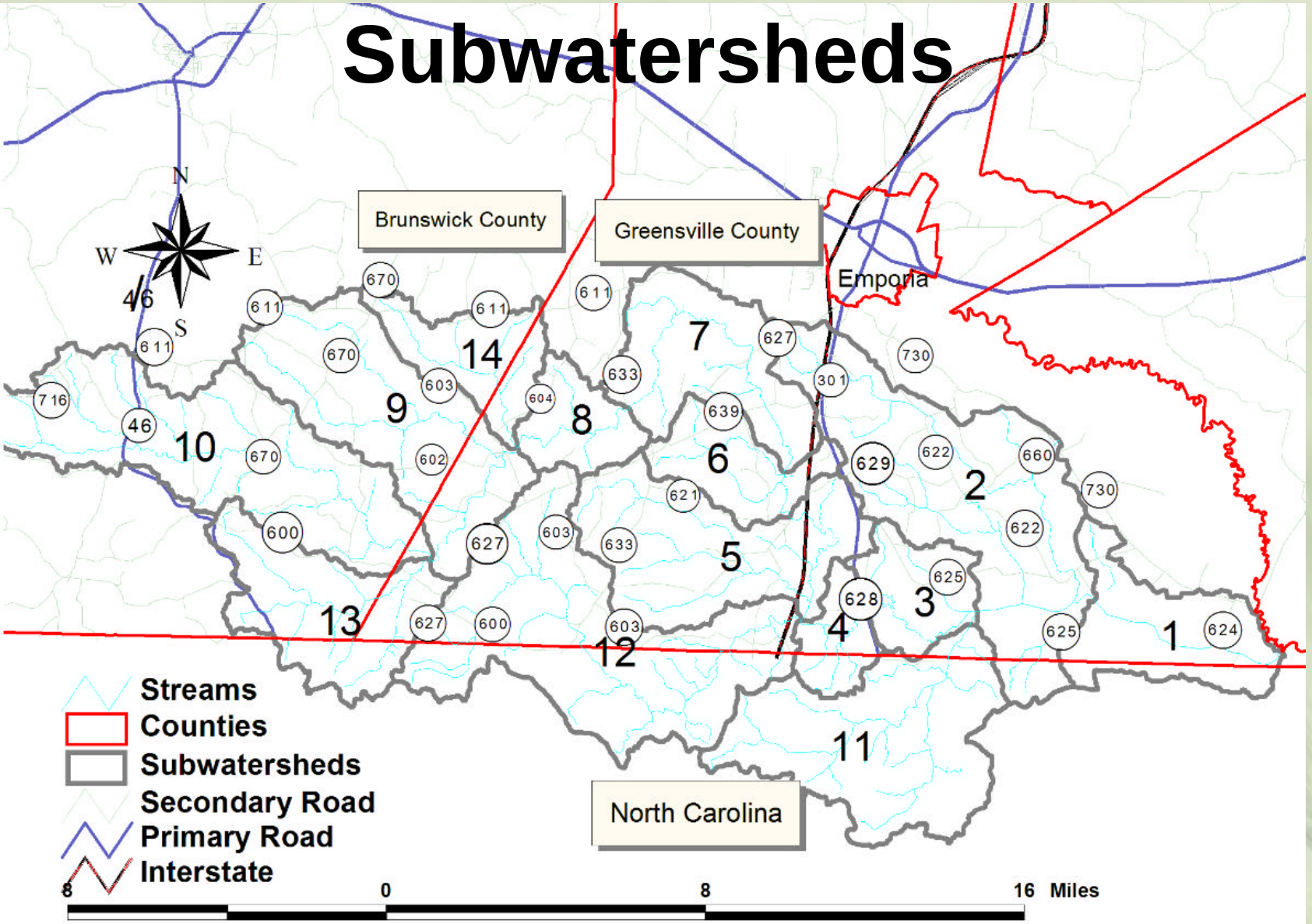
Seasonal varying applications

Livestock Population Estimates (2009)

Sub-watershed	Beef Stocker	beef Calf	Dairy	Horses	Hogs and Pigs	Broilers	Chickens
1	27	17	0	0	1,850	0	0
2	74	43	0	0	0	0	0
3	17	10	0	0	0	0	0
4	10	6	0	0	0	0	0
5	48	28	0	0	5,100	0	0
6	19	11	0	0	0	0	0
7	35	20	0	0	0	0	0
8	15	8	0	0	0	0	10,000
9	118	135	0	0	0	0	0
10	187	229	75	0	0	0	0
11	36	31	0	0	2,400	0	0
12	63	43	0	0	14,446	157,867	0
13	65	74	0	0	0	0	0
14	45	51	0	0	0	0	0
Total	758	706	75	25	23,796	157,867	10,000

Total Watershed size ~ 154,000 acres

Subwatersheds



Wildlife Sources

Animal Densities: literature values from VDGIF biologists

Habitat: literature values from VDGIF biologists

Populations: Animal density (an/acre) * Habitat (acres) = total # of animals

Species specific

Distribution of waste:

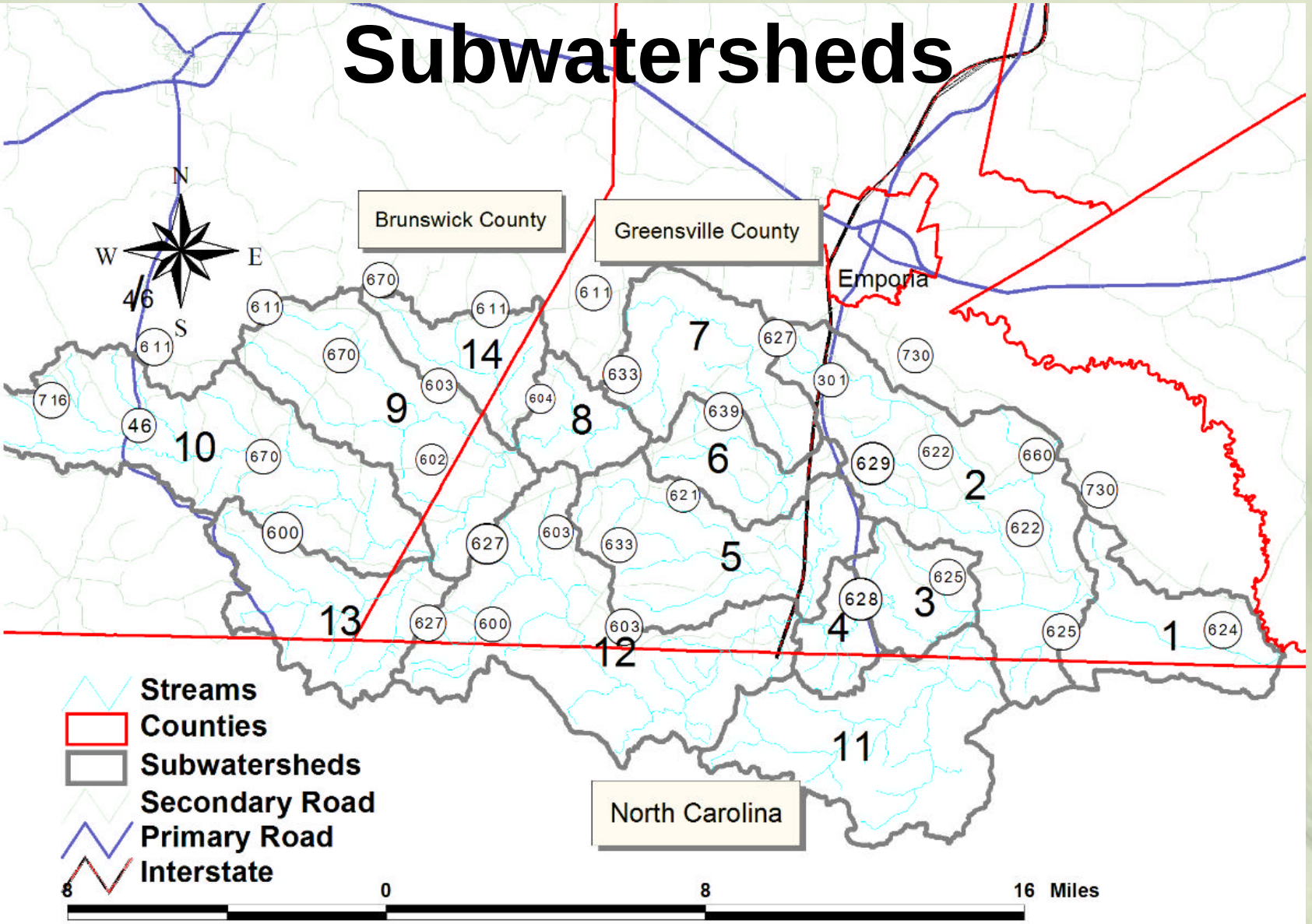
Based on habitat
Land-applied and
Direct deposition to the stream

Wildlife Population Estimates

subwatershed	Deer	Turkey	Raccoon	Beaver	Duck	Geese	Muskrat
1	273	71	566	37	6	3	2,327
2	694	182	1,441	182	15	6	5,922
3	159	42	330	51	3	1	1,358
4	103	27	212	35	3	1	1,229
5	435	110	912	132	13	6	5,243
6	172	44	361	47	5	2	2,077
7	323	82	665	80	8	3	3,194
8	134	34	275	36	3	1	1,321
9	499	126	1,029	112	11	5	4,127
10	675	169	1,387	205	18	8	6,888
11	515	134	1,070	153	12	5	4,728
12	710	179	1,462	217	18	8	6,884
13	334	83	685	98	9	4	3,675
14	190	48	391	53	4	2	1,567
total	5,216	1,331	10,786	1,438	128	55	50,540

Total watershed acreage ~ 154,000 acres

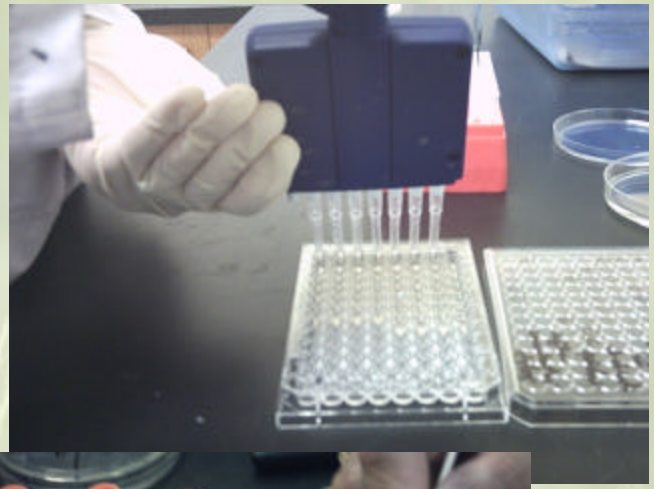
Subwatersheds

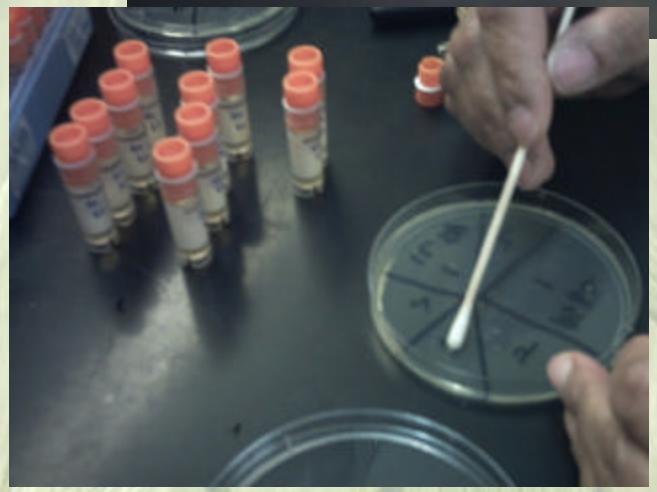


Bacterial Source Tracking (BST)

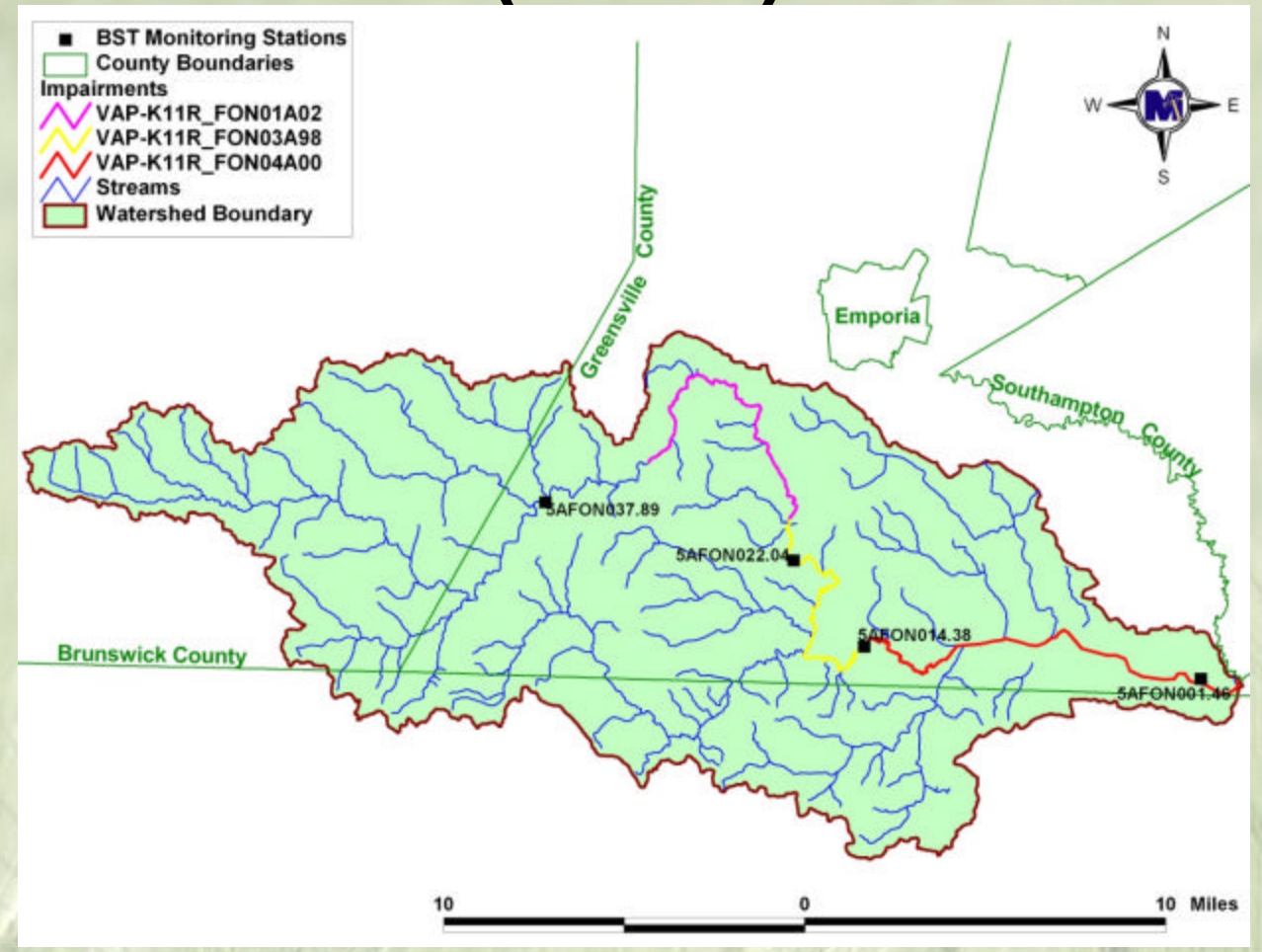
Independent Lab Test

- Attributes bacteria to a specific source type
  - Human
  - Pet
  - livestock
  - Wildlife
- 12 samples collected over one year
- BST is accurate but not exact and is helpful during implementation





Bacterial Source Tracking (BST)



Bacterial Source Tracking Results

		Weighted Averages:				
Stream Name	**Station**	**Wildlife**	**Human**	**Livestock**	**Pet**	**Anthropogenic (H+L+P)**
Fontaine Creek	5AFON001.46	29%	25%	17%	29%	71%
Fontaine Creek	5AFON014.38	9%	31%	33%	27%	91%
Fontaine Creek	5AFON022.04	24%	22%	27%	27%	76%
Fontaine Creek	5AFON037.89	19%	20%	20%	41%	81%

The isolate-weighted average considers the concentration of *E. coli* measured and the number of bacterial isolates analyzed in the BST analysis

Hydrologic Modeling Components

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

Water Quality Modeling Components

Source Populations
Fecal production per day
Bacteria densities per gram of waste

Fecal distribution
Delivery Mechanisms:
Direct:
Land-applied
Temporal Variation

Modeling

How do we determine the TMDLs?

+

Watershed data

TMDL

Contact Information

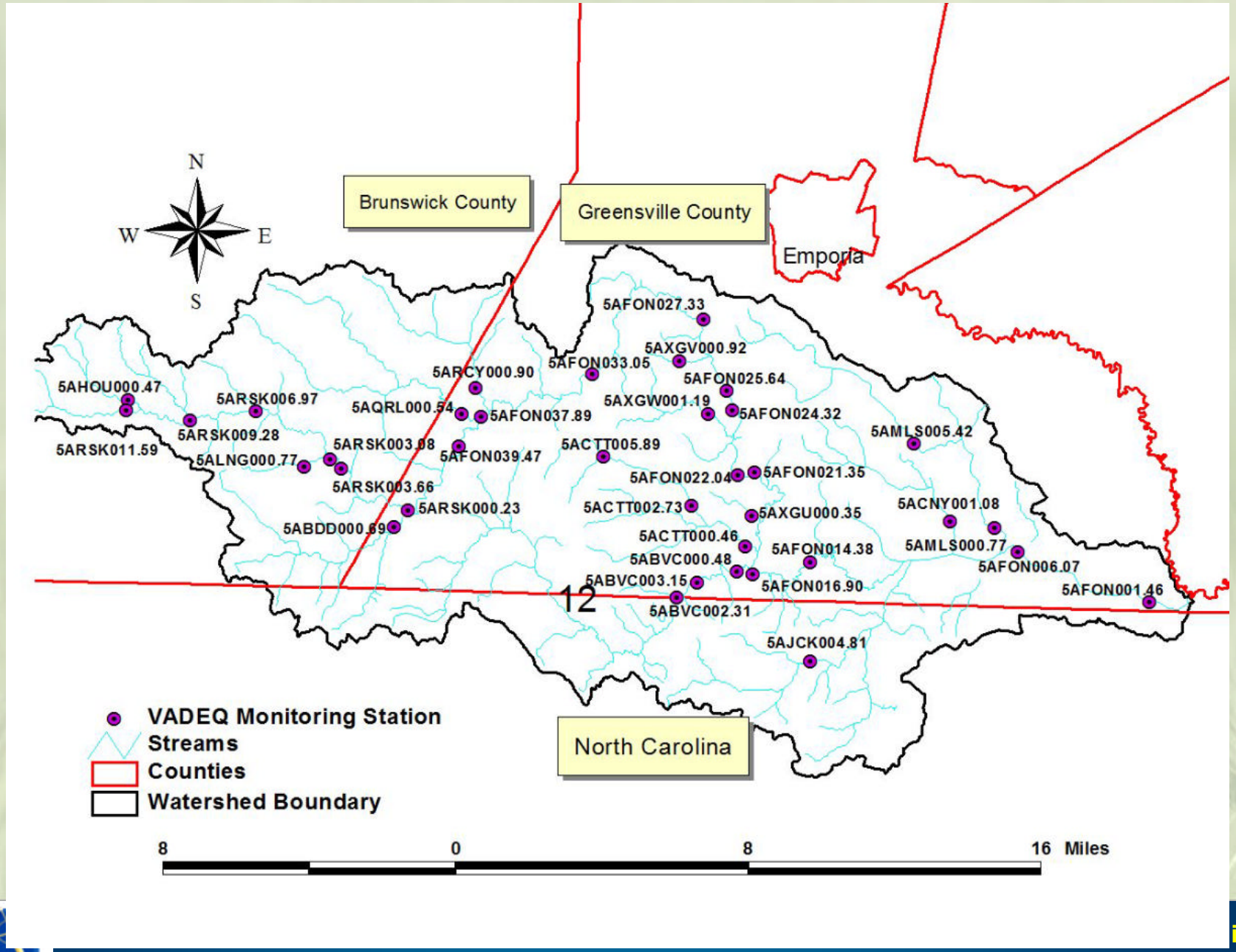
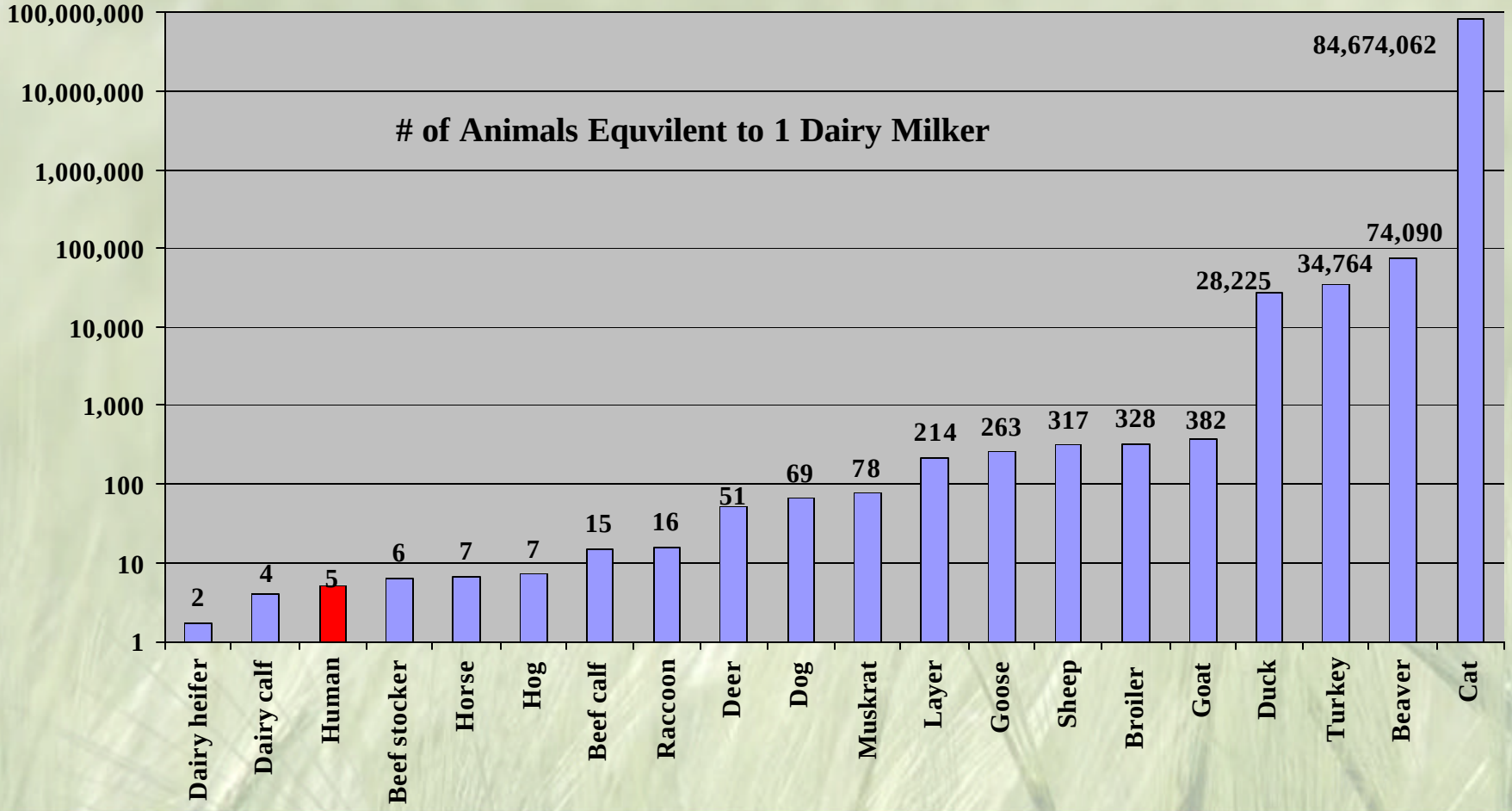
- Virginia Department of Environmental Quality
  - **Margaret Smigo**, TMDL Project Coordinator
  - Margaret.Smigo@deq.virginia.gov
  - 4949-A Cox Road
    Glen Allen, VA 23060
  - (804) 527-5124

Send written comments by June 25, 2010

- MapTech, Inc.
  - Mohammad Al-Smadi
  - malsmadi@maptech-inc.com
  - (540) 961-7864 x405

Slide 36

mjs19 The end of comment is June 28th - same day as our next meetings.
mjsmigo, 5/25/2010


N
W
E
S
Brunswick County
Greensville County
Emporia
5AFON027.33
5AXGV000.92
5AFON033.05
5ARCY000.90
5AFON025.64
5AHOU000.47
5ARSK006.97
5AQRL000.54
5AFON037.89
5AXGW001.19
5AFON024.32
5ARSK009.28
5AMLS005.42
5ARSK011.59
5ARSK003.08
5AFON039.47
5ACTT005.89
5ALNG000.77
5AFON022.04
5AFON021.35
5ARSK003.66
5ARSK000.23
5ACTT002.73
5AXGU000.35
5ACNY001.08
5ABDD000.69
5ACTT000.46
5AFON014.38
5AMLS000.77
5ABVC000.48
5AFON006.07
5ABVC003.15
5AFON016.90
5AFON001.46
12
5ABVC002.31
5AJCK004.81
VADEQ Monitoring Station
Streams
Counties
Watershed Boundary
North Carolina
8
0
8
16 Miles

Fecal Production Graph