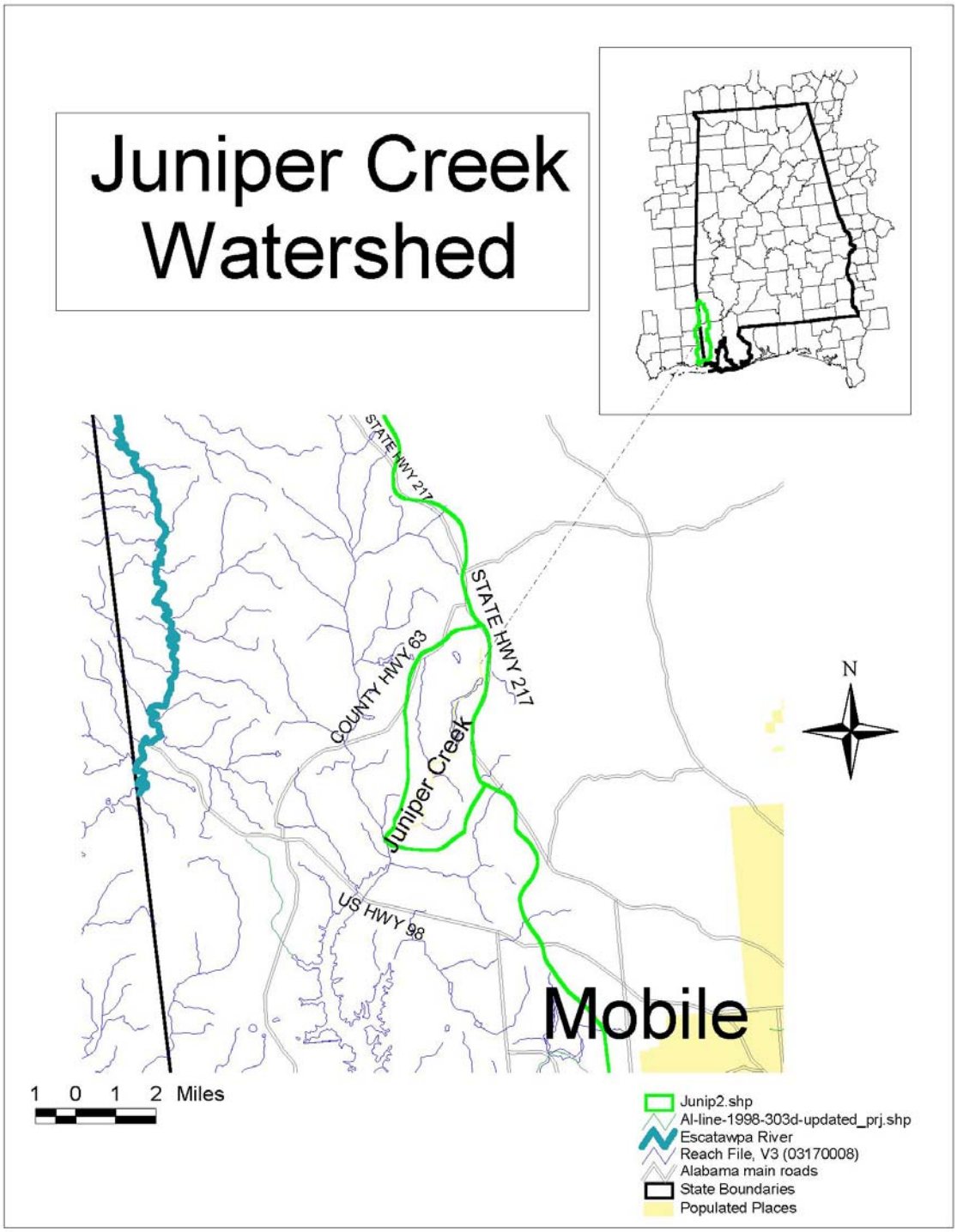
FINAL

TMDL Development for

Juniper Creek, AL/03170008-090_03

Pathogens (fecal coliform)

Alabama Department of Environmental Management
Water Quality Branch
Water Division
October 2004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Escatawpa River
Reach File, V3 (03170008)
Alabama main roads
State Boundaries
Populated Places

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1.0 Executive Summary

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify waterbodies which are not meeting their designated use and to determine the Total Maximum Daily Load (TMDL) for pollutants causing the use impairment. TMDLs are the sum of individual wasteload allocations for point sources (WLAs), load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS).

Juniper Creek in Mobile County near Fairview, Alabama lies within the Upper Big Creek Subwatershed of the Escatawpa River Basin. Its use classification is Fish & Wildlife (F&W). Juniper Creek was put on the State of Alabama's §303(d) use impairment list in 1996 for pH. However, pH was removed from the 1998 List based on the low pH values being due to natural conditions caused by acid clay soils and tannic acid from decaying vegetation which are typical of coastal blackwater streams. Juniper Creek has been on the State of Alabama's §303(d) use impairment list since 1998 for Pathogens (Fecal Coliform), which is what this TMDL report addresses.

The USGS collected data at three stations on Juniper Creek between August 1990 and the present. At one station (USGS # 022479948) 11% of the samples (7 out of 59) exceeded the single-sample maximum fecal coliform criterion of 2000 col/100ml.

The land uses in the Juniper Creek watershed indicate that the primary probable sources of fecal coliform bacteria are from forested and agricultural areas. A pollutant load from leaking septic systems was also estimated but was not significant.

Shown below in Table 1.1, is a summary of current loads, final loads and reductions needed to meet the applicable fecal coliform criteria for Juniper Creek.

Table 1.1

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
NPS load (LA)	3.30E+12	1.98E+12	1.32E+12	40%	1.98E+12
Point Source (WLA)	0.00E+00	0.00E+00	0.00E+00	0%	0.00E+00

Table 1.2 below, shows the different components of the TMDL for Juniper Creek.

Table 1.2 - TMDL for Juniper Creek Watershed

TMDL = WLA + LA + MOS			
TMDL	**WLA**	**LA**	**MOS**
2.20E+12	**0.00E+00**	**1.98E+12**	**2.20E+11**

2.0 Basis for §303(d) Listing

2.1 Introduction

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify waterbodies which are not meeting their designated uses and to determine the total maximum daily load (TMDL) for pollutants causing use impairment. The TMDL process establishes the allowable loading of pollutants for a waterbody based on the relationship between pollution sources and instream water quality conditions, so that states can establish water-quality based controls to reduce pollution and restore and maintain the quality of their water resources (USEPA, 1991).

The segment of Juniper Creek being evaluated lies within Mobile County. It is listed on the 1998 and Draft 2000 303(d) lists as non-supporting of its use classification and has a priority ranking of high.

2.2 Problem Definition

Waterbody Impaired:	Juniper Creek-from Big Creek to Its source.
Waterbody length:	6.6 miles
Waterbody drainage area:	9.27 square miles
Water Quality Standard Violation:	Fecal Coliform
Pollutant of Concern:	Pathogens (fecal coliform)
Water Use Classification:	Fish and Wildlife

Usage related to classification:
The impaired stream segment, Juniper Creek, is classified as Fish and Wildlife. Usage of waters in this classification is described in ADEM Admin. Code R. 335-6-10-.09(5)(a), (b), (c), and (d).

(a) Best usage of waters: fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming and water-contact sports or as a source of water supply for drinking or food-processing purposes.

(b) Conditions related to best usage: the waters will be suitable for fish, aquatic life and wildlife propagation. The quality of salt and estuarine waters to which this classification is assigned will also be suitable for the propagation of shrimp and crabs.

(c) Other usage of waters: it is recognized that the waters may be used for incidental water contact and recreation during June through September, except that water contact is strongly discouraged in the vicinity of discharges or other conditions beyond the control of the Department or the Alabama Department of Public Health.

(d) Conditions related to other usage: the waters, under proper sanitary supervision by the controlling health authorities, will meet accepted standards of water quality for outdoor swimming places and will be considered satisfactory for swimming and other whole body water-contact sports.

Fecal Coliform Criteria:
Criteria for acceptable bacteria levels for the Fish and Wildlife use classification are described in ADEM Admin. Code R. 335-6-10-.09(5)(e)7.(i) and (ii) as follows:

(i) Bacteria of the fecal coliform group shall not exceed a geometric mean of 1,000/100 ml; nor exceed a maximum of 2,000/100 ml in any sample. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours.

(ii) For incidental water contact and recreation during June through September, the bacterial quality of water is acceptable when a sanitary survey by the controlling health authorities reveals no source of dangerous pollution and when the geometric mean fecal coliform organism density does not exceed 100/100 ml in coastal waters and 200/100 ml in other waters. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours. When the geometric mean fecal coliform organism density exceeds these levels, the bacterial water quality shall be considered acceptable only if a second detailed sanitary survey and evaluation discloses no significant public health risk in the use of the waters. Waters in the immediate vicinity of discharges of sewage or other wastes likely to contain bacteria harmful to humans, regardless of the degree of treatment afforded these wastes, are not acceptable for swimming or other whole body water-contact sports.

Criteria Exceeded:
Water quality data collected by the United States Geological Survey (USGS) from 1990 – 1996 (see Appendix B) was used by EPA Region IV for listing the stream on Alabama's 1996 §303(d) List. Waters in which less than or equal to 10% of the samples collected over a five year period exceed the single-sample maximum of 2000 colonies/100 ml or a geometric mean of 200 colonies/100 ml (June-September) or 1000 colonies/100 ml (October-May) in at least five samples collected in a thirty day period are considered to comply with Alabama's water quality standard for fecal coliform bacteria. Waters in

which greater than 10% of the samples exceed the single-sample maximum of 2000 colonies/100 ml or a geometric mean of 200 colonies/100 ml (June-September) or 1000 colonies/100 ml (October-May) in at least five samples collected in a thirty day period are considered impaired and listed for pathogens (fecal coliform) bacteria on Alabama's §303(d) list.

The USGS collected data at the following three stations on Juniper Creek between 1990 and 2001:

247994650	Juniper Creek at Jack William Road near Georgetown
2479947	Juniper Creek at Coleman Dairy Road near Wilmer
2479948	Juniper Creek at Glenwood Road near Fairview

The rationale EPA Region IV used to list this stream was based on data from station (USGS 02479948). EPA Region IV used five annual data sets between 1990-1996 for the months of June - September to calculate geometric means. EPA Region IV states that 4 of the 5 annual data sets violated the water quality standard. However, this is incorrect because the data sets used did not include five samples collected in a thirty day period as described in ADEM Admin. Code R. 335-6-10-.09(5)(e)7.(i) and (ii). Although the data does not indicate a violation of the geometric mean, 11% (7 out of 59) of the samples collected violated the single sample maximum water quality standard of 2000 col/100 ml, thus indicating that the stream is impaired.

3.0 TMDL Technical Basis

3.1 Water Quality Target Identification

For the purpose of this TMDL a fecal coliform target level of 180 colonies/100 ml will be used. This target level should not allow the geometric mean of 200 colonies/100 or the single sample maximum of 2000 colonies/100 ml to be exceeded.

3.2 Source Assessment

Point Sources in the Juniper Creek Watershed:

- There are no point sources in the Juniper Creek watershed. Any new discharges to this stream must meet a geometric mean discharge limit of 200 col/100 ml and an instantaneous maximum limit of 2000 col/100 ml for fecal coliform.

Nonpoint Sources in the Juniper Creek Watershed:

- Due to the absence of point sources, nonpoint sources are believed to be the source of fecal coliform bacteria in the Juniper Creek watershed. The land use in this watershed is 30% agriculture (pasture/hay and row crops), 66% forested, and 4% other.

- Agricultural land can be a source of fecal coliform bacteria. Runoff from pastures, animal operations, improper land application of animal wastes, and animals with

access to streams are all mechanisms that can introduce fecal coliform bacteria to waterbodies. Sources from agricultural lands are considered to be the primary source of fecal coliform in the Juniper Creek watershed. In this TMDL the load from agricultural land is considered the total from all the above mentioned agricultural sources. These different source loads will be better identified in the implementation phase of the TMDL.

- Fecal Coliform bacteria can also originate from forested areas due to the presence of wild animals such as deer, raccoons, turkeys, waterfowl, etc. Control of these sources is usually limited to land management BMPs and may be impracticable in most cases. As a result, forested areas are not specifically targeted in this TMDL.

- Leaking or failing septic systems can be another source of fecal coliform bacteria.

3.3 Land use

See Figure 1 for a map of land uses in the Juniper Creek watershed.

Landuse	Acres	Percentage of Total Watershed
Cropland	678	11.4%
Forest	3944	66.4%
High Commercial/Industrial/Transportation	3	0.0%
Low Residential	9	0.1%
Pasture	1094	18.4%
Transitional	207	3.5%
Water	1	0.0%
Total acres	**5936**	**100.0%**
Total square miles	9.28	
Breakdown of Major Landuse Categories		
Agriculture	1772	30%
Forest	3944	66%
Other	220	4%
Total	**5936**	**100.00%**

The detailed landuse for this sub-watershed was derived from EPA's Watershed Characterization System (WCS). The WCS is a software tool that provides a means to organize GIS and other existing data by user delineated watersheds. Land use information for this assessment was derived from the Alabama's Multiple Resolution Land Coverage (MRLC) 1990.

3.4 Linkage between Numeric Targets and Sources:

- The land uses in the Juniper Creek watershed indicate that the primary probable sources of fecal coliform bacteria are from forested and agricultural areas. A load from leaking septic systems was also estimated but was not significant.

- The loading from forested lands will be considered background conditions. The geometric mean fecal coliform concentrations in waterbodies flowing through forested areas in Alabama during all flow conditions will be assumed to be 50 colonies/100 ml. The 50 colonies/100 ml falls within the range reported by Schueler 1999, of 10 to 100 colonies/100 ml of fecal coliform from forested lands.

- The loading from leaking septic systems was calculated by estimating the number of people in the watershed on septic systems using 1997 census data derived from EPA's WCS. Then it was assumed there would be 2.5 people per septic tank and that 20% of the total septic systems in the watershed would leak or fail. The load from leaking septic systems was based on a rate of 70 gallons/person-day at a concentration of 1,000 counts/100 ml (Horsley and Witten, Inc., 1996).

- The loading from agricultural lands is calculated by subtracting forested lands load and the septic systems load from the total load.

3.5 Data Availability and Analysis:

The USGS collected data at the following three stations on Juniper Creek between 1990 and 2001:

247994650	Juniper Creek at Jack William Road near Georgetown
2479947	Juniper Creek at Coleman Dairy Road near Wilmer
2479948	Juniper Creek at Glenwood Road near Fairview

At stations 247994650 and 2479947 only one sample was taken at each station. Neither sample exceeded the single sample maximum water quality standard of 2000 col/100 ml.

At station 02479948 fifty nine fecal coliform samples were taken. 11% of the samples (7 out of 59) exceeded the single-sample maximum fecal coliform criterion.

In 2001 ADEM sampled Juniper Creek under Alabama's §303(d) monitoring program at the following two locations.

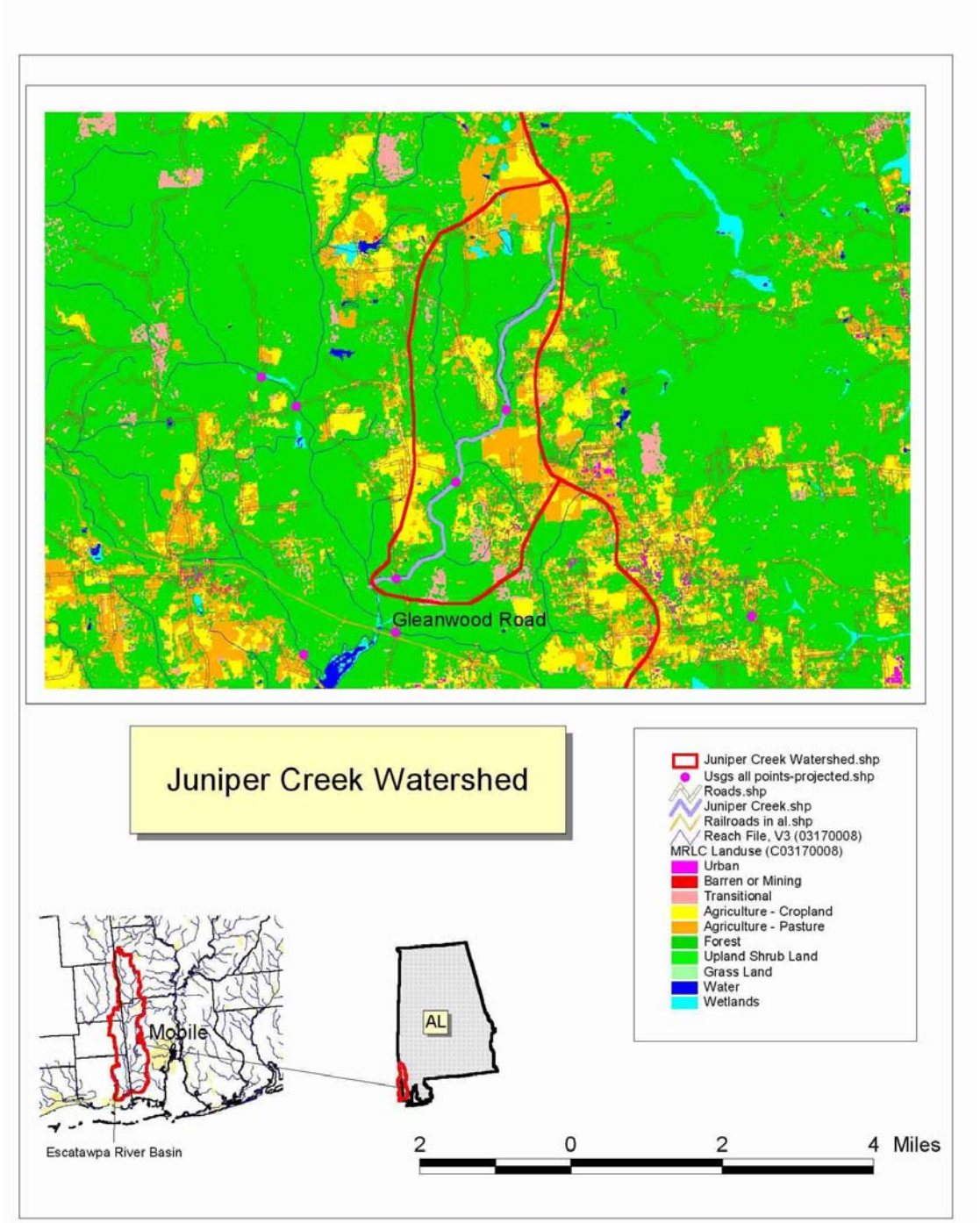
JNCM-001	Juniper Creek at Glenwood Rd. east of Wilmer.
JNCM-002	Juniper Creek at Coleman Dairy Road.

At each station (JNCM-001 & JNCM-002) eleven fecal coliform samples were taken. No sample exceeded the single sample maximum criterion. These samples were taken in intervals such that two geometric mean sets could be calculated for each station to compare to the 30 day geomean criterion. One set of geometric means for each station

was collected in October and November. Neither set exceeded the criteria of 1,000 counts/100 ml. The other set of geometric means was collected in May and June splitting the months of the two different criteria. Both of these were below the 1,000 counts/100 ml but exceeded the 200 counts/100 ml. Due to the specific way the criteria is written (June-September) the exceedence of the 200 counts/100 ml is not considered a violation since all the samples were not collected between (June-September).

See appendix for data results and Figure-2 for locations of samples.

Figure-1 Stream location and Land Use



3.6 Critical Conditions:

- Normally summer months (May – October) are generally considered critical conditions. This can be explained by the nature of storm events in the summer versus the winter. Periods of dry weather interspersed with thunderstorms allow for the accumulation and washing off of fecal coliform bacteria into streams, resulting in spikes of fecal coliform bacteria counts. In winter, frequent low intensity rain events are more typical and do not allow for the build-up of fecal coliform bacteria on the land surface, resulting in a more uniform loading rate.

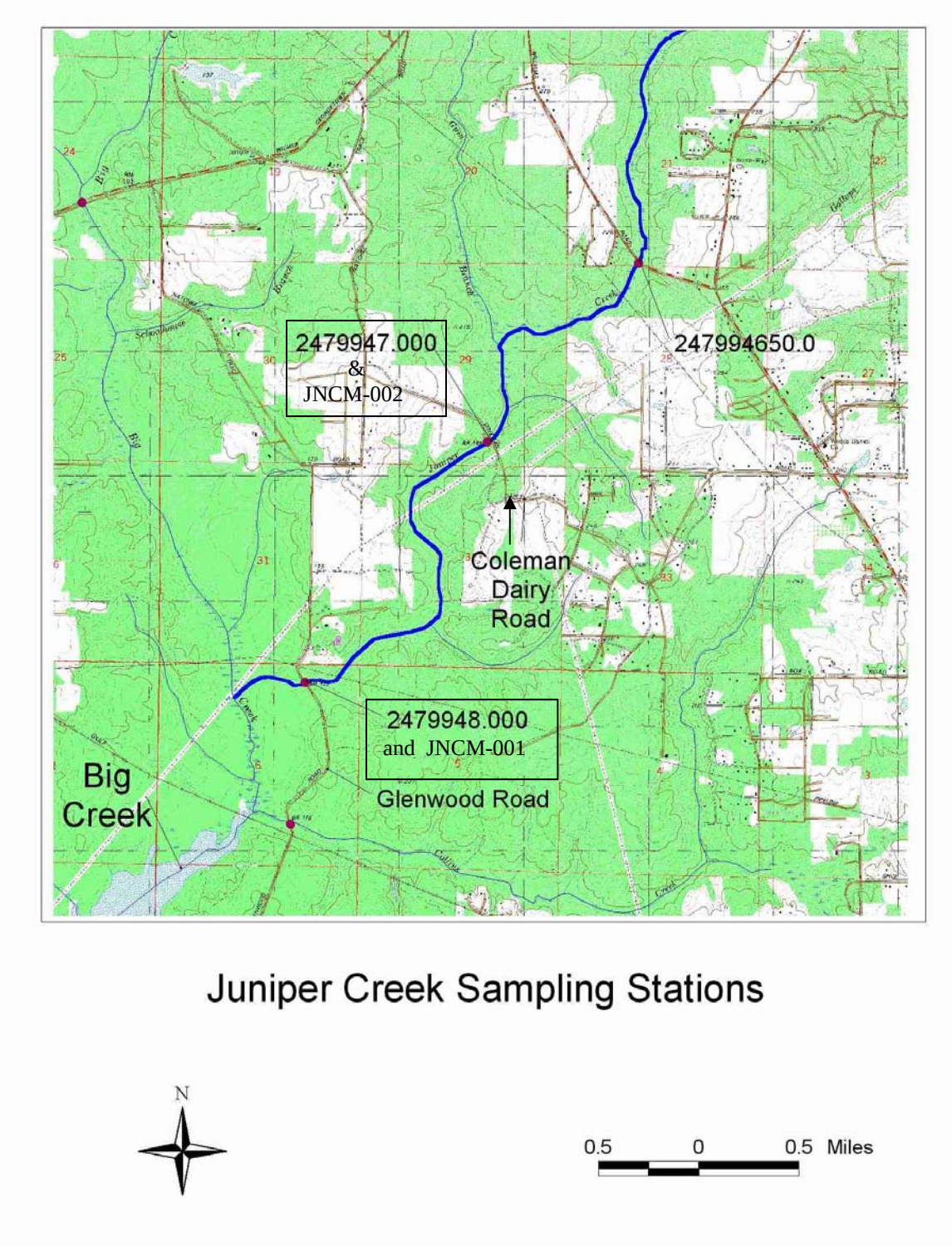
- With the Juniper Creek watershed the above does not appear from available data to hold true. A higher geometric mean is calculated using all the data (year round) than just for (May – October). Therefore all data (year round) was used to calculate a geometric mean for the loading calculations.

3.7 Margin of Safety (MOS):

- There are two basic methods of incorporating the MOS (USEPA, 1991): 1) implicitly using conservative model assumptions, or 2) explicitly specify a portion of the total TMDL as the MOS.

- An explicit MOS was incorporated in this TMDL. The explicit MOS includes the uncertainty of the fecal coliform data used in this analysis and the uncertainty of selecting an appropriate critical condition from the existing fecal coliform loads. A margin of safety was applied to the TMDL by reducing the criterion concentration by ten percent and calculating a load duration target with measured flow data. For the instantaneous criterion, a target concentration of 1,800 counts per 100mL was used instead of 2,000 counts per 100mL. The winter and summer geometric mean criteria were also reduced by ten percent to achieve the target concentrations of 900 and 180 counts per 100mL, respectively.

Figure 2 Sampling locations



4.0 TMDL

4.1 TMDL Development:

Total maximum daily loads (TMDLs) are the sum of individual wasteload allocations for point sources (WLAs), load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS). The margin of safety can be included either explicitly or implicitly and accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. A TMDL can be denoted by the equation:

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody while achieving water quality standards.

For some pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). For bacteria, however, TMDLs are expressed in terms of organism counts (or resulting concentration), in accordance with 40 CFR 130.2(l).

4.2 Load Calculations:

A loading curve approach was applied to develop the fecal coliform TMDLs for Juniper Creek. This approach utilizes existing fecal coliform and flow data in the watershed to calculate load duration curves to develop the TMDL.

The TMDL Curve is simply the flow multiplied by the instream criterion. Figure 4-1 shows the loading curve for the single sample maximum 2000 col/100 ml criteria that would be applicable to the designated use on Juniper Creek. In this analysis, the flow was measured during each sampling event and was ranked as an exceedance probability. The exceedance probability would indicate the percentage of time in days that the flow (or load) is exceeded. This is a useful technique in examining loading events because it shows the load magnitude and also reveals the corresponding hydrological event. Therefore, since the load is the measured flow multiplied by the instream fecal coliform criteria, the instream fecal coliform load is compared to the TMDL for that particular flow event.

As can be seen from the loading curve, all exceedances of the criteria are at high flow events which is indicative of non-point sources of fecal coliform being delivered to the stream during storm events. The loading curve was used to determine the critical conditions. The critical condition was determined by removing the existing loads in the 0-10% and 90-100% load exceedance ranges. Essentially, removing the high and low flow periods. Following EPA Region IV's guidance on determining critical conditions and by disregarding extreme flow conditions for the allocations, the load exceedance ranges from 10-90% were examined. The largest existing load in this range was used to calculate reductions for the stream. The sample that caused this load was collected on

01/07/97 with a fecal coliform concentration of 3000 col/100 ml and a flow of 45 cfs. From this the TMDL and load reductions were calculated as shown in Table 4.2.

Table - 4.1

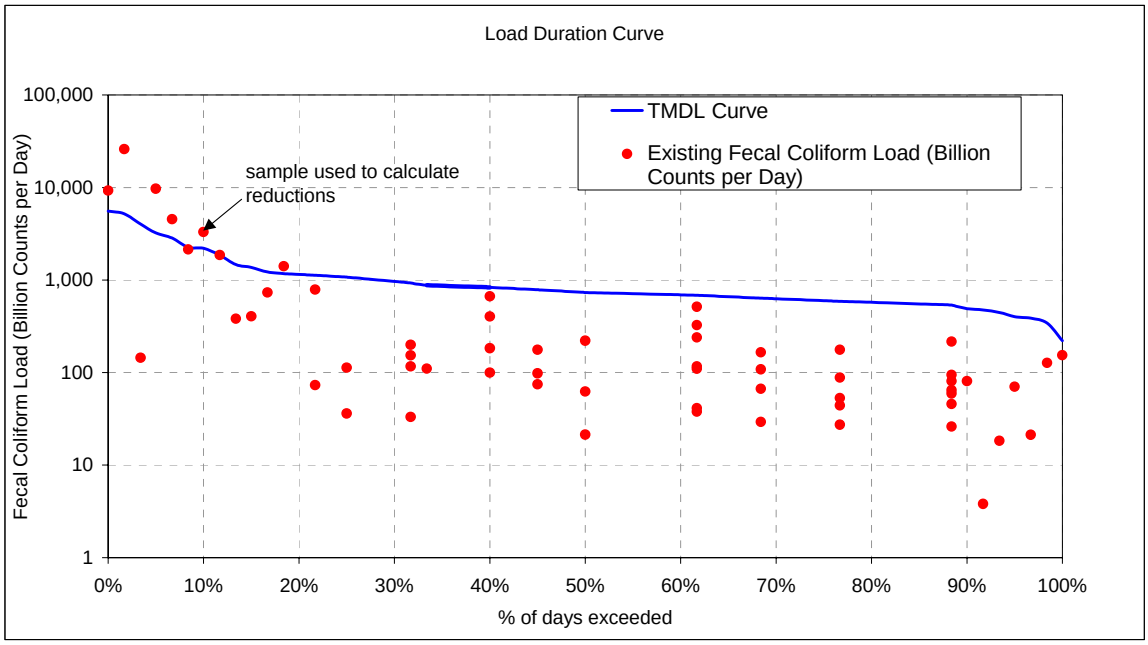


Table 4.2

Load calculation compared to the maximum criteria of "2000 col/100 ml" for Juniper Creek

Flow measured for sample used to calculate recductions:	45.0 cfs	
Max. fecal coliform concentration measured:	3000 col/100 mL	
Allowable fecal coliform maximum concentration minus MOS:	1800 col/100mL	=2000 - 10%
Margin of saftey for the maximum criteria	200 col/100mL	=10% of criteria

Load Calculations:

Load = Fecal Coliform * measured flow * Conversion Factor

Load in col of Fecal Coliform/day

Fecal Coliform in col/100 mL

Measured Flow in cfs

Conversion Factor = 24468984 (ml-s/ft3-day)

Current Load:				conversion		flow		concentration
The current total load:	3.30E+12	col/day	---------->	24468984	*	45.0	*	3000
Point source	0.00E+00	col/day	there are no point sources in this watershed					

Allowable Load:				conversion		flow		concentration
Allowable total load:	1.98E+12	col/day	---------->	24468984	*	45.0	*	1800
Point source	0.00E+00	col/day	There are no point sources in this watershed					

Margin of Saftey				conversion		flow		concentration
MOS load =	2.20E+11	col/day	---------->	24468984	*	45.0	*	200

Source	Current Load (col/day)	Allowable Load (col/day)	Required Reduction (col/day)	Reduction %	Final Load (col/day)
NPS load	3.30E+12	1.98E+12	1.32E+12	40%	1.98E+12
Point Source	0.00E+00	0.00E+00	0.00E+00	0%	0.00E+00

TMDL = WLA + LA + MOS

TMDL	WLA	LA	MOS
2.20E+12	0.00E+00	1.98E+12	2.20E+11

Percent Reduction to Achieve the Fecal Coliform Standard:

Total reduction: 40% = (current load - allowable load) / current load

The following assumptions are made for calculating the allowable load.

The water quality criteria for fecal coliform for single samples is 2000 col/100 mL.

To account for a Margin of Safety (MOS)an explicit target concentration of 1800 col/100 ml was used to calculate the allowable load compared to the maximum criteria which = 2000- 10%

4.3 TMDL Implementation:

Juniper Creek is impaired solely by nonpoint sources. For 303(d) listed waters impaired solely or primarily by nonpoint source (NPS) pollutants, necessary reductions will be sought during TMDL implementation using a phased approach. Voluntary, incentive-based mechanisms will be used to implement NPS management measures in order to assure that measurable reductions in pollutant loadings can be achieved for the targeted impaired water. Cooperation and active participation by the general public and various industry, business, and environmental groups is critical to successful implementation of TMDLs. Local citizen-led and implemented management measures offer the most efficient and comprehensive avenue for reduction of loading rates from Nonpoint sources. Therefore, TMDL implementation activities will be coordinated through interaction with local entities in conjunction with Clean Water Partnership efforts.

The primary TMDL implementation mechanism used will employ concurrent education and outreach, training, technology transfer, and technical assistance with incentive-based pollutant management measures. The ADEM Office of Education and Outreach (OEO) will assist in the implementation of TMDLs in cooperation with public and private stakeholders. Planning and oversight will be provided by or coordinated with the Alabama Department of Environmental Management's (ADEM) Section 319 Nonpoint source grant program in conjunction with other local, state, and federal resource management and protection programs and authorities. The CWA Section 319 grant program may provide limited funding to specifically ascertain NPS pollution sources and causes, identify and coordinate management programs and resources, present education and outreach opportunities, promote pollution prevention, and implement needed management measures to restore impaired waters.

Depending on the pollutant of concern, resources for corrective actions may be provided, as applicable, by the Alabama Cooperative Extension System (education and outreach); the USDA-Natural Resources Conservation Service (NRCS) (technical assistance) and Farm Services Agency (FSA) (federal cost-share funding); and the Alabama Soil and Water Conservation Committee (state agricultural cost share funding and management measure implementation assistance) through local Soil and Water Conservation Districts, or Resource Conservation and Development Councils (funding, project implementation, and coordination). Additional assistance from such agencies as the Alabama Department of Public Health (septic systems), Alabama Department of Agriculture and Industries (pesticides), and the Alabama Department of Industrial Relations and Dept of Interior - Office of Surface Mining (abandoned minelands), Natural Heritage Program and US Fish and Wildlife Service (threatened and endangered species), may also provide practical TMDL implementation delivery systems, programs, and information. Landuse and urban sprawl issues will be addressed through the Nonpoint Source for Municipal Officials (NEMO) education and outreach program. Memorandums of Agreements (MOAs) may be used as a tool to formally define roles and responsibilities.

Additional public/private assistance is available through the Alabama Clean Water Partnership (CWP) Program. The CWP program uses a local citizen-based

environmental protection approach to coordinate efforts to restore and protect the state's resources in accordance with the goals of the Clean Water Act. Interaction with the state or river basin specific CWP will facilitate TMDL implementation by providing improved and timely communication and information exchange between community-based groups, units of government, industry, special interest groups, and individuals. The CWP can assist local entities to plan, develop, and coordinate restoration strategies that holistically meet multiple needs, eliminate duplication of efforts, and allow for effective and efficient use of available resources to restore the impaired waterbody or watershed.

Other mechanisms that are available and may be used during implementation of this TMDL include local regulations or ordinances related to zoning, land use, or storm water runoff controls. Local governments can provide funding assistance through general revenues, bond issuance, special taxes, utility fees, and impact fees. If applicable, reductions from point sources will be addressed by the NPDES permit program. The Alabama Water Pollution Control Act empowers ADEM to monitor water quality, issue permits, conduct inspections, and pursue enforcement of discharge activities and conditions that threaten water quality. In addition to traditional "end-of-pipe" discharges, the ADEM NPDES permit program addresses animal feeding operations and land application of animal wastes. For certain water quality improvement projects, the State Clean Water Revolving Fund (SRF) can provide low interest loans to local governments.

Long-term physical, chemical, and biological improvements in water quality will be used to measure TMDL implementation success. As may be indicated by further evaluation of stream water quality, the effectiveness of implemented management may necessitate revisions of this TMDL. The ADEM will continue to monitor water quality according to the rotational river basin monitoring schedule as allowed by resources. In addition, assessments may include local citizen-volunteer monitoring through the Alabama Water Watch Program and/or data collected by agencies, universities, or other entities using standardized monitoring and assessment methodologies. Core management measures will include but not be limited to water quality improvements and designated use support, preserving and enhancing public health, enhancing ecosystems, pollution prevention and load reductions, implementation of NPS controls, and public awareness and attitude/behavior changes.

5.0 Public Participation

As part of the public participation process, this TMDL was be placed on public notice and made available for review and comment. The public notice was prepared and published in the four major daily newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL was made available on ADEM's Website: www.adem.state.al.us. The public can also request paper or electronic copies of the TMDL by contacting Mr. Chris Johnson at 334-271-7827 or clj@adem.state.al.us. The public was given an opportunity to review the TMDL and submit comments to the Department in writing. At the end of the public

review period, all written comments received during the public notice period became part of the administrative record. ADEM considered all comments received by the public prior to finalization of this TMDL and subsequent submission to EPA Region 4 for final review and approval.

Appendix A

References

United States Environmental Protection Agency. 1991. Guidance for Water Quality-Based Decisions: The TMDL Process, Office of Water, EPA 440/4-91-001.

USEPA. 2001. Protocol for Developing Pathogen TMDLs. EPA 841-R-00-001. U.S. Environmental Protection Agency, Office of Water, Washington DC.

Horsley & Witten, Inc.. 1996. Identification and evaluation of nutrient and bacterial loadings to Maquiot Bay, New Brunswick and Freeport, Maine. Final Report.

U.S. Geological Survey's (USGS) National Water Information System (NWIS)

Appendix B

USGS DATA				
			Fecal	
Station ID	Date	FLOW	Coliforms	
USGS #		cfs	(COL./ 100 ML)	
247994650	8/25/99	4.5	1400	
2479947	8/25/01	23	1400	
2479948	8/28/90	11	220	
2479948	10/4/90	11	300	
2479948	11/7/90	11	170	
2479948	12/5/90	12	180	
2479948	**1/10/91**	**66**	**6000**	
2479948	2/13/91	13	210	
2479948	3/6/91	22	210	
2479948	4/3/91	15	170	
2479948	5/8/91	82	72	
2479948	6/5/91	22	67	
2479948	7/9/91	19	71	
2479948	9/4/91	15	58	
2479948	10/2/91	14	120	
2479948	11/6/91	12	93	
2479948	12/4/91	16	250	
2479948	1/8/92	12	150	
2479948	2/4/92	14	110	
2479948	3/4/92	17	240	
2479948	5/7/92	11	97	
2479948	**6/3/92**	**38**	**2000**	
2479948	7/8/92	7.9	110	
2479948	8/5/92	9.1	82	
2479948	9/15/92	7	740	
2479948	10/7/92	8.2	350	
2479948	2/1/94	14	320	
2479948	5/19/94	11	240	
2479948	8/3/94	13	340	
2479948	11/2/94	9.7	16	
2479948	3/2/95	10	330	
2479948	5/24/95	13	92	
2479948	9/14/95	12	600	
2479948	1/24/96	25	1200	
2479948	3/13/96	19	250	
2479948	6/5/96	16	190	
2479948	8/6/96	18	250	
2479948	10/29/96	11	350	
2479948	11/21/96	13	520	
2479948	12/11/96	12	300	
2479948	**1/7/97**	**45**	**3000**	
2479948	2/27/97	46	1900	
2479948	3/18/97	14	950	
2479948	4/17/97	11	800	
2479948	5/22/97	17	970	
2479948	**6/25/97**	**106**	**10000**	
2479948	7/23/97	23	130	
2479948	8/13/97	30	520	
2479948	9/19/97	15	600	
2479948	**10/14/97**	**126**	**3000**	
2479948	11/20/97	17	440	
2479948	12/15/97	19	330	
2479948	**1/13/98**	**58**	**3200**	
2479948	**2/26/98**	**24**	**2400**	
2479948	3/18/98	28	590	
2479948	5/21/98	14	700	
2479948	6/24/98	14	1500	
2479948	9/3/98	14	340	
2479948	12/10/98	19	430	
2479948	2/24/99	16	450	
2479948	8/25/99	17	1600	
		22.3	**383**	
		Average	**Geomean**	
247994650	Juniper Creek at Jack Wiliams Road near Georgeto			
2479947	Juniper Creek at Coleman Dairy Road near Wilmer			
2479948	Juniper Creek at Glenwood Road near Fairview			

ADEM 303(d) Sampling Program			
Station Number	Date	Flow (cfs)	Fecal Coliform
JNCM-001	5/16/01	7.5	220
JNCM-001	5/21/01		320
JNCM-001	5/23/01		190
JNCM-001	5/30/01		120
JNCM-001	6/13/01	11.4	400
JNCM-001	6/14/01		490
		GEOMEAN	261
JNCM-001	10/11/01		340
JNCM-001	10/16/01		380
JNCM-001	10/31/01		94
JNCM-001	11/7/01		450
JNCM-001	11/8/01		160
		GEOMEAN	245
Station Number	Date	Flow (cfs)	Fecal Coliform
JNCM-002	5/16/01	4.7	250
JNCM-002	5/21/01		150
JNCM-002	5/23/01		210
JNCM-002	5/30/01		200
JNCM-002	6/13/01	7.1	460
JNCM-002	6/14/01		9300
		GEOMEAN	435
JNCM-002	10/11/01		260
JNCM-002	10/16/01		320
JNCM-002	10/31/01		230
JNCM-002	11/7/01		960
JNCM-002	11/8/01		250
		GEOMEAN	341

JNCM-001	**Juniper Creek at Glenwood Rd. east of Wilmer.**
JNCM-002	**Juniper Creek at Coleman Dairy Road.**