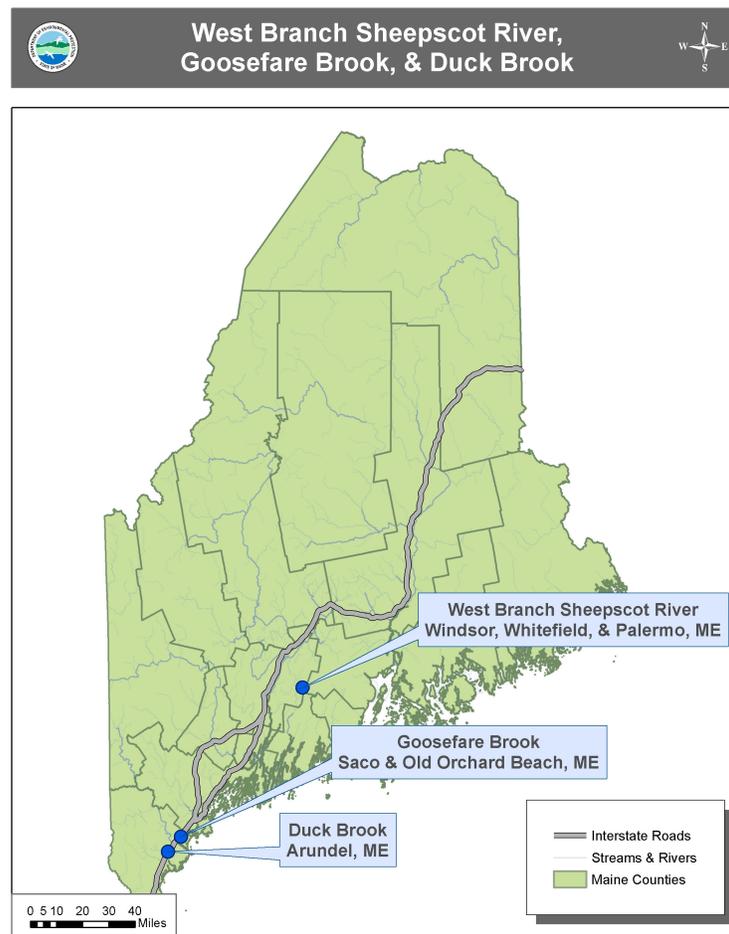


Maine Statewide Bacteria TMDL: 2013 Freshwater Addendum

Report #: *DEPLW-1254*

August, 2013

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Maine Department of Environmental Protection - Created by: KNemmer, August 2013 - Data Sources: MEGIS, MDEP



Prepared for:
US EPA New England, Region 1



MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

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INTRODUCTION

This Addendum to the USEPA approved 2009 Maine Statewide Bacteria TMDL (Total Maximum Daily Loads) Report (<http://www.maine.gov/dep/water/monitoring/tmdl/tmdl2.html>) contains the information to develop TMDLs for three streams listed for bacteria impairment. This report:

- Contains the watershed specific information necessary to add bacteria TMDLs to the existing 2009 TMDL Report
- References the basic background information and required TMDL elements from the 2009 TMDL Report
- Covers four 303D listed stream segments (Table 1) and are depicted in Figure 1

Table 1: Summary information for bacteria impaired streams (Maine DEP 2012 Integrated Water Quality Monitoring and Assessment Report Appendices).

<i>Stream Segment</i>	<i>Town</i>	<i>County</i>	<i>Segment ID</i>	<i>Assessment Unit (HUC 10)</i>	<i>Water Quality Class</i>
Duck Brook	Arundel	York	ME0106000301_622R03	0106000301	B
Goosefare Brook	Saco	York	ME0106000106_612R01 ME0106000106_612R01 _01	0106000105	B
West Branch Sheepscot	Windsor	Kennebec	ME0105000305_528R02	0105000304	AA

These streams are listed for bacterial impairments on Maine’s 303D list of impaired waters, which is included in Maine DEP’s 2012 Integrated Water Quality Monitoring and Assessment Report. TMDLS are required under the US Clean Water Act for all impaired waters on the 303D list and these will be added to the existing 2009 Bacteria TMDLs.

The purpose of a TMDL is to calculate the amount of pollutant receiving water can assimilate without exceeding water quality standards or designated uses, listed in Table 2. These TMDLs set a goal of meeting bacteria water quality criteria for all sources in order to meet water quality standards throughout the affected waterbodies. Potential sources and pathways are listed below.

Maine DEP adopted the concentration-based TMDL approach because it is the most useful format for guiding both remediation and protection efforts in the impaired watersheds. A concentration target is readily understandable to the public, and allows interested citizens and/or watershed groups to determine easily whether any particular source is exceeding its allocation. Measured bacteria concentrations in each of the impaired watersheds are used to determine the percent reduction needed to attain water quality standards.

Table 2. Maine Water Quality Criteria for Classification of Fresh Surface Waters (38 MSRA §465)

FRESHWATERS	BACTERIA (<i>E. Coli</i>) NUMERIC CRITERIA
CLASS AA	AS NATURALLY OCCURS ¹
CLASS A	AS NATURALLY OCCURS ¹
CLASS B	Between May 15th and Sept. 30 th - <i>E. coli</i> of human and domestic animal origin ² shall not to exceed a geometric mean of 64/100mL or an instantaneous level of 236/100mL
CLASS C	Between May 15th and Sept. 30 th - <i>E. coli</i> of human and domestic animal origin ² shall not to exceed a geometric mean of 126/100mL or an instantaneous level of 236/100mL

1. Defined in 38 MRSA §466(2): "As naturally occurs" means conditions with essentially the same physical, chemical and biological characteristics as found in situations with similar habitats free of measurable effects of human activity." In practice, the Class GPA (Lakes) standard for 'E. coli of human or domestic animal origin shall not exceed a geometric mean of 29/100mL or an instantaneous level of 194/100mL' may be used as a surrogate target if a freshwater's 'natural' bacteria levels are unknown.

2. This means that all *E. coli* of wildlife origin meet existing water quality standards.

This document provides (1) justification for the impaired listing status and need for the TMDL, (2) calculations for the percent reductions from existing data needed to meet the concentration-based target, and (3) details regarding sources of bacteria in the impaired watersheds. Table 3 is a stream specific summary of the relevant numbers and TMDL calculations developed in this report. For information regarding the regulatory requirements of TMDLs, Maine's water quality standards, waterbody assessment approach, target concentrations, loading allocations and source specific implementation recommendations please see the 2009 Maine Statewide Bacteria TMDL (Total Maximum Daily Loads) Report.

Bacteria Pollutant Sources-

Humans- Sewers & Septic's

- Pets & Domestic animals
- Wildlife

Pathways-

- Illicit discharges
- Surface runoff through stormwater
- Subsurface drainage
- Direct deposit



Clockwise from upper left: sewer lines, humans and pets, domestic animals, residential runoff

Table 3. Synopsis of Streams Impaired by Bacteria Contamination [Maine 2012 Listing Category 5B] Maine Water Quality Criteria for Classification of Fresh Surface Waters (38 MSRA §465) and TMDL Calculations.

SEGMENT_ID	WATERBODY NAME	NPDES_ID	POLLUTANT_ID /CAUSE	TMDL_TYPE	LENGTH MILES	WATER CLASS	TMDL_END_POINT GEOMEAN:INSTANTEOUS	STREAM GEOMEAN	TMDL% REDUCTION
ME0106000301_622R03	Duck Brook		227 (E-coli)	NPS	8.6	Class B	64 /100 mL:236 /100 mL	123 /100 mL	48
ME0106000106_612R01	Goosefare Brook	MER041011	227 (E-coli)	NPS, PS	0.6	Class B	64 /100 mL:236 /100 mL	263 /100 mL	76
ME0106000106_612R01_01	Goosefare Brook	MER041011	227 (E-coli)	NPS, PS	5.54	Class B	64 /100 mL:236 /100 mL	263 /100 mL	76
ME0105000305_528R02	West Branch Sheepscot		227 (E-coli)	NPS	2.29	Class AA	As naturally occurs OR 29 /100 mL:194 /100 mL	57 /100 mL	49

PUBLIC PARTICIPATION

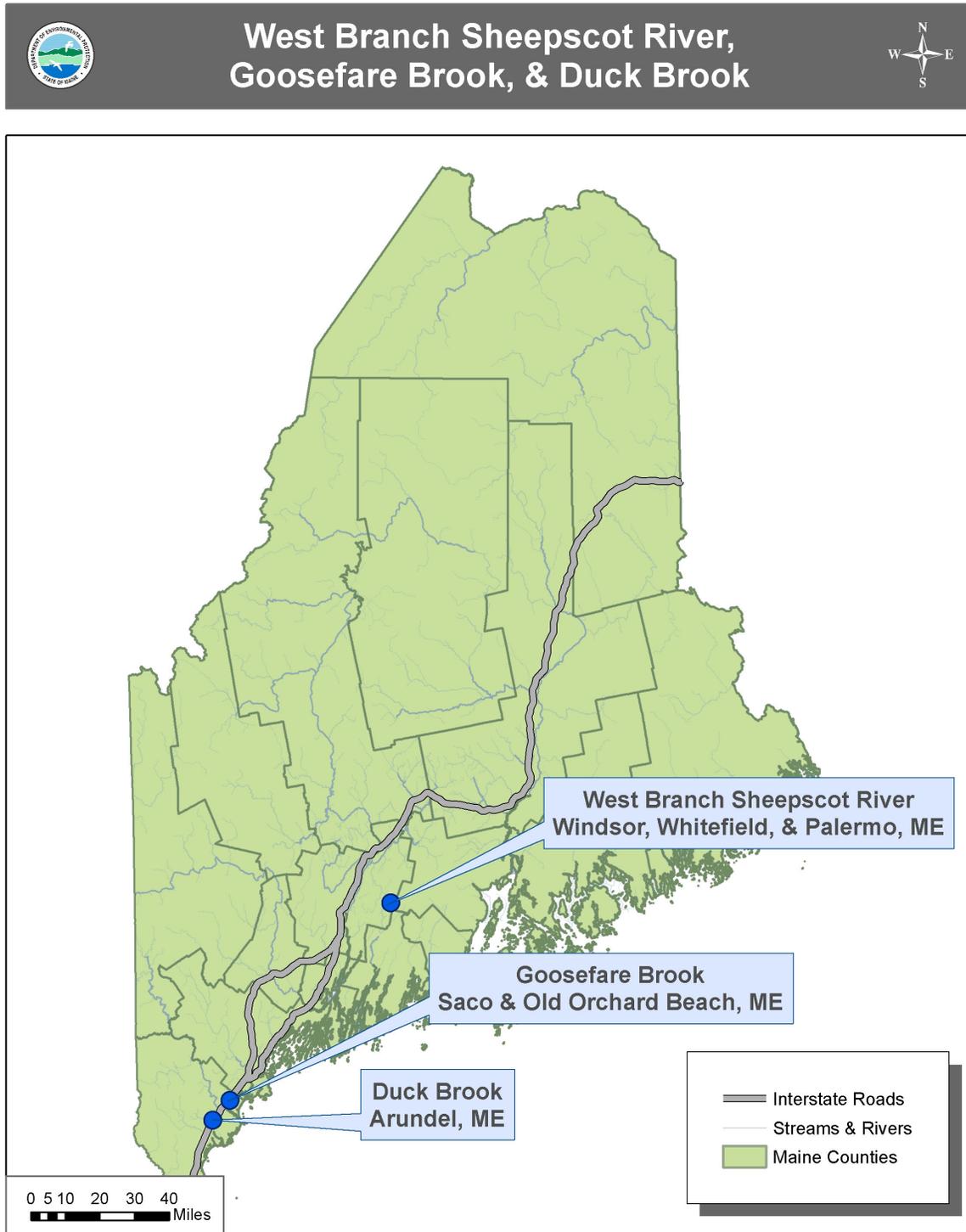
This draft was made available for a 30 day public review period beginning on September ??, 2013. A notice with a link to the public review draft has been distributed, via email, to the following interested parties and watershed stakeholder organizations:

- Sheepscot Valley Conservation Association
- York County Soil and Water Conservation District
- Kennebec County Soil and Water Conservation District
- Wells National Estuarine Research Reserve
- Maine Department of Marine Resources
- Maine Department of Transportation
- Maine Turnpike Authority
- Maine Healthy Beaches Program
- Conservation Law Foundation, Maine Office
- City of Saco
- Towns of China, Windsor, Whitefield, Arundel & Old Orchard Beach
- MS4 Area Stormwater Groups

The email also requests that the notification be further distributed to other interested persons. The document is available for public review on DEP’s Comment Web site at <http://www.maine.gov/dep/comment/index.html> . DEP staff contact information is also posted to enable the public to contact DEP with questions or concerns regarding the document.

All public comments and responses will be submitted to EPA as part of the final TMDL submittal documents and posted on DEP’s web page ‘TMDL approved by EPA’ at <http://www.maine.gov/dep/water/monitoring/tmdl/tmdl2.html> .

Figure 1: Streams covered by this TMDL that are impaired by bacteria (Category 5-B of the Maine DEP 2014 Integrated Water Quality Monitoring and Assessment Report Appendices).



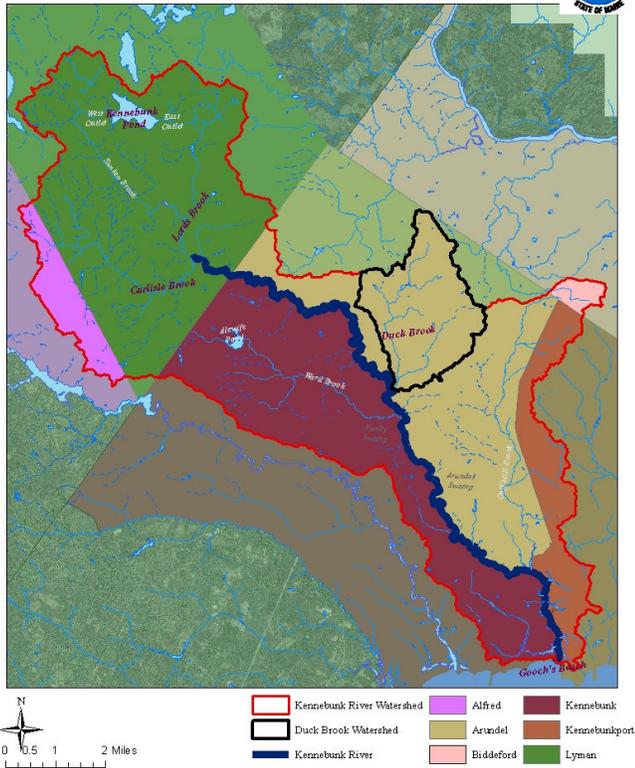
Maine Department of Environmental Protection - Created by: KNemmer, August 2013 - Data Sources: MEGIS, MDEP



BACTERIA TMDL SUMMARY

1. Duck Brook, Arundel

Kennebunk River Watershed



Waterbody Facts

- **Segment ID:**
ME0106000301_622R03
- **Town:** Arundel, ME
- **County:** York
- **Impaired Segment Length:**
8.6 miles (& Tributaries)
- **Classification:** Class B
- **Direct Watershed:** 6.64 mi²
- **Major Drainage Basin:**
Kennebunk River Watershed
- **Potential Sources:** Septic Systems, Agriculture, Pet Wastes, Wildlife

Figure 1.1: Map of the Kennebunk River & the Duck Brook watershed, with surrounding towns.

1.1 Background

Duck Brook is a Class B stream located in Arundel, a rural residential town close to the southern Maine coast. Duck Brook was first listed as impaired for *E. Coli* bacteria contamination in the Maine DEP 2012 *Integrated Water Quality Monitoring and Assessment Report*. Duck Brook flows into the Kennebunk River, which then empties onto Gooch’s Beach in Kennebunk (Figure 1.1). Both the Kennebunk River¹ and Gooch’s Beach² have bacterial impairments and Duck Brook was identified as a potential contributor to the problem by the

¹The Kennebunk River was first listed for “bacteria-only” impairment in Maine’s 2004 305(b) report and remains on the 303 (d) list of impaired waters.

² Gooch’s Beach has been closed during the summer on a number of occasions due to bacterial count exceedances.

Maine Healthy Beaches (MHB) program in 2008. DEP sampled Duck routinely in 2011 and 2012 to document the extent of bacterial contamination and narrow down the location of potential sources. Sampling results are presented in section 1.2 of this report.

The Duck Brook watershed is dominated by forested lands and is defined by drainage divides resulting from natural topography. The watershed has 6.0% impervious surface nested within a land cover mosaic of: 8% developed residential area; 72% coniferous, deciduous, or mixed forest vegetation; 7% agriculture area as characterized by pastures, crops, or fields; 3% wetland cover; and 10% is classified as other with herbaceous plants and shrubs (Figure 1.3). These patterns of landuse indicate that bacterial sources are likely from failing residential septic or agriculture activities.



Figure 1.2: Duck Brook near the mouth, by the Eastern Trail.

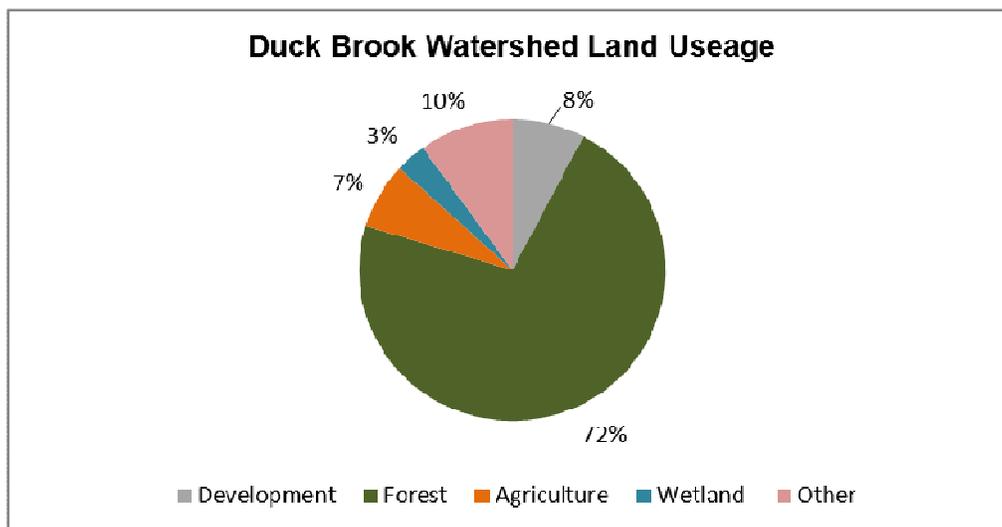


Figure 1.3: Forest and natural vegetation dominates the watershed.

1.2 Bacteria Data Summary & Percent Reduction Calculations

Data Summary

Bacteria data for the Duck Brook watershed were collected by Maine DEP staff working with Americorps and Volunteers with the Volunteer River Monitoring Program (VRMP) during 2011

and 2012. The sampling approach was designed to determine the distribution of bacteria within watershed’s network of tributaries (Figure 1.5) and diagnose the location of pollutant sources. The mainstem and all major tributaries were sampled to estimate the relative bacteria loads within the watershed and detect potential hot spots of pollution. Samples were collected during both wet (storm flow) and dry (base flow) weather to characterize the natural variability of runoff conditions found over the season. A detailed description of the sampling approach, results summary and analysis can be found in the project reports in Appendix A.

The instantaneous bacteria standard for Duck Brook is 236/100mL per sample while the geometric mean standard is 64/100mL for combined samples. All sampling results are reported as the ‘most probable number (MPN) per 100mL’, which is prescribed by the IDEXX testing method used for the project. The sampling results presented in Table 1.1 and Figure 1.4 indicates the stream is impaired for bacteria with concentrations that exceed the geometric mean standard at many sites throughout the watershed. Samples collected during storm events can be used to detect nonpoint sources of pollution, such as agriculture, while low flow conditions are better suited for detecting point sources of pollution, such as septic systems. These principles are examined in Figure 1.4 which compares wet and dry samples for 2012 sites to indicate the origin of potential pollutant sources.

Figure 1.4: Comparison of 2012 wet and dry samples to indicate potential pollutant sources.

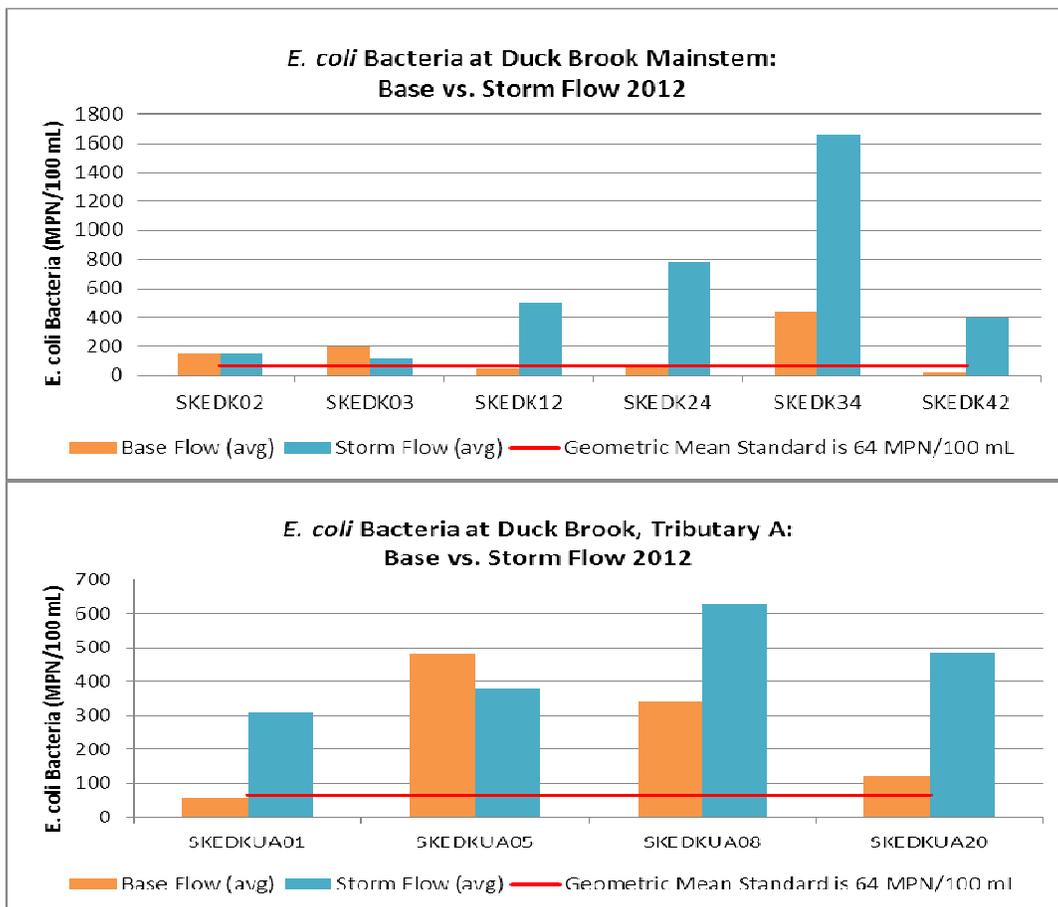
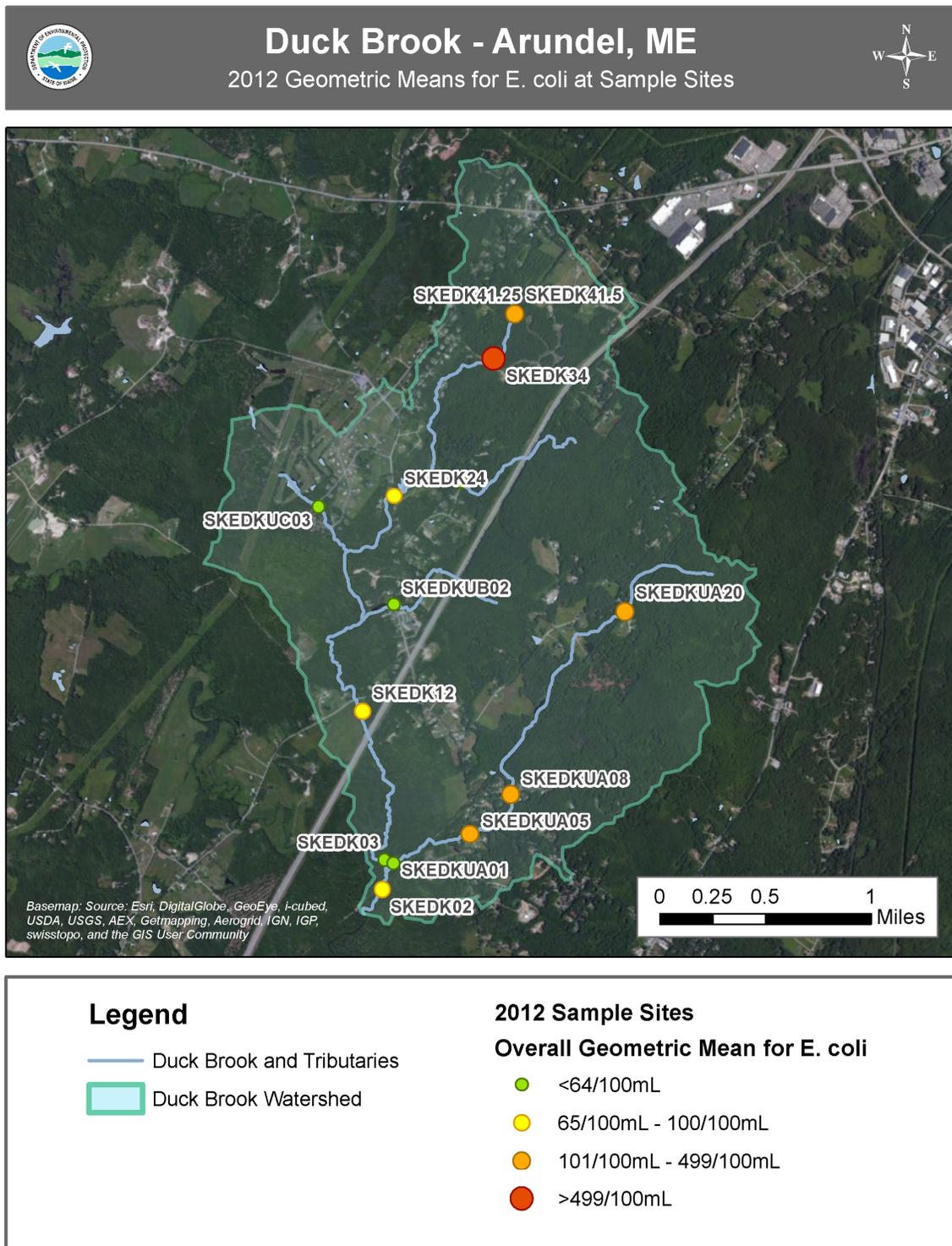


Figure 1.5: Duck Brook stream network, sampling site locations and 2102 results.



Maine Department of Environmental Protection - Created by: KNemmer, August 2013 - Data Sources: MEGIS, MDEP

Table 1.1: 2011 and 2012 sampling results for Duck Brook

Bacteria Results Summary of Duck Brook														
2011	DUCK BROOK MAIN STEM				TRIBUTARIES				Overall					
	Eastern Trail	Limerick Rd	Downing Rd	Limerick Rd	Bartlett Farms	Trib A	Trib B	Trib C	Trib D	Trib D				
MPN/100mL	SKEDK02	SKEDK03	SKEDK12	SKEDK24	SKEDK34	SKEDKUA01	SKEDKUA05	SKEDKUA09	SKEDKUA20	SKEDKUB02	SKEDKUC03	SKEDKUD02	SKEDKUD02	Overall
Flow & Date														
SF: May 18	138	-	236	-	-	236	308	291	135	161	53	27		
BF: June 16	124	143	236	517	-	59	65	36	84	59	33	76		
BF: July 12	130	102	130	161	1427	79	238	15	1046	326	236	66		
BF: August 4	169	76	36	39	345	121	155	24	579	105	32	41		
BF: August 31	140	68	80	102	131	96	162	115	269	126	46	313		
SF: September 8	1553	1733	2420	1203	228	2420	2420	2420	980	488	179	488		
Geometric Mean	208	167	192	209	348	177	257	101	349	165	69	97		172
2012														
MPN/100mL	DUCK BROOK MAIN STEM				TRIBUTARIES				Overall					
	Eastern Trail	Limerick Rd	Downing Rd	Limerick Rd	Bartlett Farms	Trib A	Trib B	Trib C	Trib D	Trib D				
SKEDK02	SKEDK03	SKEDK12	SKEDK24	SKEDK34	SKEDK42	SKEDKUA01	SKEDKUA05	SKEDKUA08	SKEDKUA20	SKEDKUB02	SKEDKUC03	SKEDKUD02	SKEDKUD02	Overall
Flow & Date														
SF: May 17	55	91	-	68	488	-	75.4	57.3	60.5	22.6	10	-	-	
SF: June 13	366	249	-	-	-	-	816.0	260.0	1300.0	1046.0	-	-	-	
BF: June 19	-	-	23	44	461	15	-	-	-	-	66	22	51	
BF: July 5	435	727	-	-	-	-	99.0	488.0	1046.0	94.0	-	-	-	
BF: July 23	-	-	76	1	27	-	-	-	-	-	52	5	17	
SF: July 24	64	28	-	-	-	-	31.0	816.0	517.0	256.0	-	-	-	
SF: August 13	-	-	88	299	1300	63	-	-	-	-	140	113	210	
BF: August 14	111	46	-	-	-	-	114.0	921.0	214.0	179.0	-	-	-	
BF: August 21	-	-	26	115	816	23	-	-	-	-	71	68	29	
BF: August 27	13	9	-	-	-	-	10.0	365.0	10.0	70.0	-	-	-	
SF: August 29	112	-	-	-	2420	-	-	-	-	613.1	-	-	-	
SF: September 5	-	-	921	1986	2420	727	-	-	-	-	1046	64	2420	
BF: September 11	24	14	-	-	-	-	5.0	152.0	86.0	144.0	-	-	-	
Geometric Mean	83	60	82	77	625	63	52	314	186	168	84	35	106	112
SF= Storm Flow, BF= Base Flow, MPN=Most Probable Number														
Exceeds Instantaneous Standard of 236/ 100mL														
Meets Geometric Mean of 64/ 100mL														
Slightly Exceeds Geometric Mean Criteria														
Exceeds Geometric Mean Criteria														
Extreme Exceedance Geometric Mean Criteria														

TMDL Calculations

Bacteria concentrations are required to meet water quality standards for the entire sampling period, which means combining wet and dry samples. This TMDL estimates the bacteria reduction needed for the waterbody to comply with water quality standards by applying a simple percent load reductions calculation. These determinations are made for geometric mean values because it is unlikely that a stream would be listed for impairment based on a single maximum instantaneous sample. In general, TMDLs compute a single reduction for an impaired segment and the most downstream mainstem site has been chosen for the purpose of calculating reductions. Choosing one site will simplify future compliance monitoring because the intensive sampling approach conducted during this project may not be feasible in the future. All data collected at the downstream Eastern Trail site during 2011 and 2012 were combined to calculate an overall geometric mean and used to compute the 48% reduction in bacteria concentration needed to achieve TMDL goals.

REDUCTIONS TO ACHIEVE BACTERIA WATER QUALITY STANDARDS

- **TMDL GOAL-CLASS B STANDARD= 64/100ML GEOMETRIC MEAN**
- **2011 & 2012 DUCK BROOK SAMPLES= 123/100ML GEOMETRIC MEAN**
- **48 % IN REDUCTION BACTERIA LOADS TO ACHIEVE TMDL GOALS**

1.3 Recommended Future Strategies

Restoration of bacterially impaired streams begins with an assessment of the location and the extent of potential contamination throughout the watershed. This sampling project identified a number of locations where sanitary surveys or an evaluation of agricultural practices are the next step towards eliminating sources. A systematic investigation of contaminated sites will either reveal a direct human or domestic animal source that can be remediated or substantiate that bacterial contamination is solely from wildlife sources and natural processes. These approaches to eliminating bacterial sources are further described in the 2009 TMDL Report and recommendations for Duck Brook are also found in the Appendix A reports. Based on observations made during 2011 and 2012 here are some specific recommendations:

- Investigate private septic systems for malfunctions by conducting sanitary surveys in the upper reach of Duck Brook, upstream of the site labeled SKEDK34 on Figure 1.5 and on residences along Tributary A near the Eastern Trail.
- Assess the impact of domestic animal waste from properties with livestock. Survey drainage ditches in the Laura Lane neighborhood for potential runoff from horse pastures.



BACTERIA TMDL SUMMARY

2. Goosefare Brook, Saco

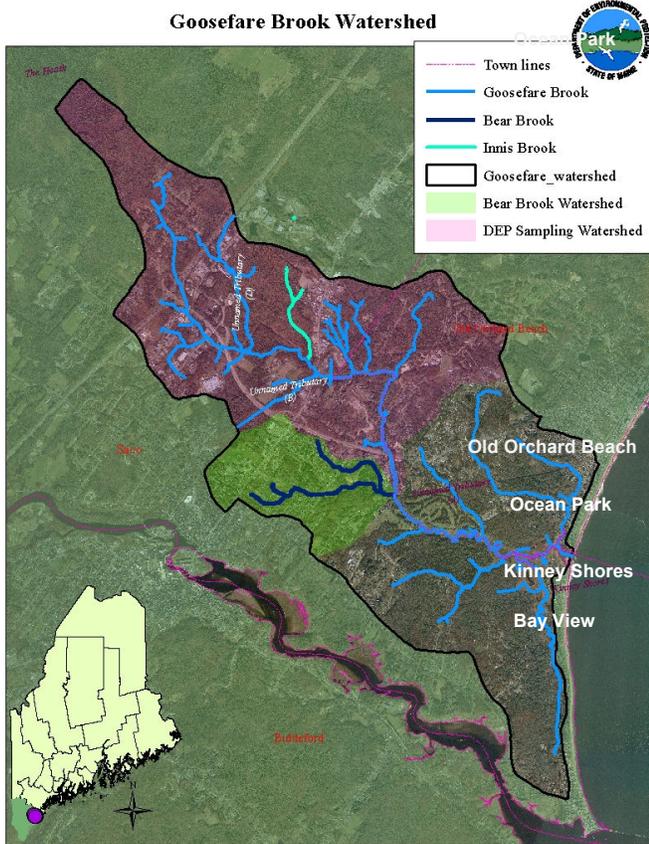


Figure 2.1: Map of the larger Goosefare Brook watershed, with coastal and beach connections.

Waterbody Facts

- **Segment ID:**
ME0106000106_612R01
ME0106000106_612R01_01
- **Town:** Saco & Old Orchard Beach, ME
- **County:** York
- **Impaired Segment Length:**
ME0106000106_612R01=0.6 miles
ME0106000106_612R01_01=5.54 miles
- **Classification:** Class B
- **Direct Watershed:** 9.46 mi²
- **Major Drainage Basin:** Piscataqua-Presumpscot-Saco
- **Potential Sources:** Sanitary Systems- both Residential Septics and Municipal Sewerage, Agriculture, Pet Wastes, Wildlife

2.1 Background

Goosefare Brook is a Class B stream situated in the city of Saco with a small segment in the town of Old Orchard Beach in York County, Maine. Goosefare Brook was first listed as impaired for *E. Coli* bacteria contamination in the Maine DEP 2012 *Integrated Water Quality Monitoring and Assessment Report*. Goosefare Brook originates in Saco Heath and flows directly to coastal waters with the potential to impact several adjacent beaches, including; Old Orchard Beach, Ocean Park, Kinney Shores and Bay View (Figure 2.1). The beaches of Ocean Park, Bay View and Kinney Shores have all had swimming advisories or closures in the past and the Maine Healthy Beaches (MHB) program has identified Goosefare Brook and its tributaries as a potential contributor to the problem. Bear Brook, in Figure 2.1, is a lower

tributary to Goosefare that is also impaired for bacteria, but was covered by the 2009 TMDL Report and therefore not included in this report. DEP sampled the upper freshwater portion of the watershed, identified in Figure 2.1 and 2.5, in 2011 and 2012 to document the extent of bacterial contamination and narrow down the location of potential sources. Sampling results are presented in section 2.2 of this report.



Figure 2.2: Goosefare Brook, site SGS15.

In 2012 the Goosefare Brook watershed was also included in the *Maine Impervious Cover Total Maximum Daily Load Assessment (TMDL) for Impaired Stream*. Goosefare was identified as having 17% impervious cover, from the combination of residential, commercial and highway development. This impervious surface is nested within a land cover mosaic of: 42% developed area, 45% mixed forest vegetation and 7% wetland cover (Figure 2.3 and 2.5). These patterns of landuse indicate that bacterial sources are likely from failing residential septic, leaky sewer pipes, illicit connections to storm drains or domestic animals.

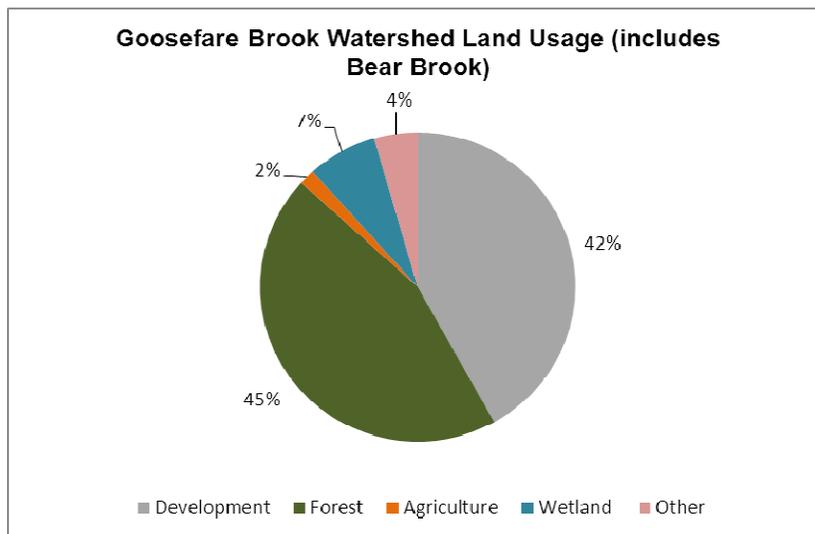


Figure 2.3: Forests and development dominate the watershed.

2.2 Bacteria Data Summary & Percent Reduction Calculations

Data Summary

Bacteria data for the Goosefare Brook watershed were collected by Maine DEP staff working with Americorps and Maine Healthy Beaches staff during 2011 and 2012. In 2011 the sampling approach was designed to: determine the distribution of bacteria within watershed's network

of tributaries (Figure 2.5), estimate the relative bacteria loads within the watershed and detect potential hot spots. In principle, source elimination should follow the flow of water, beginning in the upstream reaches, which then contribute clean water to downstream reaches. In 2012 DEP focused sampling in the upper portion of the watershed to narrow down the potential the location of pollutant sources discovered in 2011. Two tributaries that were found to meet water quality standards in 2011 were dropped from sampling in 2012. Samples were collected during both wet (storm flow) and dry (base flow) weather to characterize the natural variability of runoff conditions found over the season. A detailed description of the sampling approach, results summary and analysis can be found in the project reports in Appendix B.

The instantaneous bacteria standard for Goosefare Brook is 236/100mL per sample while the geometric mean standard is 64/100mL for combined samples. All sampling results are reported as the ‘most probable number (MPN) per 100mL, which is prescribed by the IDEXX testing method used for the project. The sampling results presented in Table 2.1 and Figure 2.4 indicates the stream is impaired for bacteria with concentrations that exceed the geometric mean standard at most sites. Samples collected during storm events can be used to detect nonpoint sources of pollution that wash off during a storm, while low flow conditions are better suited for detecting point sources of pollution, such as septic systems. Figure 2.4 compares wet and dry samples for 2012 sites and shows high values during storm events and moderate exceedances during base flow. This likely indicates discharges from both human sewerage and some contributing nonpoint sources as well, such as domestic animals.

Figure 2.4: Comparison of 2012 wet and dry samples to indicate potential pollutant sources.

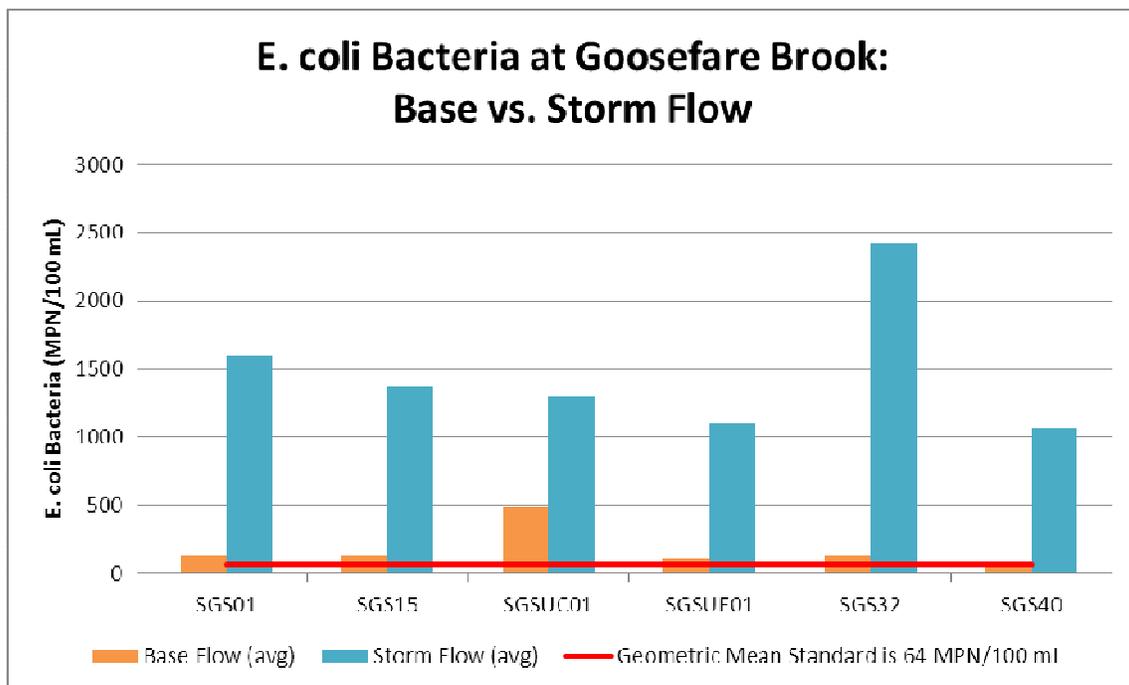
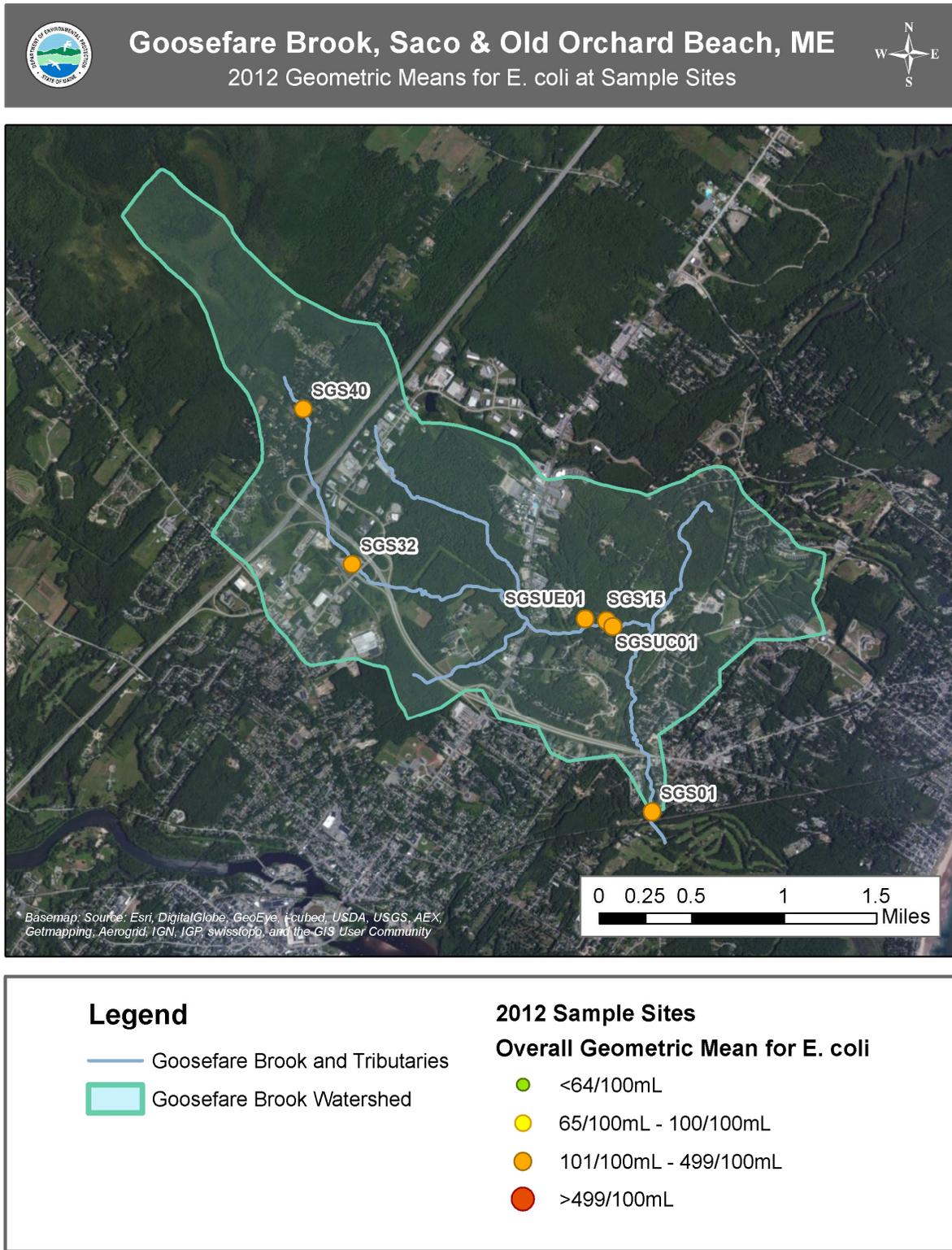


Figure 2.5: Goosefare Brook stream network, sampling site locations and 2012 results.



Maine Department of Environmental Protection - Created by: KNemmer, August 2013 - Data Sources: MEGIS, MDEP

Table 2.1: 2011 and 2012 sampling results for Goosefare Brook

Bacteria Results Summary of Goosefare Brook														
2011	GOOSEFARE BROOK MAINSTEM				TRIBUTARIES				Overall					
	Old Orchard Rd	Ocean Park Rd	Ross Rd	Industrial Park Way	Jenkins Rd	Old Salt Rd	Old Orchard Rd	Moody Rd	Main St	Valley Rd	Tribe A	Tribe B	Tribe C	Tribe E
MPN/100mL	SGS01	SGS04	SGS15	SGS32	SGS40	SGSUA05	SGUA08	SGSUB04	SGSIB01	SGSTS	SGSUC01	SGSUE01	SGSUC01	SGSUE01
Flow & Date														
BF: May 24	99	103	-	121	44	-	-	-	-	-	-	-	-	-
BF: May 31	-	-	-	-	-	-	179	185	29	11	-	-	-	-
BF: June 9	101	79	138	50	921	-	228	38	28	13	-	-	-	-
BF: June 27	236	248	291	135	124	435	192	135	-	-	-	-	-	-
BF: July 11	866	236	141	173	126	133	179	2420	93	3	-	-	-	-
BF: August 9	214	91	64	70	272	179	205	579	-	-	-	-	-	-
BF: August 23	537	727	579	579	770	-	236	214	-	-	-	-	-	-
Geometric Mean	248	178	184	134	226	218	202	256	42	8	151			
2012														
MPN/100mL	GOOSEFARE BROOK MAINSTEM				TRIBUTARIES				Overall					
	Old Orchard Rd	Ocean Park Rd	Ross Rd	Industrial Park Way	Jenkins Rd	Tribe C	Tribe E	Tribe A	Tribe B	Tribe C	Tribe E	Tribe A	Tribe B	Tribe C
Flow & Date	SGS01	SGS04	SGS15	SGS32	SGS40	SGSUC01	SGSUE01	SGSUC01	SGSUE01	SGSUC01	SGSUE01	SGSUC01	SGSUE01	SGSUC01
SF: May 10	770	NS	326	-	150	166	219	-	-	-	-	-	-	-
BF: June 11	78	NS	84	36	30	107	52	-	-	-	-	-	-	-
BF: July 9	122	NS	158	64	41	1733	179	-	-	-	-	-	-	-
BF: August 7	131	NS	120	345	111	326	73	-	-	-	-	-	-	-
BF: August 9	NS	NS	99	-	-	91	30	-	-	-	-	-	-	-
BF: September 10	201	NS	192	72	59	179	261	-	-	-	-	-	-	-
SF: September 19	2420	NS	2420	2420	1986	2420	1986	-	-	-	-	-	-	-
Geometric Mean	279	218	168	116	326	157	201							
SF = Storm Flow, BF = Base Flow, MPN=Most Probable Number														
NS = Not Sampled during this Season														
Meets Geometric Mean of 64/ 100mL														
Slightly Exceeds Geometric Mean Criteria														
Exceeds Geometric Mean Criteria														
Extreme Exceedance Geometric Mean Criteria														

TMDL Calculations

Bacteria concentrations are required to meet water quality standards for the entire sampling period, which means combining wet and dry samples. This TMDL estimates the bacteria reduction needed for the waterbody to comply with water quality standards by applying a simple percent load reductions calculation. These determinations are made for geometric mean values because it is unlikely that a stream would be listed for impairment based on a single maximum instantaneous sample. In general, TMDLs compute a single reduction for an impaired segment and the most downstream mainstem site has been chosen for the purpose of calculating reductions. Choosing one site will simplify future compliance monitoring because the intensive sampling approach conducted during this project may not be feasible in the future. All data collected at the downstream Old Orchard Road crossing, site SGS01, during 2011 and 2012 were combined to calculate an overall geometric mean and used to compute the 76% reduction in bacteria concentration needed to achieve TMDL goals.

REDUCTIONS TO ACHIEVE BACTERIA WATER QUALITY STANDARDS

- **TMDL GOAL-CLASS B STANDARD= 64/100ML GEOMETRIC MEAN**
- **2011 & 2012 GOOSEFARE BROOK SAMPLES= 263/100ML GEOMETRIC MEAN**
- **76 % IN REDUCTION BACTERIA LOADS TO ACHIEVE TMDL GOALS**

2.3 Recommended Future Strategies

Restoration of bacterially impaired streams begins with an assessment of the location and extent of potential contamination throughout the watershed. This sampling project identified a number of locations where sanitary surveys are the next step towards eliminating sources. A systematic investigation of contaminated sites will either reveal a direct human or domestic animal source that can be remediated or substantiate that bacterial contamination is solely from wildlife sources and natural processes. These approaches to eliminating bacterial sources are further described in the 2009 TMDL Report and specific recommendations for Goosefare Brook are also found in Appendix B reports. Based on observations made during 2011 and 2012 listed below are some specific recommendations:

- *Establish an Illicit Discharge Detection and Elimination (IDDE) Program for Goosefare Brook*
 - In its NPDES Permit, the City of Saco has included goals toward development of an IDDE Program and the city was made progress towards this objective. An effective IDDE Program should include the following essential elements:
 - Storm sewer system map with locations of outfalls and waters receiving discharge
 - Determine the integrity of sewer and stormwater conveyances by examining them using current engineering evaluation techniques such as cameras, dyes or smoke testing
 - Include remedial procedures and necessary actions
 - A plan to detect and address illicit discharges, including illegal dumping
 - An education program that informs public employees, businesses, and the general public of the hazards associated with illegal discharge and improper waste disposal
- *Focused Investigation of the Watershed*
 - Goosefare Brook's watershed is relatively large, and could be subdivided into smaller watersheds to facilitate a thorough investigation of stream channels (mainstem and tributaries) which should include visual inspection of the water for color, odor, and obvious evidence of waste materials as well as to note any pipes, discharges, or unusual conditions.
 - Animal sources should be attributed to either domestic animals or to wildlife, especially in subwatersheds dominated by natural land cover.
- *Sanitary Surveys* for those portions of the watershed serviced by residential septic systems
 - Survey properties for malfunctioning septics in areas with known high bacteria counts, such as Ross Rd. and Jenkins Rd.



BACTERIA TMDL SUMMARY

3. West Branch Sheepscot River

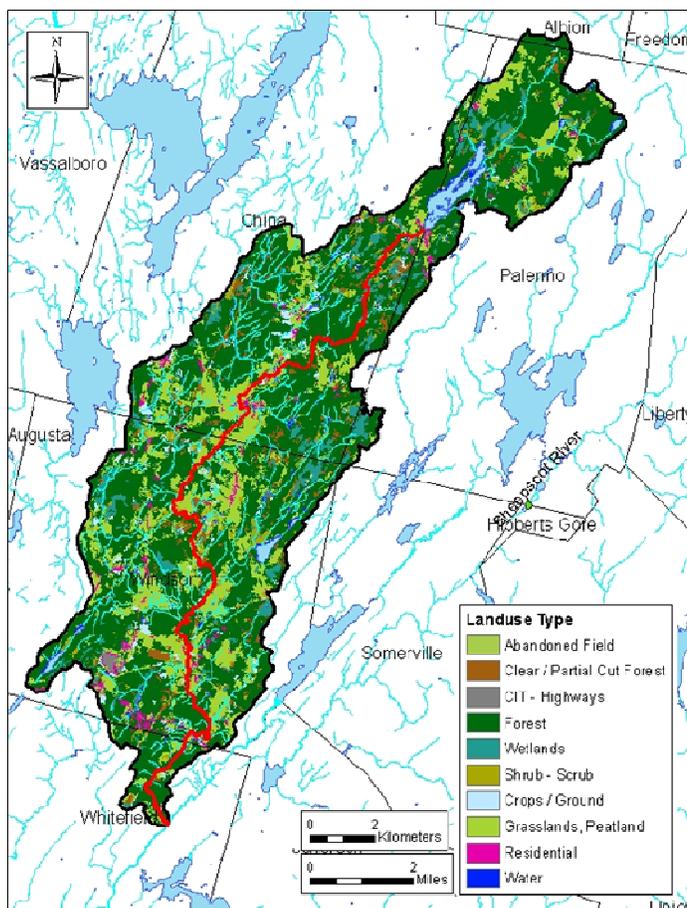


Figure 3.1: West Branch of the Sheepscot River

Waterbody Facts

- **Segment ID:**
ME0105000305_528R02
- **Towns:** China, Palermo, Windsor, Somerville, & Whitefield, ME
- **Counties:** Kennebec, Waldo, & Lincoln
- **Impaired Segment Length:**
2.29 miles
- **Classification:** Class AA, B
- **Direct Watershed:** 50.6 mi²
- **Major Drainage Basin:**
Central Coastal Watershed
- **Potential Sources:** Sanitary Systems- both Residential Septics and Municipal Sewerage, Agriculture, Pet Wastes, Wildlife

3.1 Background

The West Branch of the Sheepscot River is Class AA river that originates in China and flows through Palermo, Windsor, and Somerville before joining the mainstem of the Sheepscot in Whitefield. West Branch Sheepscot was listed as impaired for *E. Coli* bacteria contamination in the Maine DEP 2012 *Integrated Water Quality Monitoring and Assessment Report* and the impaired segment flows from Rt.17 to the mouth. The West Branch Sheepscot River flows from the mouth of Branch Pond in Palermo, and then into the mainstem of the Sheepscot, which flows directly to the marine waters. The lower Sheepscot in Alna is also impaired for bacteria, but was covered by the 2009 TMDL Report and not included in this report. The Department of Marine Resources has closed shellfish harvest areas in the estuarine portion of

the Sheepscot, near the town of Wiscasset. It is unlikely that the impairments in the West Branch directly influence the marine receiving waters due to the distance and relatively small degree of bacterial exceedances.

The West Branch of the Sheepscot has been sampled for bacteria by volunteers with the Sheepscot Valley Conservation Association (SVCA) for the past 19 years. SVCA is the source of the data presented in this report. Sampling is conducted simply to determine compliance with water standards and results are presented in Section 3.2 of this report.



Figure 3.2: SVCA Volunteer at West Branch Sheepscot.

The West Branch Sheepscot watershed is dominated by forested lands and is defined by drainage divides resulting from natural topography. The watershed has a land cover mosaic of: 66% mixed forest vegetation, 21% agriculture, 11% wetland cover and 2% residential and road development (Figure 3.3). These patterns of land use means that the bacterial sources are likely from domestic animals associated with agriculture, failing residential septic or wildlife. The West Branch watershed does have a few active dairy farms which are a potential source of bacteria.

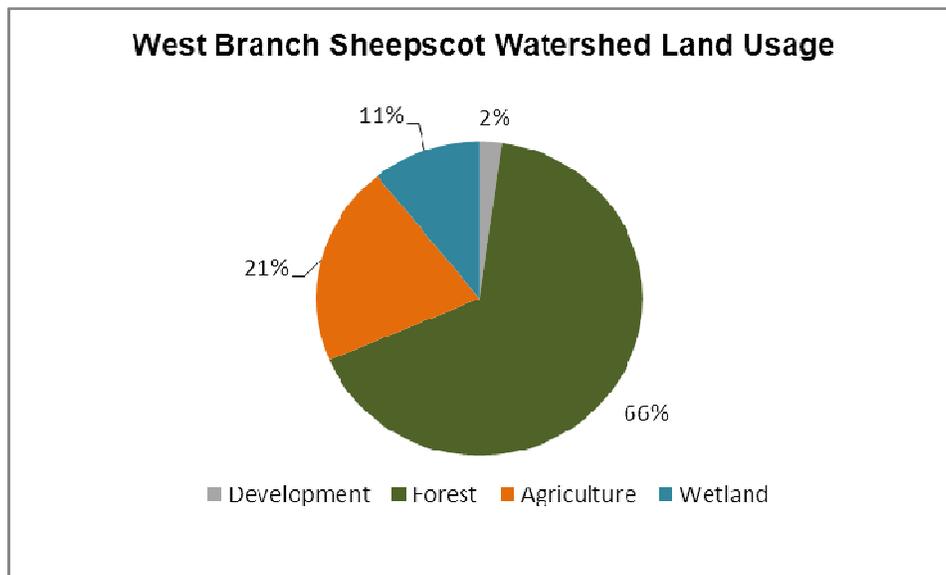


Figure 3.3: Forests and agriculture dominate the watershed.

3.2 Bacteria Data Summary & Percent Reduction Calculations

Data Summary

Bacteria data for the West Branch Sheepscot watershed were collected by Volunteers with the SVCA from 1994 to 2012. Data is collected under a DEP approved Quality Assurance Project Plan which enables DEP to accept SVCA data for inclusion in databases and to use this information for impairment or 303(d) listing decisions. SVCA’s monitoring makes no attempt to document the extent of bacterial contamination and narrow down the location of potential sources. Samples are collected on a set schedule with no distinction between wet (storm flow) or dry (base flow) sampling events, but over the course of the season both wet and dry conditions are usually encountered. Sampling locations and results are presented in Figure 3.5 and further descriptions can be found in the SVCA project report in Appendix C.



Figure 3.4: Below Maxcy’s Mills Road, Windsor

The bacteria standard for the West Branch Sheepscot is Class AA or ‘as naturally occurs’, which means the river should be consistent with bacteria levels found in waters free of measurable effects of human activity. There are no numeric criteria for monitoring results comparisons, but in practice the Class GPA (lakes) standard for *E. coli* may be used as a surrogate target if the ‘natural’ bacteria are unknown (Table 2). Therefore, for the purposes of this TMDL, the West Branch Sheepscot targets for bacteria of human and domestic animal origin should not exceed a geometric mean of 29/100mL or an instantaneous level of 194/100mL. The sampling results presented in Table 3.1 indicate the stream is impaired for bacteria with concentrations consistently exceeding the geometric mean standard at two sites.

Table 3.1: Annual geometric means for the West Branch Sheepscot River

Annual Geometric Means			
	WEST BRANCH OF THE SHEEPSCOT		
Number/100mL	Howe Rd, Whitefield	Rt 105, Windsor	Water St, Palermo
Geometric Means	WB001-F	WB002 F	WB005-F
Year			
2007	43	37	13
2008	64	53	14
2009	49	55	6
2010	46	24	15
2011	36	102	10
2012	47	69	12
Meets Geometric Mean of 29/ 100mL			
Slightly Exceeds Geometric Mean Criteria			
Exceeds Geometric Mean Criteria			
Extreme Exceedance Geometric Mean Criteria			
Exceeds Instantaneous Standard of 194/ 100mL			

The sampling results for 2012 in Table 3.2 and Figure 3.5 show the variability found for individual sampling events over the course of the season. The high values measured on June 5th were associated with a rain event, which confirms that bacteria are washed off during a runoff event. The middle sampling site has the highest geometric mean, which may be influenced by the two upstream tributaries

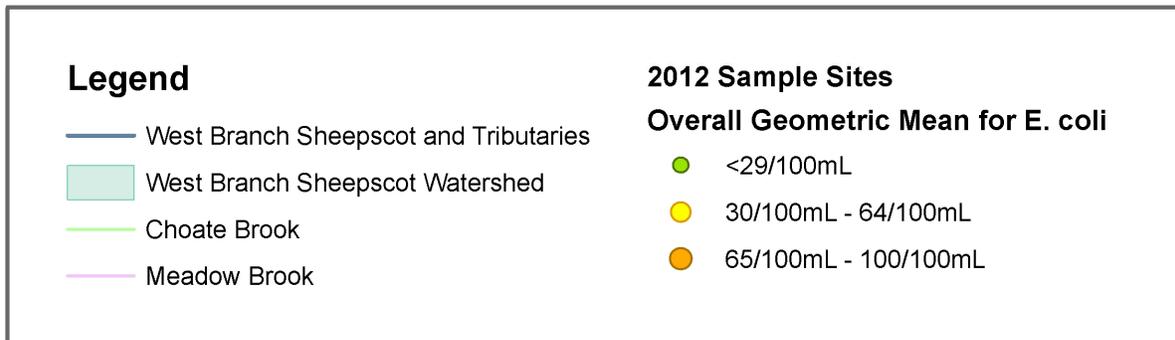
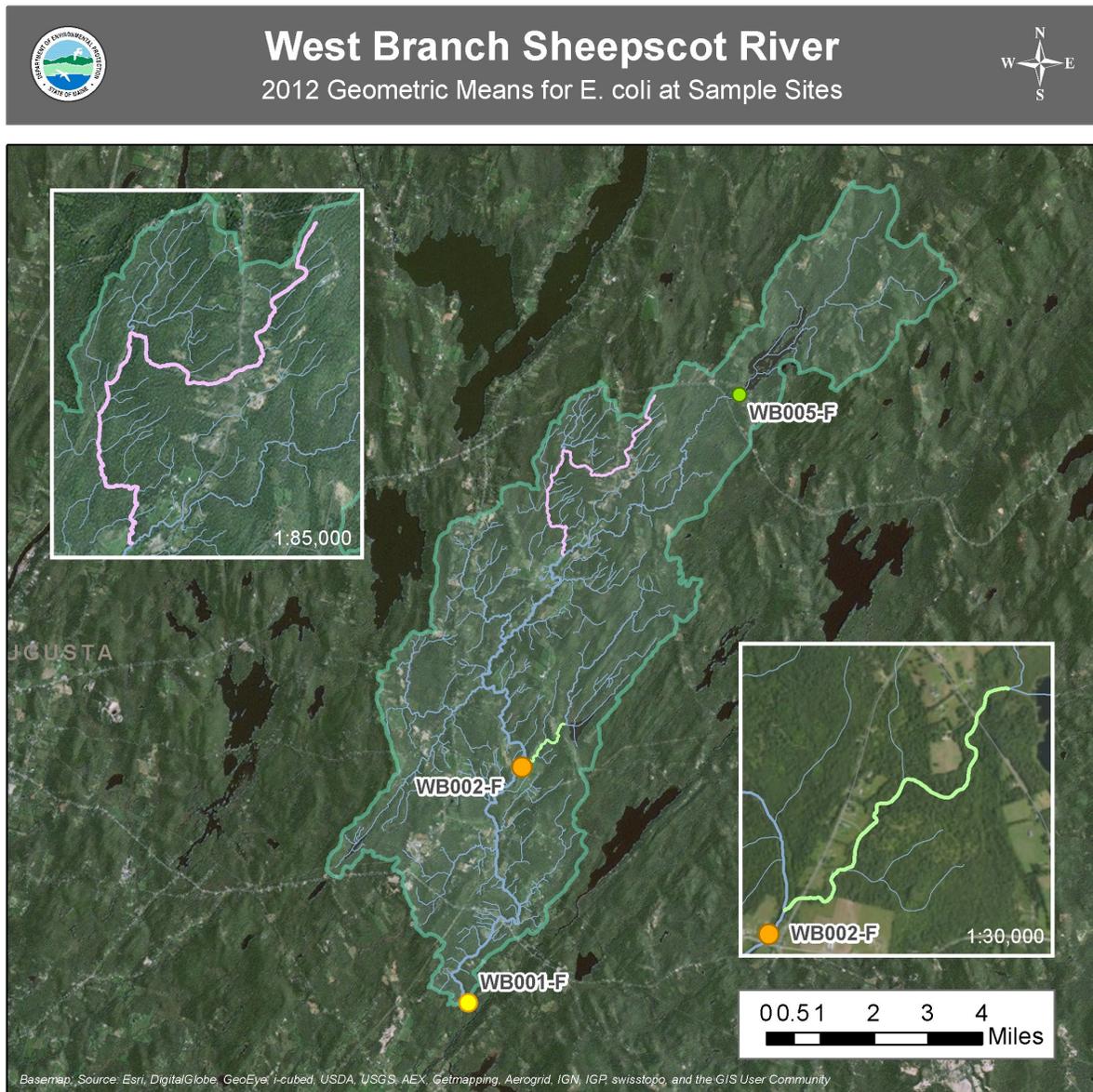
that are also monitored by SVCA, identified as Meadow Brook and Choate Brook on Figure 3.5. SVCA’s has consistently found elevated bacteria values on these small streams during the 19 years of sampling and they contribute a bacteria load to the West Branch.

The observed bacteria values exceed Maine’s surrogate water quality standards for Class AA, but they meet Class B at the downstream site and for all sites combined (Table 3.2). The observed values may actually meet the ‘as naturally occurs’ standard, but it is unknown how the bacteria load splits between wildlife and human or domestic animal sources. All bacteria derived from wildlife would be considered a natural source and not contribute to the nonattainment status.

Table 3.2: Sampling results for the West Branch Sheepscot River

Bacteria Results Summary for West Branch Sheepscot					
2012	WEST BRANCH OF THE SHEEPSCOT				
Number/100mL	Howe Rd, Whitefield	Rt 105, Windsor	Water St, Palermo		
	WB001-F	WB002 F	WB005-F	Overall	
Date					
May 8	66	50	1		
May 22	34	64	2		
June 5	313	166	29		
June 19	34	272	7		
July 3	73	172	5		
July 17	99	66	77		
July 31	22	38	35		
August 14	16	24	60		
August 28	101	61	-		
September 11	20	40	24		
September 25	18	44	6		
					35
Geometric Mean	47	69	12		
Meets Geometric Mean of 29/ 100mL					
Slightly Exceeds Geometric Mean Criteria					
Exceeds Geometric Mean Criteria					
Extreme Exceedance Geometric Mean Criteria					
Exceeds Instantaneous Standard of 194/ 100mL					

Figure 3.5: West Branch Sheepscot River network, sampling site locations and 2012 results.



Maine Department of Environmental Protection - Created by: KNemmer, August 2013 - Data Sources: MEGIS, MDEP, SVCA

TMDL Calculations

This TMDL estimates the bacteria reduction needed for the waterbody to comply with water quality standards by applying a simple percent load reductions calculation. These determinations are made for geometric mean values because it is unlikely that a stream would be listed for impairment based on a single maximum instantaneous sample. In general, TMDLs compute a single reduction for an impaired segment and the two downstream sites that are in nonattainment were chosen for the purpose of calculating reductions. These sites have been consistently monitored in the past and are suitable to use for future compliance monitoring. All data collected at these sites during 2012 were combined to calculate an overall geometric mean and used to compute the 49% reduction in bacteria concentration needed to achieve TMDL goals.

REDUCTIONS TO ACHIEVE BACTERIA WATER QUALITY STANDARDS

- **TMDL GOAL-CLASS AA STANDARD= 29/100ML GEOMETRIC MEAN**
- **2012 WEST BRANCH SHEEPSCOT SAMPLES= 57/100ML GEOMETRIC MEAN**
- **49 % IN REDUCTION BACTERIA LOADS TO ACHIEVE TMDL GOALS**

3.3 Recommended Future Strategies

Restoration of bacterially impaired streams begins with an assessment of the location and extent of potential contamination throughout the watershed. The West Branch Sheepscot is a large watershed with sampling results over a long time period that should be considered in any future restoration planning effort. A systematic investigation of tributaries may reveal whether sources are the result of a direct human or domestic animal impact or substantiate that bacterial contamination is from wildlife sources and natural processes. Further approaches to eliminating bacterial sources are described in the 2009 TMDL Report. Here are specific recommendations to move beyond attainment monitoring and work to eliminate pollutant sources:

- *Focused Investigation of the Watershed*
 - The West Branch Sheepscot watershed is relatively large and should be subdivided into smaller watersheds to facilitate a thorough investigation of stream channels (mainstem and tributaries).

- Conduct an intensive or diagnostic sampling strategy to narrow down the location of potential sources through an approach called 'bracket sampling' which focuses monitoring around known problem areas. Apply this strategy in upstream areas and move downstream systematically as sources are identified and eliminated.
 - Determine the location between the upstream site, WB005-F and WB002-F where bacteria levels begin to rise and investigate nearby properties for bacterial sources.
 - Sample in strategic locations within the Choate Brook and Meadow Brook watersheds to narrow down potential pollutant sources or determine bacteria are derived from natural sources.
- *Sanitary Surveys*
 - Survey properties for malfunctioning septic systems near areas with known high bacteria counts, such as the Rt. 105 sampling site.
- *Bacteria Source Tracking*
 - The relatively low bacteria values increase the likelihood that natural processes are a significant source of the observed values. Conduct a bacteria source tracking project to determine whether animal sources should be attributed to either domestic sources or to wildlife.
 - This entails developing a comprehensive project that includes a combination of monitoring plans, land use analysis, and applying Microbial Source Tracking (MST) methods. There are a variety of MST methods available; biochemical (antibiotic resistance analysis), molecular (DNA pattern comparisons or fingerprinting), chemical (test water for presence of human waste constituents), and immunological (antigenic determinants shed in human and animal fecal matter).

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