Roses Creek
Fecal Coliform TMDL Development

Brunswick, Virginia

Public Meeting #1
November 20, 2003

THE Louis Berger Group, INC.

Objectives

- To explain the TMDLs: What is? Why? Which segment? How?
- To present and review the steps and the data used in the development of the fecal coliform TMDL for the listed segment of Roses Creek.

Why Develop TMDLs?

Requirements of 1972 Clean Water Act:

- States are required to identify impaired waters
- Section 303(d) of the Clean Water Act:
  - Requires states to periodically list impaired waters
  - Requires TMDLs development for impaired waters

EPA in litigation for failure to promulgate Section 303(d) of the Clean Water Act.

What is a TMDL?

- A TMDL (Total Maximum Daily Load) establishes the maximum amount of an impairing substance or stressor that a waterbody can assimilate and still meet Water Quality Standards and allocates that load among pollution contributors.

- TMDLs are a tool for implementing State water quality standards. They are based on the relationship between pollution sources and in-stream water quality conditions.

- A TMDL addresses a single pollutant or stressor for each waterbody.

Which Waterbodies Require TMDLs?

Waterbodies require TMDLs when the pollution control requirements are not stringent enough to meet applicable Water Quality Standards.

Water Quality Standards

Bacteria Impairment

- The Primary Contact Recreation designated use is not met due to violations of the water quality standard for bacteria.
  - The segment is listed as impaired if more than 10% of samples exceed the criteria.
  - As of January 15, 2003 the new indicator E. coli is used instead of Fecal Coliform.
  - Virginia and EPA have agreed on translator for TMDL model development.

E. coli Criteria

- Single sample:
  - 235 counts/100mL
  - applies for all samples collected.

- Two or more samples:
  - Geometric mean: 126 counts/100mL
  - Applies to samples taken during any calendar month.

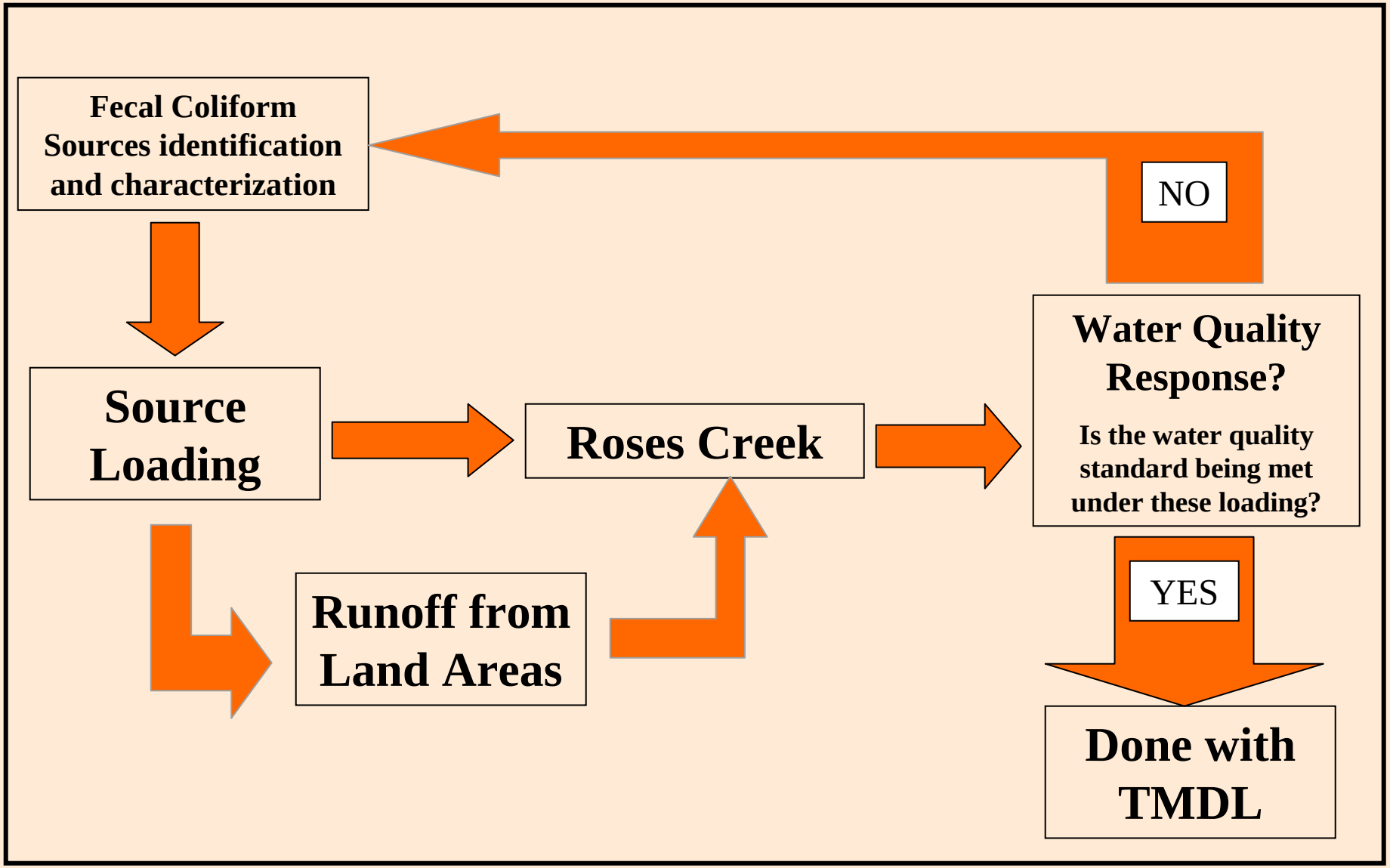
  - Roses Creek bacteria TMDLs will be developed for E. coli using FC model and in-stream translator.

What is a TMDL?

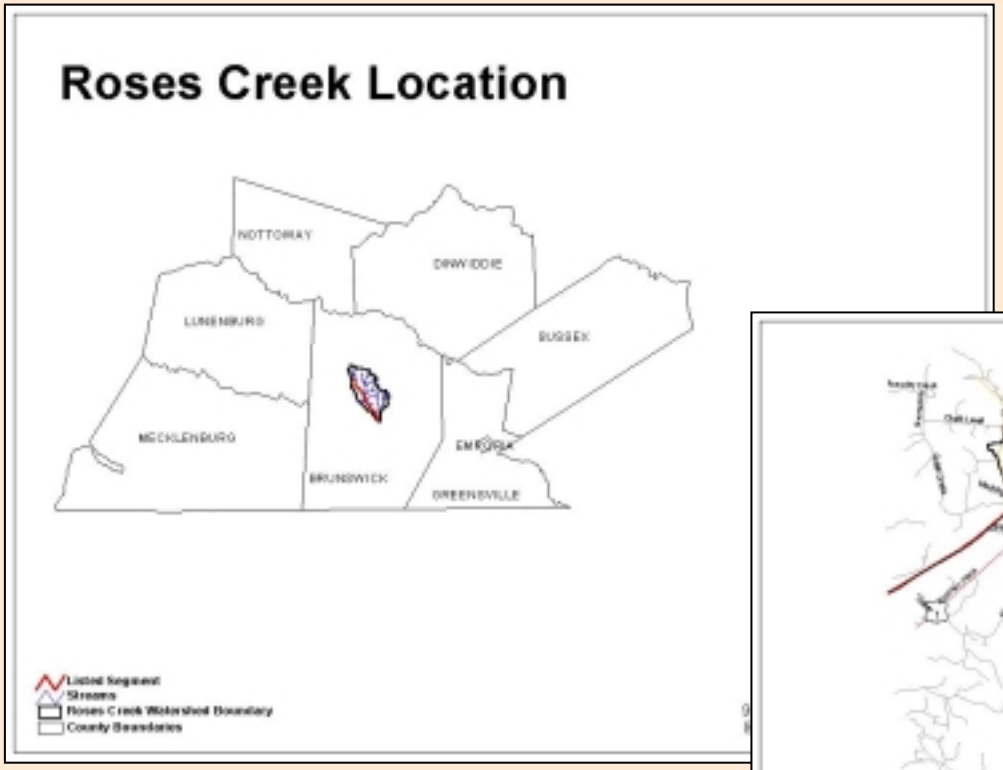
A Special Study to:

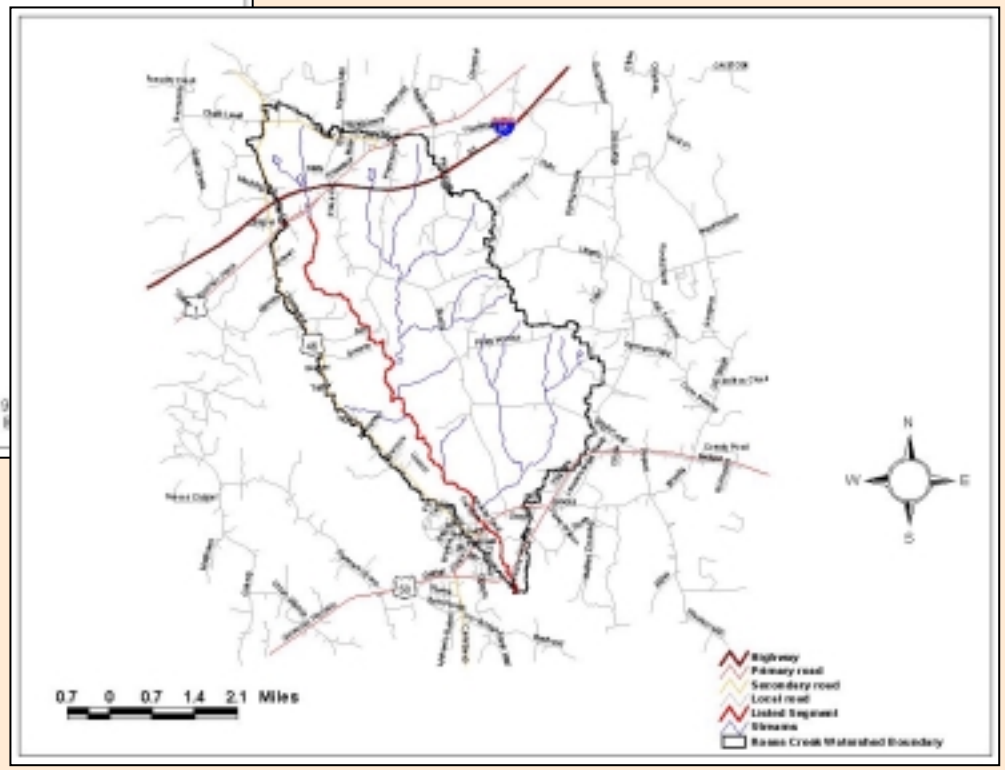
- Identify the sources of pollution contributing to violation of water quality standards.
- Calculate the amount of pollutants entering the stream from each source.
- Calculate the reductions in pollutants, by source, needed to attain/maintain water quality standards.
- Must include a margin of safety.

TMDL Process



Roses Creek Watershed





Environmental Monitoring

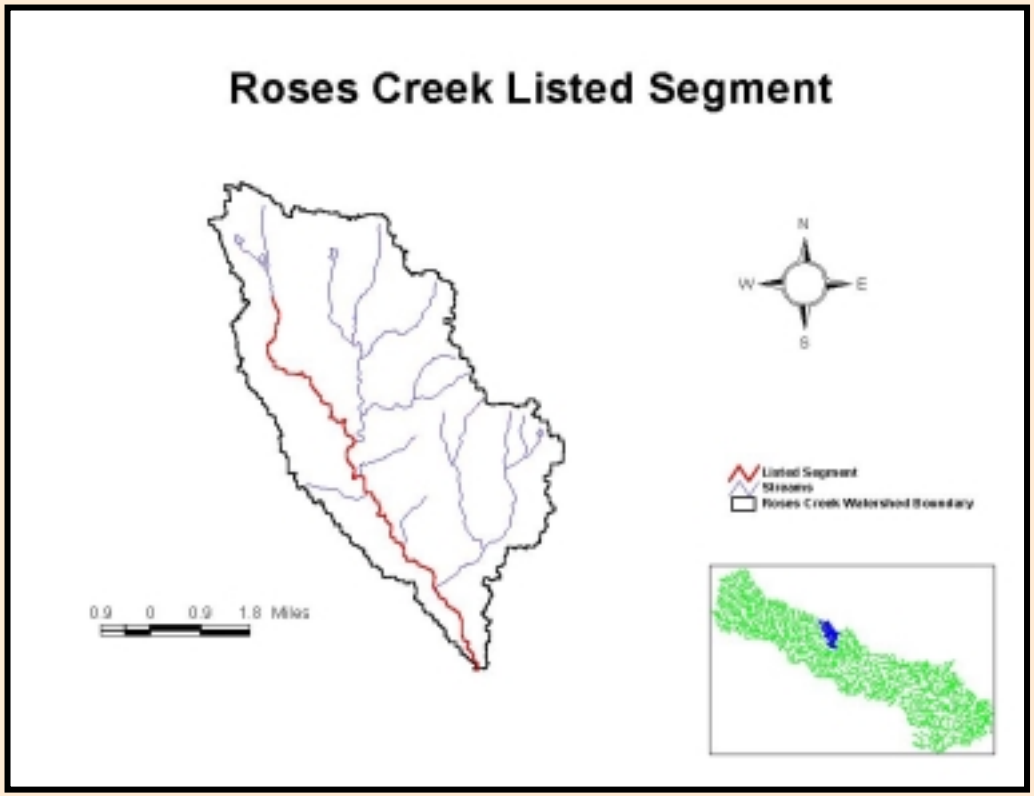
Roses Creek Impairment

- WQM Station at 5-ARSE001.22 (Rt. 678 Bridge in Brunswick County) recorded 11 exceedances out of 26 samples collected from 1997 to 2001
- Fecal coliform bacteria causes the segment to only partially meet the swimming goal

Roses Creek Listed Segment

Based on the 2002 303(d) List

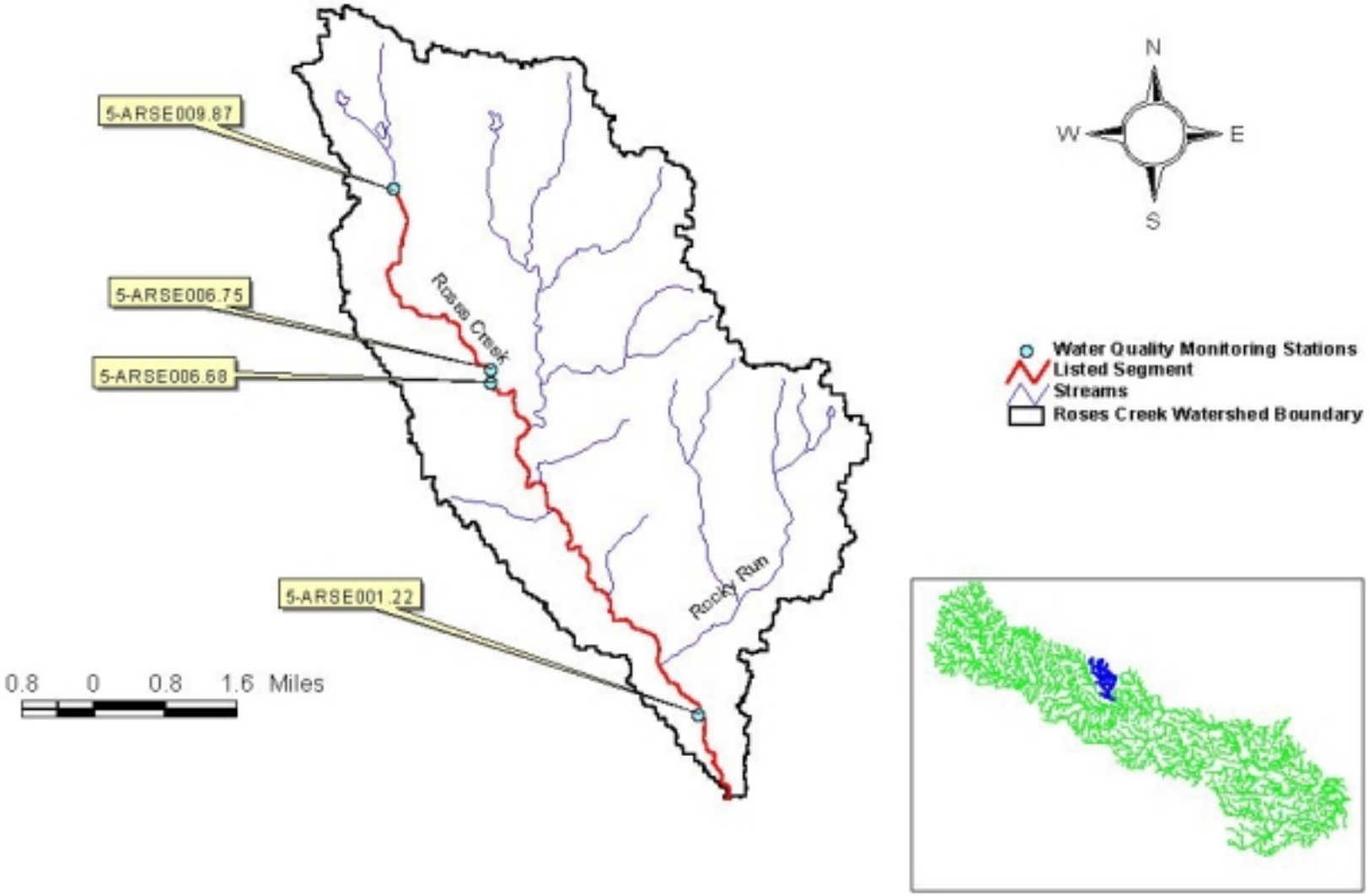
- Upstream Limit
  - Town of Alberta STP discharge
  - 9.83 River Mile
- Downstream Limit
  - Great Creek Confluence
  - 0.00 River Mile



Summary of Water Quality Conditions

No	Section ID	Period of Record	Number of Samples	Minimum (cfu/100ml)	Maximum (cfu/100ml)	# of Violation	Violation %
1	5ARSE001.22	1994-2002	40	20	16,000	20	50
2	5ARSE006.68	1974-1979	35	100	1,900	1	3
3	5ARSE009.87	2003	6	25	2,000	2	33

Roses Creek Watershed
Water Quality Stations

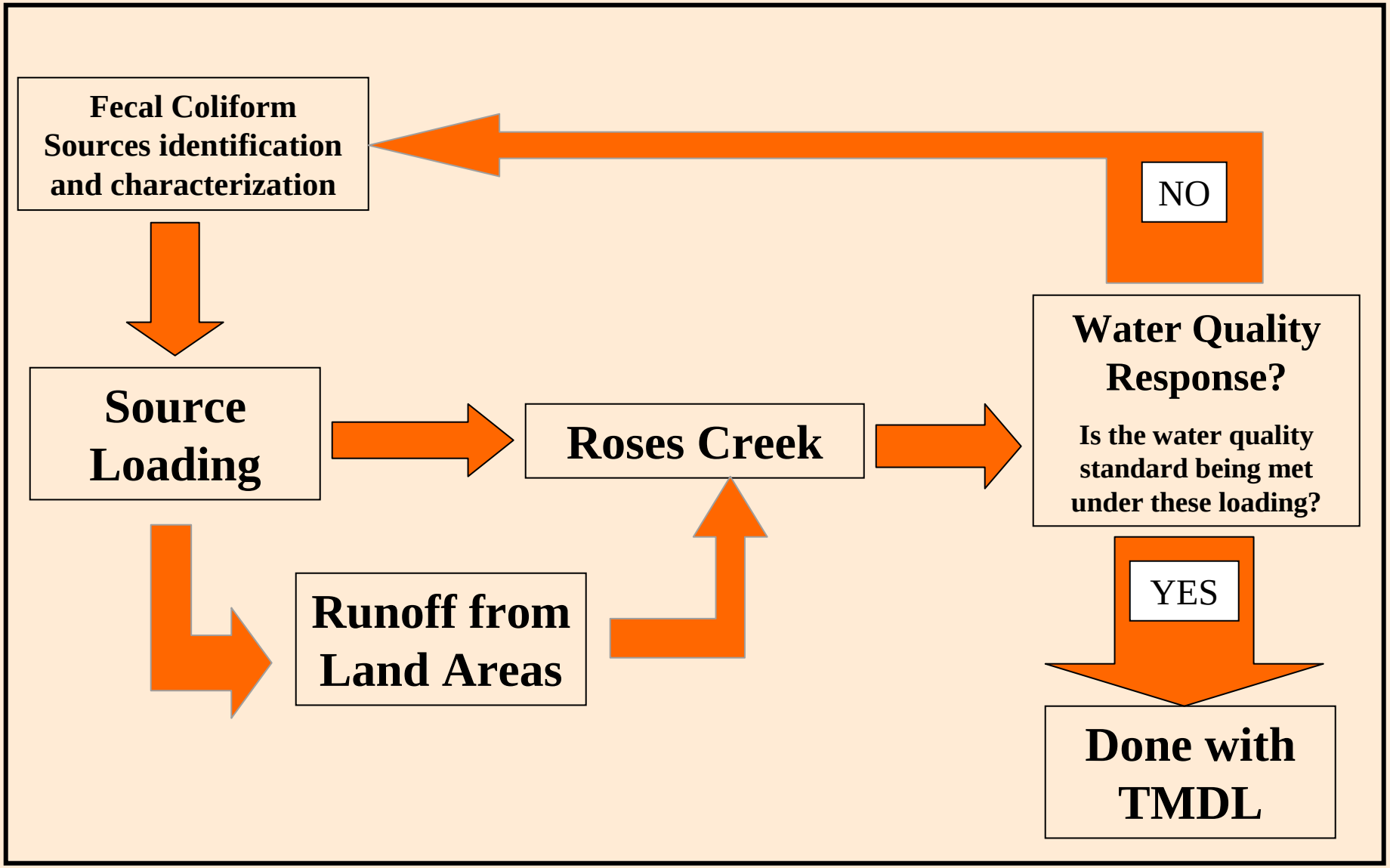


TMDL Process

TMDL Development Process

1. Define the problem
2. Define the numeric targets for fecal coliform
3. Identify and characterize fecal coliform sources
4. Estimate loadings under the existing conditions
5. Evaluate the linkage between the fecal coliform sources and instream response
6. Develop allocation scenarios that meet the water quality standards
7. Develop a follow up monitoring plan
8. Develop an implementation plan

TMDL Process



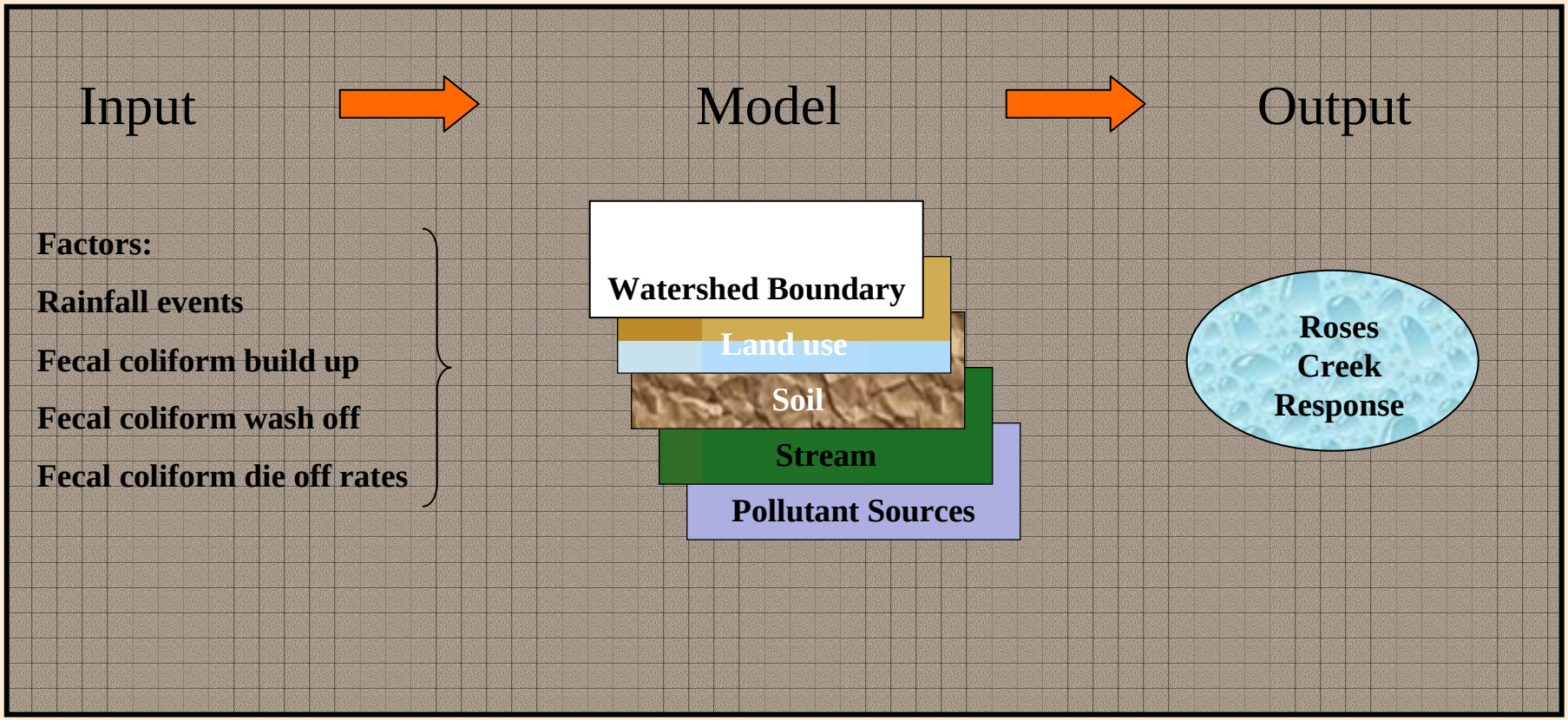
Water Quality Model

Hydrologic Simulation Program Fortran (HSPF)

- Hydrologic model
- Watershed model
- State of the art modeling system
- EPA approved approach

HSPF model

Linking Sources to Water Quality

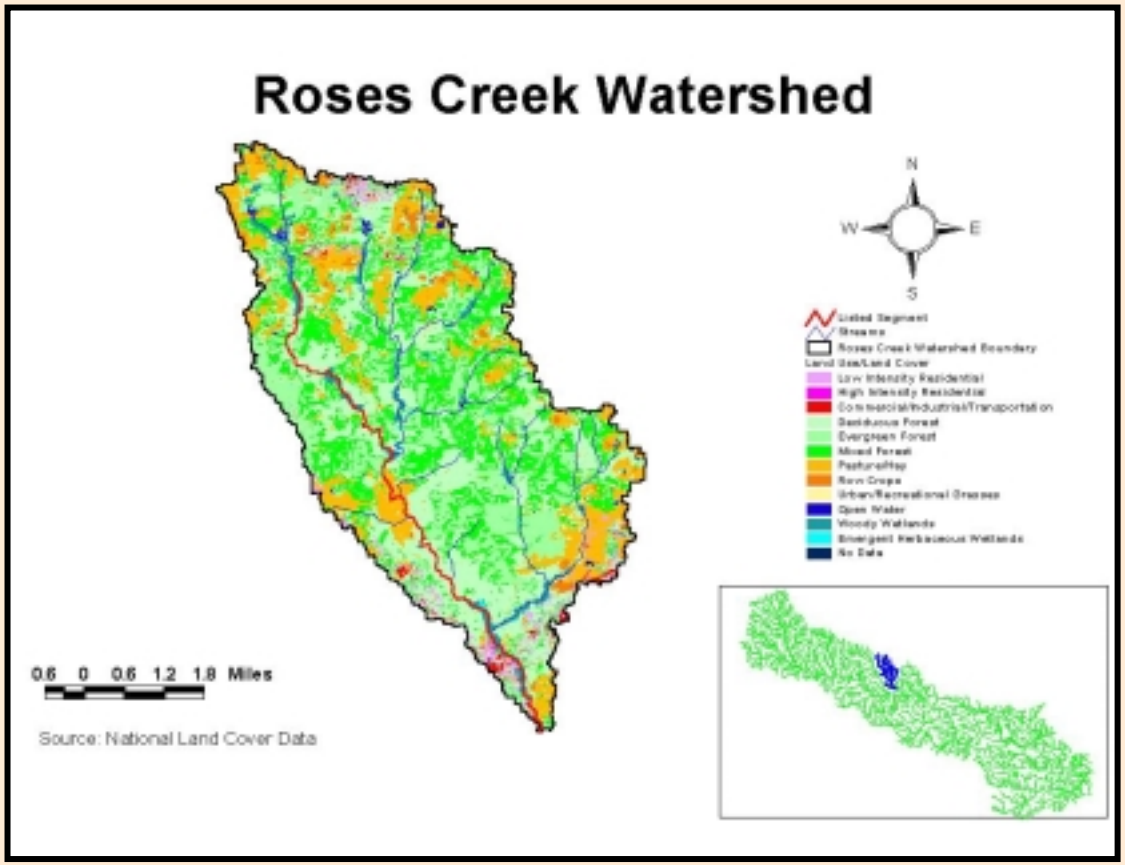


Data and Information Needs…

- Watershed Physiographic data
- Hydrographic data
- Weather data
- Watershed activities/use data and information related to fecal coliform production
- Point sources and direct discharge data and information
- Environmental Monitoring data
- Stream Flow data

Roses Creek Watershed

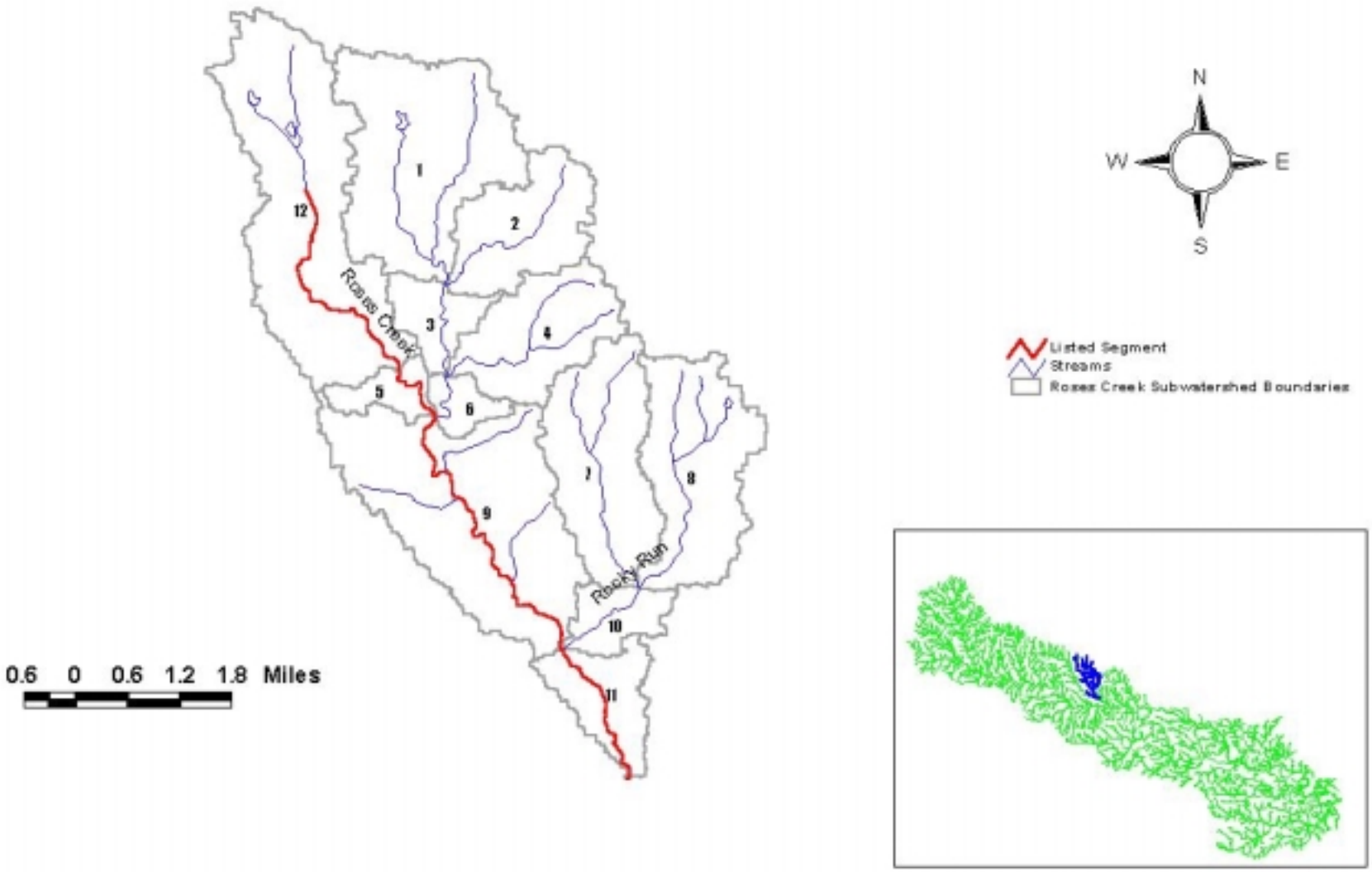
- Watershed Area is 17,724 acres
- Dominant land uses
  - 74% Forestland
  - 19% Agriculture (Pasture, Hay and Crop Land)



Roses Creek Land Use Data

Land Use Category	Land Use Type	Acres	Percent of Watershed's Land Area	Total
Water/Wetlands	Open Water	81.42	0.5	**3.9**
	Woody Wetlands	572.41	3.2	
	Emergent Herbaceous Wetlands	39.64	0.2	
Urban	Low Intensity Residential	486.1	2.7	**3.45**
	High Intensity Residential	8.33	0.05	
	Commercial/Industrial/Transportation	130.65	0.7	
Agriculture	Pasture/Hay	2,902.03	16.4	**18.7**
	Row Crop	400.61	2.3	
Forest	Deciduous Forest	5,690.10	32.1	**73.9**
	Evergreen Forest	3,247	18.3	
	Mixed Forest	4,158	23.5	
Other	Quarries/Strip Mines/Gravel Pits	0	0	**0.05**
	Transitional	0	0	
	Urban/Recreational Grasses	7.82	0.05	
Total		**17,724**		**100**

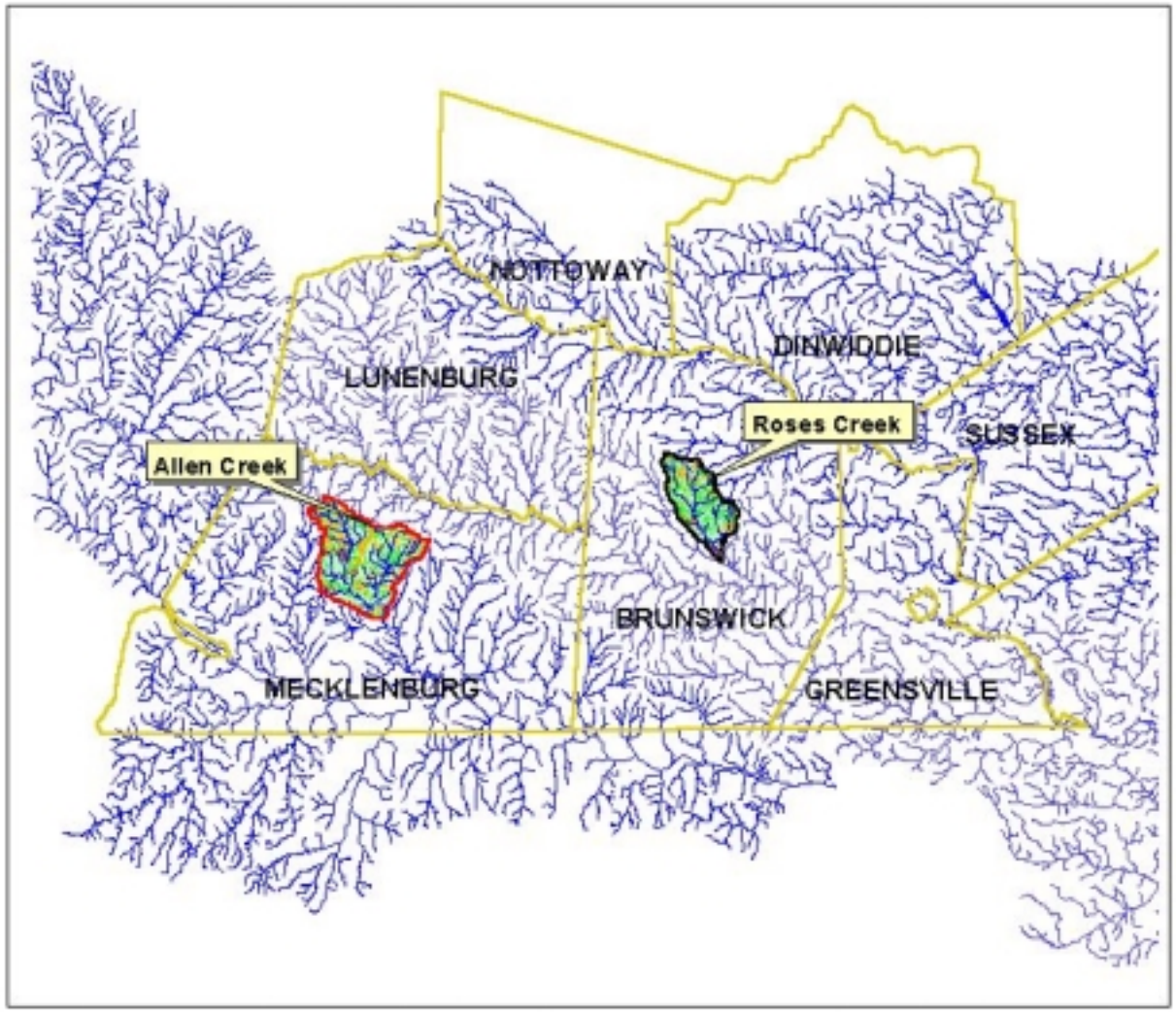
Delineated Roses Creek Watershed



Stream Flow Data

- No stream flow data exists for Roses Creek
- The paired watershed approach will be used to calibrate and validate the model
- Allen Creek watershed is used as a paired watershed

Roses Creek and Allen Creek Watersheds



Roses Creek Watershed Boundary
Allen Creek Boundary
County Boundaries
Streams
Land Use/Land Cover
Commercial/Industrial/Transportation
Low Intensity Residential
Transitional
Deciduous Forest
Evergreen Forest
Mixed Forest
Pasture/Hay
Row Crops
Woody Wetlands
Emergent Herbaceous Wetlands
Open Water

9 0 9 18 Miles

Land Use Comparison

Land Use Type	NLCD Category	GRIDCODE	% of Total Watershed	
			Roses Cr	Allen Cr
Forested	Deciduous Forest	41	32.10	40.50
	Evergreen Forest	42	18.30	12.00
	Mixed Forest	43	23.50	16.12
			73.90	68.63
Agricultrural	Pasture/Hay	81	16.40	22.05
	Row Crops	82	2.30	1.06
			18.70	23.11
Urban	Low Intensity Residential	21	2.70	0.00
	High Intensity Residential	22	0.05	0.00
	Commercial/Industrial/Transportat	23	0.70	0.03
			3.45	0.04
Water/Wetlands	Open Water	11	0.50	0.17
	Woody Wetlands	91	3.20	1.94
	Emergent Herbaceous Wetlands	92	0.20	0.08
			3.90	2.19
Other	Quarries/Strip Mines/Gravel Pits	32	0.00	0.00
	Transitional	33	0.00	5.90
	Urban/Recreational Grasses	85	0.05	0.13
			0.05	6.04

Weather Data

Description	Potential Source(s)
Hourly meteorological conditions	NOAA NCDC, Earth Info, local airports, weather stations, and colleges and universities

Station ID	Name
4414	John H. Kerr Dam

Watershed activities/uses data and information related to Bacteria production:

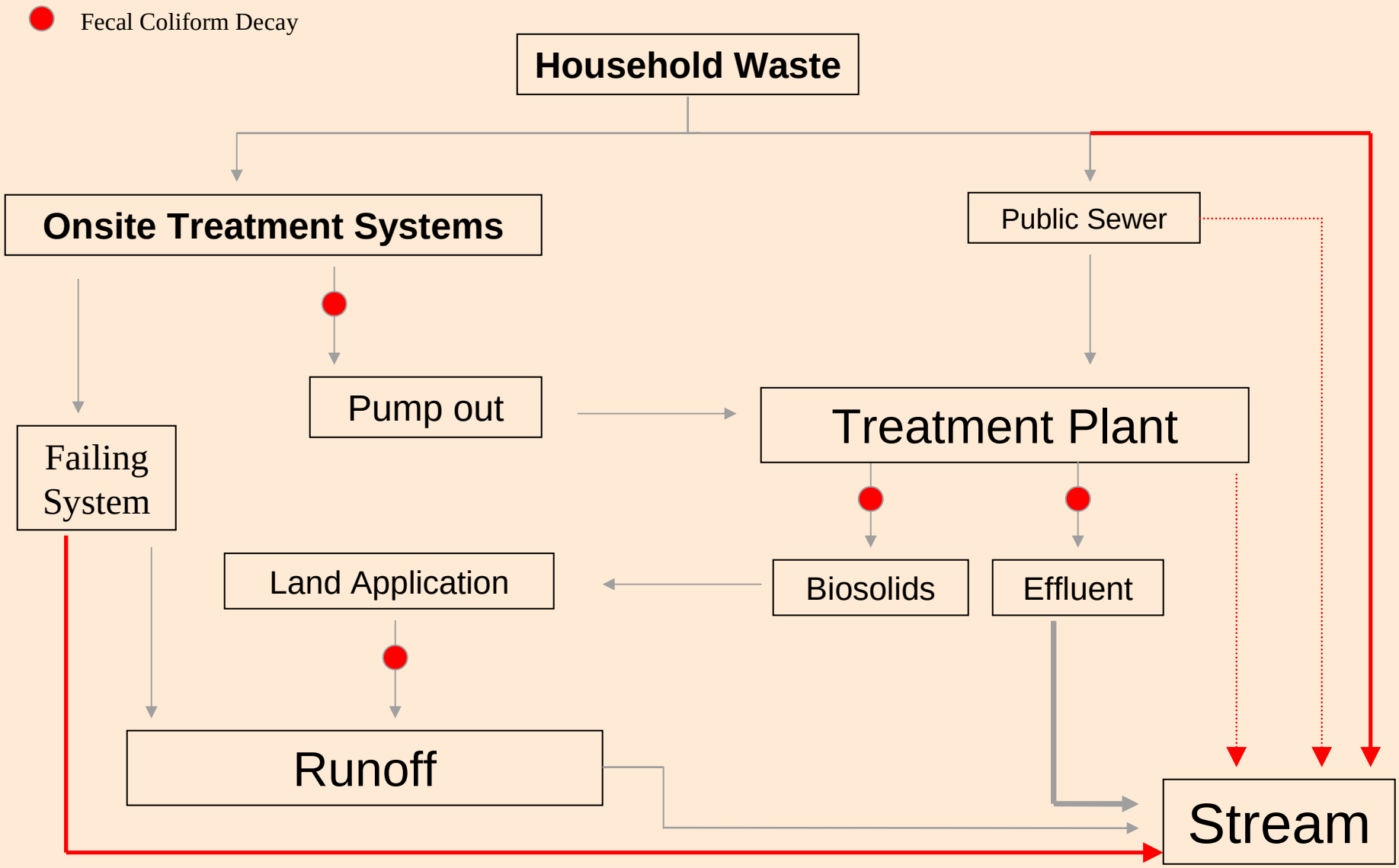
Compile information, data, reports, and maps that can be used to support bacteria source identification and loading.

Address the following issues:

- Pollutant loading from Human Sources
  - Straight pipes
  - Septic systems
  - Biosolids
- Pollutant loading from Livestock
  - Livestock inventory
  - Livestock grazing and stream access
  - Confined animal facilities
  - Manure management
- Pollutant loading from Wildlife
  - Wildlife Inventories
- Pollutant loading from Pets
  - Pet Inventories
- Best management practices (BMPs)
  - Alternative watering systems
  - Stream Fencing

Human Sources

Human Contribution



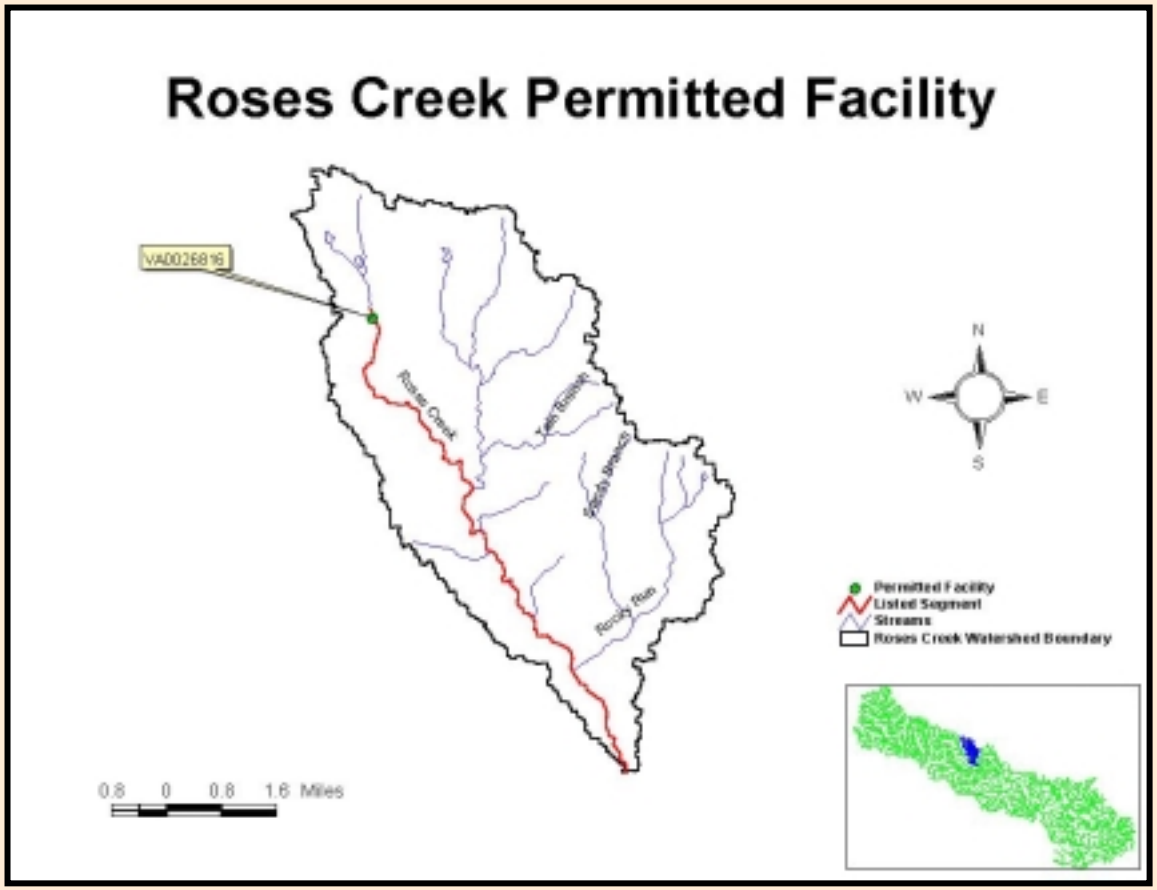
Human Contribution

- Fecal coliform loading from human sources
  - Straight pipes
  - Septic systems
    - Failure rates
  - Land application of Biosolids

Potential Information Sources

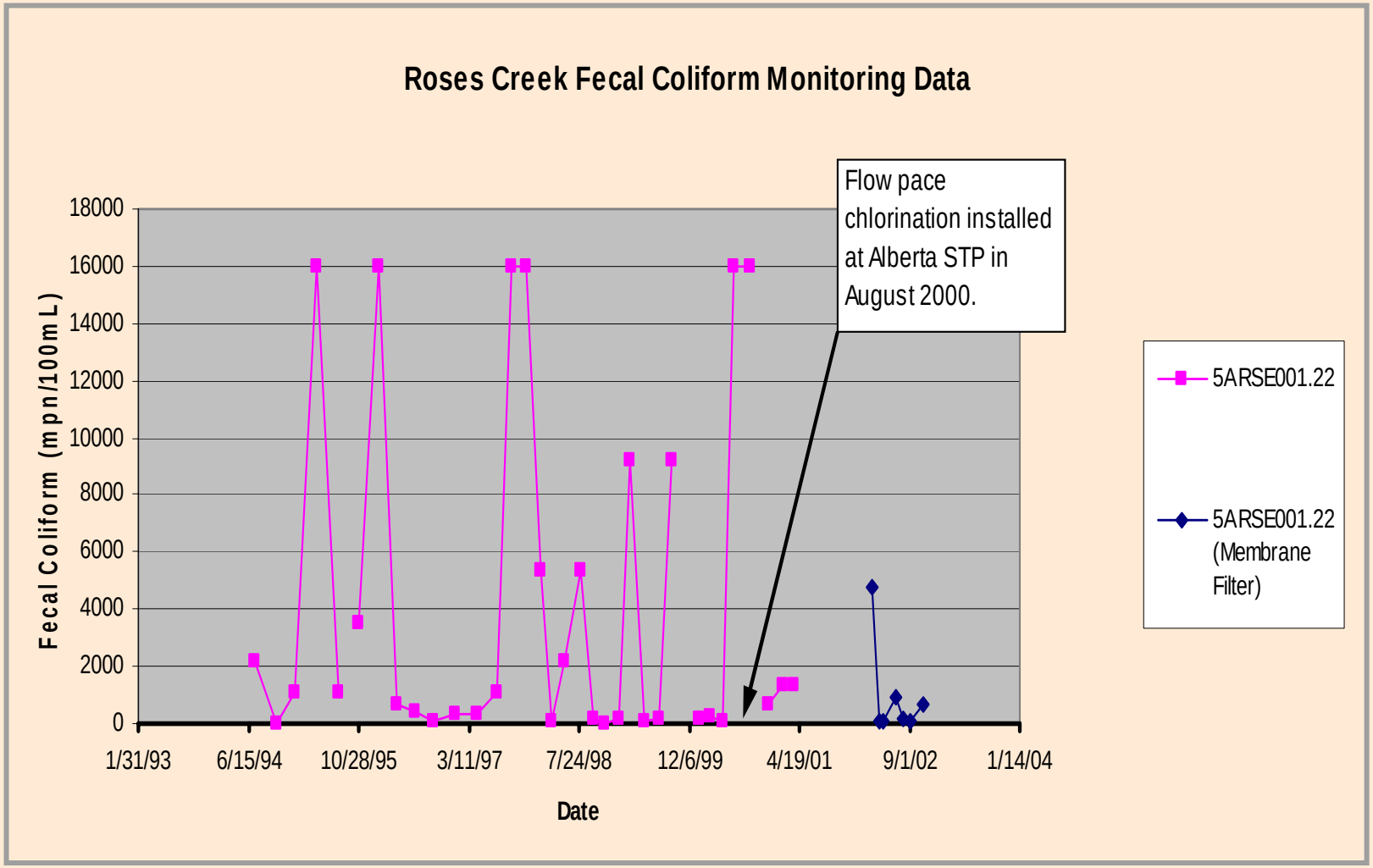
- Brunswick County Health Department
- Town of Alberta Sewage Treatment Plant
- Lawrenceville STP

Point Sources



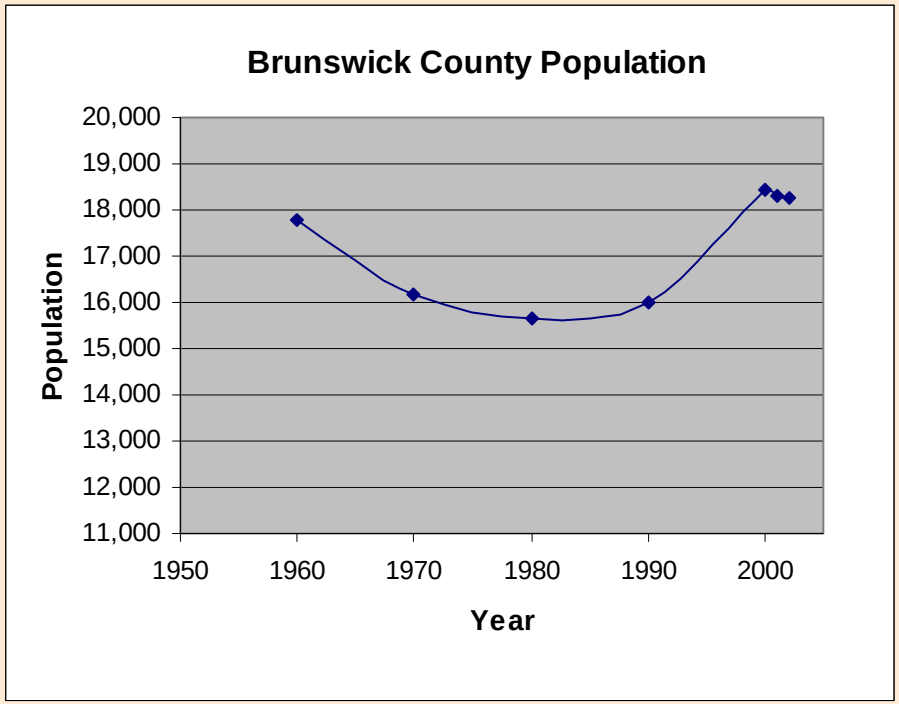
- Town of Alberta WWTP (Permit No. VA0026816)

Trends In Fecal Coliform Data



Brunswick County Population

- Based on 2000 census Data:
  - Population = 18,419
  - Total Housing units = 7,541
  - Number of Households = 6,277
  - Persons per household = 2.50
  - Population density = 31.88 persons per square mile



Septic Systems Loading

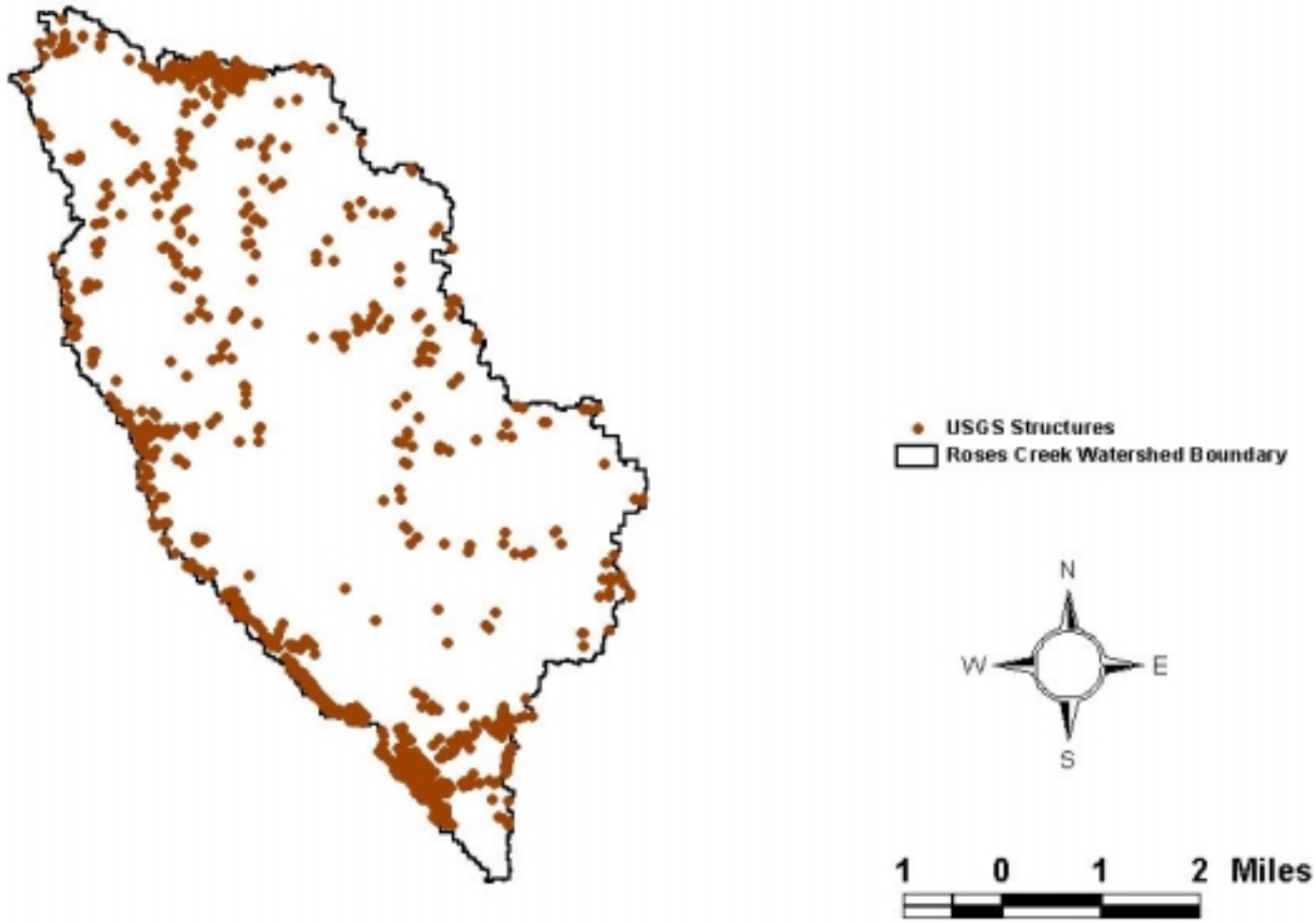
- Estimate the number of households on septic systems
- Determine the septic systems failure rate

Brunswick Sewage Disposal Report

Year	% Public Sewer	% Septic Tank	% Other Means
1990	16	77.5	6.5

Source: US Census Bureau

Roses Creek watershed
USGS Structures (1963, 1973 (REV))



Failed Septic Systems/Straight Pipes Loading

Category	Tot. # people	Person per household	# failing septics	people served	flow (gal/day)	flow (mL/hr)	FC rate (#/hr)	flow (cfs)	Daily Load #/day
Failing Septic	1,700	2.50	20	51.0	3825	603,234	6.03E+07	5.93E-03	1.45E+09
Straight Pipe	15	2.50		37.5	2813	443,555	4.44E+12	4.36E-03	1.06E+14

Notes:

- Population in Roses Creek watershed is about 2,400 people
  - Total Number of households on sewer is 261
  - Number of Households on septic System is 580 or (78%)

- Assumptions:
  - Aseptic system failure rate of 3%
  - Straight pipes constitute 5% of the septic systems installed in the 1960s
  - Septic system design flow is 75 gal per person per day
  - Typical Fecal coliform concentration from:
    - Failed septic systems is 10,000 cfu/100 ml
    - Straight pipe is 1,000,000,000 cfu/100 ml

Livestock

Loading from Livestock

Fecal Coliform loading from livestock requires developing and characterizing:

- Livestock inventory
- Livestock confinement schedules
- Livestock grazing and stream access
- Manure management
- Confined animal facilities

Livestock Inventory

- No dairy operations exist in the Roses Creek watershed
- Beef cattle on pasture area of the Roses Creek Watershed

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- No poultry operations in Roses Creek watershed
- No swine operations in Roses Creek watershed
- No feedlots are located in Roses Creek watershed

- Alternative water has not been implemented in Roses Creek Watershed

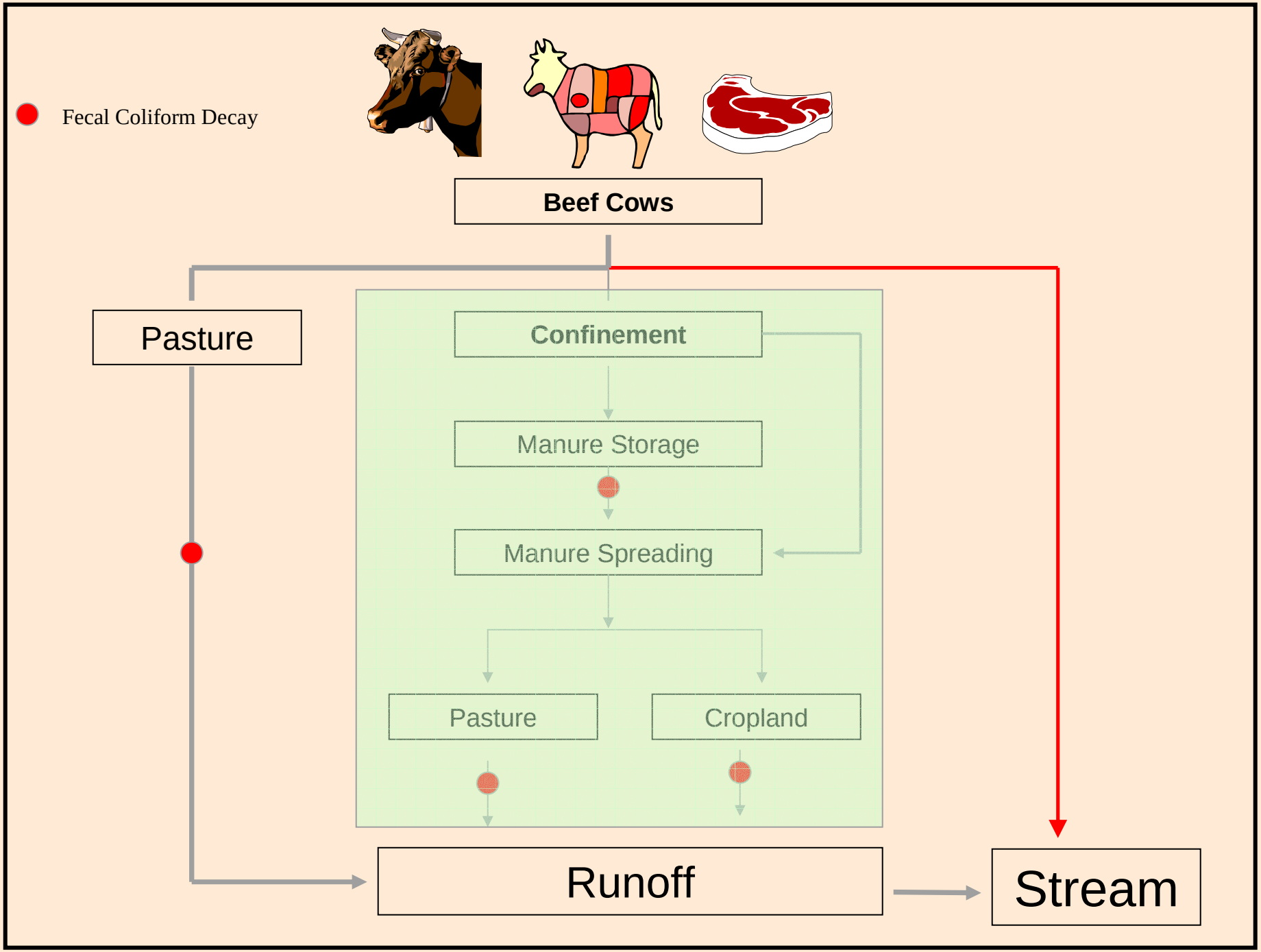
Livestock Inventory

Livestock	Watershed Totals
Beef Cattle	250
Dairy	0
Chicken	0
Horse	<10
Goat	<10
Sheep	0

Livestock Contribution

Fecal coliform produced by livestock can enter Roses Creek through four pathways:

1. Manure deposited on land by grazing livestock is washed off during rainfall events
2. Manure directly deposited into the stream by livestock with direct access to the stream
3. Manure deposited by livestock in confinement is typically collected, stored and applied to the landscape
4. Wash-water and waste from the drainage systems of confined animal facilities


Fecal Coliform Decay
Beef Cows
Pasture
Confinement
Manure Storage
Manure Spreading
Pasture
Cropland
Runoff
Stream

Beef Cows - Confinement schedule

Month	Time Spent in		
	Pasture	Stream	Loafing Lot
	(Hour)	(Hour)	(Hour)
January	23.50	0.50	0
February	23.50	0.50	0
March	23.25	0.75	0
April	23.00	1.00	0
May	23.00	1.00	0
June	22.75	1.25	0
July	22.75	1.25	0
August	22.75	1.25	0
September	23.00	1.00	0
October	23.25	0.75	0
November	23.25	0.75	0
December	23.50	0.50	0

Source: Dodd Creek TMDL Report, DCR 2002

Land Application

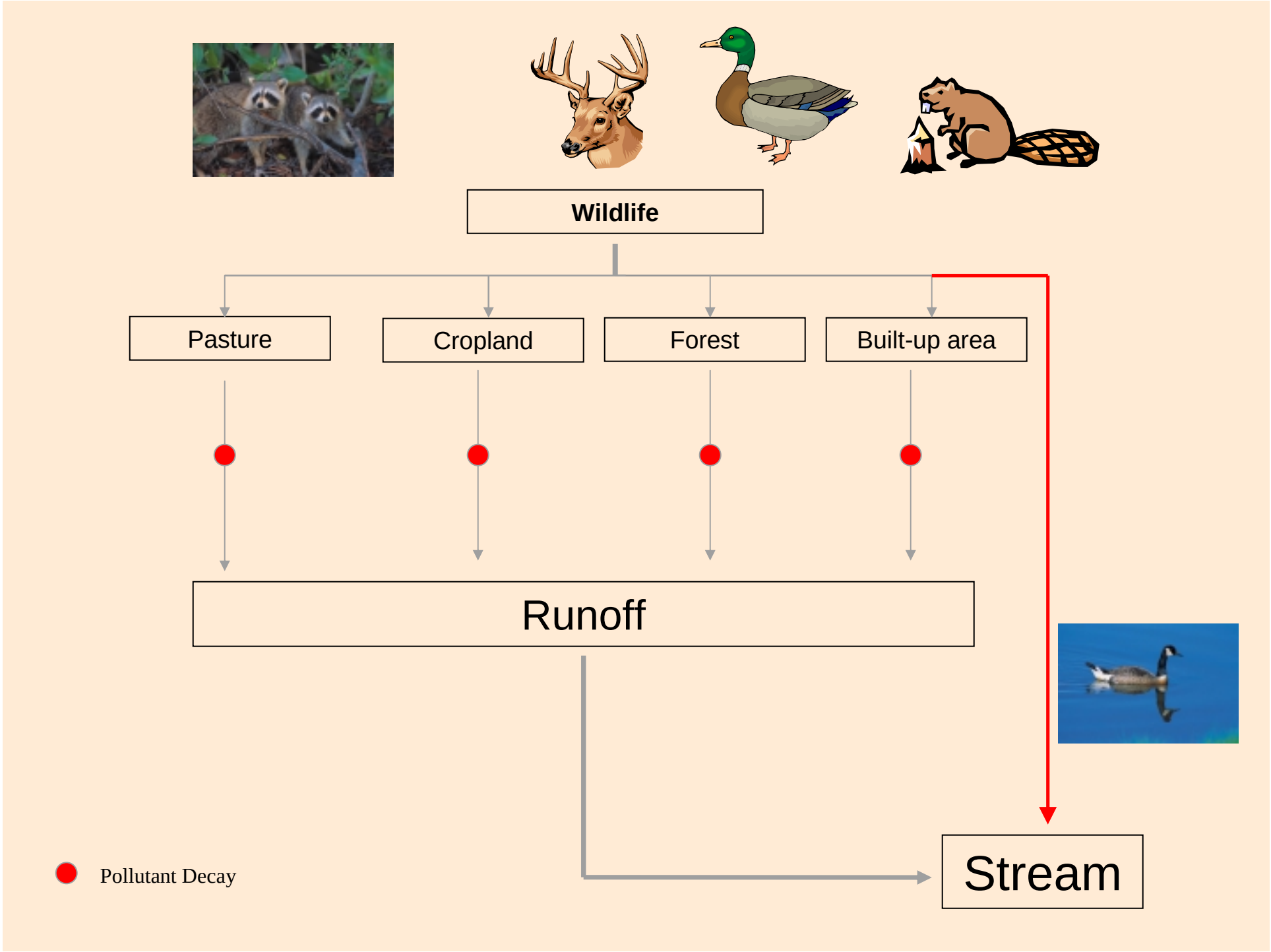
- No land application of biosolids in the watershed
- No land application of manure in the watershed

Wildlife

Wildlife

Loading from wildlife will consider the following:

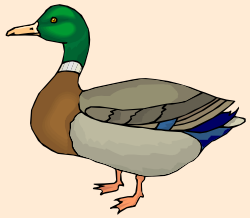
- Wildlife Inventory based on:
  - Habitat availability
  - Field observations
- Percent of time wildlife spend in the stream


Wildlife
Pasture
Cropland
Forest
Built-up area
Runoff
Stream
Pollutant Decay

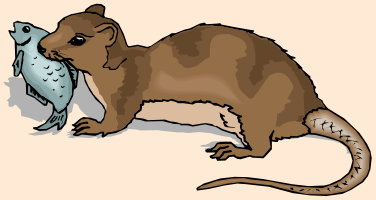
Wildlife Distribution by Habitat

Wildlife Type	# of Animals/acre-habitat	Habitat
Deer	0.047	entire watershed
Raccoon	0.07	within 600 feet of streams
Muskrat	2.75	within 66 feet of streams
Beaver	---	4.8 animals per mile of stream
Goose	0.004	within 66 feet of streams
Mallard	0.002	within 66 feet of streams
Wood duck	0.0018	within 66 feet of streams
Wild Turkey	0.01	entire watershed, excluding farmstead and urban areas
Based on discussion with Virginia Game and Inland Fisheries:		

Rose Creek Wildlife Inventory



Wildlife	Watershed Totals
Deer	837
Raccoon	413
Muskrat	1,783
Beaver	195
Goose	120
Mallard	50
Wood duck	50
Wild Turkey	172

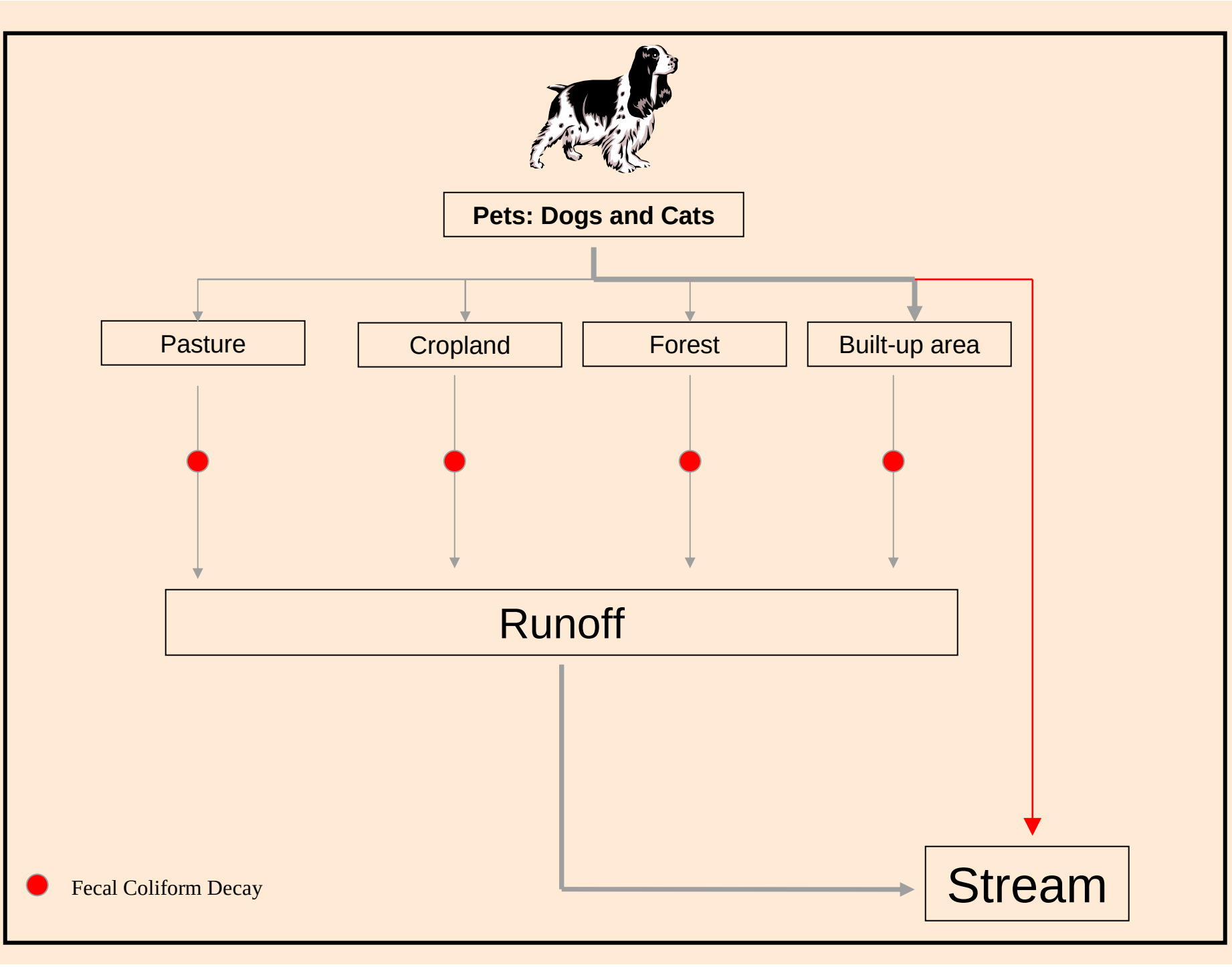


Wildlife

Wildlife	Daily Fecal Production (in millions of cfu/day)	Portion of the Day in Stream (%)
Deer	**347**	**1**
Raccoon	**113**	**10**
Muskrat	**25**	**50**
Goose	**799**	**50**
Beaver	**0.2**	**90**
Mallard	**2,430**	**50**
Wood Duck	**2,430**	**75**
Wild Turkey	**93**	**5**

Source: ASAE, 1998; Map Tech, Inc., 2000; EPA, 2001.

Pets


Pets: Dogs and Cats
Pasture
Cropland
Forest
Built-up area
Runoff
Stream
Fecal Coliform Decay

Fecal coliform loading from Pets

- Pet inventories based on
  - 1.7 Dogs per household
  - 2.2 Cats per household

- 841 households in Roses Creek watershed
  - 1,430 Dogs
  - 1,850 Cats

Source: Lehigh Valley Animal Rights Coalition for US Averages

Source Loading Estimates "Total Available Load"

Sources Loading estimates

- Estimate the size/number of each source
- Determine the daily fecal coliform production by source
- Determine whether the source is
  - Direct Source
  - Indirect Source
- Calculate the load to each land use based on a monthly schedule and for each source
- The sum of all the individual sources is the total load

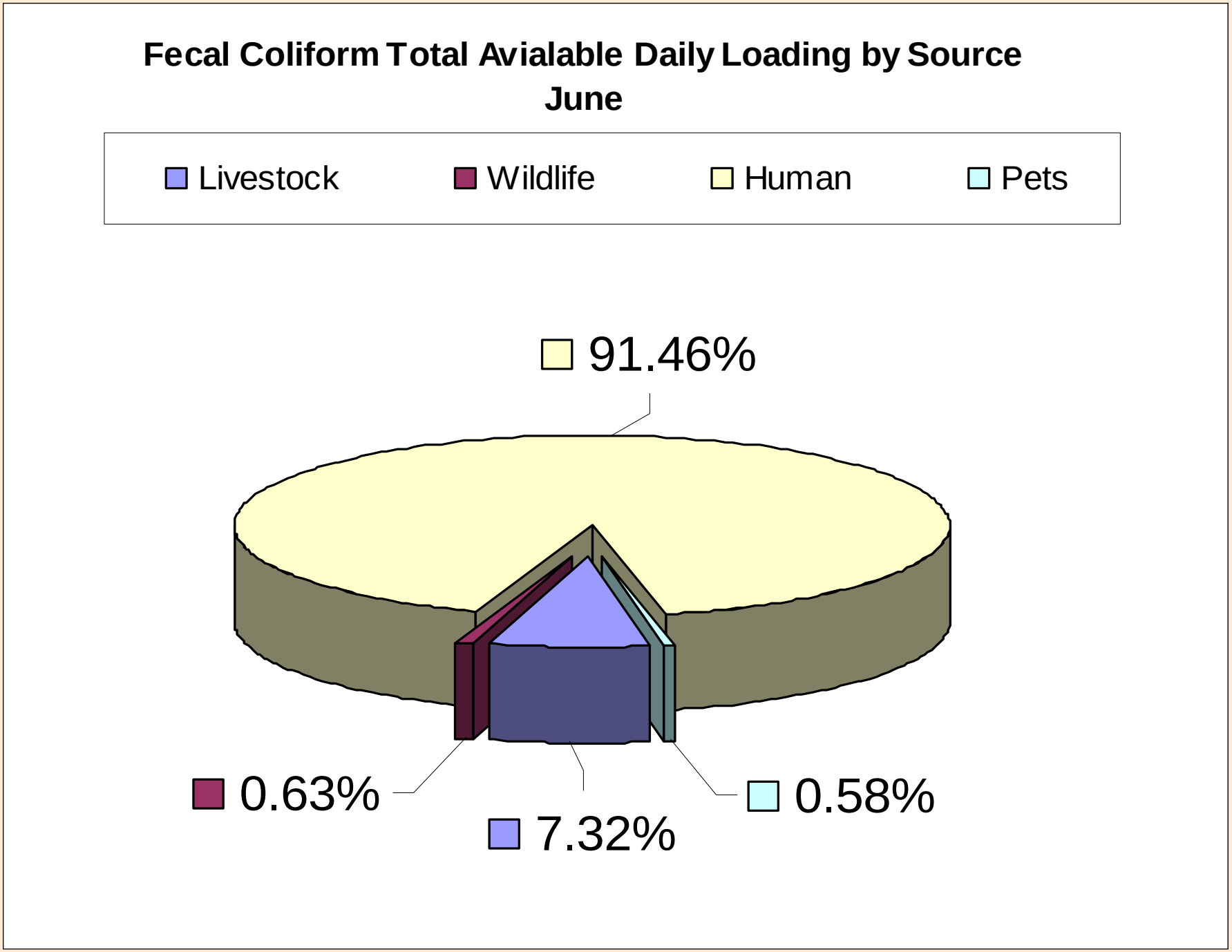
Daily Fecal Coliform production by Source

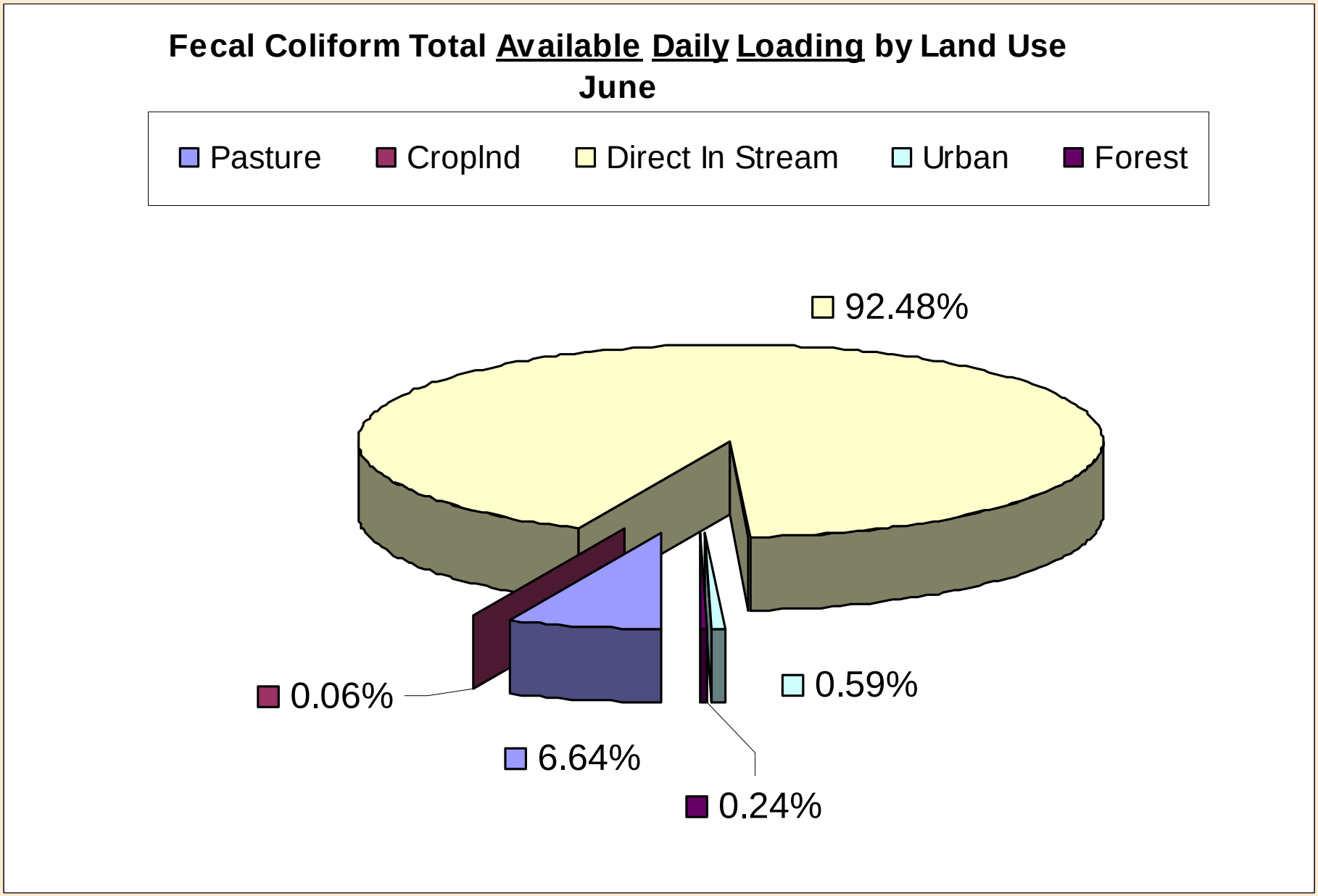
Source	Daily Fecal Production (million) (cfu/day)
Human	1,950
Pet	450
Horse	420
Beef Cattle	33,000
Diary Cattle	
Milked or dry Cow	25,200
Heifer	11,592
Sheep	27,000
Deer	347
Raccoon	113
Muskrat	25
Beaver	0.2
Goose	799
Duck	2,430
Mallard	2,430
Wild Turkey	93

Source	The equivleant number of sources to one beef cow
Human	16.9
Pet	73.3
Horse	78.6
Beef Cattle	1.0
Diary Cattle	
Milked or dry Cow	1.3
Heifer	2.8
Sheep	1.2
Deer	95.1
Raccoon	292.0
Muskrat	1,320.0
Beaver	165,000.0
Goose	41.3
Duck	13.6
Mallard	13.6
Wild Turkey	354.8

Sources: ASAE, Map Tech, Metcalf & Eddy,

				June		% of Time			
				Past	CropInd	Stream	Conf	Forest	Urban
Source	**number**	**cfu/an day**	**cfu/day**						
Beef Cattle	250	3.30E+10	8.25E+12	**0.90**		**0.05**	**0**	**0**	
Milk Dairy	-	2.52E+10	0.00E+00	**0.39**		**0.08**	**0.53**	**0**	
other diary	-	1.16E+10	0.00E+00	**0.39**		**0.08**	**0.53**	**0**	
Horses	10	4.20E+08	4.20E+09	**0.90**		**0.05**	**0**	**0**	
Sheep	10	2.70E+10	2.70E+11	**0.90**		**0.10**	**0**	**0**	
Total			**8.52E+12**						
Deer	837	3.47E+08	2.90E+11	0.1	0.1	0.05		0.75	
Racoon	413	1.13E+08	4.67E+10					0.95	
Muskrat	1,783	2.50E+07	4.46E+10						
Beaver	195	2.00E+05	3.90E+07	0		0.9	0	0.1	
Goose	120	7.99E+08	9.59E+10	0.1	0.1	0.8			
Mallard	50	2.43E+09	1.22E+11	0.1	0.1	0.8			
Wood Duck	50	2.43E+09	1.22E+11	0.1	0.1	0.8			
Wild Turkey	172	9.30E+07	1.60E+10		0.1			0.9	
Total			**7.37E+11**						
Human									
Septic	20	1.00E+04	1.45E+09			1			
Straight pipe	15	1.95E+09	1.06E+14			1			
Total			**1.06E+14**						
Pet-dog	1,430	4.50E+08	6.43E+11						1
Pet-cat	1,850	1.94E+07	3.59E+10						1
Total			**6.79E+11**						

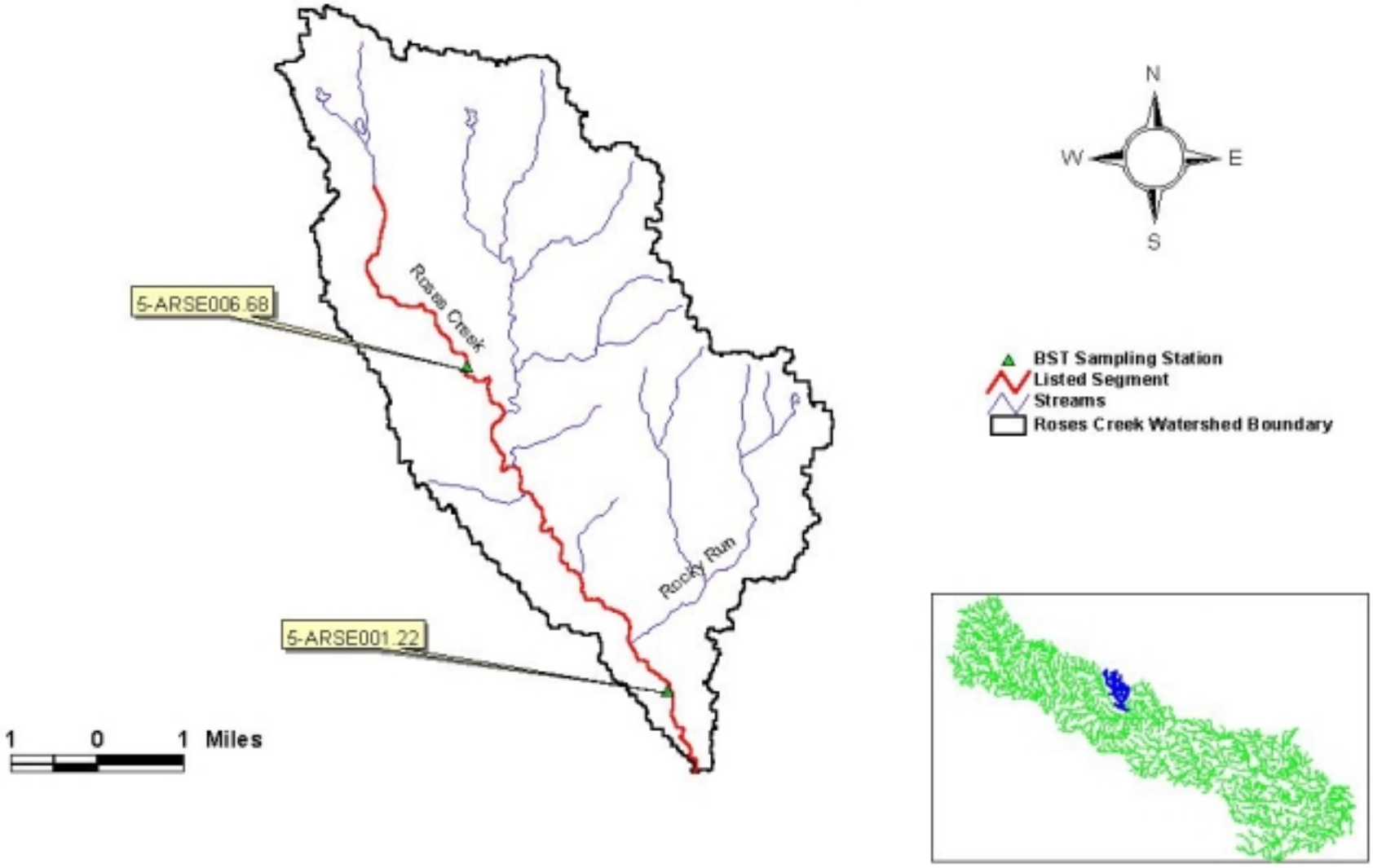

Fecal Coliform Total Avialable Daily Loading by Source
June
Livestock
Wildlife
Human
Pets
91.46%
0.63%
7.32%
0.58%


Fecal Coliform Total Available Daily Loading by Land Use
June
Pasture
Croplnd
Direct In Stream
Urban
Forest
92.48%
0.06%
0.59%
6.64%
0.24%

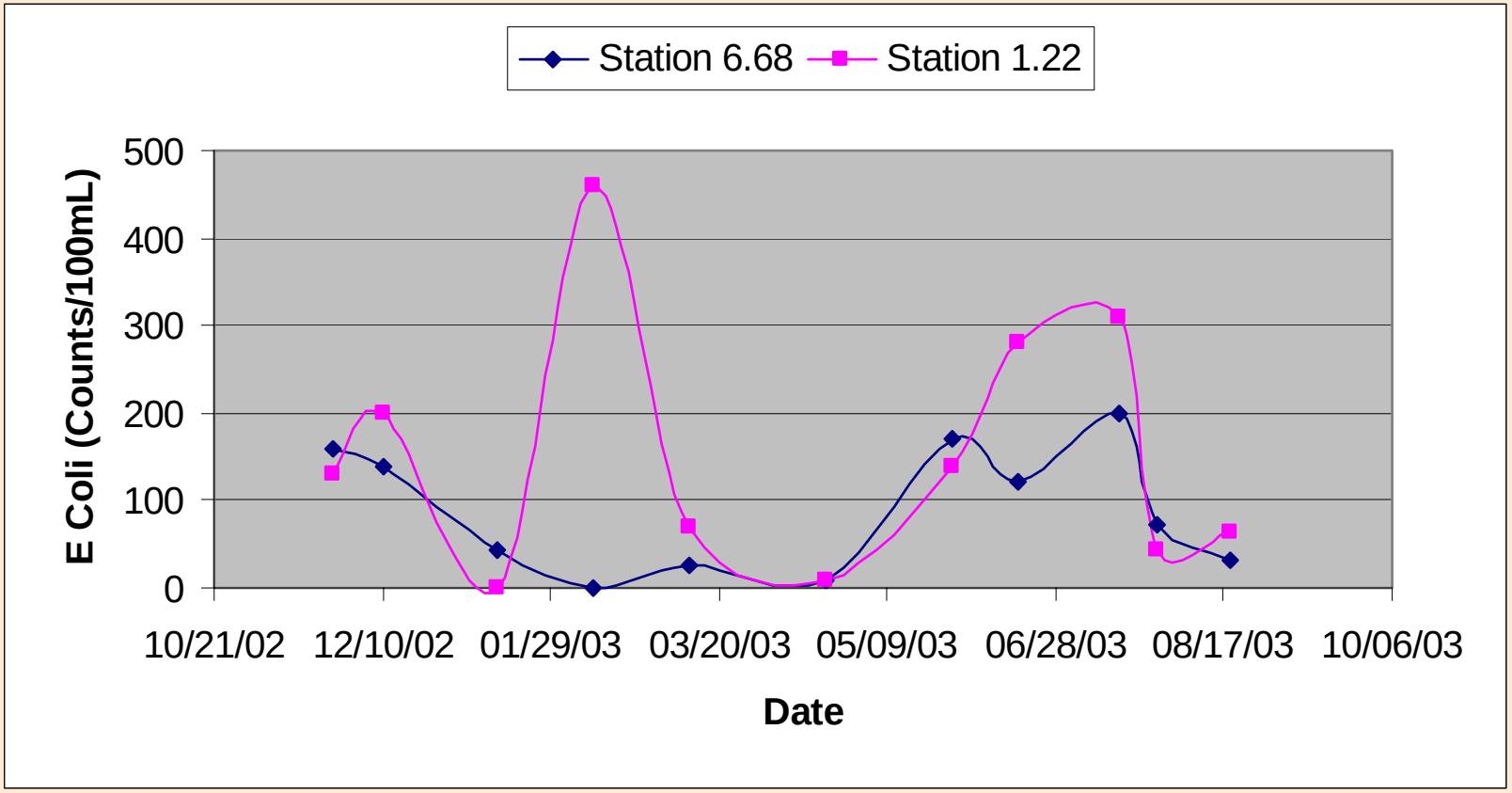
Bacteria Source Tracking (BST)

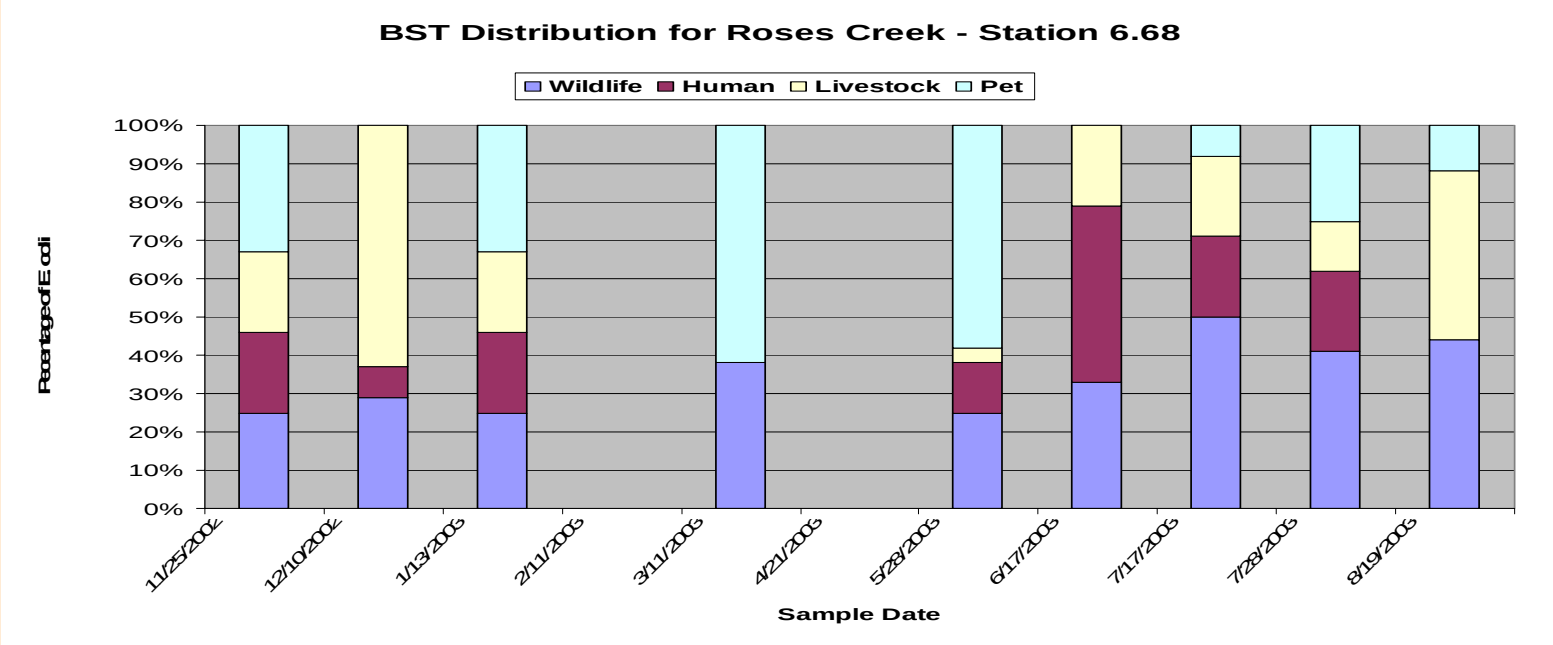
- BST was developed at 2 stations within the Roses Creek watershed.
- Objective is to identify the sources of the fecal coliform in the stream.
- Four categories considered
  - Human
  - Wildlife
  - Livestock
  - Pets

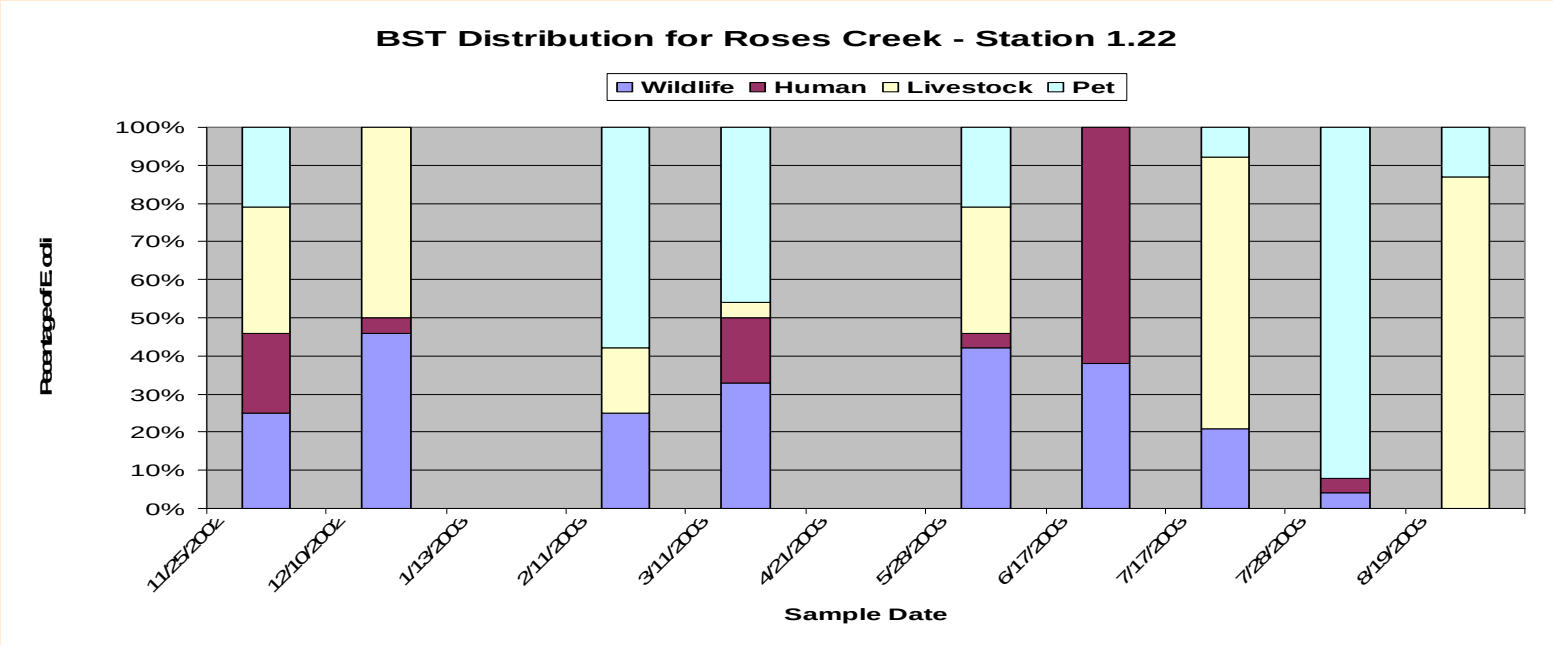
Roses Creek Watershed
Bacteria Source Tracking Station



Bacteria Monitoring Results




BST Distribution for Roses Creek - Station 6.68
Wildlife
Human
Livestock
Pet
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage of E. coli
11/25/2002
12/10/2002
1/13/2003
2/11/2003
3/11/2003
4/21/2003
5/28/2003
6/17/2003
7/17/2003
7/28/2003
8/19/2003
Sample Date


BST Distribution for Roses Creek - Station 1.22
Wildlife
Human
Livestock
Pet
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage of E. coli
11/25/2002
12/10/2002
1/13/2003
2/11/2003
3/11/2003
4/21/2003
5/28/2003
6/17/2003
7/17/2003
7/28/2003
8/19/2003
Sample Date

BST Results

Based on 9 samples collected at each station, the results indicate that bacteria from human, livestock, wildlife, and pet sources **is present** in Roses Creek.

The 9-Sample Average Contribution by Source

STATION	Wildlife	Human	Livestock	Pet
5ARSE001.22	26%	12%	33%	29%
5ARSE006.68	34%	17%	23%	26%

Next Steps

- Collect available data
- Analyze data to investigate the impairment in the watershed
- Develop the watershed model input parameters
- Calculate the fecal coliform loading from the identified sources in the watershed
- Develop the TMDL allocation Scenarios
- Prepare the Draft TMDL
- Prepare for Public meeting # 2

Local TMDL Contacts

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