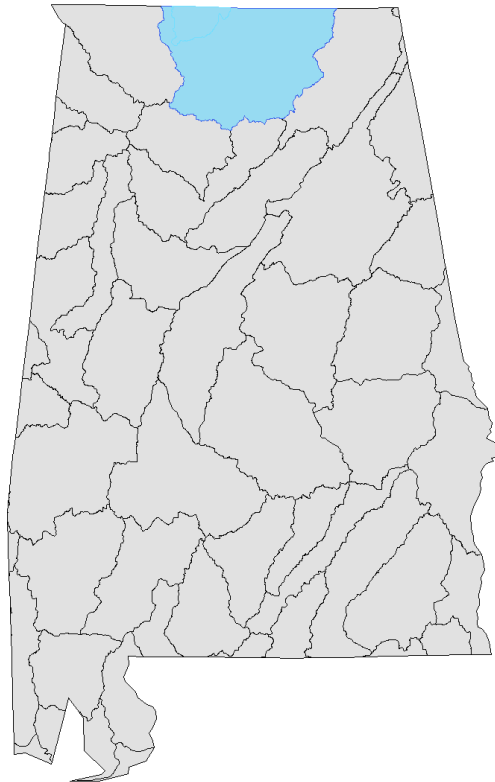


**FINAL DRAFT
WATERSHED PLAN**
for the
Middle Tennessee River Valley Watershed
of the
**Cullman, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall, and Morgan
Counties, Alabama**



United States Department of Agriculture, Natural Resources Conservation Service - Lead
Federal Agency in cooperation with the Alabama Soil and Water Conservation
Committee

Prepared by Auburn University with University of Alabama at Huntsville

Updated: August 2019

Final Watershed Plan-Environmental Assessment
for the Middle Tennessee River Valley Watershed of the
Cullman, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall, and Morgan Counties,
Alabama

Prepared by the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Alabama in cooperation with the Sponsoring Local Organization (SLO), Alabama Soil and Water Conservation Committee (ASWCC)

Authority: The Watershed Plan-Environmental Assessment (Plan-EA) has been prepared under the Authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566) as amended and supplemented. The Plan-EA was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, Public Law 91-190, (42 United States Code [U.S.C.] 43221 et seq.).

Abstract: This document is intended to fulfill requirements of the NEPA and to be considered for authorization of Public Law 83-566 (PL-566) funding for irrigation expansion within the Middle Tennessee River Valley Watershed Area. The project seeks to help modernize agricultural production and land use by providing localized sustainable water management across approximately 25,650 acres in this watershed. Rather than predetermining a specific site location, this plan evaluates a large area comprised of 665,758 acres of existing farmland potentially suitable for project implementation. The SLO will use information provided in this Plan-EA to effectively identify ideal cost-share implementation sites. Once project site locations are identified, onsite Environmental Evaluations (EE) will be carried out by authorized NRCS personnel and tiered from this Plan-EA using Form NRCS-CPA-52, Environmental Evaluation Worksheet. Total estimated project costs are \$37,133,000. Of this, \$20,794,000 is the estimated amount to be paid through NRCS PL-566 funds and \$16,339,000 would be paid as cost-share by the project participants. The projected benefit to cost ratio equates to 1.23.

Comments and Inquiries: The NRCS completed this Final Plan-EA in accordance with the NEPA and NRCS guidelines and standards. Comments should be provided to the NRCS during the allotted review period.

To submit comments, send an email to vernon.abney@al.usda.gov or via U.S. Mail to:

NRCS Alabama State Office
Attention: Vernon Abney, State Conservation Engineer
3381 Skyway Dr., Auburn, AL 36830-6443

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Middle Tennessee River Valley Watershed Plan Agreement

between the
Alabama Soil and Water Conservation Committee
(Referred to herein as Sponsors)

and the

**UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE**
(Referred to herein as NRCS)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsors for assistance in preparing a plan for works of improvement for the Middle Tennessee River Valley Watershed, State of Alabama, under the authority of the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Sections 1001 to 1008, 1010, and 1012); and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, has been assigned by the Secretary of Agriculture to NRCS; and

Whereas, there has been developed through the cooperative efforts of the Sponsors and NRCS a watershed project plan and environmental assessment for works of improvement for the Middle Tennessee River Valley Watershed, State of Alabama, hereinafter referred to as the watershed project plan or plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through NRCS, and the Sponsors hereby agree on this watershed project plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this plan and including the following:

7. **Term.** The term of this agreement is for the installation period and evaluated life of the project (27 years) and does not commit NRCS to assistance of any kind beyond the end of the evaluated life.
8. **Costs.** The costs shown in this plan are preliminary estimates. Final costs to be borne by the parties hereto will be the actual costs incurred in the installation of works of improvement.
9. **Real property.** The sponsors will acquire such real property as will be needed in connection with the works of improvement. The amounts and percentages of the real property acquisition costs to be borne by the Sponsors and NRCS are as shown in the Cost-share table in item 5 hereof.
10. The sponsors agrees that all land acquired for measures, other than land treatment practices, with financial or credit assistance under this agreement will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement
11. **Uniform Relocation Assistance and Real Property Acquisition Policies Act.** The sponsors hereby agrees to comply with all of the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. Section 4601 et seq. as further implemented through regulations in 49 CFR Part 24 and 7 CFR Part 21) when acquiring real property interests for this federally assisted project. If the sponsors are legally unable to comply with the real property acquisition requirements, it agrees that, before any Federal financial assistance is furnished, it will provide a statement to that effect, supported by an opinion of the chief legal officer of the state containing a full discussion of the facts and law involved. This statement may be accepted as constituting compliance.

5. **Cost-share for Watershed Work Plan.** The following table shows cost-share percentages and amounts for Watershed Work Plan implementation.

Cost-share Table for Watershed Operation or Rehabilitation Projects					
Works of Improvement Cost-Shareable Items	NRCS		Sponsors		Total
	Percent	Cost	Percent	Cost	Cost
Agriculture Water Management	54.5	\$9,810,000	45.5	\$8,190,000	\$18,000,000
Subtotal: Cost-Shareable Costs	54.5	\$9,810,000	45.5	\$8,190,000	\$18,000,000
Non-Cost-Shareable Items ^{1/}					
NRCS Technical Assistance/Engineering	100	\$3,000,000			\$3,000,000
Project Administration ^{2/}					
Non-Project Costs					
Subtotal: Non-Cost-Share Costs	100	\$3,000,000			\$3,000,000
Total:	61	\$12,810,000	39	\$8,190,000	\$21,000,000

1/ If actual non-cost-shareable item expenditures vary from these figures, the responsible party will bear the change.

2/ The sponsors and NRCS will each bear the costs of project administration that each incurs. Sponsor costs for project administration include relocation assistance advisory service.

6. **Land treatment agreements.** The sponsors will obtain agreements from owners of not less than 50 percent of the land above each multiple-purpose and floodwater-retarding structure. These agreements must provide that the owners will carry out farm or ranch conservation plans on their land. The sponsors will ensure that 50 percent of the land upstream of any retention reservoir site is adequately protected before construction of the dam. The sponsors will provide assistance to landowners and operators to ensure the installation of the land treatment measures shown in the watershed project plan. The sponsors will encourage landowners and operators to continue to operate and maintain the land treatment measures after the long-term contracts expire, for the protection and improvement of the watershed.
7. **Floodplain Management.** Before construction of any project for flood prevention, the sponsors must agree to participate in and comply with applicable Federal floodplain management and flood insurance programs. The sponsor is required to have development controls in place below low and significant hazard dams prior to NRCS or the sponsor entering into a construction contract.
8. **Water and mineral rights.** The sponsors will acquire or provide assurance that landowners or resource users have acquired such water, mineral, or other natural resources rights pursuant to State law as may be needed in the installation and operation of the works of improvement.
9. **Permits.** The sponsors will obtain and bear the cost for all necessary Federal, State, and local permits required by law, ordinance, or regulation for installation of the works of improvement.
10. **NRCS assistance.** This agreement is not a fund-obligating document. Financial and other assistance to be furnished by NRCS in carrying out the plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.
11. **Additional agreements.** A separate agreement will be entered into between NRCS and the sponsors before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
12. **Amendments.** This plan may be amended or revised only by mutual agreement of the parties hereto, except that NRCS may deauthorize or terminate funding at any time it determines that the sponsors have failed to comply with the conditions of this agreement or when the program funding or authority expires. In this case, NRCS must promptly notify the sponsors in writing of the determination and the reasons for the deauthorization of project funding, together with the effective date. Payments made to the sponsors or

- recoveries by NRCS must be in accordance with the legal rights and liabilities of the parties when project funding has been deauthorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between NRCS and the sponsors having specific responsibilities for the measure involved.
13. **Prohibitions.** No member of or delegate to Congress, or resident commissioner, may be admitted to any share or part of this plan, or to any benefit that may arise therefrom; but this provision may not be construed to extend to this agreement if made with a corporation for its general benefit.
 14. **Operation and Maintenance (O&M).** The sponsors will be responsible for the operation, maintenance, and any needed replacement of the works of improvement by actually performing the work or arranging for such work, in accordance with an O&M Agreement. An O&M agreement will be entered into before Federal funds are obligated and will continue for the project life (5 years). Although the sponsors' responsibility to the Federal Government for O&M ends when the O&M agreement expires upon completion of the evaluated life of measures covered by the agreement, the sponsors acknowledge that continued liabilities and responsibilities associated with works of improvement may exist beyond the evaluated life.
 15. **Emergency Action Plan.** Prior to construction, the sponsors must prepare an Emergency Action Plan (EAP) for each dam or similar structure where failure may cause loss of life or as required by state and local regulations. The EAP must meet the minimum content specified in the NRCS Title 180, National Operation and Maintenance Manual (NOMM), Part 500, Subpart F, Section 500.52, and meet applicable State agency dam safety requirements. The NRCS will determine that an EAP is prepared prior to the execution of fund obligating documents for construction of the structure. EAPs must be reviewed and updated by the sponsors annually.
 16. **Nondiscrimination Provisions.** In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at [How to File a Program Discrimination Complaint](#) and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

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By signing this agreement the recipient assures the Department of Agriculture that the program or activities provided for under this agreement will be conducted in compliance with all applicable Federal civil rights laws, rules, regulations, and policies.
 17. **Certification Regarding Drug-Free Workplace Requirements (7 CFR Part 3021).** By signing this Watershed Agreement, the sponsors are providing the certification set out below. If it is later determined that the sponsors knowingly rendered a false certification, or otherwise violated the requirements of the Drug-Free Workplace Act, the NRCS, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

Controlled substance means a controlled substance in Schedules I through V of the Controlled Substances Act (21 U.S.C. Section 812) and as further defined by regulation (21 CFR Sections 1308.11 through 1308.15);

Conviction means a finding of guilt (including a plea of *nolo contendere*) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes;

Criminal drug statute means a Federal or non-Federal criminal statute involving the manufacturing, distribution, dispensing, use, or possession of any controlled substance;

Employee means the employee of a grantee directly engaged in the performance of work under a grant, including: (i) all direct charge employees; (ii) all indirect charge employees unless their impact or involvement is insignificant to the performance of the grant; and, (iii) temporary personnel and consultants who are directly engaged in the performance of work under the grant and who are on the grantee's payroll. This definition does not include workers not on the payroll of the grantee (e.g., volunteers, even if used to meet a matching requirement; consultants or independent contractors not on the grantees' payroll; or employees of subrecipients or subcontractors in covered workplaces).

Certification:

A. The sponsors certify that they will or will continue to provide a drug-free workplace by—

- (1) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition.
- (2) Establishing an ongoing drug-free awareness program to inform employees about—
 - (a) The danger of drug abuse in the workplace;
 - (b) The grantee's policy of maintaining a drug-free workplace;
 - (c) Any available drug counseling, rehabilitation, and employee assistance programs; and
 - (d) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace
- (3) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1).
- (4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee must—
 - (a) Abide by the terms of the statement; and
 - (b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction.
- (5) Notifying the NRCS in writing, within 10 calendar days after receiving notice under paragraph (4)(b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice must include the identification numbers of each affected grant.
- (6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4) (b), with respect to any employee who is so convicted—
 - (a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or
 - (b) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.
- (7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6).

B. The sponsors may provide a list of the sites for the performance of work done in connection with a specific project or other agreement.

C. Agencies will keep the original of all disclosure reports in the official files of the agency.

18. Certification Regarding Lobbying (7 CFR Part 3018) (for projects > \$100,000)

A. The sponsors certify to the best of their knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the sponsors, to any person for influencing or attempting to influence an officer or employee of an agency, Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned must complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The sponsors must require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients must certify and disclose accordingly.

B. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by U.S. Code, Title 31, Section 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

19. Certification Regarding Debarment, Suspension, and Other Responsibility Matters—Primary Covered Transactions (7 CFR Part 3017).

A. The sponsors certify to the best of their knowledge and belief, that they and their principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(2) Have not within a 3-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph A(2) of this certification; and

(4) Have not within a 3-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

B. Where the primary sponsor is unable to certify to any of the statements in this certification, such prospective participant must attach an explanation to this agreement.

20. Clean Air and Water Certification.

A. The project sponsoring organizations signatory to this agreement certify as follows:

(1) Any facility to be utilized in the performance of this proposed agreement is (____), is not (X) listed on the Environmental Protection Agency List of Violating Facilities.

(2) To promptly notify the NRCS-State administrative officer prior to the signing of this agreement by NRCS, of the receipt of any communication from the Director, Office of Federal Activities, U.S. Environmental Protection Agency, indicating that any facility which is proposed for use under this agreement is under consideration to be listed on the Environmental Protection Agency List of Violating Facilities.

- (3) To include substantially this certification, including this subparagraph, in every nonexempt sub-agreement.

B. The project sponsoring organizations signatory to this agreement agrees as follows:

- (1) To comply with all the requirements of section 114 of the Clean Air Act as amended (42 U.S.C. Section 7414) and section 308 of the Federal Water Pollution Control Act (33 U.S.C. Section 1318), respectively, relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, issued there under before the signing of this agreement by NRCS.
- (2) That no portion of the work required by this agreement will be performed in facilities listed on the EPA List of Violating Facilities on the date when this agreement was signed by NRCS unless and until the EPA eliminates the name of such facility or facilities from such listing.
- (3) To use their best efforts to comply with clean air standards and clean water standards at the facilities in which the agreement is being performed.
- (4) To insert the substance of the provisions of this clause in any nonexempt subagreement.

C. The terms used in this clause have the following meanings:

- (1) The term "Air Act" means the Clean Air Act, as amended (42 U.S.C. Section 7401 et seq.).
- (2) The term "Water Act" means Federal Water Pollution Control Act, as amended (33 U.S.C. Section 1251 et seq.).
- (3) The term "clean air standards" means any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted pursuant to the Air Act or Executive Order 11738, an applicable implementation plan as described in section 110 of the Air Act (42 U.S.C. Section 7414) or an approved implementation procedure under section 112 of the Air Act (42 U.S.C. Section 7412).
- (4) The term "clean water standards" means any enforceable limitation, control, condition, prohibition, standards, or other requirement which is promulgated pursuant to the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. Section 1342), or by a local government to assure compliance with pretreatment regulations as required by section 307 of the Water Act (33 U.S.C. Section 1317).
- (5) The term "facility" means any building, plant, installation, structure, mine, vessel, or other floating craft, location or site of operations, owned, leased, or supervised by a sponsor, to be utilized in the performance of an agreement or subagreement. Where a location or site of operations contains or includes more than one building, plant, installation, or structure, the entire location will be deemed to be a facility except where the Director, Office of Federal Activities, Environmental Protection Agency, determines that independent facilities are collocated in one geographical area.

- 21. Assurances and Compliance.** As a condition of the grant or cooperative agreement, the sponsors assures and certifies that it is in compliance with and will comply in the course of the agreement with all applicable laws, regulations, Executive orders and other generally applicable requirements, including those set out below which are hereby incorporated in this agreement by reference, and such other statutory provisions as a specifically set forth herein.

State, Local, and Indian Tribal Governments: OMB Circular Nos. A-87, A-102, A-129, and A-133; and 7 CFR Parts 3015, 3016, 3017, 3018, 3021, and 3052.

Nonprofit Organizations, Hospitals, Institutions of Higher Learning: OMB Circular Nos. A-110, A-122, A-129, and A-133; and 7 CFR Parts 3015, 3017, 3018, 3019, 3021 and 3052.

- 22. Examination of Records.** The sponsors must give the NRCS or the Comptroller General, through any authorized representative, access to and the right to examine all records, books, papers, or documents

related to this agreement, and retain all records related to this agreement for a period of three years after completion of the terms of this agreement in accordance with the applicable OMB Circular.

23. Signatures.

NAME OF SPONSOR

The signing of this plan was authorized by a resolution by the Alabama Soil and Water Conservation Committee governing body and adopted at an official meeting held on

May 15, 2019 at Montgomery, AL

By:



Date: 05-15-2019

Alabama Soil and Water Conservation Committee
Charles Holmes, Chairman

USDA-NATURAL RESOURCES CONSERVATION SERVICE

Approved by:



Ben Malone, State Conservationist
Natural Resources Conservation Service
3381 Skyway Drive
Auburn, Alabama 36830-6443

Date: 5/15/19

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TABLE OF CONTENTS

COVER	1
ABSTRACT	2
WATERSHED AGREEMENT	3
TABLE OF CONTENTS	12
SUMMARY (OMB Fact Sheet)	19
INTRODUCTION	27
DECISION FRAMEWORK	28
PURPOSE AND NEED	29
Watershed Problems and Resource Concerns	29
SCOPE OF THE PLAN	30
AFFECTED ENVIRONMENT	38
Location	38
Surface Water	38
Topography	38
Hydrogeology	39
Geology and Soils	41
Climate	42
Socioeconomic Conditions	44
Environmental Justice	48
Land Use and Cover	49
Cultural Resources	51
Air Quality	51
Fish and Wildlife	51
Invasive Species	52
Wetlands	55
Threatened and Endangered Species	55
Natural Areas	56
Recreation	56
Floodplain Management	56
Prime Farmland/Important Agricultural Land	56
Water Quality	57
Public Health and Safety	58
Riparian Area	58
ALTERNATIVES	60
Formulation Process	60
Alternatives Eliminated from Detailed Study	60
Irrigation Districts and Expand Irrigation	60
Description of Alternative Plans	61
Alternative No. 1 – No Action/Future Without Project (No Federal Action Alternative)	61
Alternative No. 2 - Sustainable Irrigation Expansion Above Current Adoption	61
ENVIRONMENTAL CONSEQUENCES:	64

1. Effects of Alternative Plans	64
1.1 Soils	64
1.2 Air Quality	64
1.3 Water Resources	65
1.4 Land Cover/Land Use	73
1.5 Human Health & Safety	73
1.6 Wetlands	73
1.7 Historic and Cultural Resources	74
1.8 Fish, Wildlife, Plant Communities	74
1.9 Threatened and Endangered Species, Migratory Birds, and Invasive Species	75
1.10 Environmental Justice	75
1.11 Invasive Species	76
2. Cumulative Effects of Alternatives	76
3. Risk and Uncertainty	79
3.1 Engineering	79
3.2 Economics	79
4. Controversy	79
5. Precedent for Future Actions with Significant Impacts	79
6. Compliance with Federal, State and Local Laws	80
CONSULTATION, COORDINATION, AND PUBLIC PARTICIPATION	81
THE PREFERRED ALTERNATIVE	86
Rationale for Alternative Preference:	86
Measures to be Installed:	86
Mitigation Features:	87
Permits and Compliance:	88
Compliance with Local, State, and Federal Laws:	88
Economic Benefits-Costs for Preferred Alternative	88
Installation and Financing	92
Operation, Maintenance, and Replacement	95
REFERENCES	96
LIST OF PREPARERS	101
LIST OF REVIEWERS	102
DISTRIBUTION LIST	103
INDEX	104
APPENDIX A - Comments and Responses	108
APPENDIX B - Watershed Project Map	121
APPENDIX C - Supporting Maps	123
APPENDIX D - Investigation and Analysis Report	145
D.1 National Economic Development Analysis	146
D.2 Natural Resource Models and Results	166
APPENDIX E - Supporting Information	218

LIST OF TABLES

Table 1. Summary of Resource Concerns for the Middle TN River Valley Watershed - Irrigation Expansion Project	34
Table 2. Average Summer Surface Water Flows at Florence, Alabama USGS Gage (May-September)...	38
Table 3. Middle TN River Valley Aquifer Information.....	40
Table 4. Groundwater Monthly Budget Report for Project Watershed Area.....	40
Table 5. Groundwater Budget for Project Area minus Power Generation Withdrawals	41
Table 6. Socioeconomic Values for the Middle TN River Valley	44
Table 7. Farm Operator Demographics.....	47
Table 8. Land Use in the Middle Tennessee River Valley Watershed Area.....	49
Table 9. Current Irrigation Status of the Harvested Cropland - Values	49
Table 10. Agricultural Land Use Trends from 2007-2012 in the Middle TN River Valley	50
Table 11. List of Invasive Plant Species with the Middle TN River Valley Watershed Basin.....	52
Table 12. Economic Comparison of Reasonable Alternatives.....	63
Table 13. Agency and Public Consultation and Coordination Record Summary	83
Table 14. Economic Table 1-- Estimated Installation Cost	89
Table 15. Economic Table 2-- Estimated Cost Distribution Irrigation Equipment Investment.....	90
Table 16. Economic Table 4-- Estimated Average Annual NED Costs	90
Table 17. Economic Table 5a-- Estimated Average Annual Watershed Protection Damage Reduction Benefits	91
Table 18. Estimated Project Financing and Costs Middle Tennessee Watershed, 2019 Dollars.....	93
Table 19. Economic Table 1-- Estimated Installation Cost, Middle Tennessee River Valley Watershed	149
Table 20. Economic Table 2-- Estimated Cost Distribution Irrigation Equipment Investment.....	150
Table 21. Economic Table 4-- Estimated Average Annual NED Costs	151
Table 22. Irrigation Costs Per Acre for Various Systems.....	152
Table 23. Economic Table 5a-- Estimated Average Annual Watershed Protection Damage Reduction Benefits	153
Table 24. Economic Table 6-- Comparison of Average Annual NED Costs and Benefits	153
Table 25. Irrigated vs Non-irrigated comparison of net profits per acre.....	154
Table 26. Average Commodity Prices in Alabama by Year	155
Table 27. Proportional Average Damage Reduction Benefits Per Acre	155
Table 28. Irrigated Corn Enterprise Budget, 2019\$.....	158
Table 29. Non-Irrigated Corn Enterprise Budget, 2019\$.....	159
Table 30. Irrigated Cotton Enterprise Budget, 2019\$.....	160
Table 31. Non-irrigated Cotton Enterprise Budget, 2019\$	161
Table 32. Irrigated Soybeans Enterprise Budget, 2019\$.....	162
Table 33. Non-irrigated Soybean Enterprise Budget, 2019\$	163
Table 34. Irrigated Wheat Enterprise Budget, 2019\$	164
Table 35. Non-irrigated Wheat Enterprise Budget, 2019\$	165
Table 36. List of SRA Data Layers and Identified Sources.....	167
Table 37. SPARROW Model Results for Total Nitrogen Concentrations.....	169
Table 38. HUC-12 Acreage Water Quantity Analysis Results	179
Table 39. HUC-12 Irrigation Density Acreage Analysis	179
Table 40. Average Monthly Irrigation Demand: Current vs. Increased Irrigated Acreage Scenarios	188
Table 41. Surface Water Budget	195
Table 42. Current Irrigation Demand.....	196
Table 43. All Agricultural Land Irrigation Demand	196
Table 44. Watershed Withdrawal Budget	198

Table 45. Watershed Withdrawal Budget, excluding thermal power/cooling generation.	199
Table 46. Current Average Irrigation Demand as A Percentage of Total Recharge.....	200
Table 47. Threshold Irrigation Demand as A Percentage of Total Recharge	200
Table 48. All Agricultural Land Irrigation Demand as A Percentage of Total Recharge.....	201
Table 49. Crop Yield Statistics Combining Conservation Measures with Irrigation.....	202
Table 50. Return periods for PME for the period for Entire Year (at Various Thresholds)	208
Table 51. Return periods for PME for Entire Calendar Year (at Various Thresholds, with Number of Events)	208
Table 52. Return periods for PME for Growing Season Only (at Various Thresholds)	208
Table 53. Return periods for PME for Growing Season Only (with number of events).	208
Table 54. Input parameters for dust production calculations.....	210
Table 55. Pasquill-Gifford Stability Classes (after Turner 1970).	212
Table 56. Comparison of calculated and EPA standard concentrations.	212
Table 57. Input parameters for N ₂ O calculations.....	213
Table 58. Impact of increased fertilizer application with irrigation.....	214
Table 59. COMET-Farm Results. Rain-fed baseline and Irrigated Projection	215
Table 60. Summary of key variables in N ₂ O concentration calculation.	217
Table 61. Irrigation Practice Effects on T&E Species	238
Table 62. Consulting Entities Corresponding with Resource Concerns and Regulations	239
Table 63. Ranking Criteria List for Project Site / Farmer Application Prioritization	244

LIST OF FIGURES

Figure 1: ALFA Survey Respondent Count.....	31
Figure 2: ALFA Survey - Barrier to Irrigation	32
Figure 3: ALFA Survey - Cost-share Percent Desired to Invest in New Irrigation	32
Figure 4: Average monthly minimum and maximum temperatures: 1981-2010.....	42
Figure 5: Average monthly precipitation: 1981-2010.....	43
Figure 6: Cumulative distribution function for daily precipitation values: 1981-2010.	44
Figure 7: Current irrigation demand compared to OWR current and projected irrigation demand.	69
Figure 8: Irrigation demand with a 25% increase compared to OWR current and projected demand.....	70
Figure 9: Water Supply Stress Index plot for current and 25 percent irrigation demand	71
Figure 10: Watershed Project Map	122
Figure 11: Generalized Geology of the Project Area / Northern Alabama.....	124
Figure 12: Soil Capability Classification Map of the Project Area	125
Figure 13: Groundwater Map of the Middle TN River Valley Watershed Project Area	126
Figure 14: Congressional Districts Overlapping the Middle TN River Valley Watershed Basin	127
Figure 15: All Soil Types in the Project Area.....	128
Figure 16: Prime/Important Farmland in the Project Area	129
Figure 17: Map of T&E Crustacean Species in the Project Area.....	130
Figure 18: Map of T&E Fish Species in the Project Area	130
Figure 19: Map of T&E Mammal Species in the Project Area.....	131
Figure 20: Map of T&E Mussel Species in the Project Area.....	131
Figure 21: Map of T&E Plant Species in the Project Area.....	132
Figure 22: Map of T&E Reptile Species in the Project Area.....	132
Figure 23: Map of T&E Snail Species in the Project Area	133
Figure 24: Map of HUC-12 Watersheds Exceeding 10 % Irrigated Acreage Density of Surface Water in the Project Area	134

Figure 25: Flood Hazard Zones within the Project Area	135
Figure 26: Land Use in the Project Area.....	136
Figure 27: The Natural Areas within the Project Area	137
Figure 28: Topography in the Middle TN River Valley Watershed Project Area	138
Figure 29: Wetlands in the Project Area.....	139
Figure 30: Riparian Farmland in the Project Area.....	140
Figure 31: Historic Areas Listed on NRHP Within Middle TN River Valley Watershed Area	141
Figure 32: Cemeteries Listed on AHCR within Middle TN River Valley Watershed Area.....	142
Figure 33: Landmarks and Heritage Listed on ARLH within the Middle TN River Valley Watershed Area	143
Figure 34: All Named Cemeteries Within the Middle TN River Valley Watershed Area	144
Figure 35: SPARROW Model Scenario with Ten Percent Rainfed Agricultural Lands converted to Irrigated Agricultural Land - Total Nitrogen Concentrations by HUC-12	177
Figure 36: Cultivar calibration results for 2004-2009: DSSAT simulated yields compared to observed TVRC Variety Trial yields of DnyaGro 58K02.....	186
Figure 37: Cultivar evaluation results for 2000-2011: DSSAT simulated yields compared to observed TVRC and SMREC Variety Trial average yields.....	187
Figure 38: The WASSI comparison to the monthly data at the gage.....	189
Figure 39: Long-Term Average Monthly Irrigation Demand	190
Figure 40: OWR Assessment and Model for Reported Irrigation Demand.....	191
Figure 41: Center Pivot Average Monthly Demand	192
Figure 42: WaSSI Model Index with No Irrigation	193
Figure 43: WaSSI Model Index with Irrigation	193
Figure 44: Maximum Monthly WaSSI with/without Irrigation (+25%).....	194
Figure 45: Major Aquifers in the Middle TN River Valley Watershed.....	197
Figure 46: Crop Model Yields with Variable Organic Carbon.....	202
Figure 47: Average monthly minimum and maximum temperatures: 1981-2010.....	203
Figure 48: Average monthly precipitation: 1981-2010.....	204
Figure 49: Köppen-Geiger Climate Classification Map	204
Figure 50: Cumulative distribution function for daily precipitation values: 1981-2010.	205
Figure 51: Average monthly precipitation and WaSSI-derived evapotranspiration: 1916-2011.....	206
Figure 52: Average monthly precipitation minus WaSSI-derived evapotranspiration: 1916-2011.....	206
Figure 53: Probability of a return period for PME events: 1916-2011	209
Figure 54: Graph of emission components	216
Figure 55: MOU between the TVA and USDA.....	219
Figure 56: ALFA Farmer Survey	222
Figure 57: Sign-in Sheets for the October 23, 2018 Farmer Interest Meeting in Belle Mina, AL.....	226
Figure 58: Sign-in Sheets for the November 27, 2018 Farmer Listening Meeting in Moulton, AL.....	227
Figure 59: Affidavit for Announcement of Public Meeting.....	228
Figure 60: Agency Meeting Sign-In Sheet, January 22, 2019	229
Figure 61: Public Meeting Sign-In Sheet, January 22, 2019	230
Figure 62: Public Meeting Sign-In Sheet (#2), January 22, 2019.....	231
Figure 63: Agenda for Public Meeting, January 22	232
Figure 64: Fact Sheet Offered at Public Meeting (Page 1)	233
Figure 65: Fact Sheet Offered at Public Meeting (Page 2)	234
Figure 66: Invitation Letter to Cooperating Agencies – USCOE used as Example	235
Figure 67: E-mail Sent to Cooperating Agencies	236
Figure 68: Decision Diagram for Alabama NRCS Practice Effects on T&E Species	237
Figure 69: Invitations to the Deans of Agriculture at Land Grant Universities.....	240
Figure 70: Email Request to Alabama A&M University Dean of Agriculture.....	241

Figure 71: GSA Cooperating Agency Letter	242
Figure 72: OWR Cooperating Agency Letter	243
Figure 73: NRCS Conservation Practice Classification of Effects for Cultural Resources	245
Figure 74: Cultural Resources NRCS Review Form	246
Figure 75: NRCS CPA-52 Environmental Evaluation Worksheet (Page 1)	247
Figure 76: NRCS CPA-52 Environmental Evaluation Worksheet (Page 2)	248
Figure 77: NRCS CPA-52 Environmental Evaluation Worksheet (Page 3)	249
Figure 78: NRCS CPA-52 Environmental Evaluation Worksheet (Page 4)	250
Figure 79: NRCS CPA-52 Environmental Evaluation Worksheet	251
Figure 80: Alabama 303(d)-listed Streams within the Middle TN River Valley Watershed Area	252
Figure 81: HUC-12s within the Middle TN River Valley Watershed Area with 303(d)-listed streams...	253
Figure 82: HUC-12s 303(d)-listed for Agricultural Non-point Source Pollution within Project Area.....	254
Figure 83: Alabama 303(d)-listed Streams within the Project Area: Sourced from Agriculture.....	255
Figure 84: Stream Reaches in Project Area with Approved TMDLs	256

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Office of Management and Budget (OMB) Fact Sheet

Summary Watershed Plan-Environmental Assessment Document for the Middle Tennessee River Valley Watershed Cullman, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall, and Morgan Counties, Alabama Alabama 4th and 5th Congressional Districts	
Authorization	Public Law 83-566 Stat. 666 as amended (16 U.S.C. Section 1001 et seq.) 1954.
Lead Sponsor	Alabama Soil and Water Conservation Committee (ASWCC).
Proposed Action	The proposed action would utilize allocated PL-566 funds to irrigate 25,650 acres of existing non-irrigated agricultural land within the Middle Tennessee (TN) River Valley Watershed Area. This would support Alabama's agricultural land use, minimize negative effects caused by short-term drought in this watershed, and provide a sustainable approach to the area's agricultural production.
Purpose and Need	The purpose of this project is to develop, diffuse, or decentralized on farm irrigation systems suitable for the farming practices in the Middle TN River Valley that adhere to State and Federal law and sustainably use water systems. Implementation of the proposed action would satisfy PL-566 Authorized Project Purpose, Agricultural Water Management, through irrigation and agricultural water supply for the benefit of local landowners and communities. Federal assistance through PL-566 is needed to support the modernization of agricultural production and land use in this watershed by helping minimize crop losses due to drought, supplement soils with poor water holding capacity during periods of uneven rainfall distribution, improve recovery of water stressed systems, and support current agricultural land use.
Description of the Preferred Alternative	The project would support the sustainable expansion of irrigation within the watershed. Irrigated acreage within this watershed increased at an average of 1,425 acres per year from 2006-2015 (Handyside, 2017). The <i>SIE</i> Alternative is projected to double that rate (i.e., 2,850 acres per year) until available program funds are expended (approximately nine years). Depending on farmer application needs, this alternative will allocate funding for the development/additions to water delivery infrastructure at the farm level and/or provide irrigation application equipment.
Project Measures	<p>The five Irrigation Practices proposed for cost-share include Low Pressure Center Pivots, Micro-Irrigation, Linear/Lateral Irrigation, Tow/Traveler Irrigation, and Plasticulture. Power systems available for cost-share may include but are not limited to phased electricity and power units. The sources of water that will potentially be used for the diffused irrigation systems include surface stream and/or groundwater, depending on what sources are available at the specific site level.</p> <p>The type of irrigation infrastructure and necessary practices (i.e. pipes, pumps, power, application equipment, etc.) and water source selected will vary depending on specific site location and farmer project application needs.</p>

Resource Information			
Project Area			
Watersheds in Overall Project Basin	8-digit Hydrologic Unit Code		
Lower Elk	06030004		
Wheeler Lake	06030002		
Subwatersheds - 12-digit Hydrologic Unit Code (HUC-12)	Number of HUC-12 Watersheds Overlapping the Middle TN River Valley Watershed Area	HUC-12 Watersheds with Existing Agriculture	
	108	78	
Climate and Topography	The Project area is located in a warm temperate climate that is fully humid with hot summers. The average annual precipitation is 56 inches, with the maximum monthly value being in December with about 5.8 inches, and the minimum monthly value being in August with about 3.5 inches. The lowest minimum temperatures occur in December and January, with values just above and below 30 °F, respectively. The highest maximum temperatures occur in July and August with values approaching 90 °F. Topography is generally level to undulating. Elevation in the project area ranges from 505 to 1,863 feet.		
Land Use in the Middle TN River Valley Watershed (total 1,864,805 acres)	Use	Acres	Percentage of the Watershed
	Agriculture	689,348	37%
	Developed	222,633	12%
	Open Water	67,110	3.6%
	Wetlands	47,719	2.6%
	Forested Land	748,389	40%
	Shrubland	88,059	4.7%
	Barren	1,547	0.1%
Land Ownership in Alabama	Owner	Percentage	
	Private	92.9%	
	State-Local	7.1%	
Population and Demographics		Alabama	Middle TN River Valley Watershed
	Population	4,874,747	~930,000
	Population Below Poverty Rate	16.9%	15.9%
	Per Capita Income	\$40,805	\$38,437

Agricultural Production Land - Irrigation	Type	Acres	Percentage of Total Agricultural Land	
	Irrigated Land (center pivot)	24,325	3.5%	
	Non-Irrigated Land	665,022	96.5%	
Agricultural Production Demographics within Middle TN River Valley Watershed	Prime farmland in Project Area		707,220 acres	
	Farmland of Statewide Importance		367,487 acres	
	Change in Farmland Acreage from 2007-2012			-10%
	Change in number of Farms from 2007-2012			-12%
	Minority Operators			35.6%
	Full-time Operators (averaged)			44%
	Part-time Operators (averaged)			56%
Relevant Resource Concerns	Resource concerns identified through scoping are water conservation and quality, groundwater, threatened and endangered aquatic species, soil resources, cultural and historic resources, socioeconomics, and land use.			
Alternatives				
Alternatives Considered	Three alternatives were considered; one was eliminated from full analysis due to inconsistency with the purpose and need for action, inconsistency with PL 83-566 requirements, and due to cost, logistics, existing technology and regulations, and environmental reasons. The No Action Alternative and Sustainable Irrigation Expansion (<i>SIE</i>) above current Adoption Alternative were analyzed in full.			
No Action Alternative	Under the No Action Alternative, the increase of agricultural land under new irrigation may occur at approximately 1,425 acres per year, based on recent adoption trends within this watershed. However, funding is not presently available to meet the purpose of this project under existing programmatic regulations, and a constant rate of natural irrigation adoption is not certain. The need for the project would persist indefinitely, considering the lack of available cost-share for irrigation expansion. Current adoption trends are not likely to occur at a scale large enough to modernize the watershed’s agricultural land use and production as needed.			

Proposed Action	One action alternative was studied in more detail. Under the <i>SIE</i> Alternative, PL-566 funding will be offered as cost-share by the SLO to support the implementation of site-specific infrastructural needs to put currently dry production land under irrigation. Funding is available to meet farmer's needs for power, pumps, pipes, developing or expanding upon existing water sources, and the following five application equipment practices: low pressure center pivots, micro-irrigation, linear/lateral irrigation, tow/traveler irrigation, and Plasticulture. The funding provided will depend on project applications and requirements and will be capped at \$200,000 per individual producer. The <i>SIE</i> Alternative has been identified as the National Economic Development (NED) plan and is also the Preferred Alternative.					
Mitigation, Minimization, and Avoidance Measures	Expanding irrigation will increase withdrawals from both surface and groundwater sources. However, the volume of water use anticipated at the highest threshold is considered a minor use of the overall quantity of water available in the watershed. Avoiding overtaxing water supplies includes the promotion of a "distributed" expansion, avoiding concentrating irrigated acreage in particular HUC-12 sub-basins. Minimization measures include site selection criteria that promotes use of existing, underutilized water sources. Once a potential site has been identified for project implementation, the NRCS CPA-52 form will be tiered to this Plan and completed by authorized personnel. This evaluation will determine risks to riparian, wetland, fish and aquatic species, soil erosion, water quantity/quality, invasive species, cultural and historic sites while also determining any additional mitigation features necessary. Additionally, Alabama NRCS will utilize a clear matrix of irrigation practices in this evaluation, including a decision diagram, potential effects, and recommended courses of action to deal with T&E Species.					
Project costs	PL 83-566 funds		Other funds (Farmer Cost-Share)		Total	
Irrigation Equipment	\$19,570,950	54.5%	\$16,339,050	45.5%	\$35,910,000	(100%)
Engineering / Construction	Not applicable					
SUBTOTAL COSTS	\$19,570,950	54.5%	\$16,339,050	45.5%	\$35,910,000	(100%)
Technical assistance	\$1,223,184	100%	0		0	(100%)
Relocation	Not applicable					
Real property rights	Not applicable					
Project administration	Not applicable					
Permitting	Will be borne by the applicant if necessary					
Annual O&M	Will be borne by the applicant					
TOTAL COSTS	\$20,794,134	56%	\$16,339,050	44%	\$37,133,184	(100%)
Project Benefits						
Project Benefits	Implementation of the Preferred Alternative would improve crop production yields, water availability and reliability, and provide a holistic approach to agricultural water management in the Middle TN River Valley Watershed Area.					

Number of Direct Beneficiaries	The number of direct beneficiaries will depend on the number of entities that apply for program assistance and the amount of funding requested. Each applicant will be limited to \$200,000. Based on the average farm size within this watershed (150 acres) and estimated funding, up to approximately 60 farmers may receive direct project funding.	
Other Beneficial Effects-Physical Terms	Implementation of the Preferred Alternative would have minor to moderate, long-term, beneficial effects to agricultural water availability.	
Damage Reduction Benefits	Implementation of the Preferred Alternative would increase crop acreage profitability with irrigation. This provides approximately \$39,740,000 in total damage reduction benefit for an average annual equivalent of \$1,397,703.	
Total Quantified Benefits	\$39,740,405	
Benefit to Cost Ratio	1.23	
Installation Period (years)	9	
Useful life of Irrigation	20 years	
Period of Analysis	60 years	
Regional Economic Development Net Benefit	\$582,550	
Funding Schedule		
Year	Other Funds	Total
2019-2029	\$16,339,050	\$35,910,000
Environmental Effects		

Air Quality – The Preferred Alternative is anticipated to have a minor effect on air quality during installation due to construction dust generation. Based on previous research and model results, particulate matter concentrations resulting from concrete construction are anticipated to be well below the EPA standard for both 2.5 and 10.0 microns. The Preferred Alternative is anticipated to have negligible effect on air quality during operation. Increased NO_x emissions may result from increased fertilizer rates on existing farmland which are usually done in conjunction with irrigation. Based on the relatively small areas and increases in fertilizer relative to rainfed crops, the cumulative effects across the watershed are expected to be negligible. At the field level, expected fertilizer increases are anticipated to result in minor changes to air quality and will be well below the EPA threshold.

Cultural and Historic Resources – There are numerous historic and cultural resources throughout the watershed. Quantifying the potential impact on historic and cultural resources is difficult at the watershed level. For the Preferred Alternative, all available data concerning historic and cultural resources has been provided as guidance and overview as specific project sites are identified. After selection, the site will also undergo on-site evaluations as outlined in the Environmental Evaluation Worksheet (NRCS-CPA-52) and Alabama NRCS Cultural Resources Review form. Expanding Irrigation will involve following practices that may have subsequent actions based on the “Alabama NRCS Practice Effects on Cultural Resources” (see Appendix E, Table 73). Each of the project-approved practices results in a non-ground disturbing (“no effect”), “potentially ground disturbing, and/or “ground-disturbing”. Based on this tiered approach, the anticipated effects are expected to be negligible to minor. The on-site evaluation should ensure there are no here-to-fore unknown resources.

Fish and Aquatic Species – A variety of threatened and endangered fish and aquatic species exist in the watershed. Quantifying the potential impact on T&E species is difficult at the watershed level. For the Preferred Alternative, all available data concerning T&E species has been provided and will be used as guidance and overview as specific project sites are identified. After selection, each site will also undergo onsite evaluations as outlined in the Environmental Evaluation Worksheet (NRCS-CPA-52). Expanding irrigation will involve practices that may require site-specific consultation with the U.S. Fish & Wildlife Service based on the “Alabama NRCS Practice Effects on Threatened and Endangered Species” (see Appendix E, Table 61 and Figure 68). Each of the project-approved practices results in a “no effect”, “mitigating action”, and/or specific “on-farm consult”. Based on this approach, the anticipated effects are expected to be negligible to minor.

Geology & Soils – The Preferred Alternative will result in minor soil disturbance during the installation period. However, these effects will be short-term and localized to the irrigation installation site. Effects would be further minimized through implementation of soil stabilization measures during installation. The Preferred Alternative may result in increased runoff that could also carry sediment. Effects will be mitigated through NRCS conservation practices as part of the site selection process. Sites identified for implementation will also undergo onsite evaluations as outlined in the Environmental Evaluation Worksheet (NRCS-CPA-52) to identify and resolve additional mitigation measures required to reduce erosion. Anticipated effects are expected to be minor.

Land Cover/Land Use – The Preferred Alternative will have no effect on land use adjacent to the project area, as property ownership and existing use of land would not change. The project is designed to utilize existing farmland. The Preferred Alternative will encourage and promote continued agricultural land use in the watershed through the adoption of irrigation and minimization of risk of crop loss.

Public Safety and Human Health – The Preferred Alternative will result in safety risks during installation, operation, and maintenance of the system due to heavy equipment, high-voltage power and use of petroleum products. These risks will be mitigated through strict adherence to all local, state, and Federal rules concerning worker safety. Measures may include signage, lighting, and access control during and after construction.

Recreation – There will be negligible effects to land-based recreation from the Preferred Alternative. Effects to Conversion from rainfed to irrigated farmland may have minor positive impacts by increasing vegetation for wildlife that is considered beneficial for recreation. The anticipated changes to water quality and quantity are expected to be minor; therefore, impacts to recreation are anticipated to be minor.

Socioeconomics – The Preferred Alternative has an estimated annual RED benefit of \$582,550.

Vegetation – The Preferred Alternative will have negligible to minor positive effects on vegetation. Conversion of existing rainfed farmland to irrigated farmland may result in additional soil moisture for surrounding vegetation.

Visual Resources – The Preferred Alternative will have negligible to minor effect on the landscape. Existing farmland in the project area is not designated scenic and the irrigation features do not attract additional attention to the landscape.

Water Quantity – The Preferred Alternative will have minor effects on both the surface and groundwater supply. Currently there is approximately 24,000 irrigated acres in the watershed. Current irrigation demand from surface supplies in the watershed is less than one percent of the total streamflow. Current irrigation demand from groundwater supplies is also less than one percent of recharge rates across the watershed. Using conservative estimates as the threshold for the Preferred Alternative, the Watershed could support up to 180,000 irrigated acres. At that acreage, irrigation demand from surface water would still be less than one percent of total streamflow. Irrigation demand from groundwater would be approximately two percent of total annual recharge. The effects are anticipated to be minor. The Preferred Alternative may have localized impacts on smaller tributaries and watersheds within the project watershed. These effects will be mitigated by providing irrigated acreage density at the HUC-12 level to the NRCS and Sponsoring Local Organization during site selection. Promoting expanded irrigation in HUC-12s that have less than 10 percent of the overall drainage areas as irrigated acres is recommended to protect local water supplies and existing irrigation investments.

Water Quality - The Preferred Alternative is anticipated to have minor effects on both surface and groundwater quality. Water quality could be impacted by increased nutrient runoff into surface waters, increased turbidity due to sediment transport and/or biological productivity, or nutrient leaching into groundwater due to irrigation applied in excess of field capacity. If irrigation is applied using best management practices, negative impacts are not anticipated. Projections for increased nutrients carried by surface waters are minor assuming the soil moisture is maintained at or below field capacity. The Preferred Alternative may have localized impacts on smaller tributaries and watersheds within the project watershed. This will be mitigated by providing irrigated acreage density at the HUC-12 level to the NRCS and SLO during site selection. If a project site is selected in a HUC-12 with a TMDL present, the USDA-NRCS will adhere to ADEM's non-point source guidelines outlined in the Tennessee River Basin Watershed Management Plan (CWP & ADEM, 2003).

Wetlands, Flood Plains, Riparian Zones – The Preferred Alternative will have negligible impacts on Wetlands and Floodplains. Based on the minor changes to water quantity, there are no anticipated negative impacts to existing wetlands and floodplains. Sites identified for implementation will also undergo onsite evaluations as outlined in the Environmental Evaluation Worksheet (NRCS-CPA-52) to identify any potential localized risks to riparian zones and water supplies.

Wild and Scenic River - There would be no effects from the Preferred Alternative on the Wild and Scenic River or State Scenic Waterways designation. There are no Wild and Scenic Rivers in or directly downstream of the project watershed.

Major Conclusions	Implementation of the Preferred Alternative would support the modernization of agricultural production and land use in this watershed by helping minimize crop losses due to drought, supplement soils with poor water holding capacity during periods of uneven rainfall distribution, improve recovery of water stressed systems, and improve reliability of available water for farmers.
Areas of Controversy	There have been no areas of controversy identified.
Issues to be Resolved	None
Evidence of Unusual Congressional or Local Interest	None
Compliance	Is this report in compliance with executive orders, public laws, and other statutes governing the formulation of water resource projects? Yes <u> X </u> No <u> </u>

INTRODUCTION

Although the Southeast receives more annual rainfall than most of the United States (U.S.), it is still subject to periodic droughts, making the rainfall distribution throughout the year non-ideal for agricultural production (Limaye et al. 2004). Agriculture in the Middle Tennessee (TN) River Valley Watershed Area is further impacted because of relatively poor water holding soils and lack of widespread irrigation. As a result, this watershed has been considerably impacted by drought.

The Middle TN River Valley Watershed Area encompasses portions of Limestone, Marshall, Cullman, Morgan, Madison, Lawrence, Lauderdale, and Jackson Counties in the northern part of Alabama (AL). The boundary of the Middle TN River Valley Watershed encompasses one of the largest agricultural producing regions in the State. Not only is beef, dairy cattle, and poultry a large part of the production present, but row crop agriculture is also a dominant source of income for the area. Crops irrigated within these counties include soybean, cotton, corn, and specialty crops. Counties within this watershed ranked first, second, and third in the state for soybean production; first and second for corn production; and second and third for cotton production (ACES, 2013). Additionally, Cullman County is ranked second in the state for vegetable and melon production (ACES, 2013).

Due to the widespread need for improved development of water resources for agricultural uses and management in this watershed, the NRCS-AL is working with the Sponsoring Local Organization (SLO), AL Soil and Water Conservation Committee (ASWCC), to allocate funding for the diffused development of on-farm irrigation under Public Law 83-566 (PL-566). A Preliminary Investigation/Feasibility report determined that the project would be feasible and that an Environmental Assessment (EA)/Watershed Plan should be prepared to meet the purpose of agricultural water management within the Middle TN River Valley Watershed Area using PL-566 funds.

This proposed project examines the project area deductively, instead of the more commonly practiced inductive approach. Rather than pre-determining a specific site location, this plan evaluates a large area comprising 665,758 acres of existing farmland potentially suitable for expanding irrigation. The previous 250,000-acre maximum limit for PL-566 Watershed Plans was removed in 2018 as part of the "Consolidated Appropriations Act," section H.R. 1625-16. Defining sub-watersheds was not necessary nor requested by the sponsor. The SLO will use information provided in this document to effectively rank farmer cost-share applications and identify ideal project sites that benefit agriculture and have minimal impact to environmental and social resources. This ranking process selects for good stewardship and prioritizes the on-farm availability of water and power; higher ranking applicants will be considered for funding. A list of ranking questions can be found in Appendix E, Table 63. Alternatives were developed and evaluated based on the technical and financial viability to meet the purpose and needs of this project.

DECISION FRAMEWORK

This Watershed Plan-Environmental Assessment (Plan-EA) has been prepared to assess and disclose the potential effects of the proposed action. The Plan-EA is required to request federal funding through the Watershed Protection and Flood Prevention Program, PL-566, authorized by Congress in 1954. This program is managed by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Through this program, NRCS provides technical and financial assistance to project sponsors such as states, local governments, and tribes to plan and implement authorized watershed project plans for watershed protection; flood mitigation; water quality improvements; soil erosion reduction; rural, municipal, and industrial water supply; irrigation; water management; sediment control; fish and wildlife enhancement; and hydropower. NRCS is the lead federal agency for this Plan-EA and is responsible for review and issuance of a decision in accordance with the National Environmental Policy Act (NEPA).

NEPA requires that Environmental Impact Statements (EISs) are completed for projects using federal funds that affect the quality of the human and natural environment (individually or cumulatively). When a proposed project is not likely to result in major impacts requiring an EIS, but the activity has not been categorically excluded from NEPA, an agency can prepare an EA to assist them in determining whether an EIS is needed (see 40 Code of Federal Regulations [CFR] 1501.4 and 1508.9; 7 CFR 650.8).

For purposes of NEPA compliance, the intent of this Plan-EA is to provide a programmatic platform for the implementation of the proposed action. The ASWCC has partnered with NRCS to implement the *Sustainable Irrigation Expansion* Project within the Middle TN River Valley Watershed Area under the watershed authority of the PL-566 program.

NRCS has determined the need for a Plan-EA to implement the proposed action under PL-566 watershed authority. Due to the broad spatial scale of this analysis and the deductive planning approach, this Plan-EA does not identify the specific details associated with the engineering design and construction activities that would be required to implement the proposed action. Instead, this document intends to present an analysis in sufficient detail to allow implementation of a proposed action within the potential project area with minimal additional NEPA analysis.

Tiering is a staged approach to NEPA as described in the Council on Environmental Quality's Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500 to 1508). Broad programs and issues are described in initial analyses, while site-specific proposals and impacts are described in subsequent site-specific studies. The tiered process permits the lead agency to focus on issues that are ripe for decision and exclude from consideration issues already decided or not yet ripe. Tiering eliminates repetitive discussions of the same issues across site specific project groups through incorporation by reference of the general discussions.

Consistent with the tiering process as described above, before implementing each site-specific project, an onsite Environmental Evaluation (EE) review will occur using Form NRCS-CPA-52, Environmental Evaluation Worksheet. The EE process determines if a particular individual site and project meets applicable project specifications, and whether the site-specific environmental effects are consistent with those as described and developed in this Plan-EA. This process provides information for the Responsible Federal Official to determine if the proposed action has been

adequately analyzed, and if the conditions and environmental effects described in the Plan-EA are still valid. Where the impacts of the narrower project-specific action are adequately identified and analyzed in the broader NEPA document, no further analysis would occur, and the Plan-EA would be used for purposes of the pending action.

If it is determined that the Plan-EA is not sufficiently comprehensive, is not adequate to support further decisions, or if resource concerns or effects have not been adequately evaluated through the programmatic approach, either a separate site-specific supplemental EA will be prepared, or the funding will be allocated to a different project site.

This Plan-EA has been prepared in accordance with applicable Council on Environmental Quality's regulations for implementing NEPA (40 CFR 1500–1508), USDA NEPA regulations (7 CFR Part 650), NRCS Title 190 General Manual Part 410, and NRCS National Environmental Compliance Handbook Title 190 Part 610 (May 2016). The Plan-EA also meets the NRCS program policy of the 2015 NRCS National Watershed Program Manual (NWPM) and guidance of the 2014 NRCS National Watershed Program Handbook. This Plan-EA serves to fulfill the NEPA and NRCS environmental review requirements for the proposed action.

PURPOSE AND NEED

The purpose of this project is to develop, diffuse, or decentralized on-farm irrigation systems suitable for the farming practices in the Middle TN River Valley that adhere to State and Federal law and sustainably use water systems. Implementation of the proposed action would satisfy PL-566 Authorized Project Purpose, Agricultural Water Management, through irrigation and agricultural water supply for the benefit of local landowners and communities. Federal assistance through PL-566 is needed to support the modernization of agricultural production in this watershed by helping minimize crop losses due to drought, supplement soils with poor water holding capacity during periods of uneven rainfall distribution, improve recovery of water stressed systems, and support current agricultural land use.

Watershed Problems and Resource Concerns

The Middle TN River Valley Watershed has been impacted physically and economically by periodic droughts, uneven annual rainfall distribution, and relatively poor water holding soils with a lack of widespread irrigation (McNider et al. 2015; Limaye et al. 2004). Alabama crop insurers paid \$36.7 million in 2017 to cover crop losses (NCIS, 2018). The averaged crop insurance indemnities for corn, soybean, wheat, and cotton crop losses occurring within the Middle TN River Valley Watershed between the years 2007-2017 equaled to \$15,668,738. These crop insurance claims are primarily associated with drought and unfavorable climate conditions during the growing season in this watershed. The growing season, defined as April-September, correlates with the highest maximum temperatures and lowest minimum precipitation values experienced in this region of Alabama. Thus, significant evapotranspiration occurs, and prime, rain-fed agricultural cropland suffers. The need for irrigation is expected to increase as the climate continues to harshen and the demand to feed a growing population continues. Therefore, the need to increase on-farm irrigation exists and must be addressed to ensure that this watershed can manage drought stresses effectively and bolster the resilience of U.S. agricultural productivity in the uncertainty of climate variability.

As the most concentrated row crop producing area in Alabama (Mitchell, 2016), federally supporting this watershed's agricultural production and land use may be a wise investment for the U.S. agricultural industry. According to a review of the agricultural land use trends from 2007-2012, an average of 12 percent decrease in the number of farms and an approximate 10 percent decrease in farmland acreage occurred within the eight counties overlapping the watershed (USDA, 2018). Additionally, four counties in the Middle TN River Valley watershed are currently listed in the top 15 fastest growing counties by population in Alabama (USDA, 2018). Although much of the watershed is considered as Alabama's prime agricultural land, it is likely that the current land use and ownership patterns may change to favor developed land over agricultural land. However, converting dry land to irrigated land in Alabama increases the average cash rent per acre from approximately \$55 to \$121 (USDA NASS, 2017), which may serve as an incentive for landlords who rent out farmland to retain agricultural uses. Furthermore, the anticipated reduction of crop insurance dependency and increases in both crop yields and sense of security during times of need may incentivize farmers to retain land ownership and continue agricultural production. Decreasing land conversion from agriculture to urban or suburban uses is not expanded upon in detail within the Plan-EA since it cannot be guaranteed that this project will influence land use changes. Federal support of the existing agricultural production in this watershed may incentivize farmers to continue providing a reliable food source needed for the future.

SCOPE OF THE PLAN

The scoping process followed the general procedures per NRCS guidance and PL-566 requirements. Both NRCS procedures and NEPA regulations (40 CFR 1500-1508) require that the NRCS begin scoping early in the planning process. The NRCS, as the lead federal agency, has initiated NEPA analysis in the form of a Plan-EA to analyze impacts to the natural and human environment from this project.

The purpose of scoping is to identify issues, concerns, and potential effects that require detailed analysis. Using the input obtained during the scoping process, the project was refined to focus on relevant resource concerns and issues, and to eliminate minor or irrelevant issues from further detailed study. Relevant resource concerns are carried forward for further detailed study and discussion.

Federal, state, and local agency representatives and non-governmental organizations were invited to become cooperating agencies on this project and participate in the planning process for the Plan-EA.

Tribal consultation is currently being conducted in accordance with the National Historic Preservation Act (NHPA) of 1966 and Executive Order 13175 to maintain a relationship between NRCS and native tribes and to ensure the local tribal populations were notified of the scoping process. NRCS sent a letter to the Tribal Historic Preservation Office (THPO) requesting the Poarch Creek Tribe delegate input and making the local tribal communities aware of the planning process. Confirmation and details regarding this communication and outreach are to be provided by Vernon Abney with NRCS-AL.

The scoping process began in 2015 with a survey conducted by cooperating agencies, Alabama Farmers Federation (ALFA) and the Alabama Association of Conservation Districts (AACD), for the

purpose of gaging interest and assessing participation in this program. The survey provided a scoping platform to gain information on current irrigation use, barriers to irrigation adoption, farmer interest in a cost-share program, and preferred conservation practices.

There was a total of 263 responses to the survey. As shown in Figure 1, the highest survey participation occurred in Dallas, Limestone, and Chilton Counties and the lowest participation occurred in Winston, Wilcox, and Walker Counties. Approximately 69 percent of survey respondents listed “Economics” as their main barrier to irrigation, followed by Access to Water with 28 percent (Figure 2). When asked how much cost-share farmers were willing to match for irrigation, 38 percent of respondents said they would invest up to 50 percent of the total cost (Figure 3). Only eight percent of respondents said they would invest in irrigation regardless of the funding offered.

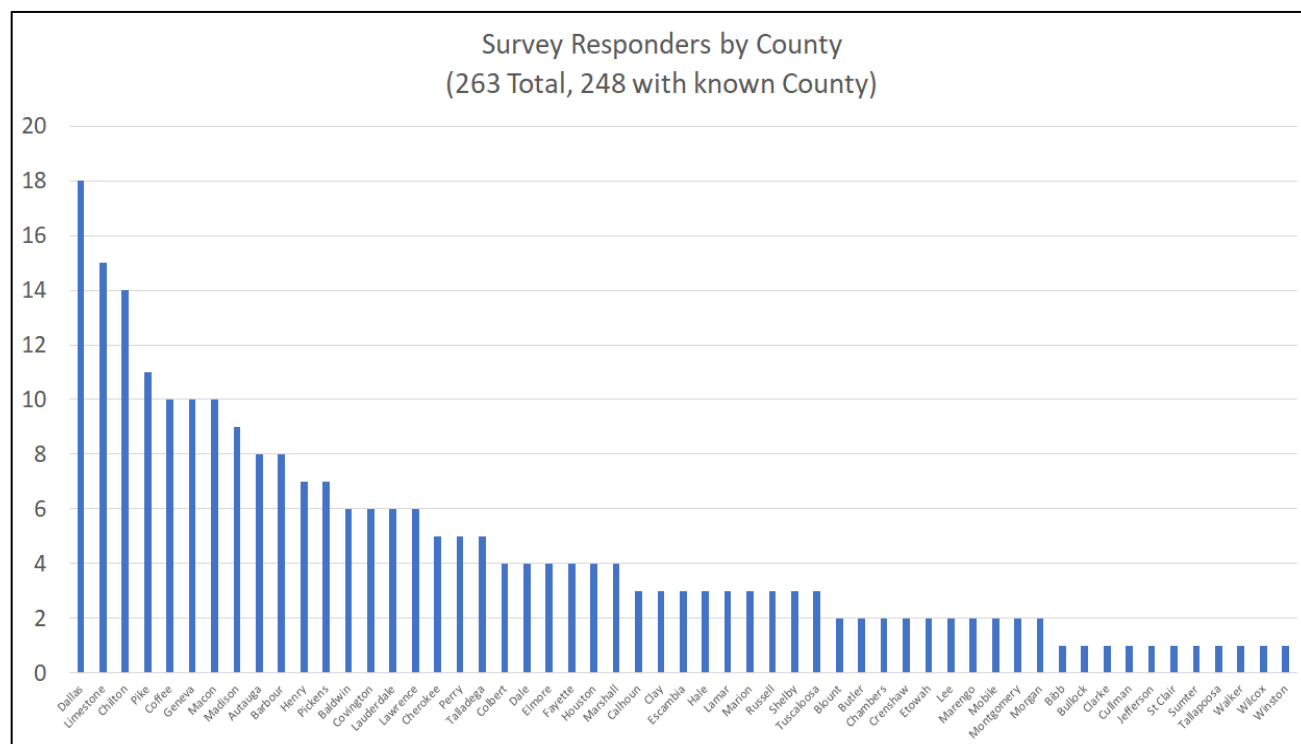


Figure 1: ALFA Survey Respondent Count

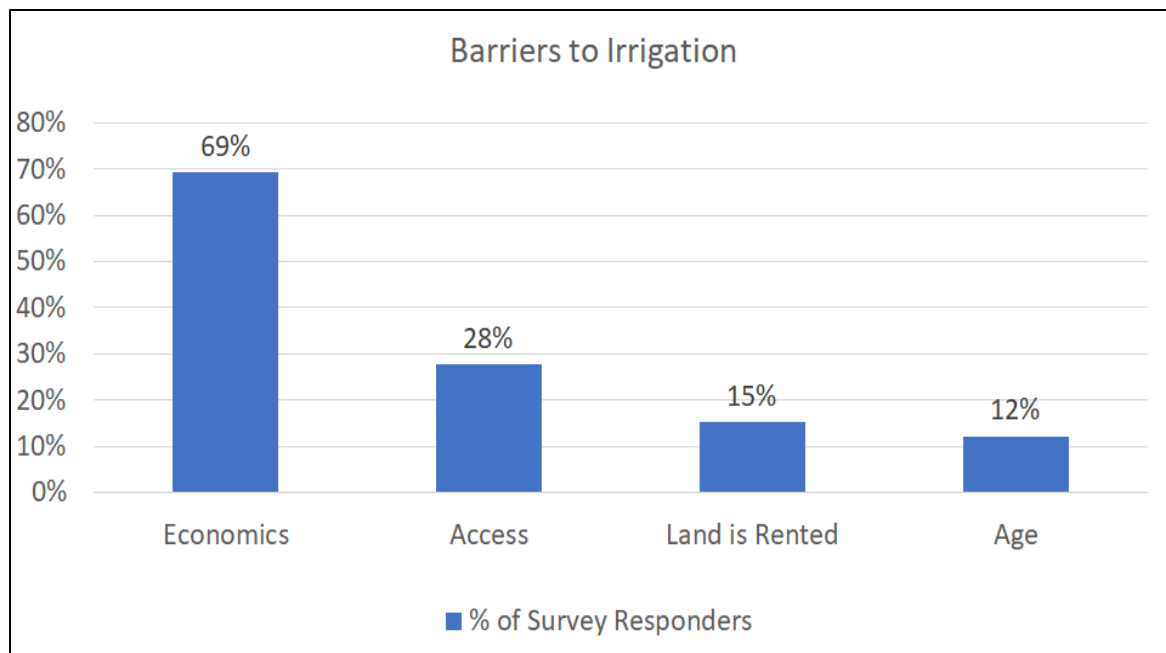


Figure 2: ALFA Survey - Barrier to Irrigation

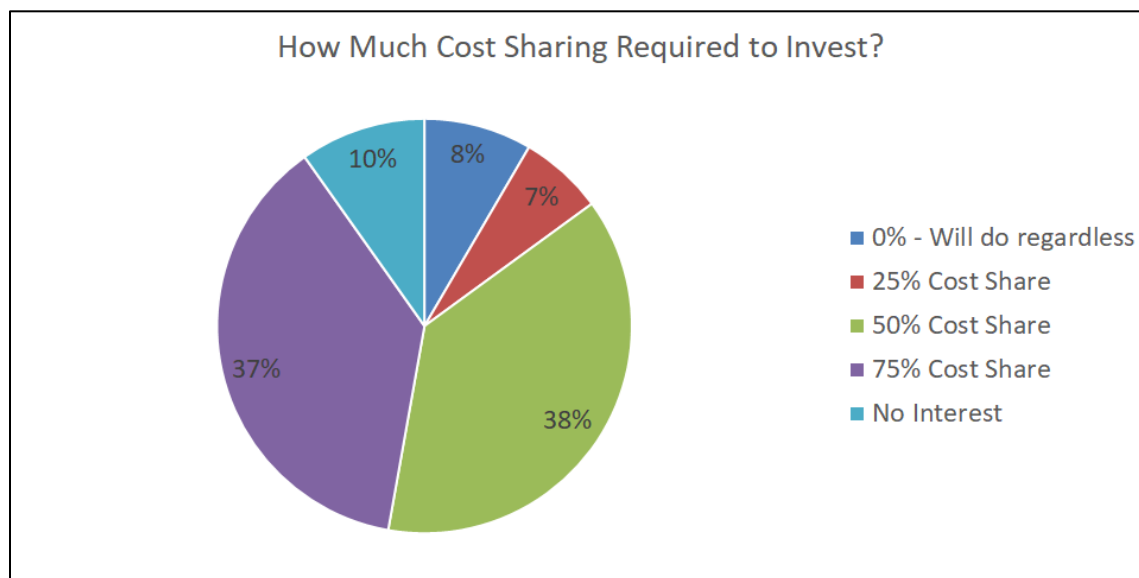


Figure 3: ALFA Survey - Cost-share Percent Desired to Invest in New Irrigation

In 2018, a Statewide Resource Assessment (SRA) was completed to assess variables such as the areas with considerable water resource concerns, areas of maximum potential for project success, and areas with considerable agricultural land use. The National Water Management Center (NWMC) recommended data layers for inclusion in the SRA (Appendix D, Table 36). Sources and information for these data layers were then identified and acquired through coordination with Federal and State agencies and universities. Throughout the development of the SRA, meetings were held with non-governmental organizations and government agencies to receive comments, address concerns, and provide information and details regarding the scoping process.

To further the scoping process, a statewide stakeholder steering committee meeting was held on September 19, 2018, at the ALFA Insurance Service Center Office (2108 E. South Blvd, Montgomery, AL). Presenters at the meeting included Mr. Ben Malone, AL NRCS State Conservationist; Mr. Cameron Handyside, University of Alabama Huntsville (UAH); Dr. Eve Brantley, Auburn University (AU); and Dr. William Puckett, ASWCC Executive Director. The presentations covered the proposed financial assistance available through PL-566, the project purpose and need, the Watershed Plan-EA process, the draft SRA, and opportunities for further cooperating agencies participation. Questions and comments were discussed throughout the meeting. A total of 15 cooperating agency representatives attended the meeting, excluding staff from NRCS, ASWCC, UAH, and AU.

Apart from agency consultation, two farmer listening sessions were also conducted (October 23, 2018 and November 27, 2018) to receive input from farmers, offer project information and expectations, and assess participation and interest for this project. Details concerning public participation are found in the Consultation, Coordination, and Public Participation section of this document. Questions and comments were discussed and informally addressed as an open floor discussion between the farmers, SLO, NRCS, and the technical team. Approximately 46 people attended the farmer listening session on October 23rd in Belle Mina, AL, and approximately 26 people attended the Underserved Farmer focused listening session held on November 27th in Moulton, AL.

A preliminary investigation (PI) was prepared to provide sponsors, local partners, agencies, and the public with information to evaluate the goals and objectives of the project. During the development of the PI, project sponsors conducted initial consultation with natural resource agencies and stakeholders in the Middle TN River Valley Watershed Area.

Main resource concerns identified throughout the scoping process included aquatic resources, groundwater, soils, surface water, water quality and quantity, threatened and endangered (T&E) species, and cultural and historic resources. Table 1 provides a summary of resource concerns and their relevancy to the proposed action. Resources determined to be non-relevant were eliminated from detailed study, and those resources determined to be relevant have been carried forward for analysis.

Table 1. Summary of Resource Concerns for the Middle TN River Valley Watershed - Irrigation Expansion Project

ITEM/ CONCERN	Relevant to the Proposed Action?		RATIONALE
	YES	NO	
SOILS			
Upland Erosion	X		Potential for increased soil loss due to irrigation runoff.
Stream Bank Erosion	X		Potential for stream bank erosion during installation of surface water intake.
Sedimentation	X		Potential for additional runoff by increasing irrigation; might lead to more sediment transport.
Prime and Unique Farmland (Farmland Protection Policy Act)	X		Potential for protection and enhancement by increasing irrigation.
WATER			
Surface Water Quality	X		Potential for additional on-farm pollution runoff.
Surface Water Quantity	X		Potential for excess water withdrawal.
Ground Water Quantity	X		Potential for excess groundwater withdrawal.
Clean Water Act	X		Nationwide or individual permits may be required for projects if determined by NRCS consultation.
Regional Water Mgmt. Plans		X	This project will have a neutral effect on existing regional water management plans. This includes the Tennessee River Basin Management Plan (2002).
Coastal Zone Mgmt. Area		X	None in Project Area.

Table 1. Summary of Resource Concerns for the Middle TN River Valley Watershed - Irrigation Expansion Project-continued

Floodplain Management	X		This project is not likely to increase risk of flood loss, or impact of floods on human safety, health, and welfare, as stated in Executive Order 11988. Also, it will not result in any changes to existing floodplain ordinances.
Forest Resources		X	Forest Resources will not be impacted by this project.
Wetlands	X		Potential for limited impact through additional runoff.
Flood Damages		X	Project is expected to have no impact on flooding. No multiple purpose dams that provides both flood and irrigation storage will be developed.
Ecological Critical Areas		X	All critical areas (Strategic Habitat Units) will be avoided, thus minimizing any potential impact.
Water Bodies (Including waters of the U.S.)	X		Potential withdrawals for irrigation could have an impact on both the quantity and quality of a major water body.
Wild and Scenic Rivers		X	There are no Wild and Scenic Rivers in the Project Area.
AIR			
Air Quality	X		Potential for minimal impact due to machinery emissions and airborne dust would slightly degrade air quality during construction and maintenance. Increased irrigation is associated with increased fertilizer application which may impact air quality.
Clean Air Act		X	The Middle TN River Valley Watershed is not located in a nonattainment area. All project induced impacts to air quality would be minor and of short duration and will not breach limits set by the Clean Air Act. Increased fertilizer application would be minimal and not breach limits set by the Clean Air Act.
PLANTS			
Endangered and Threatened Species	X		Potential to “may affect.” Impacts to both water quality and quantity may impact threatened & endangered aquatic species.

Table 1. Summary of Resource Concerns for the Middle TN River Valley Watershed - Irrigation Expansion Project-continued

Essential Fish Habitat		X	None present in project area.
Invasive Species		X	Project will not affect populations or re-location of invasive species. Crop management techniques are expected to remove invasive species that would be of concern.
Natural Areas		X	Project will have no effect on natural areas in the watershed.
Riparian Areas	X		Riparian areas may be affected by surface water intakes. Potential for stream bank erosion during installation of surface water intake.
ANIMALS			
Fish and Wildlife Habitat	X		Potential for affecting fish and wildlife habitat through irrigation runoff that may cause erosion and sediment/nutrient transport.
Coral Reefs		X	None in Project Area.
Endangered and Threatened Species	X		Potential to "may affect." Impacts to both water quality and quantity may impact threatened & endangered aquatic species.
Invasive Species		X	Project will not affect populations or re-location of invasive species.
Migratory Birds/Bald and golden Eagles		X	Purpose of action is not to take migratory birds or Eagles and will not have impact on these populations.
HUMANS			
Cost, NED	X		Federally assisted plan will maximize net economic benefits and meet the required criteria by Economic & Environmental Principles and Guidelines (P&G).
Historic and Cultural Resources	X		Historic properties are in the project area. There is potential to effect cultural resources eligible or potentially eligible for the National Register of Historic Places, which will depend upon the specific areas of ground disturbance.

Table 1. Summary of Resource Concerns for the Middle TN River Valley Watershed - Irrigation Expansion Project-continued

Environmental Justice		X	Project intended to benefit subject populations. No environmental justice groups adversely impacted by the project. Compliance with E.O. 12898.
Local and Regional Economy	X		The Local and Regional Economy is expected to benefit from this project. Actions proposed by this Plan recommends sustainable groundwater and surface water withdrawals that will cause minimal to no effect on competing interests.
Potable Water Supply		X	There is potential for localized excess groundwater withdrawal where karst geology limits groundwater production. Sites identified for implementation will also undergo onsite evaluations as outlined in the Environmental Evaluation Worksheet (NRCS-CPA-52) to identify any potential localized risk to water supply.
Recreation		X	The project is anticipated to have no effect/neutral effect on recreation.
Scenic Beauty and Parklands		X	None impacted by the project.
Public Health and Safety		X	Minimal potential for injuries during temporary project construction and maintenance.
Land Use		X	No impact. The land use in the project area is not expected to change due to project.
Significant Scientific features		X	No significant scientific features will be affected by this project.

AFFECTED ENVIRONMENT

Location

The Middle TN River Valley Watershed Area encompasses 1,864,805 acres spanning the Wheeler Lake and the Lower Elk Hydrologic Unit Code- 8 (HUC-8) watersheds (See Appendix A, Figure 10). The potential area for project implementation will occur on existing agricultural land which consists of 665,022 acres, approximately 35.7 percent of the entire watershed area. This watershed also encompasses all, or portions of, 108 Hydrologic Unit Code-12 (HUC-12) watersheds in Alabama. The watershed reaches through the following Alabama counties: Cullman, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall, and Morgan. The Middle TN River Valley Watershed encompasses one of the largest agricultural producing regions in the state.

Surface Water

The portions of the Wheeler Lake and Lower Elk watersheds located in Alabama comprise 2,876 square miles of the TN River Basin. The total drainage area of the TN River at the Florence, AL gage (downstream of the Wheeler Dam) is 30,810 square miles. The mean monthly flow at the gage is 80,700 cubic feet per second (cfs) ranging from a high of 87,800 cfs in January to a low of 33,500 cfs in September. Mean summer flows (May-September) at the gage are shown below in Table 2, in units of cubic feet per second. Alabama does not regulate instream flow, and has no law prescribing flow standards.

Table 2. Average Summer Surface Water Flows cubic feet per second (cfs) Tennessee River at Florence, Alabama USGS Gage (May-September)

May	June	July	August	September
44,300 cfs	37,100 cfs	36,200 cfs	36,200 cfs	33,500 cfs

Major tributaries to the Tennessee River in this area include the Paint Rock River, Flint River, Hurricane Creek, Limestone Creek, Piney Creek, and the Elk River. These tributaries and other smaller tributaries have sufficient flow to serve as sources of water for irrigation. For example, the average monthly flow of the Flint River at Chase, AL is 570 cfs while the mean monthly flow of the Paint Rock River near Woodville, AL is 671 cfs. The basin is dominated by the Wheeler Lake itself, a reservoir that encompasses 67,000 acres of water surface and contains over 1 million-acre feet of storage at summer conservation pool level of 556 feet above mean sea level (MSL).

Topography

Topography in the Middle TN River Valley Watershed is generally level to undulating (see Appendix C, Figure 28). Elevation in the project area ranges from 505 to 1,863 feet. In the Limestone Valleys and Uplands, elevation ranges from 600 to 700 feet (Mitchell & Loerch, 2008). The Appalachian Plateau region of the watershed is located at 1,300 feet elevation with slopes less than 10 percent. The majority of the low topography and area of relief surrounds the Tennessee River and its tributaries. Most of the higher topography is located in the northeast section of the watershed, which correlates to areas too steeply sloping for agricultural use.

Hydrogeology

The physiography in the Middle TN River Valley Watershed Area is contained within the Highland Rim groundwater province in Alabama (see Appendix C, Figure 13). This formation is composed of six individual aquifers: Pottsville, Bangor, Hartselle, Monteagle, Fort Payne-Tuscumbia, and Nashville-Stones River. The Bangor, Hartselle, and Monteagle aquifers are generally unconfined with well depths varying from a minimum of 32 ft in Bangor to a maximum of 450 ft in the Hartselle aquifer, while depth to water ranged from 1 ft to 139 ft. Pumping rates vary from 1 to 100 gallons per minute (gpm), both in the Bangor Aquifer, while specific capacities vary from less than 1 gpm/ft to 2.27 gpm/ft. The Pottsville aquifer is a confined unit due to low permeability strata within the formation and can serve as a better source of water than the unconfined aquifers. Well depths range from 55 ft to 520 ft while depth to water varies from 15 ft to 113 ft. Pumping rates of wells within the aquifer vary from less than 1 gpm to 510 gpm while specific capacity values range from 1 gpm/ft to 125 gpm/ft. The Fort Payne-Tuscumbia aquifer serves as a water source across all sectors in most of the Highland Rim domain. Depth of wells range from 36 ft to 440 ft, while depth to water varies from 8.5 ft to 104 ft. Pumping rates can reach up to 2000 gpm in this aquifer with specific capacities ranging less than 1 gpm/ft to 173 gpm/ft.

The information given in this section is taken from the “Assessment of Groundwater Resources in Alabama, 2010-16 Geological Survey Bulletin 186” published by the Geological Survey of Alabama (GSA) in 2018.

Aquifers

There are six defined aquifers in the basin. The GSA assessment provides recharge rates for the three largest aquifers in the basin. Annual recharge averages nine inches. Three aquifers account for 80 percent of the total basin area, 85 percent of total agricultural land area and 87 percent of current irrigated land. See Table 3 below for details.

Table 3. Middle TN River Valley Aquifer Information

Aquifer	Area (ac)	Percent of Total Basin Area	Average Annual Recharge (in)	Storage (Mg/D)	Total Ag Land (ac)	Percent of Total Ag Land	Center Pivot Irrigated Ag Land Area (ac)	Aquifer Status
Fort Payne-Tuscumbia aquifer	907,842	50.2%	9.27	965	438,376	63.6%	20,812	Stable
Bangor aquifer	270,575	15.0%	8.85	255	85,486	12.4%	18	Stable
Pottsville aquifer	231,905	12.8%	8.9	2,706	59,631	8.6%	0	Stable
Monteagle aquifer	158,986	8.8%			44,480	6.5%	1,525	N/A
Hartselle aquifer	114,527	6.3%			40,154	5.8%	0	Stable
Nashville-Stones River aquifer	44,417	2.5%			13,514	2.0%	1,504	
Confining units	79,556	4.4%			7,796	1.1%	0	
Totals	1,807,808	100.0%			689,437	100.0%	23,859	

The water budget report (Harper et al., 2015) shows that groundwater accounts for approximately 1.4 percent of total withdrawals in the basin. The budget includes all sector withdrawals, including power generation, which accounts for the large total withdrawals from surface sources. This can increase to about 1.8 percent of total monthly withdrawals during the growing season (see Table 4).

Table 4. Groundwater Monthly Budget Report for Project Watershed Area

Month	Basin All Withdrawals (MGD)	Basin All Withdrawals (in)	Basin GW Withdrawals (MGD)	Basin GW Withdrawals (in)	GW Percentage of ALL Withdrawals
Jan	3,152	1.99	33	0.02	1.06%
Feb	3,016	1.72	34	0.02	1.12%
Mar	2,110	1.33	35	0.02	1.66%
Apr	3,185	1.95	41	0.02	1.28%
May	3,227	2.04	44	0.03	1.36%
Jun	3,253	1.99	49	0.03	1.52%
Jul	3,179	2.01	56	0.04	1.75%
Aug	2,898	1.83	51	0.03	1.75%
Sep	3,235	1.98	43	0.03	1.34%
Oct	2,991	1.89	40	0.03	1.35%
Nov	2,759	1.69	34	0.02	1.24%
Dec	3,154	1.99	34	0.02	1.09%
Average	3013	1.87	41	0.03	1.38%

Removing the power generation withdrawals, groundwater accounts for approximately 6.5 percent of the budget. This can increase to approximately eight percent of total monthly withdrawals during the growing season (see Table 5).

Table 5. Groundwater Budget for Project Area minus Power Generation Withdrawals

Month	Basin All Withdrawals minus Power (MGD)	Basin All Withdrawals minus Power (in)	Basin GW Withdrawals (MGD)	Basin GW Withdrawals (in)	GW Percentage of ALL Withdrawals
Jan	664	0.42	33	0.02	5.02%
Feb	637	0.36	34	0.02	5.31%
Mar	457	0.29	35	0.02	7.68%
Apr	677	0.41	41	0.02	6.01%
May	689	0.44	44	0.03	6.35%
Jun	701	0.43	49	0.03	7.06%
Jul	692	0.44	56	0.04	8.05%
Aug	631	0.40	51	0.03	8.02%
Sep	691	0.42	43	0.03	6.26%
Oct	638	0.40	40	0.03	6.33%
Nov	586	0.36	34	0.02	5.85%
Dec	664	0.42	34	0.02	5.18%
Average	644	0.40	41	0.03	6.43%

Major municipal withdrawals from the cities of Huntsville and Decatur are from surface water predominately the Tennessee River. Huntsville Utilities has expanded surface water withdrawals while retiring existing wells.

Geology and Soils

The Middle TN River Valley Watershed lies in an area that is composed of mainly karst-natured limestone. The rock type surrounding underlying aquifers include sandstone or a mixture of sandstone and carbonate-rock.

According to the USDA NRCS Soil Survey, most of the soils of the uplands are derived from cherty limestone. Bodine and Fullerton soils are extensive in many of these landscapes. They typically have a gravelly loam, gravelly clay subsoil and a gravelly silt loam surface layer. However, in the more level areas of the Appalachian Plateau region, Nauvoo, Hartsells, and Wynnville soils dominate which were formed in residuum from sandstone. They have a loamy subsoil and a fine sandy loam surface layer. The more rugged portions of the Appalachian Plateau are dominated by soils such as Montevallo and Townley, which were formed in residuum from shale. These soils have either a very channery loam, or a clayey subsoil and a silt loam surface layer. See Appendix C, Figure 11 for a generalized map of the geology of northern Alabama.

Soil data was mapped using the NRCS Soil Survey Geographic database (SSURGO). Soils within the area consist of both Limestone Valleys/Uplands and Appalachian Plateau soils (see Appendix C,

Figure 15). Using the Soil Classification Capability Class demarcations, the majority of the Middle TN River Valley Watershed is comprised of capability classes one through four (see Appendix C, Figure 12). Soils classified between one and four are considered generally “good” for both rainfed and irrigated crop production. While Soil class one is preferred with “few limitations that restrict their use” (SSURGO, 2018), even class four is described as “severe limitations that reduce the choice of plants or that require very careful management or both” (SSURGO, 2018). Any soils classified as five or greater are not considered suitable for crop production but rather for pasture, rangeland, forestland, or wildlife habitat (SSURGO, 2018). The areas where the capability classes are higher than four are largely situated in the western and southwestern section of the watershed. The soil capability map of the watershed will be provided during the allocation of resources as guidance.

Climate

Monthly Normals

The Livneh et al. (2014) climate dataset has an original horizontal resolution of 1/16 degrees which contains daily values of minimum temperature, maximum temperature, and precipitation for the period 1915-2011. This daily data was area weighted to the HUC-8 regions of the United States. With the focus on the Wheeler Lake HUC-8, this data was further averaged to monthly values for the 30-year period 1981-2010 which is the current period for climate normals in the United States. These average monthly temperature values are displayed in Figure 4. The lowest minimum temperatures occur in December and January with values just above and below 30 °F, respectively. The highest maximum temperatures occur in July and August with values approaching 90 °F. The average annual precipitation is about 56 inches with the maximum monthly value occurring in December of about 5.8 inches and the minimum monthly value occurring in August of about 3.5 inches (Figure 5).

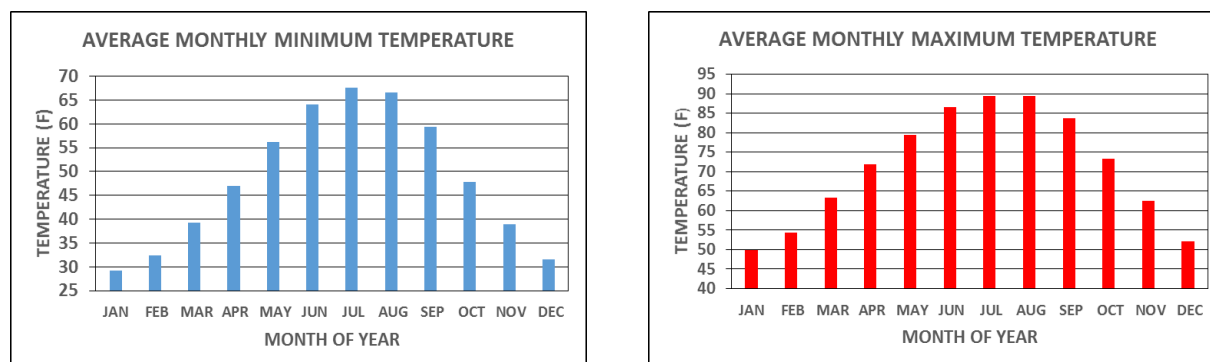


Figure 4: Average monthly minimum temperature (left) and maximum temperature (right) in units of °F for the Wheeler Lake HUC-8 basin for the period 1981-2010.

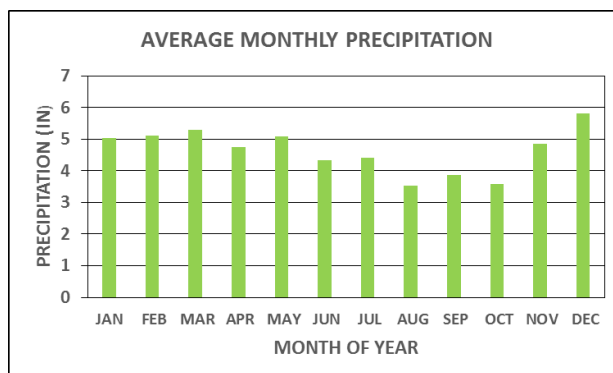


Figure 5: Average monthly precipitation in units of inches for the Wheeler Lake HUC-8 basin for the period 1981-2010.

Daily Precipitation

The daily precipitation data from 1981-2010 for the Wheeler Lake HUC-8 was sorted from smallest to largest and the cumulative distribution function was calculated and shown in Figure 6. The period comprises 10,957 days which, when divided by 30 years, gives an average year length of 365.23 days, which is equivalent to 100 percent of the data. The vertical axis in Figure 6 is labeled with respect to the “average day” rather than percentages. The 1-inch threshold is at about day 356 which leads to the conclusion that about 98 percent of the time daily precipitation amounts are 1 inch or less. The National Weather Service threshold for measurable precipitation at a given location is 0.01 inches. This threshold is at about day 158, so about 207 days of the year have values at or above this amount.

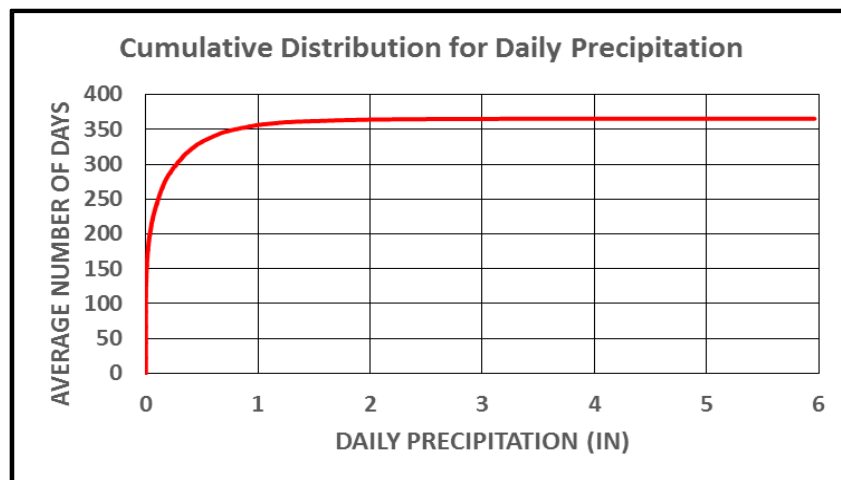


Figure 6: Cumulative distribution function for daily precipitation values for the Wheeler Lake HUC-8 basin for the period 1981-2010. The horizontal axis is precipitation amount in units of inches. The vertical axis is the average number of days.

Socioeconomic Conditions

Social and economic demographic data such as income, education, and median age were assessed using information from the U.S. Census, USDA National Agricultural Statistics Service (NASS), and Bureau of Economic Analysis, and depicted in Table 6 by county. This information assisted with identifying watershed areas that may need more assistance and outreach as part of planning and implementation and estimating project cost to adjust for acreage in a watershed that may receive historically underserved (HU) cost-share rates for conservation practices.

Table 6 presents the socioeconomic data listed in the most recent U.S. Census Bureau QuickFacts summary (V2018).

Table 6. Socioeconomic Values for the Middle TN River Valley

County →	Cullman	Jackson	Lauderdale	Lawrence	Limestone
POPULATION AND RACE					
Total Population, 2018	83,442	51,736	92,387	32,957	96,174
Population Percent Change (2010-2018)	3.8%	-2.8%	-0.3%	-4.0%	16.2%
White Alone	96.1%	91.5%	86.8%	78.4%	81.5%

Table 6. Socioeconomic Values for the Middle TN River Valley

County →	Cullman	Jackson	Lauderdale	Lawrence	Limestone
Minority Population	3.9%	8.5%	13.2%	21.6%	18.5%
AGE					
Total Median Age (2017)	40.60	43	41.50	42	39.10
Population over 65 years of age	18.3%	19.5%	19.6%	18.2%	14.9%
LANGUAGE SPOKEN AT HOME					
Total Households	31,097	20,368	38,634	13,056	32,386
Language other than English spoken at home	4.4%	1.8%	3.0%	1.2%	5.8%
EDUCATIONAL ATTAINMENT					
High School Graduate	82.1%	81.4%	85.9%	78.0%	83.7%
Bachelor's degree or higher	14.9%	13.4%	22.5%	10.2%	24.6%
EMPLOYMENT					
Total Employment, 2016	25,274	13,259	25,563	3,138	16,958
INCOME					
Median Household Income, 2017	\$40,997	\$39,281	\$44,888	\$43,779	\$52,831
Per Capita Income*	\$38,615	\$35,774	\$36,448	\$33,003	\$40,381
POVERTY					
Population below Poverty Level	16.4%	19.0%	16.3%	16.6%	14.8%

Table 6. Socioeconomic Values for the Middle TN River Valley

County →	Madison	Marshall	Morgan	Alabama	United States
POPULATION AND RACE					
Total Population, 2018	366,519	96,109	119,089	4,887,871	327,167,434
Population Percent Change (2010-2018)	9.5%	3.3%	-0.3%	2.3%	6.0%
White Alone	68.8%	93.1%	83.0%	69.2%	76.6%
Minority Population	31.2%	6.9%	17.0%	30.8%	23.4%
AGE					
Total Median Age (2017)	38.70	38.80	40.10	38.90	38.00
Population over 65 years of age	14.6%	16.8%	17.1%	16.5%	15.6%
LANGUAGE SPOKEN AT HOME					
Total Households	142,253	34,588	45,904	1,856,695	118,825,921
Language other than English spoken at home	6.5%	11.6%	7.6%	5.1%	21.3%
EDUCATIONAL ATTAINMENT					
High School Graduate	90.8%	80.0%	82.5%	85.3%	87.3%
Bachelor's degree or higher	40.6%	17.7%	20.9%	24.5%	30.9%
EMPLOYMENT					
Total Employment, 2016	158,629	30,833	42,737	1,673,249	126,752,238
INCOME					
Median Household Income, 2017	\$61,318	\$41,104	\$47,529	\$46,472	\$57,652
Per Capita Income ¹	\$49,650	\$35,005	\$38,617	\$40,805	\$51,640

Table 6. Socioeconomic Values for the Middle TN River Valley

County →	Madison	Marshall	Morgan	Alabama	United States
POVERTY					
Population below Poverty Level	13.6%	21%	16.6%	16.9%	12.3%

¹Per capita income values are based on the 2017 U.S. Department of Commerce Bureau of Economic Analysis

Socioeconomic demographic data related to agricultural production, such as full-time and part-time principal operators, minority operators, and estimated agricultural economic impact were assessed by county using information from USDA NASS.

The Middle TN River Valley Watershed is one of the largest agricultural producing regions in the state. Irrigated crops include soybean, cotton, corn, wheat, and specialty crops. Specific counties within this watershed ranked first, second, and third in the state for soybean production; first and second at corn production; and second and third for cotton production (USDA, 2018). Also, Cullman County is ranked second in the state at vegetable and melon production (USDA, 2018). Limestone County contributed the highest agricultural output impact at about \$149.1 Million, with an average of \$75.7 Million among the eight counties in the project area (USDA, 2018). However, a single year census does not account for crop rotations. Many full-time operations utilize year-to-year crop rotations with soybeans, corn, crimson clover, hairy vetch, or other.

Farm operator statistics, as depicted in Table 7, are consistent throughout the study area. The counties, on average, have more part-time operators than full-time farm operators. The average percentage of part-time operators to full-time operators in the watershed is 56 percent to 44 percent, respectively (USDA/NASS QuickStats, n.d.). Minorities were determined to be any farmer other than Caucasian males, as defined by the USDA Economic Research Service ("Socially Disadvantaged Farmers: Race, Hispanic Origin, and Gender," 2017). Approximately 35.6 percent of the watershed's farm operators are from minority populations, with a high in Lawrence County of 47 percent minority operators, and a low in Lauderdale County with 29 percent of minority operators (USDA/NASS QuickStats, n.d.).

Table 7. Farm Operator Demographics

	Middle TN River Valley	Alabama	United States
# of Principal Operators	11,405	43,223	2,109,303
Full-time Principal operators	44.3%	44.2%	47.8%
Part-time Principal operators	55.7%	55.8%	52.2%
Percent of Minority¹ Operators	35.6%	45.8%	35.5%

¹Minority operators include operators of Asian, black or African American, Hispanic, Multi-race, Native Hawaiian/Pacific Islander descent, as well as all females.

Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice (EJ) in Minority Populations and Low-Income Populations, requires that “each federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations” (CEQ, 1997). Environmental Justice is defined by USDA NRCS “as the fair treatment and meaningful involvement of all people regardless of race, color, national origin or income regarding the development, implementation and enforcement of environmental laws, regulations and policies. Environmental Justice is achieved when all citizens enjoy the same degree of protections and equal access to the NRCS programs and services to achieve a healthy environment in which to live, learn and work.”

The watershed area has an average of 15.9 percent of the population below poverty level (U.S. Census 2010) and approximately 35.6 percent of the watershed’s farm operators are from minority populations (USDA/NASS QuickStats, n.d.). Invitations to participate on the project steering committee were emailed to the Deans of Agriculture at Tuskegee and Alabama A&M Universities, the Morrill Act of 1890 land grant universities in Alabama (Appendix E, Figure 69). Tuskegee and Alabama A&M Universities are highly regarded for their roles in providing access and opportunities for underserved communities and leaders in agriculture and environmental issues. An additional invitation to encourage farmer participation in a ‘listening session’ was sent to the Alabama A&M University Dean of Agriculture (Appendix E, Figure 70). Email invitations with meeting details were sent to the NRCS District Conservationists, Extension agents, and ASWCC representatives in each of the counties with an encouragement to invite all farmers interested in the project to attend the farmer listening sessions. To improve outreach and access to minority and underserved communities and to provide USDA and ASWCC technical and financial assistance, the cost-share program administered by the ASWCC will allocate 30 percent of the funds for underserved farmers, at a cost-share rate of 65 percent.

The EJSCREEN report (EPA 2016), identifies eleven EJ Indexes that reflect the eleven environmental indicators. The eleven EJ Index names are:

- National Scale Air Toxics Assessment Air Toxics Cancer Risk
- National Scale Air Toxics Assessment Respiratory Hazard Index
- National Scale Air Toxics Assessment Diesel PM (DPM)
- Particulate Matter (PM2.5)
- Ozone
- Lead Paint Indicator
- Traffic Proximity and Volume
- Proximity to Risk Management Plan Sites
- Proximity to Treatment Storage and Disposal Facilities
- Proximity to National Priorities List Sites
- Proximity to Major Direct Water Dischargers

Land Use and Cover

Using ArcGIS and USDA data sources, the land use and cover in the project area was mapped and evaluated (see Appendix C, Figure 26). The total acreage of the watershed is 1,864,805 acres and is categorized by six main types of land use (Table 8). The breakdown of the watershed's land use and percentages are depicted in Table 8 below. According to the U.S. Census Bureau Statistical Abstract of the United States from 2000, 7.1 percent of Alabama's land ownership was State/Federally owned, and 92.9 percent was privately owned (U.S. Census Bureau, 2015).

Table 8. Land Use in the Middle Tennessee River Valley Watershed Area

		Acres	Percentage of Watershed
Total Acreage		1,864,805	100%
Agricultural Production		689,348	37%
	Irrigated Agricultural Production	24,325	1.3%
	Rainfed Agricultural Production	665,022	35.7%
Forested Land		748,389	40%
Developed Land		222,633	12%
Open Water		67,110	3.6%
Wetlands		47,719	2.6%
Shrubland		88,059	4.7%
Barren		1,547	0.1%

The current status of irrigation on harvested cropland in the watershed area is insignificant compared to Alabama's neighboring states. Values for current irrigation status of neighboring states were summarized by USDA NASS for 2017 and are available for comparison below in Table 9.

Table 9. Current Irrigation Status of the Harvested Cropland - Values

[Excludes institutional, research, and experimental farms]	Middle TN River Valley ¹	Alabama	Georgia	Mississippi	Florida	U.S.
Number of Operations with Irrigation	350	1,645	5,801	2,355	9,484	296,303
Acres Irrigated	24,771	133,335	1,263,575	1,807,551	1,363,029	55,822,231

¹The values listed are summarized for all eight counties within the specified region and may account for county area that crosses the watershed boundary.

Using UAH state irrigation survey data from 2006-2015, irrigated acreage has increased in the Middle TN River watershed from a low of 11,298 acres (1.6 percent of total agriculture area) to 24,325 acres (3.5 percent of total agriculture area), (Handyside, 2017). Most of this increase in

irrigated land was clustered in two counties (Limestone and Madison). This depicts a recent adoption trend of approximately 1,425 acres of new irrigated agriculture land per year.

Agricultural production data, such as farm size, number of farms, and estimated agricultural economic impact were assessed by county using information from USDA NASS and county agricultural economic reports from Auburn University (Table 10).

In 2012, the Census of Agriculture showed the counties in the study area averaged 1,426 farms per county (USDA, 2018). Cullman County had the most with 2,007 farms, and Madison County had the least with 1,033 farms. The average acreage for farmland was 206,619 acres among the eight counties. Limestone County had the most farmland acreage with 246,697 acres and Morgan County had the least with 152,567 acres. The total acreage for farmland in Alabama is 8,902,654 acres (USDA, 2018). The percent rate of change in number of farms across Alabama from 2007 to 2012 decreased by 12 percent. Within the counties of the project area, the percent change in number of farms was highest in Cullman County with decrease of 19 percent and lowest in Lawrence County with decrease of three percent. The percent change in farmland acreage from 2007 to 2012 in Alabama was decrease of one percent. Within this watershed, change in farmland acreage ranges from Cullman County, with a decrease of 16 percent, to Lawrence County, with an increase of 10 percent (USDA, 2018).

Table 10. Agricultural Land Use Trends from 2007-2012 in the Middle TN River Valley

	2007	2012	Percent Change	2007	2012	Percent Change
County	Number of Farms			Land in Farms (Acres)		
Cullman	2,465	2,007	-19	229,791	194,083	-16
Jackson	1,523	1,376	-10	242,850	231,845	-5
Lauderdale	1,697	1,466	-14	227,692	211,589	-7
Lawrence	1,601	1,551	-3	222,401	243,840	+10
Limestone	1,352	1,230	-9	237,188	246,697	+4
Madison	1,187	1,033	-13	199,294	209,352	+5
Marshall	1,731	1,505	-13	154,548	162,980	+5
Morgan	1,457	1,237	-15	161,531	152,567	-6
Alabama	48,753	43,223	-11	9,033,537	8,902,654	-1
Average for Project Area	1,627	1,426	-12	209,412	206,619	-1.3

Cultural Resources

Cultural resources consist of the traces of all of the past activities and accomplishments of people, and include any prehistoric or historic district, site, building, structure, earthwork, or object listed in or eligible for listing in the National Register of Historic Places (NRHP) or an equivalent register maintained at the State or local level, in addition to unevaluated resources that may be eligible for inclusion in the NRHP or a State or local equivalent. Cultural resources may also include cemeteries, karst features (e.g., caves, rock shelters, or sinks), landscapes (i.e., geographic areas that include both cultural and natural resources that exhibit cultural or aesthetic value), vistas, sacred sites, and cultural or religious practices. The NRHP, maintained by the National Park Service (NPS), the Alabama Register of Landmarks and Heritage (ARLH) and the Alabama Historic Cemetery Register (AHCR), maintained by the Alabama Historical Commission (AHC), and the Alabama State Site File (ASSF), maintained by the University of Alabama Office of Archaeological Research (OAR), were used in conjunction with ArcGIS to assess historic and cultural resources located within the watershed. One hundred and seventeen historic properties listed in the NRHP were identified within the project area and include three historic sites, 26 historic districts, and 88 historic buildings (NPS, 2019). Seventy extant cultural resources listed in the ARLH were identified within the project area and include homes, schools, courthouses, churches, mills, districts, military sites, plantation slave quarters, and cemeteries, among others (AHC, 2019). A total of 934 named cemeteries have been identified thus far within the project area, 33 of which are listed in the AHCR (AHC, 2019). These NRHP, ARLH, and AHCR resources were mapped to the watershed boundary. See Appendix C for maps regarding NRHP, ARLH, and AHCR historic and cultural resources identified within the watershed. Additionally, approximately thousands of previously identified archaeological sites are located within the watershed.

Under a State-based Prototype Programmatic Agreement (SPPA), NRCS practices and activities that have no potential to effect cultural resources have been identified through consultation with the AHC. The SPPA and classifications of effects to cultural resources can be found in Appendix E and Figure 73. The extent of potential impacts on historic and cultural resources will be evaluated when the Area of Potential Effects (APE) for specific project sites have been identified by the NRCS and the SLO and in accordance with NRCS policies and procedures for identifying, evaluating, and protecting cultural resources, including historic properties, and in compliance with the National Historic Preservation Act.

Air Quality

The Clean Air Act as amended (CAA) is the underlying Federal environmental law for air quality in the U.S. Regulatory agencies, such as the EPA and other state and local regulatory agencies must promulgate specific regulations to implement the CAA. The CAA requires the EPA to establish National Ambient Air Quality Standards (NAAQS) for specific pollutants. The Middle TN River Valley Watershed is not located in a nonattainment area.

Fish and Wildlife

Wildlife distribution and populations depend largely on the quantity and quality of available habitat. Habitat conditions are in turn influenced by land use, land management, distribution of water, climate, human influences, and other limiting factors. Wildlife populations are directly proportional

to the availability and suitability of their habitat requirements. Wildlife species are opportunistic in obtaining necessary requirements for life. The most favorable habitat condition for terrestrial wildlife is a mixture of vegetative cover types that are all within the home range of the various species. Diversity is an important element of productivity.

The project area provides diverse and extensive habitat for fish and wildlife. Almost 45 percent of the area is classified as forest or shrubland, which includes portions of Bankhead National Forest. Almost four percent of the area is classified as open water, which includes Wheeler Lake and all its tributaries. Wheeler Lake is also part of the expansive Wheeler Wildlife Refuge (35,000 acres). Additionally, almost three percent of the area is classified as wetlands.

Invasive Species

NRCS policy states that a plant species is considered "invasive" only when it occurs on the Federal or State-specific noxious weed list or a list developed by the State-specific Department of Agriculture with their partners and approved by the State Technical Committee which prohibits or cautions its use due to invasive qualities. Invasive species in a watershed can have major effects on water quality and aquatic ecosystem health due to the ways they affect bank stability and the volume and pollution levels in runoff. Alabama state law lists 141 identified noxious weed species within the State (USDA, n.d.). The Alabama Invasive Plant Council lists approximately 65 invasive plant species in Alabama (Alabama Invasive Plant Council, 2012). This includes 10 species of trees, 18 species of shrubs, 10 species of vines, eight species of grasses, grass-like and canes, nine species of forbs (broadleaf plants), and 10 species of aquatic and wetland plants (see Table 11, below). Of these 65 invasive species, 31 have been identified within aquatic-wetland/riparian regions, six species were found in row crops/nurseries, and 15 species were found in pastures/orchards (Alabama Invasive Plant Council, 2012).

Table 11. List of Invasive Plant Species with the Middle TN River Valley Watershed Basin

	Common Name	Scientific Name
Trees		
	Tree-of-heaven	<i>Ailanthus altissima</i>
	Silktree	<i>Albizia julibrissin</i>
	Camphor tree	<i>Cinnamomum camphora</i>
	Chinese parasol tree	<i>Firmiana simplex</i>
	Chinaberry Tree	<i>Melia azedarach</i>
	Princess tree	<i>Paulownia tomentosa</i>
	Trifoliate orange, hardy orange	<i>Poncirus trifoliata</i>
	Callery pear "Bradford"	<i>Pyrus calleryana</i>
	Tallowtree	<i>Triadica sebifera</i>

Table 11. List of Invasive Plant Species with the Middle TN River Valley Watershed Basin-continued

	Tungoil tree	<i>Verinicia fordii</i>
Shrubs		
	Coralberry, hen's eye	<i>Ardisia crenata</i>
	Thorny olive	<i>Elaeagnus pungens</i>
	Autumn olive	<i>Elaeagnus umbellata</i>
	Lantana	<i>Lantana camara</i>
	Shrubby lespedeza	<i>Lespedeza bicolor</i>
	Glossy privet	<i>Ligustrum lucidum</i>
	Japanese privet	<i>Ligustrum japonicum</i>
	Chinese privet	<i>Ligustrum sinense</i>
	Bell's honeysuckle	<i>Lonicera X bella</i>
	Sweet breath of spring	<i>Lonicera fragrantissima</i>
	Amur honeysuckle	<i>Lonicera maackii</i>
	Leatherleaf mahonia, Beale's barberry	<i>Mahonia bealei</i>
	Nandina, sacred bamboo	<i>Nandina domestica</i>
	Macartney rose	<i>Rosa bracteata</i>
	Cherokee rose	<i>Rosa laevigata</i>
	Multiflora rose	<i>Rosa multiflora</i>
	Tropical soda apple	<i>Solanum viarum</i>
	Beach vitex	<i>Vitex rotundifolia</i>
Vines		
	Oriental bittersweet	<i>Celastrus orbiculatus</i>
	Sweet autumn virginsbower	<i>Clematis terniflora</i>
	Chinese yam	<i>Dioscorea oppositifolia</i>
	English ivy	<i>Hedera helix</i>
	Japanese honeysuckle	<i>Lonicera japonica</i>

Table 11. List of Invasive Plant Species with the Middle TN River Valley Watershed Basin-continued

	Japanese climbing fern	<i>Lygodium japonicum</i>
	Kudzu	<i>Pueraria montana var. lobata</i>
	Bigleaf periwinkle	<i>Vinca major</i>
	Common periwinkle	<i>Vinca minor</i>
	Chinese wisteria	<i>Wisteria sinensis</i>
Grasses, Grass-like, and Canes		
	Giant weed	<i>Arundo donax</i>
	Pampas grass	<i>Cortaderia sellona</i>
	Cogongrass	<i>Imperata cylindrica</i>
	Japanese stiltgrass, Nepalese browntop	<i>Microstegium vimineum</i>
	Torpedo grass	<i>Panicum repens</i>
	Vaseygrass	<i>Paspalum urvillei</i>
	Golden bamboo	<i>Phyllostachys aurea</i>
	Johnsongrass	<i>Sorghum halepense</i>
Forbs (Broadleaf Plants)		
	Nodding plumeless thistle, musk thistle	<i>Carduus nutans</i>
	Wild taro, coco yam, elephant ears	<i>Colocasia esculenta</i>
	Tropical spiderwort, benghal dayflower	<i>Commelina benghalensis</i>
	Hairy cranberry, mulberry weed	<i>Fatoua villosa</i>
	Chinese lespedeza	<i>Lepedeza cuneata</i>
	Purple loosestrife	<i>Lythrum salicaria</i>
	Asiatic dewflower, wartremoving herb	<i>Murdannia keisak</i>
	Chamber bitter	<i>Phyllanthus urinaria</i>
	Rattlebox, scarlet wisteria	<i>Sesbania punicea</i>
Aquatic and Wetland Plants		
	Alligatorweed	<i>Alternanthera philoxeroides</i>

Table 11. List of Invasive Plant Species with the Middle TN River Valley Watershed Basin-continued

	Brazilian elodea	<i>Egeria densa</i>
	Common water hyacinth	<i>Eichhornia crassipes</i>
	Hydrilla, waterhyme	<i>Hydrilla verticillata</i>
	Parrot feather watermilfoil	<i>Myriophyllum aquaticum</i>
	Cuban bulrush	<i>Oxycaryum cubense</i>
	Common reed (grass)	<i>Phragmites australis</i>
	Water lettuce	<i>Pistia stratiotes</i>
	Giant salvinia, kariba-weed	<i>Salvinia molesta</i>

Recently, the TVA found water hyacinth in a slough near Scottsboro, AL and partnered with the state of Alabama to address the invasive water weed (Tennessee Valley Authority, 2018). The TVA's Public Land Information Center will be contacted if areas of hyacinth or other aquatic invasive are found.

Wetlands

Wetland communities are high in species diversity and provide essential habitat for many species. Species include ducks, geese, herons, egrets, shore birds, songbirds, birds of prey, raccoons, rabbits, beavers, muskrats, white-tailed deer, reptiles, and amphibians. The study area contains 47,719 acres of wetlands, approximately 2.6 percent of the total land cover in the project area (see Appendix C, Figure 29). This acreage includes the 35,000-acre Wheeler National Wildlife Refuge, established in 1938 to provide habitat for wintering and migrating birds in the eastern United States. Approximately 4,618 acres of mapped agricultural land within the project area is within a 0.5-kilometer (km) distance of a wetland. This equates to less than one percent of the total agricultural land in the watershed area. Wetland impacts will be avoided and/or minimized with on-farm EE consultations performed by the NRCS.

Threatened and Endangered Species

U.S. Fish and Wildlife Service 12-digit HUC data were used to assess the T&E species within the watershed. There are approximately 32 T&E species within the project area including six species of plants, seven species of fish, one crustacean, twelve mussels, three snails, and three mammals. Using USFWS data, species of concern are heavily populated in the Eastern part of the watershed. See Appendix C, Figures 17-23 for maps of the T&E species within the watershed area.

The extent of potential impact on T&E species will be evaluated when specific project sites have been identified by the NRCS and the SLO. Measures have been and will continue to be taken to prevent negative impact on T&E populations. Personnel from the USFWS will provide

on-farm consultation if needed to prevent negative impacts on T&E species in this area. The decision diagram used by the NRCS for consultations regarding T&E species can be found in Appendix E, Figure 68 and Table 61.

Natural Areas

Natural areas within this watershed include, but are not limited to, the Wheeler National Wildlife Refuge, parts of Bankhead National Forest, Monte Santo State Park, Lake Guntersville State Park, Cathedral Caverns State Park, Joe Wheeler State Park, Fern Cave National Wildlife Refuge and the Wheeler Arsenal. Natural areas will not be impacted by the project. See Appendix C, Figure 27 for a map of the natural areas within the watershed.

Recreation

According to the Outdoor Industry Association (OIA), outdoor recreation generates \$14 billion in consumer spending annually and over 130,000 jobs in Alabama. Residents of Alabama's 4th and 5th Congressional Districts (associated with the Middle TN River Watershed Area) spend a combined \$2.67 billion on outdoor recreation each year (Outdoor Industry Association, 2017). The most popular recreational activities in these districts include camping, hiking, fishing, and off-roading.

According to a 2017 University of Tennessee study, recreation on Tennessee River and its reservoirs provides about \$12 billion to the local economy and creates about 130,000 jobs each year (Poudyal, et al., 2017). This includes all regions of the river within Tennessee and Alabama. These waters will not be impacted by increasing water withdrawal for increased irrigation.

Floodplain Management

All counties within the study area have opted into the Federal Flood Insurance Program and are therefore subject to FEMA regulations in addition to any further floodplain restrictions applied by the individual counties (i.e., no fill, etc). Therefore, most significant streams have been mapped and regulatory floodplains and floodways have been identified (See Appendix C, Figure 25 for a map of the flood hazard zones within the watershed area).

Farms which contain streams within them could directly impact the associated floodplains while other lands would have indirect impacts on downstream floodplains. Although this project could result in encroachments into the contiguous A1 flood zones, or even the regulatory flood ways by irrigation related structures, the individual farmer would be required to work through the proper authorities in counties to fulfill any necessary public notification, permitting requirements, or variances. The minimal impacts that may result from increased irrigation, either due to small construction projects or small increases in runoff, will not be expected raise the base flood elevation by one foot which is the FEMA requirement. Therefore, it is not anticipated that floodplains will be impacted by the proposed project

Prime Farmland/Important Agricultural Land

Farmland is classified according to its potential to produce food, feed, fiber, forage, and oilseed crops. The farmland subject to the Farmland Protection Policy Act (FPPA) include prime farmland, unique farmland, and farmland of statewide importance. Within the Middle TN River Valley Project

Area, there is 707,220 acres of prime farmland (see Figure 16 in Appendix C). Farmland of statewide importance encompasses 367,487 acres of the watershed. Agricultural production accounts for 689,348 acres, approximately 37 percent of the watershed land use. The actions described in this plan will not convert farmland to a nonagricultural use; therefore, is not subject to the FPPA Rule, 7 CFR Part 658.5. Improved yield due to consistent water supply will sustain agricultural production and has potential to help prevent irreversible conversion of farmland to nonagricultural uses.

Water Quality

Section 303(d) of the Clean Water Act requires EPA and the States to identify and develop plans to restore impaired waters (Total Maximum Daily Loads, TMDL). Review of the 2018 303(d) list of impaired waters in Alabama reveals approximately 34 HUC-12 sub-watersheds containing 303(d)-listed streams are located within the overall project area. Two of the 303(d)-listed streams have high priority status: West Fork Cotaco Creek (siltation) and Elk River (pH and Nutrients). The ADEM cites agriculture as the impairment source for 24 of these 34 impaired HUC-12s.

The ADEM lists 70 approved TMDLs for 48 stream reaches within the Middle TN River Valley Watershed. Of these 48 reaches, there are 21 streams with organic enrichment/dissolved oxygen-focused TMDLs, three streams with nutrient-focused TMDLs, 18 streams with siltation-focused TMDLs, three streams with ammonia-focused TMDLs, and 17 streams with pathogen-focused TMDLs, as shown in the list below.

Name of Waterbody with EPA-Approved TMDL	TMDL - Impairments
1. Aldridge Creek	OE/DO, Siltation
2. Big Shoal Creek	OE/DO
3. Cedar Creek	OE/DO, Pathogens
4. Chase Creek	OE/DO, Siltation
5. Cole Spring Branch	OE/DO, Siltation
6. Cotaco Creek	Pathogens
7. Crowabout Creek	Pathogens, OE/DO, Siltation
8. East Fork Flint Creek	Pathogens, OE/DO
9. Elam Creek	OE/DO
10. Flat Creek	OE/DO, Ammonia, Nutrients, Siltation
11. Flint Creek	OE/DO, Pathogens, Nutrients, Siltation
12. Flint River	Pathogens
13. French Mill Creek	Pathogens
14. Goose Creek	OE/DO, Pathogens
15. Guess Creek	Pathogens
16. Herrin Creek	OE/DO, Ammonia, Nutrients, Siltation
17. Hester Creek	Pathogens
18. Hurricane Creek	Pathogens
19. Indian Creek	OE/DO, Siltation
20. Limestone Creek	Siltation
21. Little Paint Rock Creek	OE/DO, Siltation
22. Mack Creek	OE/DO, Siltation
23. Mallard Creek	OE/DO, Siltation
24. McDaniel Creek	OE/DO, Siltation
25. Mountain Fork	Pathogens

26. No Business Creek	OE/DO, pathogens
27. Robinson Creek	OE/DO, Siltation
28. Round Island	OE/DO
29. Round Island Creek	Siltation
30. Second Creek	Pathogens
31. Shoal Creek	OE/DO, Pathogens, Pathogens
32. Swan Creek	OE/DO, Siltation
33. Town Branch	OE/DO
34. Town Creek	OE/DO, OE/DO, Ammonia
35. Village Branch	OE/DO, Siltation
36. West Flint Creek	Pathogens, OE/DO, Siltation
37. West Fork Cotaco Creek	Pathogens
38. Yellow Bank Creek	OE/DO

The main parameter considered during water quality analyses was total nitrogen due to its correlation with the purpose of this project. Furthermore, nitrogen levels are also used as an indicator of nutrient content for streams in the southeast. High nutrient levels may result in eutrophication and harmful algal blooms (HABs) that reduce the quality of water.

Though the EPA does not have a regulation for total nitrogen loads (nor has the state of Alabama established a standard), EPA guidelines note an acceptable range of 2 to 6 mg/L. A modified USGS SPARROW nitrogen model predicted total nitrogen concentrations for 122 reaches within the study area (See Appendix D, Table 37). Of these, 16 reaches (13 percent) had total nitrogen concentrations above 6 mg/L. Six of these reaches were branches of Paint Rock Creek in the northeast section of the study area. The overwhelming majority of reaches do not exceed the EPA guideline for total nitrogen of 6 mg/L.

Public Health and Safety

Past and ongoing operation of agricultural equipment and vehicle traffic in the watershed presents low to moderate risks to public health and safety. Implementation of additional irrigated acres is not expected to change from current conditions.

All local, state and Federal rules concerning worker safety should be observed. Measures may include signage, lighting, and access control during and after construction.

Riparian Area

There are approximately 765 miles of “blue line” streams in the Middle TN River Valley Watershed based on the USGS National Hydrography Dataset. Using this and Crop Data Layer (USDA/CDL, 2018), there are approximately 136,012 acres of agricultural land adjacent to streams (riparian) (See Appendix C, Figure 30). This defined riparian acreage is found within 2 km of the TN River “blue line” and 0.5 km of all other “blue line” streams. This impacts approximately 707 miles of stream reaches in the watershed. Continuing the analysis and using the state irrigation survey (Handyside 2017), there are approximately 12,161 acres of center pivot irrigated agricultural land adjacent to streams (riparian). This impacts approximately 260 miles of stream reaches in the watershed.

Once a potential site has been identified for project implementation, the NRCS CPA-52 form will be completed by authorized personnel, who will further evaluate if there is riparian area present or at risk and/or what mitigation features should be implemented. The onsite EE will be tiered to this Plan-EA.

NRCS policy (190-GM, Part 411) requires NRCS to integrate riparian area management into all plans and alternatives. Although Federal law does not specifically regulate riparian areas, portions of riparian areas, such as wetlands and other waters of the U.S. may be subject to Federal regulation under provisions of the Food Security Act, Clean Water Act, and State, Tribal, and local legislation.

ALTERNATIVES

Formulation Process

Numerous structural and non-structural measures were considered and evaluated in the formulation of alternative plans. Measures which had been determined either not feasible, unacceptable, or did not meet the needs of the area during feasibility studies were not considered in the general reevaluation. These measures included groundwater artificial recharge, intensified drilling of deeper aquifers, moving water across properties, and reallocation of storage in reservoirs and construction of large reservoirs. Engineering, environmental, economic, sociological, institutional, acceptability, and other factors were key in the formulation of alternatives to ensure that resources were not wasted in the development of unreasonable plans.

The process used to formulate alternatives was based on the primary objectives of the SLO. The objectives are to expand irrigation acreage in the Middle TN River Valley Watershed Area while avoiding or minimizing adverse environmental impacts. Additionally, alternatives were devised to meet the project's purpose of agricultural water management, and further the conservation, development, utilization, and disposal of water through the expansion of agricultural water application. The federally assisted alternatives will represent works or practices needed to address the purpose and need for action, while providing the flexibility required for appropriately assessing specific practices at the site level. Given the potential diversity of application and need, the SLO does not wish to limit the flexibility in which this project will support agricultural land use in the form of sustainable expansion of diffused irrigation systems.

Per PL-566 policy and guidelines, project sponsors must have the legal authority and resources to carry out, operate, and maintain works of improvement (Public Law 83-566, Section 2 and Section 4(3)). Alternatives that are not within the scope of actions that ASWCC can entertain as the project sponsor, consistent with PL 83-566 authorities under which this plan was prepared, were eliminated from further study.

Alternatives Eliminated from Detailed Study

Alternatives that did not meet the purpose and need of the project or were determined not feasible as success is unlikely because of the high cost, potential for unacceptable environmental impacts, necessary changes in legislation, and time to develop irrigation districts were removed from subsequent more detailed evaluations. A summary of the alternatives eliminated, and the reason for elimination, is provided below.

Irrigation Districts and Expand Irrigation

The project would support the creation of irrigation districts within the selected watershed as described in the 1965 Alabama Irrigation Districts, Amendment Six legislation. Additionally, the project would support the direct expansion of irrigation on the farm level. The five Irrigation Practices available for cost-share include Low Pressure Center Pivots, Micro-Irrigation, Linear/Lateral Irrigation, Tow/Traveler Irrigation, and Plasticulture. The water source would be supplied by the irrigation district infrastructure. The type of irrigation infrastructure required would vary depending on specific site location and farmer requested applications. The selection of farm

specific details would be planned with the intent to prevent water quality degradation and minimize environmental and cultural resources impacts while supporting existing agricultural land use. However, Alabama abides by the doctrine of riparian rights (2016 Code of Alabama) which prohibits transfer of water off riparian tracts of land and as such, the development of this alternative would require legislative action. The likelihood of success of the required legislation changes, costs, and time to develop across irrigation districts is unknown. Controversy and unacceptable environmental impacts are anticipated with this alternative.

This plan was not considered in further detail due to the estimated potential for unacceptable environmental impacts, anticipated controversy, and unfavorable likelihood of success.

Description of Alternative Plans

The alternatives carried forward for further examination include the *No-Action* Alternative and the *Sustainable Irrigation Expansion (SIE)* Alternative (NED/Preferred). The alternatives were developed in detail and are evaluated in this section of the Watershed Plan/EA.

Alternative No. 1 – No Action/Future Without Project (No Federal Action Alternative)

The project would not provide federal support for the expansion of agricultural water application in the watershed and no action will be taken. Agricultural production is expected to continue as a dominant economic activity within the Middle TN River Valley for the foreseeable future. Using UAH state irrigation survey data from 2006-2015, irrigated acreage has increased in the Middle TN River watershed from a low of 11,298 acres (1.6 percent of total agriculture area) to 24,125 acres (3.5 percent of total agriculture area), (Handyside, 2017). Most of this increase in irrigated land was clustered in two counties (Limestone and Madison). However, there is external evidence that the current land use and ownership may change to favor developed land over agricultural land. A review of the agricultural land use trends from 2007-2012 included an average of 12 percent decrease in number of farms, and an approximate 10 percent decrease in farmland acreage for the counties within the project area (USDA, 2018). Furthermore, according to 2018 U.S. Census Bureau data, four counties in the Middle TN River Valley watershed are listed in the top 15 fastest growing counties by population in Alabama (USDA, 2018). Currently, there is no other program or agency funding that would meet the purpose and need for expanding new, diffused irrigation systems. Therefore, forecasting future adoption would be unreliable as it cannot be assumed that farmers will continue adopting new irrigation or that irrigation adoption trends will remain constant over time.

This alternative was not selected because it does not address the project purpose or needs of the agricultural producers/landowners in the watershed.

Alternative No. 2 - Sustainable Irrigation Expansion Above Current Adoption

The project would support the sustainable expansion of irrigation within the watershed. As aforementioned, irrigated acreage within this watershed increased at an average of 1,425 acres per year from 2006-2015 (Handyside, 2017). The *SIE* Alternative is projected to double that rate (i.e., 2,850 per year) until available program funds are expended (approximately nine years). Depending on farmer application needs, this alternative will allocate funding for the development or additions to water delivery/supply infrastructure and/or irrigation application equipment at the farm level. The selection of farm specific details will be planned to best meet farmer needs and onsite agency

approval/recommendations. Rather than narrowing each possible combination of proposed works and practices into separate alternatives, this alternative is used to provide the necessary flexibility required for appropriately assessing specific practices at the unknown site level. Once project locations are known, an onsite EE will be performed and tiered to this Plan-EA to address the specific environmental effects and assurance of NED effects.

This alternative was selected as the preferred alternative because it contains components that would meet the project purpose, the needs of agricultural producers and land users in the watershed and contribute to the National Economic Development (NED) objective.

Table 12 provides the economic comparison of the two alternatives considered reasonable per NEPA requirements.

Table 12. Economic Comparison of Reasonable Alternatives

	NED/Preferred Alternative (SIE)	No-Action Alternative¹
NED Costs (Average Annual Equivalents) ²		
Technical Assistance Cost	\$37,435.86	-
Investment Costs for increased irrigation	\$1,099,034.49	-
Total Costs	\$1,136,470.35	-
NED Benefits (Average Annual Equivalents) ²		
Damage reduction benefits from increased irrigation	\$1,397,703.44	-
Total Benefits	\$1,397,703.44	-
NED Net Benefits (Average Annual Equivalent) ²	\$261,233.09	-
Benefit-Cost Ratio	1.23	-

¹ With no plan, funds dedicated towards irrigation investment in the future are uncertain. Therefore, there are no NED costs and benefits to be projected in a future without the plan.

² Price base: 2019 dollars, amortized over 60 years at a discount rate of 2.875%

ENVIRONMENTAL CONSEQUENCES:

The purpose of this section is to provide a comparison of effects under each of the alternatives being carried forward for further analysis in the Plan-EA, in addition to, measuring the effects the alternatives have on existing conditions (no-action).

1. Effects of Alternative Plans

The plans selected for evaluation have the potential for affecting resources to a varying degree.

1.1 Soils

No Federal Action

Under rainfed farming, erosion from fields may occur during drought periods. This results from poor crop root structure development that stabilizes soils during these drought periods, leaving the land potentially fallow with no cover. Eventual rainfall creates excessive runoff and erosion.

Expand Irrigation

Direct Effects

Erosion from irrigated fields can result from numerous reasons. Methods that directly flood parts or all of the field (e.g., surface or border irrigation) can carry large amounts of sediment off the field when drained or applied improperly. The increase in natural runoff that can accompany irrigation could also carry sediment from the field. In this case, the amount of erosion, or sediment flushing, would be highly dependent on several conditions including irrigation technology used, the amount and intensity of rainfall and runoff, the erodibility of the soil, and the slope of the field. For example, tow irrigation systems can have instantaneous application rates that exceed soil infiltration rates resulting in erosion.

Indirect Effects

Indirect effects may include waterlogging.

Temporary Impacts

Temporary impacts may occur when trenching for irrigation delivery systems.

1.2 Air Quality

No Federal Action

No direct effects expected for no federal action.

Expand Irrigation

Direct Effects

Increase of N₂O emissions resulting from the enhanced fertilizer applications which are usually done in conjunction with crop irrigation. Calculations have been done for the average farm size in both the Wheeler and Lower Elk HUCs, and for rainfed and irrigated scenarios. Given the relatively small areas and increase in application rates, models show impacts would be negligible (see Appendix D, Table 58).

Indirect Effects

No indirect effects anticipated.

Temporary Impacts

The generation of particulate dust by construction activities related to installing the irrigation equipment presents the potential air quality impacts. As stated previously, given the relatively small areas and time involved, models show that the impacts would be small (see Appendix D).

1.3 Water Resources

Water Quality

No Federal Action

Direct Effects

Total Nitrogen Loads in Streams:

Overall, rainfed fields receive less fertilizer compared to irrigated fields. However, during a drought, plants are unable to fully develop root systems that are needed to take up the applied fertilizer. When the rainfall returns, the residual nitrogen may be carried off the fields by surface runoff or leached into the groundwater during fallow periods. While the results are varied, some studies show that increases in plant uptake of nitrogen allow for fewer nitrates to be available in surface runoff or leaching. The conversion of agricultural land into urban land would likely increase surface runoff due to the correlated conversion to impervious surfaces.

The USGS Spatially-Referenced Regression On Watershed attributes (SPARROW) nitrogen model estimated baseline water quality conditions for reaches in the Wheeler and Lower Elk HUCs that comprise the Middle TN River Valley Watershed Plan Area. These areas have been evaluated with a modified SPARROW model that constrains outputs to HUC-8s in Alabama and a portion of central and southeastern Mississippi. The modified SPARROW model was first used to evaluate if the total irrigated acres were related to nitrogen outputs. A notable relationship was not found between the total irrigated acres and nitrogen outputs. The current irrigated acreage is not driving the total nitrogen concentrations in streams and rivers ($p = 0.94$).

SPARROW was also used to determine the impact on total nitrogen concentrations if the existing trends to irrigate agricultural lands continue for the 60-year project planning scope. In that scenario, approximately five percent of the total area in the basin would be irrigated

lands which would not result in any additional reaches to exceed the total nitrogen guideline of 6 mg/L.

Overall, the No-Action alternative is unlikely to have considerable effects on the current nitrogen loads in streams. See Appendix D for modeled data on total nitrogen per reach for the current or baseline conditions.

Dissolved Oxygen:

Excess nutrient and sediment loads that may run off of farmlands contribute to eutrophication resulting in removal of dissolved oxygen. Dissolved oxygen may be removed by algal respiration, the decomposition of dead algae, and sediment oxygen demand. Low dissolved oxygen levels are harmful to aquatic life. Under the No-Action alternative, the SPARROW model does not predict that excessive nutrients will be added to the streams.

Water Turbidity:

Sediment transported in runoff from barren fields (caused by drought) could increase the turbidity of the receiving waters. Increased sediment turbidity impacts primary productivity, degrades stream habitat, and negatively affects some fish and macroinvertebrates. Model results under the No-Action alternative indicate that water turbidity is unlikely to be impaired in the future.

Indirect Effects/ Temporary Impacts

No indirect effects or temporary impacts are anticipated for the no federal action alternative.

Expand Irrigation

Direct Effects

Groundwater Leaching:

Results concerning the effects of leaching on groundwater quality are varied, but the majority of studies indicate that leaching is increased under irrigation. Leaching is influenced by field irrigation application methods. Application of irrigation water that exceeds field capacity allows for vertical movement of moisture and nutrients out of the soil column. Soil texture and subsurface conditions, such as depth to the water table, also contribute to groundwater leaching. Irrigation applied according to best management practices reduces the risk of groundwater leaching.

Increased Runoff due to Irrigation:

The purpose of irrigation is to maintain the soil moisture of agricultural fields at an optimum level for plant growth during dry periods. The stabilization of soil moisture from irrigation may increase runoff during rainstorms and smaller rain events that typically would not have runoff. Runoff increases are minor, and the irrigated area is small compared to the watershed area as a whole. The small increases in runoff are not expected to degrade downstream habitats or increase flood levels.

Increased Total Nitrogen Loads in Streams:

More fertilizer is applied to irrigated fields when compared to rainfed cases because the stable soil moisture in irrigated fields allows for increased uptake of nutrients by the plants. The potential exists for some of this increased nitrogen to be carried off the fields directly by surface runoff or leached into the groundwater during fallow periods. While results are varied, some studies show that increases in plant uptake of nitrogen allow fewer nitrates to be available for surface runoff or leaching.

An increase in irrigated agricultural lands has the potential to increase fertilizer loads. The Alabama Cooperative Extension System estimated fertilizer rates of 202 kg/ha for rainfed agricultural fields and 280 kg/ha for irrigated fields. The USGS SPARROW model was used to determine the effects of additional fertilizer loads on existing agricultural lands at the reach scale in the Wheeler and Lower Elk study area. This approach assumes that all existing agricultural land is rainfed and that other model variables are constant for each scenario of additional fertilizer tested. The approach assumes 5, 10, 15, 20, and 25 percent increases in the amount of existing agricultural land that convert from rainfed to irrigated status. Using this assumption, the potential impact of the preferred alternative on water quality is analyzed to provide information covering a broad range of potential impacts over the 60-year planning horizon (see Appendix D). Total irrigated lands will increase to approximately 10 percent of total land area in the basin given existing irrigation trends plus the anticipated expansion of irrigated lands through this project.

Total nitrogen concentration data was modeled for each of the alternate percentage scenarios for 122 reaches in the study area (see Appendix D, Table 37 and Figure 35). SPARROW modeling results for a 10 percent conversion of rainfed irrigated agricultural lands indicate that only two tributaries of Sugar Creek, both located in the Sugar Creek HUC-12, will increase enough to change class or category on the HUC-12 total nitrogen concentration map. In the ten percent scenarios, the Sugar Creek HUC-12 moves from a low (< 2 mg/L) to a medium (2 -6 mg/L) category for total nitrogen. No additional reaches increase total nitrogen concentrations above the 6 mg/L EPA guideline for the 15 percent and 20 percent irrigation scenarios. One reach located in Mallard Creek exceeds 6 mg/L of total nitrogen concentration in the 25 percent scenario. Reaches in the study area that exceed 6 mg/L should be evaluated on a case-by-case basis in accordance with the NRCS-CPA-52 on-farm evaluation to determine the impacts of additional irrigation on nitrogen loads and the mitigation measures required.

Dissolved Oxygen:

Excess nutrient and sediment loads that may run off of farmlands contribute to eutrophication resulting in removal of dissolved oxygen. Dissolved oxygen may be removed by algal respiration, decomposition of dead algae, and sediment oxygen demand. Low dissolved oxygen levels are harmful to aquatic life. In the expand irrigation alternative, the SPARROW model does not predict that excessive nutrients will be added to the streams that would lower the dissolved oxygen.

Water Turbidity:

Sediment transported in runoff from barren fields (caused by drought) could increase the turbidity of receiving waters. Increased sediment turbidity impacts primary productivity, degrades stream habitat, and negatively affects some fish and macroinvertebrates. Model results under this alternative show that water turbidity is unlikely to be impaired in the future.

Indirect Effects

This alternative has minimal to moderate potential for indirectly affecting downstream water quality.

Temporary Impacts

Water quality parameters such as turbidity and water clarity could be temporarily impacted due to land disturbing activities associated with the construction of irrigation delivery systems. Impacts would be short-term and of low magnitude. Projects should be evaluated per NRCS-CPA-52 on-farm evaluation to determine if the short-term construction to implement irrigation systems requires mitigation measures.

Water Quantity**No Federal Action**

This alternative would have negligible impact, above current adoption rates, on water quantity.

Expand Irrigation***Direct Effects*****Surface Water**

Withdrawal of water from streams for irrigation will naturally lead to reduced flow in the streams. It may also affect the statistical frequency of events such as hydrologic droughts and floods. Irrigation withdrawals occur during the growing season (spring-summer) and increase during dry or drought conditions. Withdrawals during a drought may exacerbate already low stream flows. This could result in impacts on in-stream and riparian habitats. According to the USGS and OWR assessment, 65 percent of irrigation withdrawals in the basin are surface water sources while 35 percent of irrigation withdrawals are from groundwater. Water quantity was analyzed for the entire basin using multiple methods. Extensive modeling at the HUC-8 watershed level was conducted using the Water Supply Stress Index (WaSSI) in conjunction with the DSSAT/GriDSSAT crop model. Tributaries within the basin were analyzed using the SPARROW model for impacts associated with runoff. This was done to further predict irrigation use that may not have direct access to the Tennessee River. Finally, the “irrigation density” analysis is used as a proxy to protect in-stream flows in the smaller watersheds (HUC-12). Promoting expanded irrigation in HUC-12s that have less than 10 percent of the overall drainage areas as irrigated acres is recommended to protect local water supplies and existing irrigation investments (Srivastava et al., 2010). This is to further ensure impacts to local water resources are negligible to minor in intensity (see Appendix D). Groundwater and aquifers were analyzed using available information from the GSA. In this

case, current and projected irrigation demands were compared to documented aquifer recharge.

DSSAT/GriDSSAT crop modeling is used to estimate irrigation demand as a first step to determining direct effects. Using corn as a proxy for the highest crop demand, the model is run for 90 years, covering both very wet and dry growing seasons as proxies for potential future weather variability. The result is an average irrigation demand as well as a “worst case scenario” driest extreme (See Appendix D). This model demand is then compared to the OWR assessment that included a 2010 snapshot and a 2040 projected irrigation demand. Note that the assessment includes other irrigation users not included in the model such as golf courses, nurseries, and livestock, which reflect water use outside the growing season. The results in Figure 7 below show that the model is in line with reported irrigation use and well below the 2040 projected irrigation demand.

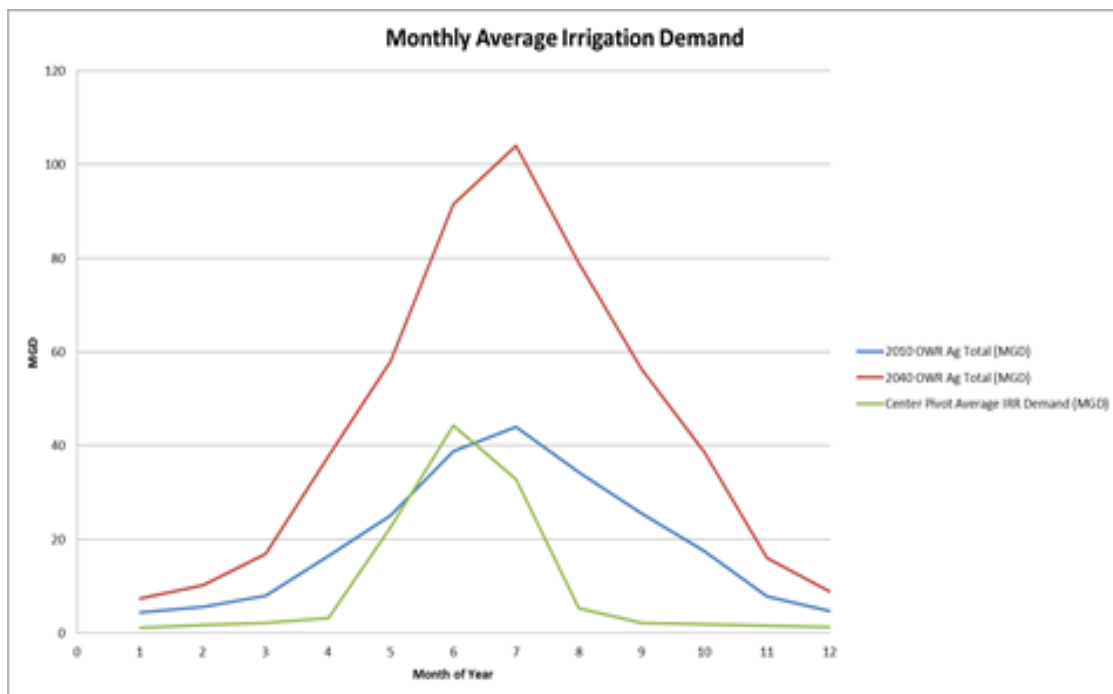


Figure 7: Current irrigation demand compared to OWR current and projected irrigation demand.

When expanding the irrigated acreage up to 25 percent, the model irrigation demand returns an increase well below the projected demand for the basin.

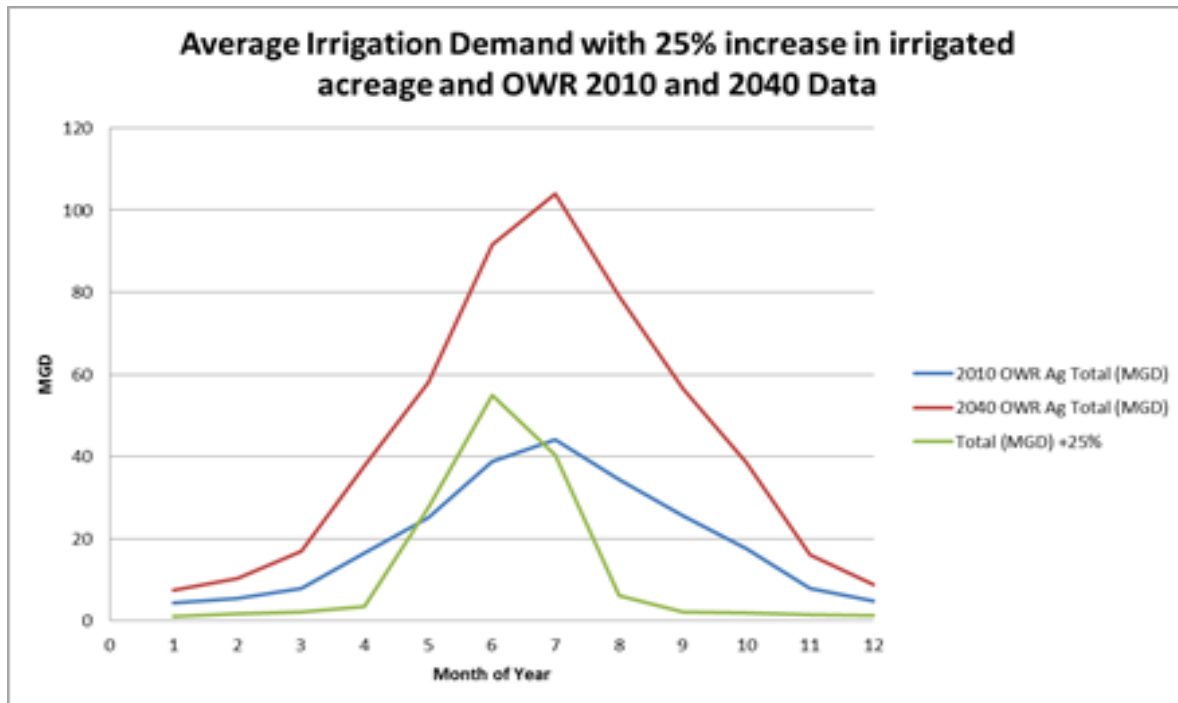


Figure 8: Irrigation demand with a 25% increase compared to OWR current and projected irrigation demand.

Hydrologic modeling was conducted using WaSSI. The model combines both hydrologic surface modeling and estimated sector withdrawals, including irrigation across the entire basin, to produce an index of total demand over total available flow in the basin. Using 65 percent surface water withdrawal rates, the model was run with no irrigation demand and with irrigation increased to the 25 percent maximum. The average monthly index values are plotted in Figure 9.

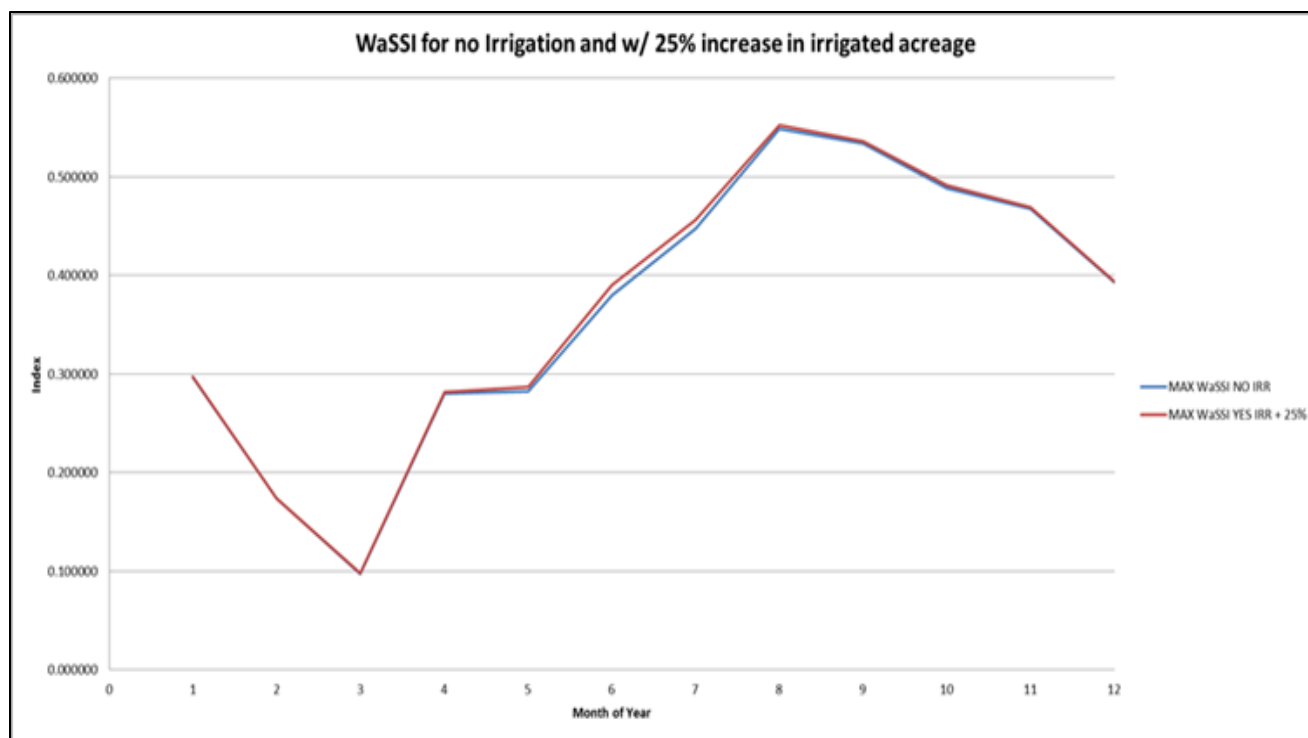


Figure 9: Water Supply Stress Index plot for current and 25 percent irrigation demand

Results indicate no considerable changes in monthly water demand/streamflow as the overall irrigated acreage is increased by 25 percent over the baseline in the basin. The results include the Tennessee River flowing into and out of the basin. The long-term average annual flow at the discharge point (Florence, AL) is approximately 38 million acre-feet. Current and projected irrigation demand is a fraction of a percent of this flow (see Appendix D for details).

The impact to water supplies across the basin would be negligible to very minor.

Surface water extreme scenarios

Separate analysis of the tributaries within the watershed was conducted excluding the Tennessee River flowing into the basin as well as the storage in both Gunterville and Wheeler Lakes. Analyzing the available gauged tributaries within the basin show an average annual runoff of 23 inches.

Current Irrigated Land Scenarios

An average case scenario was assumed where 65 percent of the irrigation demand was supplied by surface water originating only within the basin. If the currently irrigated land in the basin used runoff originating in the basin at the average demand estimate, the irrigation demand would be 0.18 percent of total annual runoff. Current irrigation demand, while not negligible, is minor in intensity.

Threshold Irrigated Land Scenarios

An average case scenario was assumed where 65 percent of the irrigation demand was supplied by surface water originating within the basin. If the sensitivity threshold of approximately 117,000 acres (surface water fraction of 180,000) were irrigated using runoff originating in the basin and at the average demand estimate, irrigation demand would be nine percent of total annual runoff. This upper limit of irrigated land in the basin would be classified as minor intensity.

All Agricultural Land Scenarios

If all the agricultural land in the basin were irrigated and 65 percent of that demand was supplied by runoff originating in the basin at the average demand estimate, it would be about 60 percent of total annual runoff. This is an extremely unlikely scenario but would be classified as major intensity.

Groundwater

According to the USGS and OWR, 35 percent of irrigation withdrawals in the basin are from groundwater sources. Withdrawal of groundwater that exceeds aquifer recharge may result in a lowering of the groundwater table.

As covered in the affected environment section previously, the Fort Payne-Tuscumbia, Bangor, and Pottsville are the 3 largest aquifers in the watershed with an average annual recharge of approximately nine inches. The recharge is used when analyzing current and projected irrigation demand.

Groundwater Extreme Scenarios**Current Irrigated Land Scenarios**

If 35 percent of withdrawals were groundwater sources and all the current irrigated land in the basin used the average demand estimate, it would be 0.04 percent of total recharge in Fort Payne-Tuscumbia (this excludes storage). Current irrigation demand, while not negligible, is very minor in intensity.

Threshold Irrigated Land Scenarios

Assuming an average case scenario where 35 percent of the irrigation demand came from groundwater originating within the basin. If the sensitivity threshold of approximately 90,714 acres (Fort Payne-Tuscumbia fraction of 180,000) were irrigated using runoff originating in the basin and at the average demand estimate, it would be 1.7 percent of total annual recharge. This upper limit of irrigated land in the basin would be classified as minor intensity.

All Agricultural Land Scenarios

Over the long-term, if all the agricultural land in the basin were irrigated and 35 percent of that demand came from groundwater at the average demand estimate, it would be 7.9 percent of total annual recharge in the Fort Payne-Tuscumbia (this excludes storage). This is an unlikely scenario but would be classified as minor intensity.

Indirect Effects

Withdrawals of groundwater that exceed recharge have the potential to lower groundwater levels and decrease stream baseflow recharge.

Temporary Impacts

Temporary streamflow impacts may be experienced in extreme drought low flow stream events.

1.4 Land Cover/Land UseNo Federal Action

No federal action would not result in any direct change to land cover or land use.

Expand Irrigation

The Preferred Alternative will have no effect on land use adjacent to irrigated fields. Installation of irrigation on existing fields will not result in land use changes.

1.5 Human Health & SafetyNo Federal Action

This alternative would not result in any change to transportation routes.

Expand Irrigation*Direct Effects*

During operation and maintenance, there is risk due to heavy equipment, high-voltage electricity, and the use of petroleum products.

Installing irrigation systems on existing farmland should not result in any permanent change to transportation routes.

Temporary Impacts

The Project has increased potential for injuries during project construction, operation, and maintenance. During construction, heavy equipment for trenching and installation of large-scale equipment pose safety risks. Many of the systems may include high-voltage electricity and/or petroleum products. All local, state, and Federal rules concerning worker safety should be observed. Measures may include signage, lighting, and access control during and after construction.

Expanding irrigation has the potential to create minor delays on local roads during installation. However, these would be brief.

1.6 WetlandsNo Federal Action

This alternative should not result in any change to the current depth or spatial extent of existing wetlands over the planning horizon.

Expand Irrigation

Direct Effects

The Preferred Alternative is anticipated to have no adverse impacts on wetlands. The groundwater analyses previously described show that the water table in the region will not be adversely impacted so that the depth and extent of wetlands should remain unchanged. The planned spray and drip irrigation systems will not cause erosion and associated sediment transfer that could fill wetlands and reduce water quality. Expanded irrigation may result in slight increases of runoff and nutrient loads at some sites in close proximity to existing wetlands. An on-farm evaluation (EE) per NRCS-CPA-52 will be required on a case-by-case basis to determine impacts and any required mitigation measures. Also, NRCS Conservation Measures as defined in the “Alabama NRCS Practice Effects on Threatened and Endangered Species” may be required to determine if additional mitigation measures are needed (see Appendix E, Table 61 and Figure 68).

Temporary Impacts

Installation of irrigation systems and related items may temporarily impact wetlands by increasing erosion and runoff from short-term construction activities to access water resources for irrigation. Measures defined in the “Alabama NRCS Practice Effects on Threatened and Endangered Species” will be used to avoid or minimize impacts (see Appendix E, Table 61 and Figure 68).

1.7 Historic and Cultural Resources

No Federal Action

This alternative should have negligible effect on the historical and cultural resources.

Expand Irrigation

Irrigation will only occur on existing farmland currently in production. This alternative will have negligible effect on the historical and cultural resources.

1.8 Fish, Wildlife, Plant Communities

Fisheries

No Federal Action

This alternative should not result in any effect on the fishery communities.

Expand Irrigation

This alternative should not result in any effect on the fishery communities.

Wildlife Habitat

No Federal Action

This alternative should not result in any effect on wildlife habitat.

Expand Irrigation

This alternative should not result in a positive or negative direct effect on wildlife habitat.

Indirect/Temporary Effects

Expanded irrigation is not expected to have a positive or negative direct effect on wildlife habitat.

1.9 Threatened and Endangered Species, Migratory Birds, and Invasive Species

Threatened and endangered species

The extent of potential impact on T&E species is difficult to evaluate until specific project sites have been identified by the NRCS and the SLO. Measures have been and will continue to be taken to prevent negative impact on T&E populations. The SHU data will inform project areas of possible conflict or intersection. Personnel from the FWS will provide on-farm consultation if needed to prevent negative impacts on T&E species in this area. An example decision diagram used by the NRCS for consultations regarding T&E species concerns can be found in Appendix E, Figure 68 and Table 61.

No Federal Action

This alternative should not result in any effect on the current conditions of T&E species.

Expand Irrigation

Direct & Indirect Effects

Expanding Irrigation will involve practices that may have an impact on Federally listed T&E species. All requirements of the USFWS-NRCS Informal ESA Consultation for federally listed species will be followed. See “Alabama NRCS Practice Effects on Threatened and Endangered Species” (see Appendix E, Table 61 and Figure 68). Each of the project-approved practices will be evaluated on a site-specific basis in order to achieve a designation of “no effect” or “not likely to adversely affect.” Endangered Species Act Section 7(a) consultation will occur if necessary, to develop or negotiate reasonable and prudent measures to mitigate potential negative impacts.

1.10 Environmental Justice

No Federal Action

This alternative should not result in any effect on the current conditions of environmental justice.

Expand Irrigation

Expanding irrigation is not expected to cause disproportionately high and adverse environmental or human health effects for minority or low-income populations. The potential effects on the general population's health, social, and economic status will be further evaluated once farm applications have been received. The agency has existing mechanisms to ensure the environmental and public-health concerns of historically underserved communities are considered in its decision-making process to ensure the fair implementation of policies, programs, and activities nationwide.

Once a potential site has been identified for project implementation, the NRCS CPA-52 form will be completed by authorized personnel, who will further evaluate the specific environmental justice conditions. As part of this EE process, agencies must identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations, low-income populations, and Indian Tribes. The NRCS EJ principles that are integrated into conservation program policies and the Field Office Technical Guide will be followed to meet Executive Order 12898.

1.11 Invasive Species

No Federal Action

This alternative should not result in any effect on invasive species.

Expand Irrigation

The expansion of irrigation is not likely to affect the population or re-location of invasive species.

Crop management techniques are designed to remove invasive species of concern. Furthermore, the NRCS-CPA-52 form will be used upon site-selections to evaluate the on-farm risks pertaining to invasive species, ensuring that Executive Order 13112 is followed. Executive Order 13112 states that “a Federal agency shall not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction and spread of invasive species in the U.S. or elsewhere.”

2. Cumulative Effects of Alternatives

Air Quality – The Preferred Alternative is anticipated to have a minor effect during installation due to construction dust generation. Based on previous research and model results, particulate matter concentrations resulting from concrete construction are anticipated to be well below the EPA standard for both 2.5 and 10.0 microns. The Preferred Alternative is anticipated to have negligible effect on air quality during operation. Increased NO_x emissions may result from increased fertilizer rates on existing farmland which are usually done in conjunction with irrigation. Based on the relatively small areas and increases in fertilizer relative to rainfed crops, the cumulative effects across the watershed are expected to be negligible. Even at the field level, expected fertilizer increases are anticipated to result in only minor changes to air quality and are still well below the EPA threshold.

Cultural and Historic Resources – Based on the Alabama Register of Landmarks and Heritage, the Preferred Alternative would not result in disturbances of cultural or historic resources. Installation takes place on existing farmland currently in production. The effect is anticipated to be negligible. Sites identified for implementation will also undergo onsite evaluations as outlined in the Environmental Evaluation Worksheet (NRCS-CPA-52). The onsite evaluation should ensure there are no heretofore unknown resources.

Fish and Aquatic Species – There are a variety of T&E fish and aquatic species throughout the watershed. Quantifying the potential impact on T&E species is difficult at the watershed level. For the Preferred Alternative, all available data concerning T&E species has been provided and will be used as guidance and overview as specific project sites are identified. After selection, the site will also undergo onsite evaluations as outlined in the Environmental Evaluation Worksheet (NRCS-CPA-52). Expanding Irrigation will involve following practices that may have subsequent actions based on the “Alabama NRCS Practice Effects on Threatened and Endangered Species” (see Appendix E, Table 61 and Figure 68). Each of the project-approved practices results in a “no effect”, “mitigating action”, and/or specific “on-farm consult”. Based on this tiered approach, the anticipated effects are expected to be negligible to minor.

Geology & Soils – The Preferred Alternative would result in minor soil disturbance during the installation period. Soil disturbances would be minor, as these effects would be short-term and localized to the irrigation installation site. Effects would be further minimized if necessary, through implementation of soil stabilization measures during installation. The Preferred Alternative may result in increased runoff that could also carry sediment. Effects will be mitigated through NRCS conservation practices as part of the site selection process. Sites identified for implementation will also undergo onsite evaluations as outlined in the Environmental Evaluation Worksheet (NRCS-CPA-52) to identify and resolve additional mitigation measures required to reduce erosion. Anticipated effects are expected to be minor.

Land Cover/Land Use – The Preferred Alternative would have no effect on land use adjacent to the project area, as property ownership and existing use of land would not change. The project is designed to utilize existing farmland; conversion of any other land use to farmland is not anticipated. It is anticipated that the Preferred Alternative would encourage and promote agricultural sustainability in the watershed through adoption of irrigation.

Public Safety and Human Health – The Preferred Alternative would result in safety risks during installation, operation and maintenance of the system due to heavy equipment, high-voltage electricity and use of petroleum products. These risks will be mitigated through strict adherence to all local, state and Federal rules concerning worker safety. Measures may include signage, lighting, and access control during and after construction.

Recreation – There would be negligible effects to land-based recreation from the Preferred Alternative. Effects to Conversion from rainfed to irrigated farmland may have minor positive impacts by increasing vegetation for wildlife that is considered beneficial for recreation. The Preferred Alternative has the potential to affect water-based recreation through impacts to water quality and quantity. Because the anticipated changes to water quality and quantity are expected to be minor, impacts to recreation are anticipated to be minor.

Socioeconomics – The Preferred Alternative has an estimated annual RED benefit of \$582,550.

Vegetation – The Preferred Alternative would increase the volume of crop vegetation. Conversion of existing rainfed to irrigated farmland may result in additional soil moisture for surrounding vegetation which is anticipated to be a negligible to minor positive effect.

Visual Resources – The Preferred Alternative would have negligible to minor effect on the landscape. Existing farmland in the project area is not designated scenic and the irrigation features do not attract additional attention to the landscape.

Water Quantity – The Preferred Alternative is anticipated to have minor effects on both the surface and groundwater supply. Currently there are approximately 24,000 irrigated acres in the watershed. Current irrigation demand from surface supplies in the watershed is less than one percent of total streamflow. Current irrigation demand from groundwater supplies is also less than one percent of recharge rates across the watershed. Using conservative estimates as the threshold for the Preferred Alternative, the Watershed could support up to 180,000 irrigated acres (see Appendix D). At that acreage, irrigation demand from surface water would be less than one percent of total streamflow. Likewise, irrigation demand from groundwater would be approximately five percent of total annual recharge for this 180,000 irrigated acre scenario. The effects are anticipated to be minor. The Preferred Alternative may have localized impacts on smaller tributaries and watersheds within the project watershed. This is mitigated by providing irrigated acreage density at the HUC-12 level to the NRCS and SLO during site selection. Promoting expanded irrigation in HUC-12s that have less than 10 percent of the overall drainage areas as irrigated acres is recommended to protect local water uses and existing irrigation investments.

Water Quality - The Preferred Alternative is anticipated to have minor effects on both surface and groundwater quality. Water quality could be impacted by increased nutrients flushed into surface waters, increased turbidity due to sediment transport and/or biological productivity, or nutrient leaching into groundwater due to irrigation applied in excess of field capacity. However, if irrigation is applied using best management practices, negative impacts are not anticipated to occur. Projections for increased nutrients carried by surface waters are minor assuming the soil moisture is maintained at or below field capacity. The Preferred Alternative may have localized impacts on smaller tributaries and watersheds within the project watershed. This will be mitigated by providing irrigated acreage density at the HUC-12 level to the NRCS and SLO during site selection. If a project site is selected in a HUC-12 with a TMDL present, the USDA-NRCS will adhere to ADEM's non-point source guidelines outlined in the Tennessee River Basin Watershed Management Plan (CWP & ADEM, 2003).

Wetlands, Flood Plains, Riparian Zones – The Preferred Alternative is anticipated to have negligible impacts on Wetlands and Floodplains. Based on the minor changes to water quantity, there are no anticipated negative impacts to existing wetlands and floodplains. Sites identified for implementation will also undergo onsite evaluations as outlined in the Environmental Evaluation Worksheet (NRCS-CPA-52) to identify any potential localized risk to water supply (See Appendix E, Figures 75-79).

Wild and Scenic River - There would be no effects from the Preferred Alternative on the Wild and Scenic River or State Scenic Waterways designation. There are no Wild and Scenic Rivers in or directly downstream of the project watershed.

3. Risk and Uncertainty

3.1 Engineering

Under the preferred alternative, all irrigation systems must be designed by professional engineers or Certified Irrigation Designers (CID). This ensures the system meets (or exceeds) industry standards.

Should the system not be designed and/or installed properly, the risks range from inefficient operation, ineffective results (poor crop production), poor soil, and water quality due to excess erosion to potential injury from high-voltage electricity and malfunctioning petroleum systems (diesel, natural gas).

3.2 Economics

The economic calculations are subject to several components of uncertainty that may influence the actual project outcome. Commodity prices and economic markets fluctuate, so realized prices may differ from those used here. Yield benefits may vary depending on irrigation and farming methods, impacting the benefits of the preferred alternative. Additionally, irrigation may be used for other crops than the four analyzed which may impact both costs and benefits of the preferred alternative.

Furthermore, the uncertainty of future land use conversion and ownership may impact both costs and benefits for the No-Action alternative.

The economic estimations for the NED alternative were based on the assumption that there will be an increase of 2,850 irrigated acres per year for nine years through implementation of new irrigation infrastructure and/or practices. The rate of adoption, and irrigation equipment adopted, may be higher or lower depending on farmer preferences, access to water, and economic conditions. Uncertainty in the rate of adoption of irrigation influences the costs and benefits of the preferred alternative. Actual costs of irrigation may vary from farm to farm, depending on the type of equipment installed, creating uncertainty in the costs of the preferred alternative.

Estimates made for both alternatives were forecasted to 60 years into the future based on the sensitivity analysis of impact projections (see Appendix D). A long-term analysis, such as this, presents risk for uncertainty when making economic estimations.

4. Controversy

No areas of controversy have been identified during stakeholder review meetings or the public involvement process.

5. Precedent for Future Actions with Significant Impacts

The alternatives do not set a precedent for future actions to follow that would be associated with major impacts. Future, similar watershed projects would be evaluated on their own merits and evaluated for effects based on relevant resources identified during each project's scoping process.

6. Compliance with Federal, State and Local Laws

6.1 Federal

SECTION 404 PERMIT

A Section 404 permit from the USCOE would be required for impacts on wetlands and other waters of the U.S. The USCOE requires prior authorization of discharges of dredge or fill material, including those for temporary construction purposes, into waters of the U.S. (33 USC 1344). However, no mitigation is anticipated after preliminary in house review.

ENDANGERED SPECIES ACT

The agency taking the action decides if the proposed action has either a “no effect” or “may affect” on a listed species or designated critical habitat. If the agency determines there is a “may affect” then, Section 7(a)(2) of the Endangered Species Act states that the federal agency shall consult with U.S. Fish and Wildlife Service (USFWS).

Based on a review of the federally listed species concerns within the Project area, the No-Action Alternative has no effect on a listed species or designated critical habitat. On-farm consultation requirements with the USFWS will address concerns with increasing irrigated agricultural acreage to avoid or minimize T&E species impacts.

NATIONAL FLOOD INSURANCE PROGRAM

Neither the No-Action nor the preferred alternative are anticipated to be influenced by or influence the National Flood Insurance Program.

NATIONAL HISTORIC PRESERVATION ACT

Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires Federal agencies to determine whether their undertakings will have an adverse impact on historic properties that are listed on or are eligible for listing on the National Register of Historic Places and to afford the Advisory Council on Historic Preservation a reasonable opportunity to comment.

BALD AND GOLDEN EAGLE PROTECTION ACT

The proposed project is unlikely to affect either the bald or golden eagle or their habitats.

MIGRATORY BIRD TREATY ACT

The proposed project is unlikely to affect migratory birds or their habitats as the lands that will be irrigated will be existing agricultural lands.

CONSULTATION, COORDINATION, AND PUBLIC PARTICIPATION

The public involvement process for this project assisted in identifying environmental resources and sensitivities within the watershed, developing the most thorough and effective options for meeting project goals, maintaining public buy-in for the project objectives and alternatives selection process, and gathering public and farmer input of desired outcomes.

Public Participation Objectives included the following:

- Use clear and concise messaging to communicate with the public and various stakeholders.
- Successfully communicate realistic goals and schedule for the assessment.
- Promote science-based decision-making informed by public and stakeholder input.
- Provide appropriate notice of opportunities for public participation.

On behalf of the SLO, two farmer listening sessions were conducted during the development of the Preliminary Investigation to receive feedback and encourage stakeholder engagement. The first listening session was held on October 23, 2018 from 5:00 pm to 7:00 pm at the Tennessee Valley Research and Extension Center in Belle Mina, AL. An additional meeting that targeted participation of underserved farmers was conducted on November 27, 2018 from 9:30 am to 12:00 pm at the Lawrence County Agricultural Center in Moulton, AL. The sign-in sheets for the meetings can be found in Appendix E, Figures 57 and 58.

A Public Meeting was held on January 22, 2019 to share information and details regarding the Plan-EA, and to receive public comment and concerns (See Appendix E, Figure 61-62). The intent of the meeting was to explain the evaluated project alternatives and findings of the scoping process and investigation.

The public meeting was approximately one hour in duration and was held between the hours of 5:00 pm and 6:00 pm. The meeting was held at the Aerospace Training Center – Calhoun Community College 6250 US-31, Decatur, AL 35609. Public notice was placed twice in the local newspaper, 14 days in advance of the open house. Meeting displays and project maps were available for consideration by attendees. A project factsheet was developed and provided. Notecards and a station for public comment were available throughout the meeting. The NRCS, ASWCC, and technical team were available for discussion with attendees.

Prior to the public meeting, a cooperating agency pre-meeting was held to receive input and share additional information with the invited cooperating agencies (see Appendix E, Figure 60 for the Agency sign-in Sheet). An online (Zoom format) was also offered for any Cooperating Agency representative that could not attend the meeting in Decatur on January 22. This online meeting took place on January 25, 2019 from 9 am to 11 am.

Attendance: 17 people attended and signed-in at the public meeting. See Appendix E, Figures 61-62 for copies of the meeting sign-in sheets.

Meeting Materials and Comments: The public meeting included a formal presentation as well as an open floor discussion period to receive and answer questions or comments from attendees. Comments received from attendees are documented in Appendix A. The meeting itinerary/agenda and project fact sheet was distributed to all attendees (attached as Figures 63-65 in Appendix E). Also, a webpage to share project information was developed and shared at the public meeting as a means to access the Draft EA and offer comment. The link to the webpage is included below:
<https://cses.auburn.edu/eve-brantley/draft-middle-tn-river/>

Public Notice: The public and interested stakeholders were notified of the public meeting by public notice placed twice in the Huntsville Times newspaper. The notice ran on January 6 and January 13, 2019. See Figure 59 in Appendix E for the public notification advertisement affidavit.

Direct Mailing Invitations: An invitation letter was created and distributed to agencies and organizations identified as cooperating agencies. Additionally, an Email was sent to cooperating agencies to share the project web page, a copy of the Draft Plan, provide specific dates and details for sending comments and suggestions, and to remind agencies of the interactive webinar held on January 25. See Appendix E for the Invitation Letter (Figure 66) and E-mail (Figure 67) sent to Cooperating Agencies.

Agency Consultation: The following agencies and tribal communities were contacted and invited to be cooperating agencies to cooperate with the EA process and determine if there were new circumstances or information relevant to the environmental concerns and bearing on the proposed actions or its impacts. In accordance with the NRCS guidelines, each group was formally invited to participate. Agencies invited to participate include the Tennessee Valley Authority (TVA), U.S. Fish and Wildlife Service (USFWS), Alabama Department of Economic and Community Affairs (ADECA), U.S. Army Corps of Engineers (USCOE), United States Geological Survey (USGS), Geological Survey of Alabama (GSA), Alabama Department of Environmental Management (ADEM), Alabama Association of Conservation Districts (AACD), Alabama Soil and Water Conservation Districts (SWCD), Auburn University (AU), Alabama Cooperative Extension System (ACES), Tuskegee University (TU), Alabama A&M (AAMU), Rural Development (RD), USDA Farm Service Agency (FSA), The Nature Conservancy (TNC), Alabama Rivers Alliance (ARA), Poarch Band of Creek Indians (THPO), State Historic Preservation Office (SHPO), and Alabama Department of Conservation and Natural Resources (ADCNR). Furthermore, representatives from local NRCS, SWCD, Extension, and 1890 Land Grant Universities (Tuskegee University and Alabama A&M) were invited, via email, to participate and encourage participation of their stakeholders in the farmer listening sessions and public meeting (see Appendix E, Figures 69 & 70).

Tribal consultation is currently being conducted in accordance with the National Historic Preservation Act (NHPA) of 1966 and Executive Order 13175 to maintain a relationship between NRCS and native tribes, and to ensure the local tribal populations were notified of the scoping process. NRCS sent a letter to the Tribal Historic Preservation Office (THPO) requesting the Poarch Creek Tribe delegate input and making the local tribal communities aware of the planning process.

Confirmation and details regarding this communication and outreach are to be provided by Vernon Abney with NRCS-AL.

Significant coordination and collaboration occurred with agencies such as the GSA, TVA, ADEM, USFWS, and OWR as seen in Table 13, below.

The USCOE was invited as a Cooperating Agency. The CPA-52, EE, will identify consultation per the MOU between the NRCS and USCOE.

Further, the Tennessee Valley Authority is considered a Special Designated Area where special commissions have been established with statutory authority to coordinate resource planning and development activities. The TVA and NRCS, formerly the Soil Conservation Service (SCS), entered into a memorandum of understanding (MOU) on November 6, 1958. The MOU between TVA and SCS has been included in Appendix E, Figure 55 of this Plan.

Table 13. Agency and Public Consultation and Coordination Record Summary

Date	Contact, Agency	Communication
August 14, 2018	Bill Pearson, USFWS Eric Spadgenske, USFWS Evan Collins, USFWS Shannon Holbrook, USFWS Josh Rowell, USFWS Jennifer Pritchett, USFWS Andy Ford, USFWS Shannon Weaver, NRCS Vernon Abney, NRCS Jeff Thurmond, NRCS Steve Musser, NRCS Cameron Handyside, UAH (via phone, PL-566 discussion only)	<ul style="list-style-type: none"> ● Overview of Watershed Assessment & Planning process ● Requested assistance and data ● Identified potential concerns
September 12, 2018	Jason Throneberry, TNC Mitch Reid, TNC Cindy Lowry, ARA Curt Chaffin, ARA Eve Brantley, ACES/AU Cameron Handyside, UAH	<ul style="list-style-type: none"> ● Overview of Watershed Planning process ● Identify resource concerns ● Discuss collaboration on Sustainable Agriculture Initiative
September 14, 2018	Chris Johnson, ADEM Eve Brantley, ACES/AU Cameron Handyside, UAH	<ul style="list-style-type: none"> ● Discussion of streamflow necessary for assimilation of effluent discharge. ● Discussion of reaches identified in the 303d report, identifying pollutants and sources
September 19, 2018	Jason Throneberry, TNC Curt Chaffin, ARA Shannon Weaver, NRCS Roy McCauley, AL Pulp & Paper Bob Plaster, AL Agriculture and	<ul style="list-style-type: none"> ● Steering Committee Meeting to identify concerns and contacts to aid scoping process ● Multi-Criteria Decision Analysis Explanation ● Discussed milestones & concerns ● Request input and ideas for farmer participation and

Table 13. Agency and Public Consultation and Coordination Record Summary

	Industries Vernon Abney, NRCS Ben Malone, USDA-NRCS Tom Littlepage, ADECA-OWR Pat O'Neil, GSA Ann Arnold, GSA Chris Johnson, ADEM William Puckett, ASWCC John Christy, UAH Cameron Handyside, UAH David Thompson, ADEM Brian Atkins, ADECA-OWR Katy Sulhoff, AACD Mitch Reid, TNC Bennett Bearden, GSA Greg Guthrie, GSA David Cole, ALFA Mitt Walker, ALFA Brenda Ortiz, AU/ACES Eve Brantley AU/ACES Laura Bell, AU Nikki Dictson, AU Rachel Kuntz, AU Ashley Henderson, ASWCC J.O. Norris, ASWCC	outreach <ul style="list-style-type: none"> Watershed selection process and site prioritization tools Timeline and Agency cooperation in data searching and analyses
September 21, 2018	Dewayne Johnson, New Market Agricultural Equipment Company Cameron Handyside, UAH	<ul style="list-style-type: none"> Discuss irrigation, the process he normally follows with a customer, and all the different components of an irrigation system.
October 23, 2018	46 attendees (see Appendix E, Figure 57 for copy of sign-in sheet)	<ul style="list-style-type: none"> Farmer Interest meeting to present overview of project planning process Request/discuss stakeholder information, input, and interest for participation
November 9, 2018	Jeannie Barlow, USGS Drew Westerman, USGS Wade Kress, USGS Michael Bradley, USGS Eve Brantley, AU Cameron Handyside, UAH Ashley Henderson, ASWCC	<ul style="list-style-type: none"> Zoom meeting to provide overview of Alabama irrigation watershed planning. USGS provided overview of current data and models that may be applicable to current and future watershed plans. Meeting date set for January 2019, canceled due to federal government shut down.
November 26, 2018	Nick Morris, TVA Gary Springston, TVA Cameron Handyside, UAH Eve Brantley, AU Ashley Henderson, ASWCC William Puckett, ASWCC	<ul style="list-style-type: none"> Discussed TVA 26A permitting process for obstructions entering TVA controlled waters Discussed easement processes and necessary environmental reviews TVA's official guidelines on temporary withdrawals are <i>"If the State in which the extraction is to take place"</i>

Table 13. Agency and Public Consultation and Coordination Record Summary

		<p><i>approves or concurs in writing to TVA that the temporary withdrawal or extraction of water is acceptable to that particular state, then TVA will make a determination as to whether a Section 26a permit is required. TVA's decision on the need for a Section 26a permit will be based on a number of factors including (but not limited to) the State's approval, location of extraction, purpose, extraction amount, duration, environmental impacts, operational impacts, and other potential case-specific considerations."</i></p> <p>Thus, permits may not be required for temporary intakes, determined by TVA.</p> <ul style="list-style-type: none"> ● Permits are not required for users using a pipe of less than 6 inches in diameter or pulling less than 50k gal/day from tributaries of the TN River. ● TVA noted that T&E may be the main focus watershed wide, but low flow impacts could be a bigger issue locally. ● TVA staff indicated that irrigation impacts would likely be negligible on TVA impounded waters (e.g. Wheeler and Elk River up to approximately mile 29). Outside of the impounded waters, water quantity could be a major concern.
November 27, 2018	26 attendees (see Appendix E, Figure 58 for copy of sign-in sheet)	<ul style="list-style-type: none"> ● Underserved farmer listening session ● Receive input from underserved farmers ● Give updated information regarding the Planning process
January 22, 2019	14 attendees (see Figure 60 in Appendix E for list of attendees)	<ul style="list-style-type: none"> ● Agency pre-meeting to receive agency input and offer updated information regarding the Planning process
January 22, 2019	17 attendees (see Figures 61-62 in Appendix E for list of attendees)	<ul style="list-style-type: none"> ● Share the Draft Plan-EA and receive public comments and questions ● Update attendees on anticipated timeline and further requirements
January 25, 2019	Ann Arnold, GSA Greg Guthrie, GSA Bennett Bearden, GSA David Thompson, ADEM Mitt Walker, ALFA Cameron Handyside, UAH Eve Brantley, AU Rachel Kuntz, AU Brian Atkins, OWR Michael Harper, OWR Tom Littlepage, OWR Ashley Henderson, ASWCC	<ul style="list-style-type: none"> ● Agency webinar meeting held to receive questions and comments regarding the Plan-EA

THE PREFERRED ALTERNATIVE

The project sponsors selected the *SIE* Alternative as the Preferred Alternative, based on its ability to meet the purpose and need for the project and provide the most beneficial effects on environmental and social resources. The Preferred Alternative is the only alternative that meets the SLO purpose and needs and meets the NED benefit-cost ratio.

Rationale for Alternative Preference:

Alternative plans were formulated as required by NRCS policy and the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) (USWRC, 1983). According to P&G, an alternative that reasonably maximizes net national economic development benefits while protecting the Nation's environment is to be formulated. This alternative is to be identified as the National Economic Development (NED) Plan. Alternative II, *Sustainable Irrigation Expansion (SIE)*, is the NED plan and the Preferred Alternative. This alternative was selected as the Preferred Alternative because it contains components that meet the project purpose, the needs of agricultural producers and land users in the watershed and contribute to the National Economic Development (NED) objective. A local sponsor (ASWCC) has agreed to fund the local share of the cost. The Preferred Alternative provides funding for projects that will increase irrigation on acreage used for agricultural production within the project area. Conservation measures will be planned and applied based on the NRCS onsite EE/consultations and recommendations in order to increase irrigation efficiencies and/or mitigate possible impact on the surrounding environmental resources.

Measures to be Installed:

Supporting practices appropriate for the farm irrigation technology selected will be considered for cost-share. The five Irrigation Practices proposed for cost-share include Low Pressure Center Pivots, Micro-Irrigation, Linear/Lateral Irrigation, Tow/Traveler Irrigation, and Plasticulture. The list below describes the supporting practices associated with each technology. Power systems available for cost-share may include but are not limited to phased electricity and power units. The sources of water that will potentially be used for the diffused irrigation systems include surface stream and/or groundwater, depending on what sources are available at the specific site level. The type of irrigation infrastructure and necessary practices (i.e. pipes, pumps, application equipment, etc.) and water source selected would vary depending on specific site location, farmer project application needs, and must follow NRCS standards.

Mitigation and conservation associated with each practice will be determined by Environmental Evaluation (CPA-52) that will be conducted on each project site and tiered to this document. All work must be performed in accordance with a plan that meets the standards and specifications of the CID, PE, or other qualified design professional. The five irrigation application practices proposed for cost-share are listed below.

- **CENTER PIVOT LOW PRESSURE:** Telemetry, Pumping plant, Variable Rate/Speed Control, Pivot system/Benders/Corners, 3-phase electricity, GPS, Pipeline, Generator, Motors, Well /pump, Remote Management, Flow Meter
- **MICRO-IRRIGATION:** Telemetry, Buried drip tape, Chemical injection system, GPS, Flow meter, Filter System, Pipeline, Backflow preventer, Well/pump, Trenching earth
- **LINEAR/LATERAL IRRIGATION SYSTEM:** Linear/Lateral irrigation system, Telemetry, Pumping plant, Variable Rate/Speed Control, Pivot system/Benders/Corners, 3-phase electricity, GPS, Pipeline, Generator, Motors, Well /pump, Remote Management, Flow Meter
- **TOW/TRAVELER SYSTEM:** Telemetry, Trenching earth, Flow meter, Tow System, Pipeline
- **PLASTICULTURE (MICRO IRRIGATION):** Bedding of soil, Mulching (plastic), Drip system (Pipe and fittings), Well/pump

Mitigation Features:

Irrigation systems will be designed and approved by certified irrigation designers or professional engineers, and requirements exist for systems to be installed and maintained properly. Soil disturbing practices may be minimized by limiting disturbance and providing temporary erosion control. All local, state and Federal rules concerning worker safety should be observed. Measures may include signage, lighting, and access control during and after construction.

The NRCS may find specific mitigation features to be necessary once the onsite EE has been conducted, and recommended conservation measures will be incorporated into site-specific project designs to prevent negatively impacting cultural resources, wetlands, streams, T&E species, etc. Mitigation for impacts associated with on-farm construction will also be provided as needed. These measures may include the Best Management Practices (BMP) described below.

- Appropriate erosion control measures would be used.
- Adjacent landowners would be provided a construction schedule before construction begins.
- Ground disturbances would be limited to those areas necessary to safely implement the Preferred Alternative.
- Stormwater and erosion BMPs would be implemented as appropriate.
- Construction would occur outside of the nesting period and outside of the USFWS approved buffer distances for any known bald and golden eagle nests. Should an active bald or golden eagle nest be found during construction, construction would be paused and consultation with a local USFWS biologist would occur to determine the following steps.
- Appropriate emission control devices would be required for all construction equipment.
- When needed, water or other dust suppressants would be used on unpaved roads and areas of ground disturbance to minimize dust and any effects on air quality.
- An Inadvertent Discovery Plan would be followed if cultural materials including human remains were encountered during construction. Construction would stop accordingly, SHPO

and NRCS cultural resources staff would be consulted, and appropriate tribes would be notified. Continuation of construction would occur in accordance with applicable guidance and law.

Permits and Compliance:

Permits and compliance required for the installation of the NED alternative will depend onsite specific project proposals and agency consultations. A list of possible permits that may be required has been formulated and described below. This list includes examples brought to the local sponsor's attention but may not be complete or inclusive of all possible permits and compliance necessary.

- I. A Certificate of Use will be required by the OWR for the installation of irrigation systems requiring water greater than 100,000 gallons per day
- II. A permit from TVA will be required for surface water withdrawal
- III. An easement for the property owner to traverse TVA property
- IV. National Pollutant Discharge Elimination System (NPDES)
- V. Section 404 Permit

Invitations were sent to agencies and organizations identified as cooperating agencies (see the Consultation, Coordination, and Public Participation section) to determine if there are new circumstances or information relevant to the environmental concerns and bearing on the proposed actions or its impacts which may require additional permits or compliance.

Compliance with Local, State, and Federal Laws:

All applicable local, state, and federal laws will be complied with in the installation of this project.

Economic Benefits-Costs for Preferred Alternative

A summary of the economic analysis of the Preferred Alternative (NED Alternative) and No Action Alternative is provided in Alternatives Section (see Table 12). The full NED analysis can be found in Appendix D. Average annual benefits range between are estimated at roughly \$1.4 million; average annual costs are estimated at roughly \$1.1 million, for an estimated benefit–cost of 1.23. We estimate average annual RED benefits to be \$582,550. The following tables provide more detail on the costs and benefits associated with the Preferred Alternative.

Table 14 (NWPM 506.11, Economic Table 1) presents the projected installation costs and the percentages of costs to be shared by PL 83-566 and other funding sources.

Table 14. Economic Table 1-- Estimated Installation Cost, Middle Tennessee River Valley Watershed, Alabama, 2019\$

Works of Improvement	Unit	Number			Estimated cost (dollars) ^{1,2,3}						
					Public Law 83-566 Funds			Other Funds			Total
		Federal Land	Non-Federal Land	Total	Federal Land NRCS	Non-Federal Land NRCS	Total	Federal Land	Non-Federal Land	Total	
Investment in Irrigation Equipment	Acres	0	25,650	25,650	\$-	\$20,794,134	\$20,794,134	\$-	\$16,339,050	\$16,339,050	\$37,133,184
Total Project	Acres	0	25,650	25,650	\$-	\$20,794,134	\$20,794,134	\$-	\$16,339,050.	\$16,339,050	\$37,133,184

¹Price Base: 2019 dollars

²Project cost includes 6.25% technical assistance costs

³Assume 70% of PL 83-566 funds go towards a 50% cost-share with farmers, while 30% of PL 83-566 funds go towards a 65% cost-share with farmer. Other funds represent farmer contributions.

Table 15 (NWPM 506.12, Economic Table 2) presents the project's cost distribution, as well as the proportion of PL 83-566 funding and other funding sources.

Table 15. Economic Table 2-- Estimated Cost Distribution Irrigation Equipment Investment, Middle Tennessee River Valley Watershed, Alabama, 2019\$

Works of Improvement	Installation Costs-PL 83-566 Funds ^{1,2}			Installation Costs-Other Funds			Total
	Construction	Project Admin ³	Total PL 83-566	Construction	Project Admin	Total Other	
Investment in Irrigation Equipment	\$19,570,950.00	\$1,223,184.38	\$20,794,134.38	\$16,339,050.00	\$-	\$16,339,050.00	\$37,133,184.38
Total costs	\$19,570,950.00	\$1,223,184.38	\$20,794,134.38	\$16,339,050.00	\$-	\$16,339,050.00	\$37,133,184.38

¹Price Base: 2019 dollars

²Assume 70% of PL 83-566 funds go towards a 50% cost-share with farmers, while 30% of PL 83-566 funds go towards a 65% cost-share with farmer. Other funds represent farmer contributions.

³Project Admin includes project administration, technical assistance costs and permitting costs.

The average annual NED costs are shown in Table 16 (NWPM 506.18, Economic Table 4).

Table 16. Economic Table 4-- Estimated Average Annual NED Costs, Middle Tennessee River Valley Watershed, Alabama, 2019\$

Works of Improvement	Project Outlays (Amortization of Installation Costs) ¹	Project Outlays (OM&R cost)	Other Direct Costs	Total ¹
Investment in Irrigation Equipment	\$1,136,470.35	\$-	\$-	\$1,136,470.35
Total	\$1,136,470.35	\$-	\$-	\$1,136,470.35

¹Price base: 2019 dollars, amortized over 60 years at a discount rate of 2.875%

Table 17 (NWPM 506.20, Economic Table 5a) summarizes annual average NED project benefits.

Table 17. Economic Table 5a-- Estimated Average Annual Watershed Protection Damage Reduction Benefits, Middle Tennessee River Valley Watershed, Alabama, 2019\$

Item	Damage Reduction Benefit, Average Annual	
	Agricultural-Related ¹	Non-Agricultural Related ¹
Onsite Damage Reduction Benefits		
Increasing crop acreage profitability with irrigation ²	\$1,397,703.44	\$-
Subtotal	\$1,397,703.44	\$-
Offsite Damage Reduction Benefits		
Subtotal	\$-	\$-
Total Quantified Benefits	\$1,397,703.44	\$-

¹Price base: 2019 dollars, amortized over 60 years at a discount rate of 2.875%

²Increased profitability includes yield increases and increased operating costs from irrigation.

Installation and Financing

Framework for Carrying Out the Plan

The plan will be carried out through a partnership between the NRCS, the ASWCC, and the Alabama Agricultural & Conservation Development Commission (AACDC). The ASWCC and the AACDC through a memorandum of understanding will use applicable mechanisms of the existing AACDC cost-share program to implement the project in the watershed. This program allows individuals and entities (producers) to apply for cost-share dollars to complete on-farm water supply, distribution and irrigation practices necessary to install a completed Agricultural Water Management Element listed in the AACDC cost-share manual. The localized development of water sources and irrigation practices along with the required power supply will be funded by Federal funds at approximately 54.5 percent of purchase and installation costs. Federal funds will also be expended to provide NRCS Technical Assistance for installation of the systems.

Planned Sequence of Installation

The sequence for each on-farm installation of an approved Agricultural Water Management (AWM) Element will be determined by the items that are required on-farm to complete the selected element. Before, the start of construction or installation of any individual items of the AWM element, the CPA-52 Environmental and Cultural Resources Review will be completed, and all applicable permits will be obtained by the producer (See Appendix E, Figures 75-79). Typically, water supply sources and power supplies will be developed first. After development of the water and power supply, the remaining practices which include piping, pumps, pivots or other irrigation methods can be installed in a practically parallel fashion. Mitigation measures will be identified and developed through on-farm consultation with the local NRCS district conservationists and will be completed in the same manner required for a typical Environmental Quality Incentives Program (EQIP) practice. No real property must be acquired by the SLO for installation of the AWM elements since the elements will be installed on property or easements held by the producer.

Project Costs and Financing

The plan does not require the SLO to finance installation. The NRCS will provide 54.5 percent of the equipment purchase and installation of the AWM Elements for each applicant. The remaining 45.5 percent will be provided by the producer through cash on hand or private financing. Operation and maintenance costs will be borne by the producer as per the standard NRCS operations and maintenance agreement. Estimated installation and technical assistance costs and the portion needed from Public Law 83-566 Funds are show in the following table.

Table 18. Estimated Project Financing and Costs Middle Tennessee Watershed, Alabama, 2019 Dollars (\$)

Works of Improvement		Number			Estimated Cost (Dollars) ¹						
					Public Law 83-566 Funds			Other Funds			Total
	Unit	Federal Land	Non-Federal Land	Total	Federal land NRCS _v FS _v	Non-Federal land NRCS _v FS _v	Total	Federal Land	Non-Federal Land	Total	
Agricultural Water Management	Acres	0	25,650	25,650	0	\$19.6M	\$19.6M	-	\$16.3M	\$16.3M	\$35.9M
Technical Assistance						\$1.2M	\$1.2M	-	-	-	\$1.2M
Total Project						\$20.8M	\$20.8M		\$16.3M	\$16.3M	\$37.1M

Responsibilities

The SLO is responsible for implementing the cost-share program with the assistance of the NRCS District Conservationists. The SLO, through a Memorandum of Understanding with the AACDC, will be responsible for developing and implementing a cost-share program to install AWM Elements on-farm. The SLO or its associated districts will take applications from producers, rank applicants, enter into agreements and pay successful applicants. The SLO or its associated districts will enter into O&M agreements with applicants for the operation and maintenance of the AWM Elements as per the program guidelines. The NRCS will evaluate each application to help determine the eligibility and ranking score of each. Additionally, the NRCS will perform a CPA-52 Environmental Review and Cultural Resources Review to determine whether further action is required. The producer will be required to obtain all applicable permits and certificates, an irrigation design completed by a Certified Irrigation Designer, a Professional Engineer and/or a Professional Well Driller, necessary financing to complete the project; and enter into an O&M agreement with the SLO or its associated districts.

Contracting

The SLO (ASWCC) and its associated Soil and Water Conservation Districts will use the standard State of Alabama Cost-Share agreement to contract with the producer to install AWM elements. The AL SWCC and the associated Districts will work with NRCS during installation of all practices. No LTC will be required for this project.

Conditions for Providing Assistance

The NRCS will aid the SLO upon implementation of the Cost-Share program described above. The appropriation for funding for NRCS assistance has already been authorized.

Operation, Maintenance, and Replacement

Operation, maintenance and replacement responsibilities of the AWM Elements will be assumed by the producer. The approved producers will sign an O&M agreement for the AWM Elements concurrently with the Cost-Share agreement. The AWM elements and the associated life span for each element is listed in the AACDC Cost-Share Manual, Book 2. Inspection of AWM Elements will follow EQIP standard procedure for similar practices.

The Alabama Irrigator's Pocket Guide 2006 (Equipment Maintenance and Water Management) produced by the National Center for Appropriate Technology and provided by the NRCS-AL and the Office of Water Resources, a division of the Alabama Department of Economic and Community Affairs provides detailed information for maintenance of pumps and distributions systems and will be available to all participants. Additionally, producers should follow the specific guidelines as outlined by the equipment's manufacturer and distributor for best practices.

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DISTRIBUTION LIST

Agencies, organizations, and persons to whom the Draft Watershed Plan-EA was sent include the following:

- Tennessee Valley Authority (TVA),
- U.S. Fish and Wildlife Service (USFWS),
- Alabama Department of Economic and Community Affairs/Office of Water Resources (ADECA/OWR),
- U.S. Army Corps of Engineers (USCOE),
- Geological Survey of Alabama (GSA),
- Alabama Department of Environmental Management (ADEM),
- Rural Development (RD),
- USDA Farm Service Agency (FSA),
- The Nature Conservancy,
- Alabama Rivers Alliance,
- Poarch Band of Creek Indians (THPO),
- State Historic Preservation Office (SHPO),
- Alabama Department of Conservation and Natural Resources (ADCNR),
- Alabama Association of Conservation Districts (AACD),
- Soil and Water Conservation District Offices (SWCD) in Cullman, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall, and Morgan Counties.

A copy of the Draft Plan was also made available online at:

<https://cses.auburn.edu/eve-brantley/draft-middle-tn-river/>

Acronyms, Abbreviations, and Short-forms

AWM	Agricultural Water Management
AAMU	Alabama A&M University
AACDC	Alabama Agricultural and Conservation Development Commission
AACD	Alabama Association of Conservation Districts
ACES	Alabama Cooperative Extension System
ADCNR	Alabama Department of Conservation and Natural Resources
ADECA	Alabama Department of Economic and Community Affairs
ADEM	Alabama Department of Environmental Management
AHC	Alabama Historical Commission
AHCR	Alabama Historic Cemetery Register
ARA	Alabama Rivers Alliance
ARLH	Alabama Register of Landmarks and Heritage
ASSF	Alabama State Site File
ASWCC	Alabama Soil and Water Conservation Committee
SWCD	Alabama Soil and Water Conservation Districts
APE	Area of Potential Effect
AU	Auburn University
COU	Certificate of Use
CID	Certified Irrigation Designers
CAA	Clean Air Act
cfs	Cubic feet per second
P&G	Economic and Environmental Principles & Guidelines
EE	Environmental Evaluation
EIS	Environmental Impact Statements

EJ	Environmental Justice
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FPPA	Farmland Protection Policy Act
FSA	USDA Farm Service Agency
gpm	Gallons per minute
GSA	Geological Survey of Alabama
HAB	Harmful algal blooms
HU	Historically underserved
HUC	Hydrologic Unit Code
MSL	Mean sea level
NAAQS	National Ambient Air Quality Standards
NED	National Economic Development
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NWPM	National Watershed Program Manual
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NPS	National Park Service
SSURGO	NRCS Soil Survey Geographic Database
NWMC	National Water Management Center
OAR	University of Alabama Office of Archeological Research
OMB	Office of Management and Budget
OWR	Office of Water Resources
OIA	Outdoor Industry Association

PBL	Planetary Boundary Layer
PI	Preliminary Investigation
Plan- EA	Watershed Plan- Environmental Assessment
PL-566	Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566)
RD	Rural Development
SCS	Soil Conservation Service
SPARROW	Spatially-Referenced Regression On Watershed attributes
SPPA	State-based Prototype Programmatic Agreement
SLO	Sponsoring Local Organization
SHPO	State Historic Preservation Office
SRA	Statewide Resources Assessment
SIE	Sustainable Irrigation Expansion
TVA	Tennessee Valley Authority
TNC	The Nature Conservancy
T&E	Threatened & Endangered
TSS	Total Suspended Solids
THPO	Tribal Historic Preservation Office
TU	Tuskegee University
USCOE	U.S. Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USWRC	United States Water Resources Council
UAH	University of Alabama Huntsville
USGS	United States Geological Survey
WaSSI	Water Supply Stress Index

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APPENDIX A

Comments and Responses

Comments received from agencies partners by February 20, 2019 are listed below. Comments were received from GSA, ADEM, ALFA, and the OWR.

Comment	Response
Define Minority	Minority farmers were determined to be any farmer other than Caucasian males, as defined by the USDA Economic Research Service ("Socially Disadvantaged Farmers: Race, Hispanic Origin, and Gender," 2017).
Explain the local cost-share in more detail - does that mean that farmer does not have to pay his half? There is a local entity who may or will pay the cost-share portion. (Is that a name you want to release?)	Thank you for your comment. Please see the Installation and Financing section.
State numbers with the same decimal fields (two places after). Right Justify your numbers, and use commas, for the ease of reading – to quickly see order of magnitude change.	Thank you for this suggestion. All suggestions made have been taken into consideration and appropriate changes have been made.
Was main driver for preferred alternative economics ratio crop insurance? What about the secondary benefits of increased yields?	Please see an updated Appendix D outlining the NED benefits. We have changed the analysis to address damage reduction benefits (increased yield benefits) rather than crop insurance reductions. This was done according to NWPM 506.
Who will be putting out a call for cost-share applications?	The SLO, ASWCC, will call for applications.
Does the plan need to include any part of the scoring and how farm applications will be ranked?	Please see Appendix E for an outline of the ranking sheet.
What watersheds are greater than 10 percent water irrigated? Also, no agency or entity has made official regulations on withdrawal, so producers could challenge this [ranking penalty from being in an over-subscribed HUC-12] because there's no specific delineation making them any less competitive.	That is correct. But there is also nothing protecting the farmer for loss of water source. This is not a regulatory-based standard, but it is at the discretion of the SLO providing the cost-share and their responsibility to local farmers and the environment. Though this is considered in the ranking process, it still doesn't eliminate farmers within these HUC-12s from the selection criteria.
How is money given out/structured?	We will match dollar for dollar at 50 percent cost-share (65 percent cost-share for historically underserved farmers) up to \$200,000 and looking at it per project basis- won't pay for in-house work, the agreement being signed, materials or labor done by applicant themselves. Each project selected must include bringing new acreage under irrigation. Everyone will

	be ranked together; we don't anticipate having a problem reaching underserved farmers, so everyone will be all ranked together. Targeting up to 30 percent of the money for HU farmers. See the Installation and Financing section for this information.
Is this program open for nursery operators?	Yes, eligibility follows EQIP program. The only difference is that this project does not require farmers to show previous irrigation history.
GSA supports the use of WaSSI modeling at the HUC-8 watershed scale. GSA's current Groundwater Assessment Program includes a project to develop water budgets for the state at the HUC-8 level, primarily due to generally consistent aquifer characteristics within most of the states HUC-8 basins. The proposed water budget, in addition to the "Assessment of Groundwater Resources in Alabama 2010-16 (GSA Bulletin 186, 2018)," will provide more detailed estimates of groundwater availability in areas north of the Fall Line, particularly the Wheeler Lake project area. The additional information will be useful if WaSSI models are reconstructed for future allocations.	Thank you for the comment. Both the surface and groundwater assessments authored by the OWR and the GSA are critical for the watershed plans. Both reports are used extensively as the plan is developed. The WaSSI model is utilized to address the "what if" scenarios, such as historic drought situations and/or expanded irrigation acreage. The WaSSI model is run for the last 90 years with current irrigated acreage as a baseline. Then run again with increasing acreage (10 percent, up to 25 percent) to evaluate the potential effect expanding irrigation could have on surface water supplies.
As stated on p. 18 in the <i>Purpose and Need</i> section of the plan, "The purpose of the watershed project is agricultural water management. The objectives of meeting this purpose are (is in the text) also to further the conversation, development, utilization, and disposal of water by expanding irrigated acreage for agricultural production and avoiding significant negative impacts on the surrounding natural environment." Potential for environmental impacts related to six major categories, further delineated into 40 items concern, were documented in the plan. However, as written, the plan did not indicate how future impacts would be evaluated. GSA suggests the incorporation of groundwater monitoring of both water levels (quantity) and quality at selected intervals throughout the project to evaluate environmental impacts. Monitoring in the Wheeler Lake/Elk project area is critical due to the unconfined character of the groundwater system and its degree of interconnectivity with the surface water system. Zones of influence around high-capacity wells can extend great distances from the wellhead and could result in observable negative impacts to surround surface water features such as wetlands, strategic habitat zones, stream headwaters etc. Monitoring water levels and water quality around these wells can help mitigate potential problems and may be essential for	Thank you for the comment. Monitoring both water quantity and quality would be beneficial. There are no current requirements for farmers to install monitoring wells or funding through this particular program. During farmer listening sessions, the benefits of monitoring wells could be discussed, including other programs that could work in conjunction with this project.

<p>the end-user (farmer) to make informed decisions. For participating farmers in the geographic area, the installation of 3 observation piezometers around the irrigation well would characterize the radius of influence from pumping.</p>	
<p>Owing to diverse groundwater characteristics in the Wheeler Lake/Elk project area, pivot irrigation may not be a viable technique for all localities. In that 1,000-gpm wells do not occur on every farm, alternative techniques may need to be utilized. Groundwater availability may necessitate drip irrigation, or other techniques. If center pivot is the desired irrigation method, then surface ponds or small wellfields may be a viable option. Groundwater availability will dictate flexible plan design to select the best irrigation method to be used on a given farm.</p>	<p>Thank you for your comment. It is noted that farmers may not have access to ground or surface water to run a pivot. Alternatives such as drip are viable alternatives as part of this program. Additionally, irrigation ponds could be built and “trickle charged” with lower flow wells then used to drive a pivot as part of other NRCS funded projects. Applying farmers must have a detailed design that includes water sources.</p>
<p>Using only wells with an Office of Water Resources Certificate of Use (COU) as the definitive groundwater component in the WaSSI model will skew water availability results. COUs provide better estimates of groundwater availability in the southern half of Alabama because aquifer transmissivity values in porous Coastal Plain water-bearing units are more consistent. However, north of the State’s Fall Line, aquifer characteristics can vary within a matter of feet, largely controlled by fractures and dissolution features in karstic limestone. Due to this spatial heterogeneity, COU values will not provide a valid estimate of groundwater availability. Predicting well yield is highly speculative in karstic hydrology. As a result, many wells drilled north of the Fall Line produce less than 100 gallons per minute (gpm), (thus not requiring a COU), in comparison to the few 1,000-gpm wells, which report a COU.</p>	<p>Thank you for the comment. Understanding the limitations of source data such as COU reports is critical to estimating accuracy of models like WaSSI. The watershed plan has also incorporated additional well data provided by the GSA.</p>
<p>Four of the eight counties (roughly half of the watershed) are in the top 15 fastest growing counties of the U.S., according to 2018 Census data. This fact alone represents a steep trajectory of land-use change and underscores the need for resource planning. Since, the watershed plan is a living document, it is highly sensitive to the projected population changes in the future. The current trend of high-magnitude population growth implies that “all bets are off” in terms of agricultural land use. These numbers portend a major change in land use in progress. In this case, the “Irrigation Districts or Irrigation Districts & Expanded Irrigation” alternative may well address the needs of current and future agricultural landowners.</p>	<p>Thank you for your comment. Please see Alternatives section for reasons why this alternative was eliminated from further study.</p>

Comments received July 17th, 2019 from TVA are listed below.

Comments	Responses
<u>River Operations and Water Supply:</u>	
<p>The flow rates discussed in the Surface Water section (page 37) may not be correct. TVA suggests the flow rates be submitted to TVA River Operations staff to determine validity.</p>	<p>Thank you for this comment. We agree that the flows used for the Tennessee River are observed at a station slightly downstream of the HUC and may therefore be slightly in error. However, as the respective drainage areas are off by only about 2% we believe that any errors are small. Nevertheless, we would be grateful to receive feedback from TVA River Operations on this matter and would gladly incorporate any corrections they may provide.</p>
<p>On a watershed wide basis, the impacts to surface water from expanded irrigation may be insignificant, as described on pages 24, 75, and 167. However, localized impacts can be very significant. This point doesn't appear to be stated in the Environmental Effects and Cumulative Effects of the Alternatives sections of the EA. It is located in the appendix in the Natural Resource Investigation and Analysis sections. In that section, a guideline for avoiding localized impacts states <i>"Any watershed where the irrigated acreage density exceeds 10 percent may be considered less than desirable for expanding irrigation using surface water supplies."</i> While this is a start, "less than desirable" does not mean that these areas will not be considered for expanded irrigation. Depending on program participation, and politics, irrigation could be expanded significantly in these areas. TVA believes the plan should take a stronger stance such that <i>"Any watershed where the irrigated acreage density exceeds 10 percent will not be considered for expanding irrigation using surface water supplies."</i></p>	<p>Thank you for the comment. The 10% guideline is based on research conducted at Auburn and UAH and adopted as a guideline and sensitivity analysis threshold only for this project. Using this guideline as a ranking tool attempts to protect watersheds and farmer investments by analyzing "irrigation density". It is not intended to define any restrictions, regulations or requirements or curtail farmers' decisions.</p>
<p>In the Consultation, Coordination, and Public Participation section on Page 81, TVA makes the following suggested edits:</p> <p>Third bullet—TVA's official guidelines on temporary withdrawals are <i>"If the State in which the extraction is to take place approves or concurs in writing to TVA that the temporary withdrawal or extraction of water is acceptable to that particular state, then TVA will make a determination as to whether a Section 26a permit is required. TVA's decision on the need for a Section 26a permit will be based on a number of factors including (but not limited to) the State's approval, location of extraction, purpose, extraction amount, duration, environmental impacts, operational impacts, and other potential case-specific considerations."</i></p>	<p>Thank you for this suggestion. We have edited this bullet within the Plan accordingly. Please see the updated version of this section.</p>

<p>In the Consultation, Coordination, and Public Participation section on Page 81, TVA makes the following suggested edits:</p> <p><u>Fourth bullet</u>—Less than 50k gal/day or a pipe of less than 6 inches in diameter.</p>	<p>Thank you for this suggestion. We have edited this bullet within the Plan accordingly. Please see the updated version of this section.</p>
<p>In the Consultation, Coordination, and Public Participation section on Page 81, TVA makes the following suggested edits:</p> <p><u>Fifth bullet</u>—T&E’s maybe the main focus watershed wide, but low flow impacts could be a bigger issue locally.</p>	<p>Thank you for this suggestion. We have edited this bullet within the Plan accordingly. Please see the updated version of this section.</p>
<p>In the Consultation, Coordination, and Public Participation section on Page 81, TVA makes the following suggested edits:</p> <p><u>Sixth bullet</u> – The waters are not TVA owned waters. TVA staff indicated that irrigation impacts would likely be negligible on TVA impounded waters (e.g. Wheeler and Elk River up to approximately mile 29). Outside of the impounded waters, water quantity could be a major concern.</p>	<p>Thank you for providing this correction. We have edited this bullet within the Plan accordingly. Please see the updated version of this section.</p>
<p><u>Floodplains and Flood Risk:</u></p>	
<p>The May 2019 Watershed Plan Agreement between the Alabama Soil and Water Conservation Committee and USDA includes the following provision (Item 7): “Before construction of any project for flood prevention, the sponsors must agree to participate in and comply with applicable Federal floodplain management and flood insurance programs”. Flood Risk agrees with this Item.</p>	<p>We acknowledge this comment.</p>
<p>Cropland could be located in a floodplain; therefore, the irrigation equipment could potentially be located in the floodplain. Because the irrigation equipment/infrastructure could be located in the floodplain, the following activities/facilities need to be addressed in the Plan-EA for flooding impacts, both effects of floods on the actions/facilities and effects of the actions/facilities on floods.</p> <p>o Low Pressure Center Pivots- Telemetry, Pumping plant, Variable Rate/Speed Control, Pivot system/Benders/Corners, 3-phase</p>	<p>The landowner will assume liability of all damages regarding floodplain hazards. There will be no construction in this project for flood prevention as it is outside the scope and needs of this project. Irrigation will be expanded on currently existing agricultural lands. As part of the required Environmental Evaluation (NRCS form CPA-52) process, all floodplain risks will be addressed and recommended mitigation strategies will be incorporated with the assistance of NRCS personnel.</p> <p>Typically, vendors would provide farmers with the option to include weather and flood protection</p>

<p>electricity, GPS, Pipeline, Generator, Motors, Well /pump, Remote Management, Flow Meter</p> <p>o Micro-Irrigation-Telemetry, Buried drip tape, Chemical injection system, GPS, Flow meter, Filter System, Pipeline, Backflow preventer, Well/pump, Trenching earth</p> <p>o Linear/Lateral Irrigation-Linear/Lateral irrigation system, Telemetry, Pumping plant, Variable Rate/Speed Control, Pivot system/Benders/Corners, 3-phase electricity, GPS, Pipeline, Generator, Motors, Well /pump, Remote Management, Flow Meter</p> <p>o Tow/Traveler Irrigation-Telemetry, Trenching earth, Flow meter, Tow System, Pipeline</p> <p>o Plasticulture-Bedding of soil, Mulching (plastic), Drip system (Pipe and fittings), Well/pump</p> <p>o Surface water intakes</p> <p>o Groundwater wells</p>	<p>technologies within their equipment design and bundled purchase. For example, a vendor in the watershed area has provided the following mitigation strategies/technologies currently being used in the Middle TN River Valley Area:</p> <ul style="list-style-type: none"> • Electrical Components: Move control panel to a higher location on the pivot, or mount the pivot panel remotely. • Pump Site Equipment: build the engine driven pumps and electric pumps on trailers that can be hooked to and moved quickly; in some cases they are built on steel skids designed to be lifted out with forks on a telehandler. Also use release couplers when possible on Z pipe, pump, and suction pipe. Use ringlock fittings at the Z pipe on the discharge pipe to simplify removal. We also have a lifting boom that can be installed to lift the Riverscreen out of the water. • Electric Pump Panels: usually build a platform above the maximum water level and we use a waterproof plug/receptacle to quick disconnect the leads to the electric pump.
<p>According to TVA's 1981 Class Review of Certain Repetitive Actions in the 100- year Floodplain, agricultural use of land (and thus irrigation) and surface water intakes would be considered repetitive actions in the 100-year floodplain. However, the individual components of the irrigation infrastructure could be damaged in a flood. What would be done to minimize adverse flood impacts to irrigation equipment (specifically to the equipment listed)?</p>	<p>We agree with this comment. Repetitive damage from flooding and resultant insurance claims will be decided by landowners and insurance providers under existing policies and regulations. Minimizing flood impacts to irrigation equipment is outside the scope of this plan. Typically, vendors would provide farmers with the option to include weather and flood protection technologies within their equipment design and bundled purchase. See the response above for specific examples.</p>
<p>Additionally, groundwater wells are not repetitive actions in the floodplain; therefore, the floodplains no practicable alternative analysis would need to be done by the applicant if wells would be drilled in the floodplain under this program. (Better yet, wells would be located outside the floodplain.)</p>	<p>Thank you for this comment. The placement of a groundwater well in a floodplain would support existing agricultural lands and unlikely have additional floodplain impact.</p>
<p>Its presence is implied, but I recommend adding Wheeler Dam to Figure 10 – Watershed Project Map</p>	<p>Thank you for your suggestion. An updated map which now includes Wheeler Dam has been added to the Final Plan.</p>
<p>Discharges out of Wheeler would give a better picture of water flow in the Wheeler-Elk watershed than streamflow</p>	<p>Thank you for this comment. We agree that the flows used for the Tennessee River are observed at a station slightly downstream of the HUC and may therefore be slightly in error. However, as the respective drainage</p>

records at Florence, Alabama. Additionally, Florence is outside the Wheeler-Elk watershed.	areas are off by only about 2% we believe that any errors are small. Nevertheless, we would be grateful to receive feedback from TVA River Operations on this matter and would gladly incorporate any corrections they may provide.
Figure 25 – does the light-green shading depict 0.1-percent-annual-chance flood (1,000-year) or 1-percent-annual-chance flood (100-year) floodplain areas? Perhaps that is a typo?	The light-green shading depicts 0.1-percent-annual-chance flood. An updated map has now replaced Figure 25, as seen in the Final Plan, to correct this confusion.
Recommend including the table heading on every page of a table (if a table continues onto the next page, etc.).	Thank you for this feedback. The Final Plan has been updated to incorporate this suggestion where applicable.
On page 26, the list of ranking questions can be found in Table 63, not Table 61.	We appreciate you catching this error. You can find the correction to this error within the updated Final Plan.
<u>Hydrologic and Hydraulic Modeling:</u>	
The text states “ <i>Estimation of infiltration, soil storage, base flow and runoff are accomplished through algorithms from the Sacramento Soil Moisture Accounting Model.</i> ” TVA has put a lot of effort into calibrating this model for use operationally and in studies. We would request that NRCS work with us in this effort.	Thank you for this request. Yes, we would like to meet with you to review our model parameters and share both our work and results with you. We will contact Mr. Nick Morris, West Region Manager, Reservoir Land Use and Permitting, nbmorris@tva.gov.
The text states, “ <i>The regulation effects are simulated through the incorporation of the area-capacity and operating (rule) curve relationships for the reservoirs of significant size to impact streamflow at the 8-digit HUC level.</i> ” In reality, the entire TVA watershed is operated as an integrated system, so the full system must be modelled to understand it.	We agree with this comment. However, as currently constituted the WASSI model is not capable of integrated stream routing. Since the model is run on a monthly time step we assume that TVA does attempt to keep to the operating curve at that temporal resolution. Of course, anything at shorter time scales is likely to contain significant errors.
Figure 38: Can NRCS describe in more detail why the modelling results don’t hit the “shoulder” seasons well?	Thank you for the comment. The reason the model does not hit the shoulder is due to how the model irrigation withdrawal is handled. The OWR assessment includes agricultural withdrawals throughout the year which includes livestock, nurseries and golf courses. The model uses only crop water demand during the growing season, which goes to zero before/after. So even though the other ag water users are minor when compared to row crop irrigation, they are not zero.
Figure 40: This is good information for us to use at TVA. I have attached a similar analysis that we did with the Sacramento model and our own consumptive use data. It would be interesting to learn from each other and work together on this.	We appreciate your feedback on this and very much welcome the opportunity to meet/work with TVA on our continuing modeling effort.

Figure 51 and 52: It would be good to be very clear on whether this table means - 25mm per month or -25mm total. Reading these can be confusing at times.	Thank you for the question. The precipitation minus evaporation thresholds of -12.50, -25.0, and -50.0 mm are monthly deficits which may occur consecutively for one or more months.
Tables 50, 51 and 52: The text seems to assume that most irrigation water will be sourced very close to the farm in question, from groundwater as needed. The giant reservoir in the center of the basin is almost certain to never dry up, as opposed to smaller surface supplies and some groundwater areas. Would it make sense to have irrigation be more of a regional approach, where some irrigation canal cooperative would use the reservoir water? Can that be considered?	We appreciate the concept of this approach. An irrigation district alternative was considered as part of the plan but was eliminated due to cost and potential controversy surrounding Alabama's Riparian Doctrine and prohibition of transfer of water to non-riparian land.
<u>NEPA and Section 26a Program:</u>	
Projects authorized under this proposed program have the potential to require permit authorization from TVA. TVA recommends that the NRCS work with local TVA offices to determine permit applicability for individual projects. If TVA authorization is determined to be required, site specific environmental reviews under the National Environmental Policy Act (NEPA) would be conducted prior to the issuance of any permit or authorization.	Thank you for this comment. Applicants must acquire all necessary permits. A NRCS CPA-52 Environmental Evaluation (EE) will be conducted on each site prior to any project implementation, release of funding, or request for permits are submitted. It is to our understanding from our previous correspondence with TVA that the NRCS CPA-52 EE is extremely similar to the TVA 26A permit site assessment. In response to this comment, NRCS will abide by its MOU with TVA and will coordinate with TVA where these 26A permits may be necessary.

Comments received August 12th, 2019 from the EPA are listed below.

Comments	Responses
<u>Clean Water Act and Hydrologic Unit Codes</u>	
<p>The Clean Water Act (CWA) regulates pollutants discharging into individual water bodies. Many states, including Alabama, utilize assessment units derived from 12-digit Hydrologic Unit Code (HUC) subwatersheds to determine compliance with water quality standards, list impaired waters, and establish Total Maximum Daily Loads (https://www.epa.gov/sites/production/files/2015-07/documents/cadmus_tmdl_effectiveness_final_report_02_03_10.pdf). HUC12s, which consist of “<i>segments of rivers, streams, lakes, reservoirs, and estuaries</i>” (http://www.adem.state.al.us/programs/water/wquality/2018AL303dFactSheet.pdf), typically range in size from 10,000 to 40,000 acres (https://pubs.usgs.gov/tm/11/a3/pdf/tm11-a3_4ed.pdf), whereas the two HUC8 sub-basins comprising the Middle Tennessee River Valley Watershed - Wheeler Lake (HUC8 = 06030002) and Lower Elk (06030004) - encompass a total of 2,457,600 acres (https://water.usgs.gov/GIS/huc_name.html).</p>	<p>This is correct. Encompassed in the overall basin is all, or parts of, 108 HUC-12 subwatersheds located within Alabama; 78 of which have existing agricultural land and thus make up the potential project area. The available HUC-12 water quality data was implemented into the environmental assessment and forecasted further through SPARROW modeling, which can be reviewed in further detail in Appendix D.2 of the Plan.</p>
<p>The Plan/EA did not address the potential for the project to violate water quality standards and impair waterbodies. Although it admits that “[w]ater quality could be impacted by increased nutrient runoff into surface waters [and] increased turbidity due to sediment transport” at the HUC12 level, the Plan/EA minimizes impacts by stating that “<i>the irrigated area is small compared to the watershed area as a whole</i>”. Furthermore, the Plan/EA identifies the number of impaired streams on the Alabama Department of Environmental Management’s (ADEM’s) 2018 CWA Section 303(d) list (http://www.adem.state.al.us/programs/water/waterfor.ms/2018AL-IWQMAR.pdf), but not the agricultural sources of impairments. Of the 29 impaired HUC12s in the Wheeler Lake and Lower Elk sub-basins, ADEM cites agriculture as the impairment source for 23. Given the statutory importance of local water quality and the known impact of agricultural runoff in the Middle Tennessee River Valley, the EPA recommends that the Plan/EA recognize the potential for expanded irrigation to cause or contribute to violations of water quality standards and surface water quality impairments.</p>	<p>The Plan/EA addressed the potential for violations of water quality standards in the manner necessary and to the extent practical for assessing 689,348 acres of potential project implementation. As summarized in the body of the Plan and described in detail in Appendix D.2, the Preferred Alternative is anticipated to have minor effects on both surface and groundwater quality. Water quality may be impacted by increased nutrient runoff into surface waters, increased turbidity due to sediment transport and/or biological productivity, or nutrient leaching into groundwater due to irrigation applied in excess of field capacity. If irrigation is applied using BMPs recommended per the NRCS CPA-52, Environmental Evaluation (EE), to protect water quality, negative impacts will be negligible. Furthermore, the modeled SPARROW projections for increased nutrients carried by surface waters are minor/unlikely assuming the soil moisture is maintained at or below field capacity. It is also noted on page 25 of the Final Plan that the Preferred Alternative may have localized impacts on smaller tributaries and watersheds within the project watershed but will be mitigated by the NRCS and SLO during site selection using the irrigated acreage density data.</p>

<p>The difference between the scale of the project area and the HUC12 level used for CWA compliance is further blurred by the use of terminology that is not consistent with the Watershed Boundary Dataset (https://www.usgs.gov/core-science-systems/ngp/national-hydrography/watershed-boundary-dataset). The term “watershed” is used interchangeably throughout the document to reference the project area, the Wheeler Lake and Lower Elk HUC8 sub-basins, and HUC12 subwatersheds, even though watersheds are defined in the WBD as 10-digit hydrologic units. HUC8s and HUC12s are also misidentified as basins. The EPA recommends that the Natural Resource Conservation Service (NRCS) clarify the terminology in future NEPA documents and the final plan.</p>	<p>Acknowledged.</p>
<p style="text-align: center;"><u>Total Maximum Daily Loads and Watershed Management Plans</u></p>	
<p>The Plan/EA enumerates Total Maximum Daily Loads (TMDLs) established in the Wheeler Lake and Lower Elk sub-basins, but the connection to agriculture is omitted. Of the 64 EPA-approved TMDLs in 40 HUC12 subwatersheds, 36 target crop-related, nonpoint sources (http://www.adem.state.al.us/programs/water/approvedTMDLs.htm).</p>	<p>Thank you for the comment. This is correct. The source distinction was omitted because the analysis in this plan is restricted to irrigating existing farmland. No land conversion from other use classes is allowed. Furthermore, the analysis was focused on the incremental impact the additional irrigated farmland would have over the baseline. The reaches’ baseline levels are defined as-is, regardless of source.</p>
<p>The EPA notes that the Plan/EA does not discuss Watershed Management Plans (WMPs) developed by ADEM and HUC12 stakeholders to implement TMDLs or federal grant funding from the CWA Section 319 nonpoint source (NPS) management program used for Best Management Practices (http://www.adem.state.al.us/programs/water/nps/files/mgmtplancover.pdf). The EPA has published ‘success stories’ about Section 319 grant funded restoration efforts in several HUC12s (https://www.epa.gov/nps/nonpoint-source-success-stories-alabama) and ADEM describes NPS activities in its annual program reports:</p> <ul style="list-style-type: none"> • 2018, http://www.adem.alabama.gov/programs/water/nps/files/NPS2018.pdf • 2017, http://adem.alabama.gov/programs/water/nps/files/NPS2017.pdf 	<p>Thank you for this comment. We agree that the watershed management plans are critical. Reviewing the Tennessee River Basin Watershed Management Plan (http://www.adem.alabama.gov/programs/water/nps/files/TennesseeBMP.pdf), the relevant sections are 3.2.1 (Reduce nonpoint source pollution from agriculture) and 3.2.6 (Protect diminishing farmlands).</p> <p>Section 3.2.1 States that the USDA-NRCS take the lead on reducing NPS pollution from agriculture. NRCS conservation programs such as EQIP are referenced as potential actions. This plan continually references NRCS conservation practices required as part of the preferred activity. This project requires farmers to have an updated conservation plan and the ranking criteria gives preference to farmers with a documented record of stewardship as defined by the NRCS. This program also requires a NRCS onsite Environmental Evaluation (CPA-52) to determine if any additional conservation measures or best management practices are required.</p> <p>Additionally, Section 3.2.6 of the WMP states that</p>

<ul style="list-style-type: none"> • 2016, http://adem.alabama.gov/programs/water/nps/files/NPS2016.pdf • 2015, http://www.adem.alabama.gov/programs/water/nps/files/NPS2015.pdf • 2014, http://www.adem.alabama.gov/programs/water/nps/files/NPS2014.pdf • 2013, http://www.adem.alabama.gov/programs/water/nps/files/NPS2013.pdf • 2012, http://adem.alabama.gov/programs/water/nps/files/NPS2012.pdf • 2011, http://adem.alabama.gov/programs/water/nps/files/NPS2011.pdf • 2010, http://adem.alabama.gov/programs/water/nps/files/NPS2010.pdf • 2009, http://adem.alabama.gov/programs/water/nps/files/NPS2009.pdf • 2008, http://adem.alabama.gov/programs/water/nps/files/NPS2008.pdf <p>Given that ADEM's reports distinguish which HUC12s have WMPs, the EPA recommends that NRCS review them for information about subwatersheds where projects may be considered. The 2018 report identified WMPs for 30 HUC12s in the Wheeler Lake and Lower Elk sub-basins.</p>	<p>Objective 6 of the Plan is to Protect diminishing farmlands. As outlined in the purpose and needs of the Plan, existing farmland will be supported through sustainable irrigation expansion.</p>
<p style="text-align: center;"><u>Site Ranking and Selection Criteria</u></p>	
<p>Because the Plan/EA admits that the Preferred Alternative may have localized impacts on smaller tributaries and watersheds within the project area, the EPA advocates disqualifying sites that may affect impaired waters, TMDLs, and ongoing and completed water quality restoration efforts. Additionally, it is recommended that all site selections be coordinated with ADEM's NPS Program (http://www.adem.state.al.us/programs/water/npsprogra</p>	<p>Thank you for the comment. We agree that all sites will coordinate with ADEM's NPS recommendations which depend upon NRCS conservation plans, BMPs and farmer stewardship as outlined in a previous response. Disqualifying all existing rain-fed farmland from irrigation in these sub-watersheds (HUC-12) is overly restrictive based on site and local conditions. As part of the tiered process mentioned in the Plan, each selected farmer application must undergo a NRCS on-site Environmental</p>

m.cnt) and HUC12 stakeholders.	Evaluation. The EE will identify potential pollution issues, including those that may affect impaired waters, and require measures to mitigate or correct it.
<u>Mitigation Measures</u>	
Consistent with the CWA's water quality-approach, surface water quality monitoring should be included as a mitigation measure. The EPA also recommends instituting stream flow protection procedures (e.g., reducing surface water withdrawals, etc.) during droughts (https://bhamnow.com/2016/11/16/alabama-river-groups-plea-for-water-plan-our-rivers-are-drying-up/).	Thank you for this comment. We agree that surface (and groundwater) quality should be monitored. We also agree that stream flows should be protected. The current plan requires participants to adhere to all State and Federal regulations regarding both water quality and quantity. Additionally, the plan promotes sustainable levels of irrigation density, water use, favors voluntary farmer stewardship and current use of BMPs, and requires updated comprehensive nutrient management plans.
<u>Finding of No Significant Impact</u>	
The FONSI reiterates that the Preferred Alternative may/will impact surface and groundwater quality, but the analysis in the Plan/EA demonstrates that the quality of the natural environment will not be significantly impacted. Similarly, the FONSI states that <i>"[t]he proposed action does not threaten to violate Federal, State, or local requirements imposed for protection of the environment."</i> However, as discussed above, the Plan/EA did not address potential violations of water quality standards. To ensure consistency with the Council on Environmental Quality's regulations at 40 CFR §1501.4(e), please include a brief description of the reasons why there will be no potential significant impacts to water quality and any mitigation measures that may be necessary to reduce their significance.	<p>Thank you for this comment. The plan addresses water quality through modeling and analysis of the entire basin utilizing the SPARROW model to establish both a baseline (current) and incremental increases in irrigated acreage (w/ increased fertilizer application). A synopsis of the baseline is included in the "Affected Environment" section under Water Quality.</p> <p>Results from increasing irrigated acreage (preferred alternative) are reported in the "Environmental Consequences" section. The conclusion of minor significance is based on model results in which the preferred action is projected to have minimal NPS pollution increase over current levels. We agree that some streams have pollution levels of concern that are identified in the ADEM WMP. We anticipate few or no projects will be undertaken affecting streams with existing pollution levels of concern.</p> <p>If projects are selected that affect these reaches, the NRCS and this project will abide by the WMP to promote and implement conservation measures to mitigate and reduce any potential NPS pollution, based on the NRCS on-site farm evaluation and the updated comprehensive nutrient management plan for each farm.</p> <p>Detailed explanation of the water quality analysis is covered in section 2 of Appendix D.2, Natural Resources Investigation and Analysis, in the Plan.</p>

APPENDIX B

Watershed Project Map

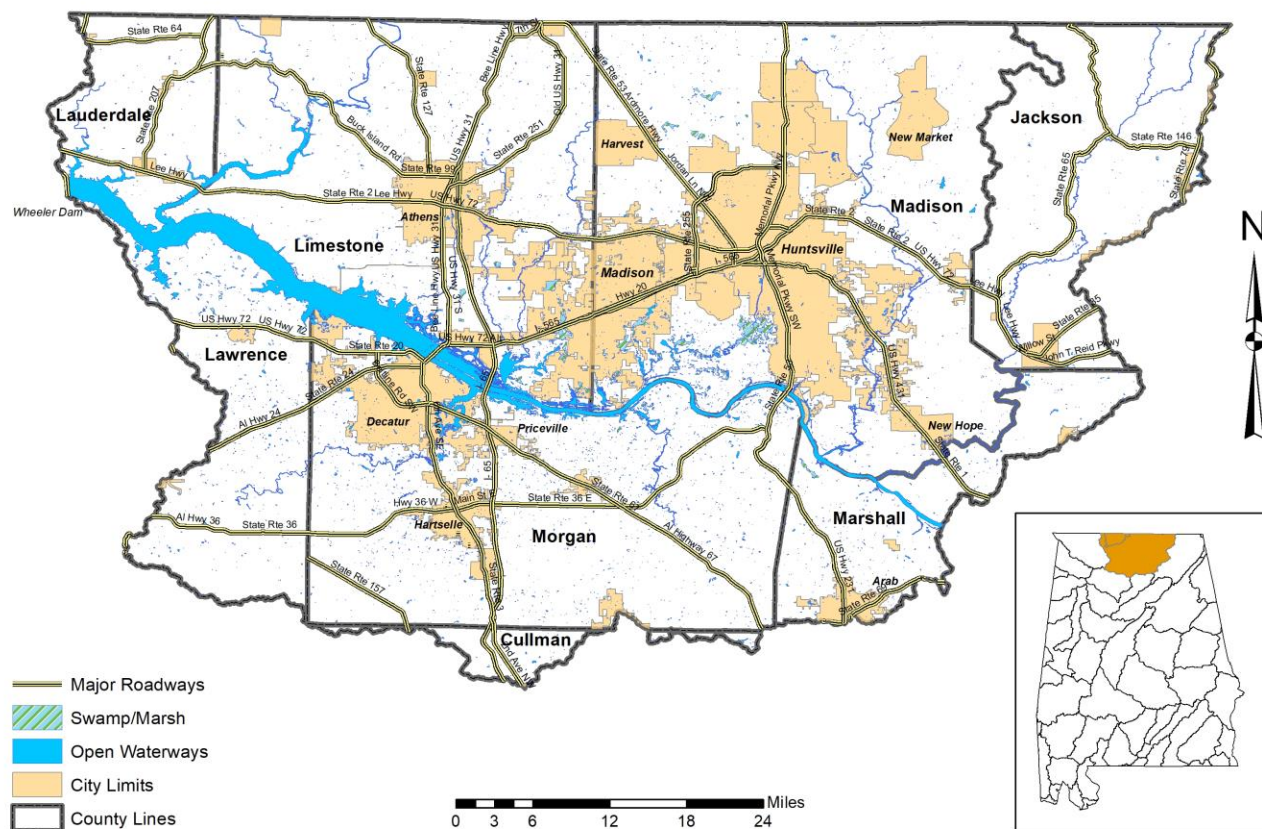


Figure 10: Watershed Project Map

APPENDIX C

Supporting Maps

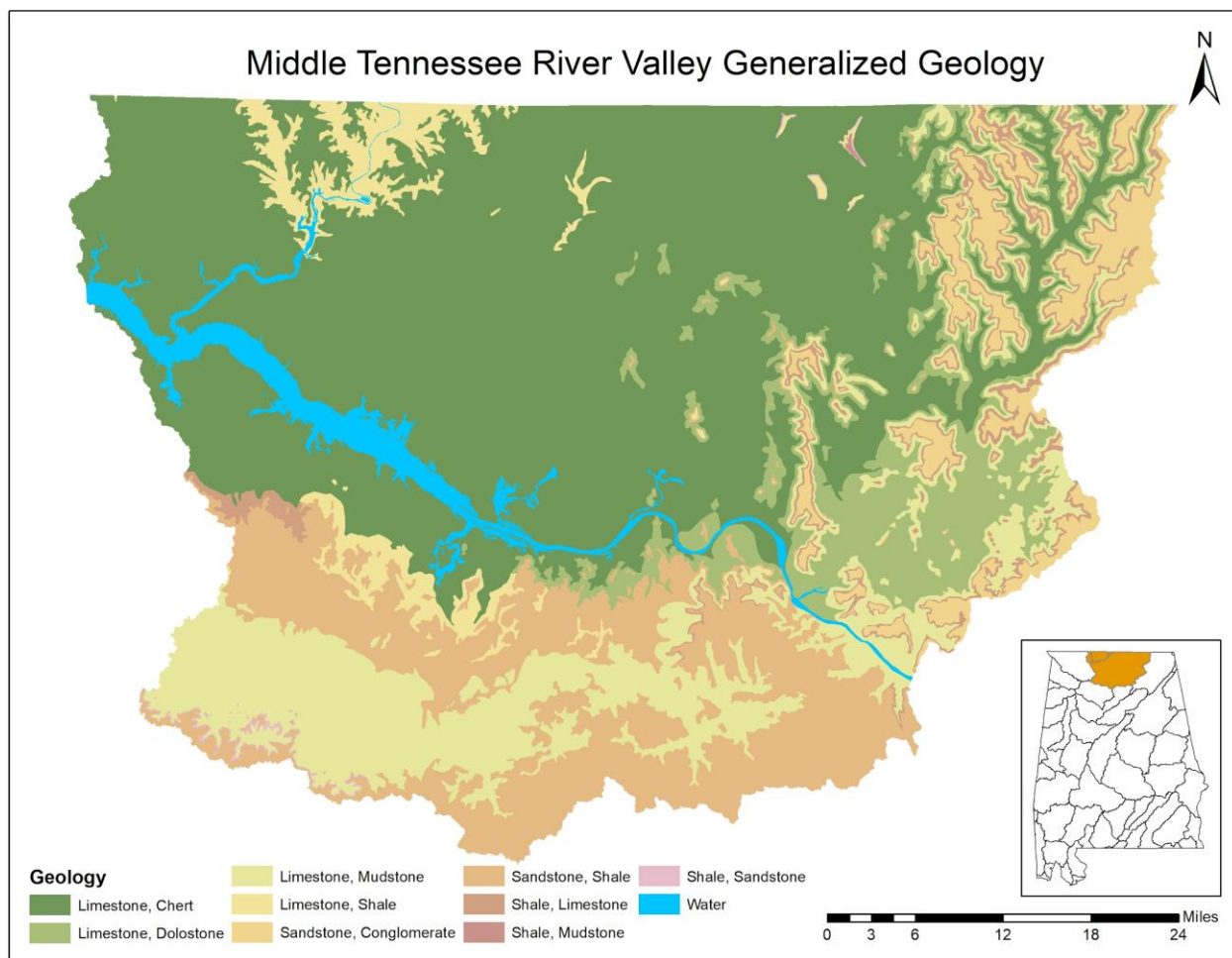


Figure 11: Generalized Geology of the Project Area / Northern Alabama

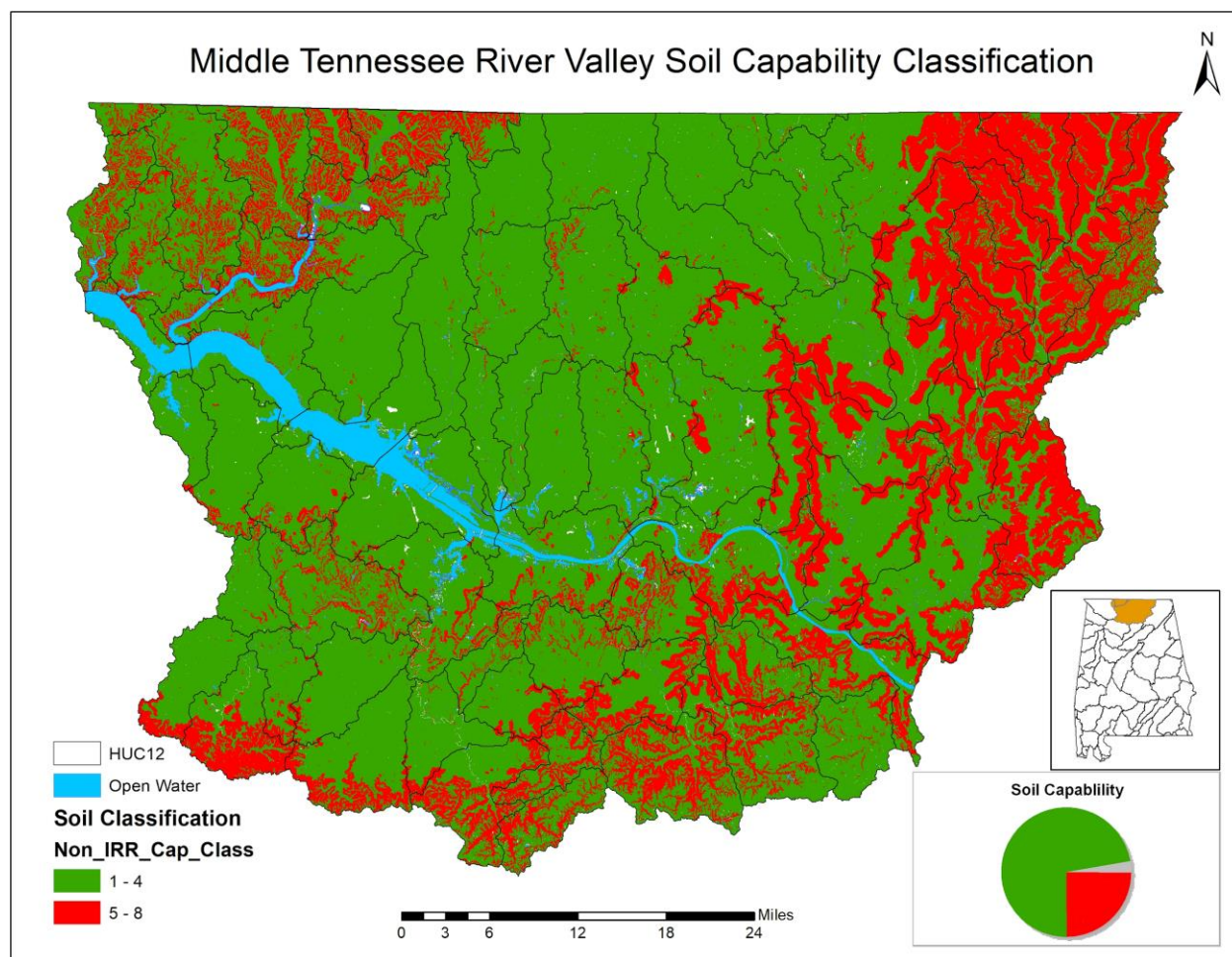


Figure 12: Soil Capability Classification Map of the Project Area

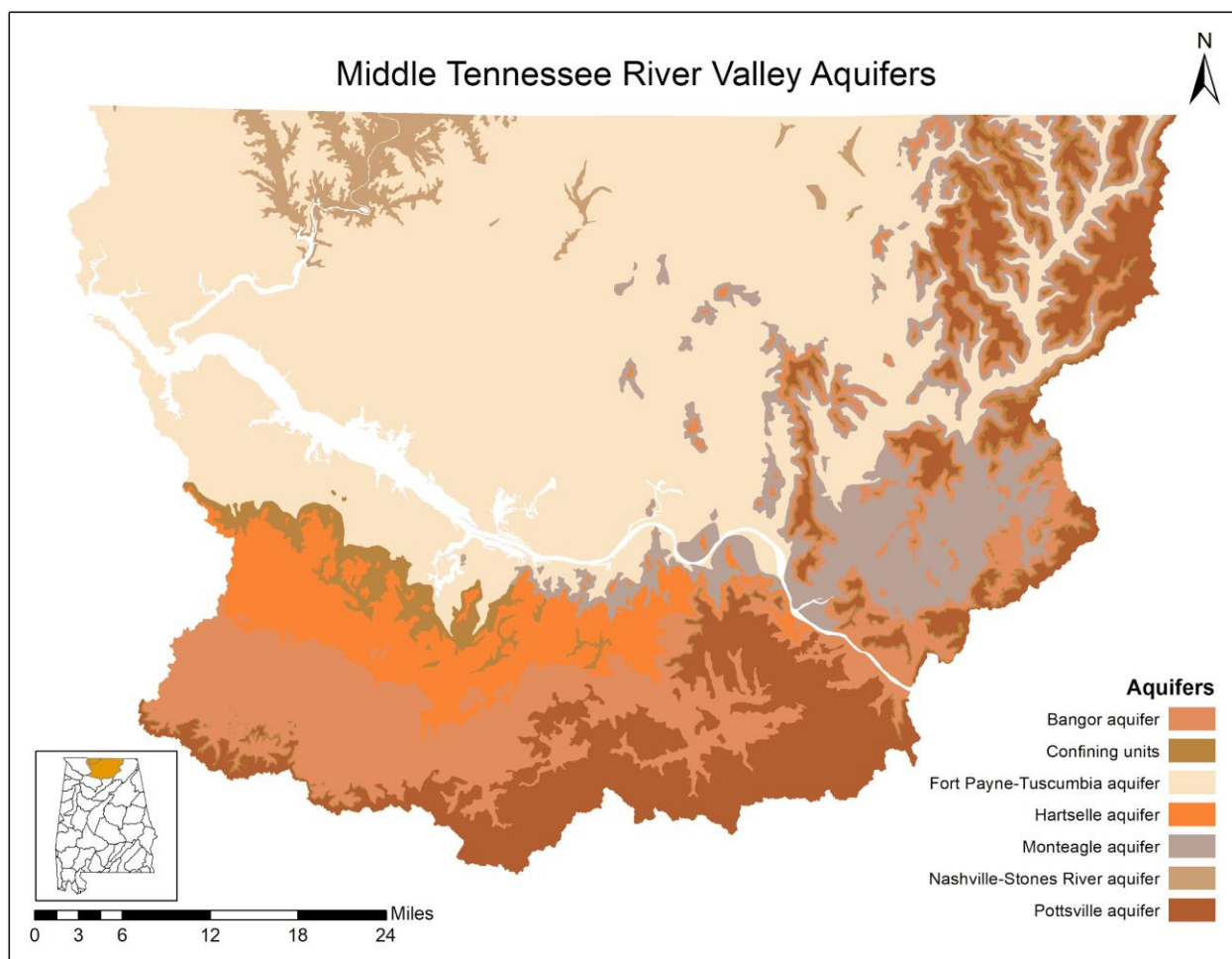


Figure 13: Groundwater Map of the Middle TN River Valley Watershed Project Area

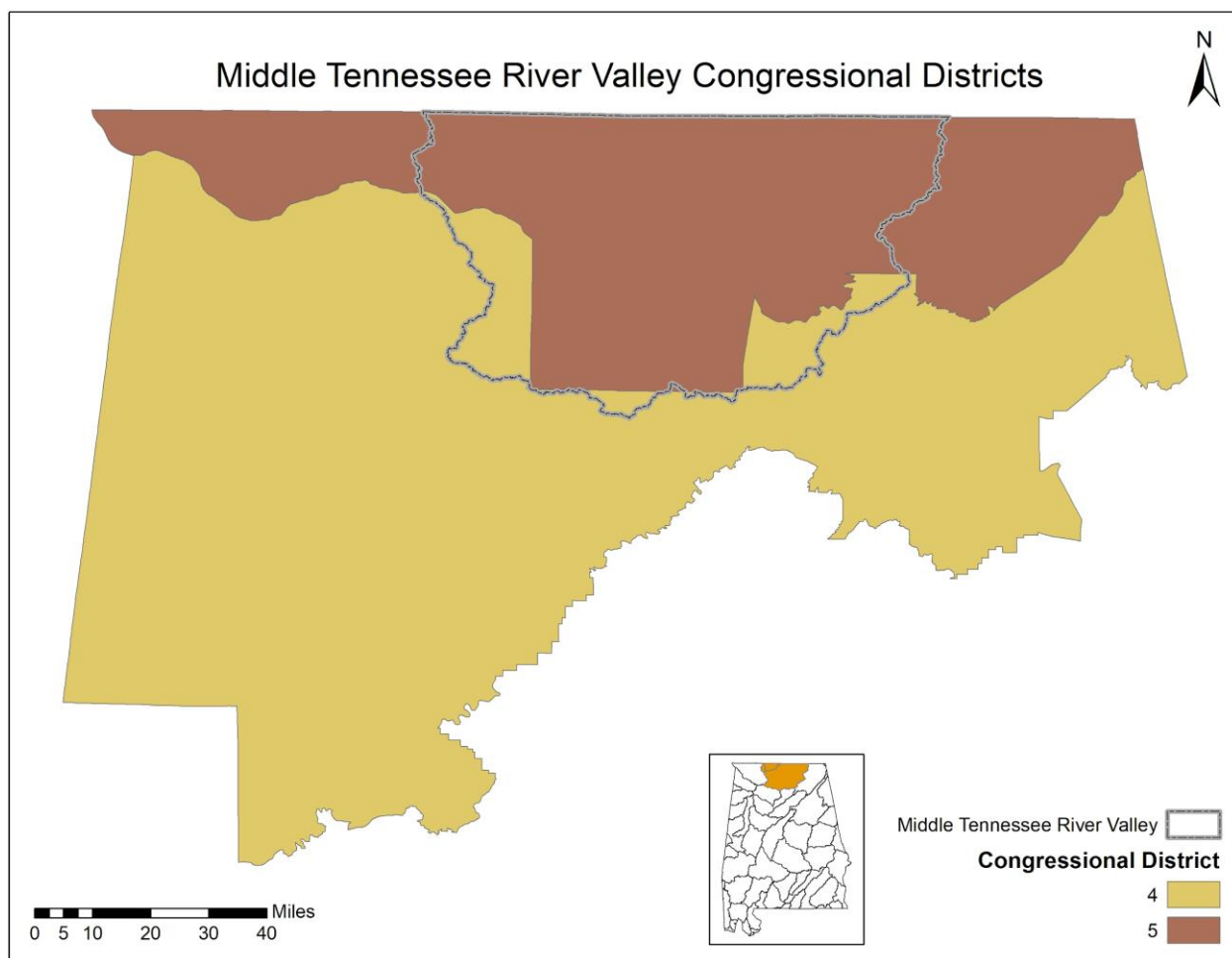


Figure 14: Map of Congressional Districts Overlapping the Middle TN River Valley Watershed Basin

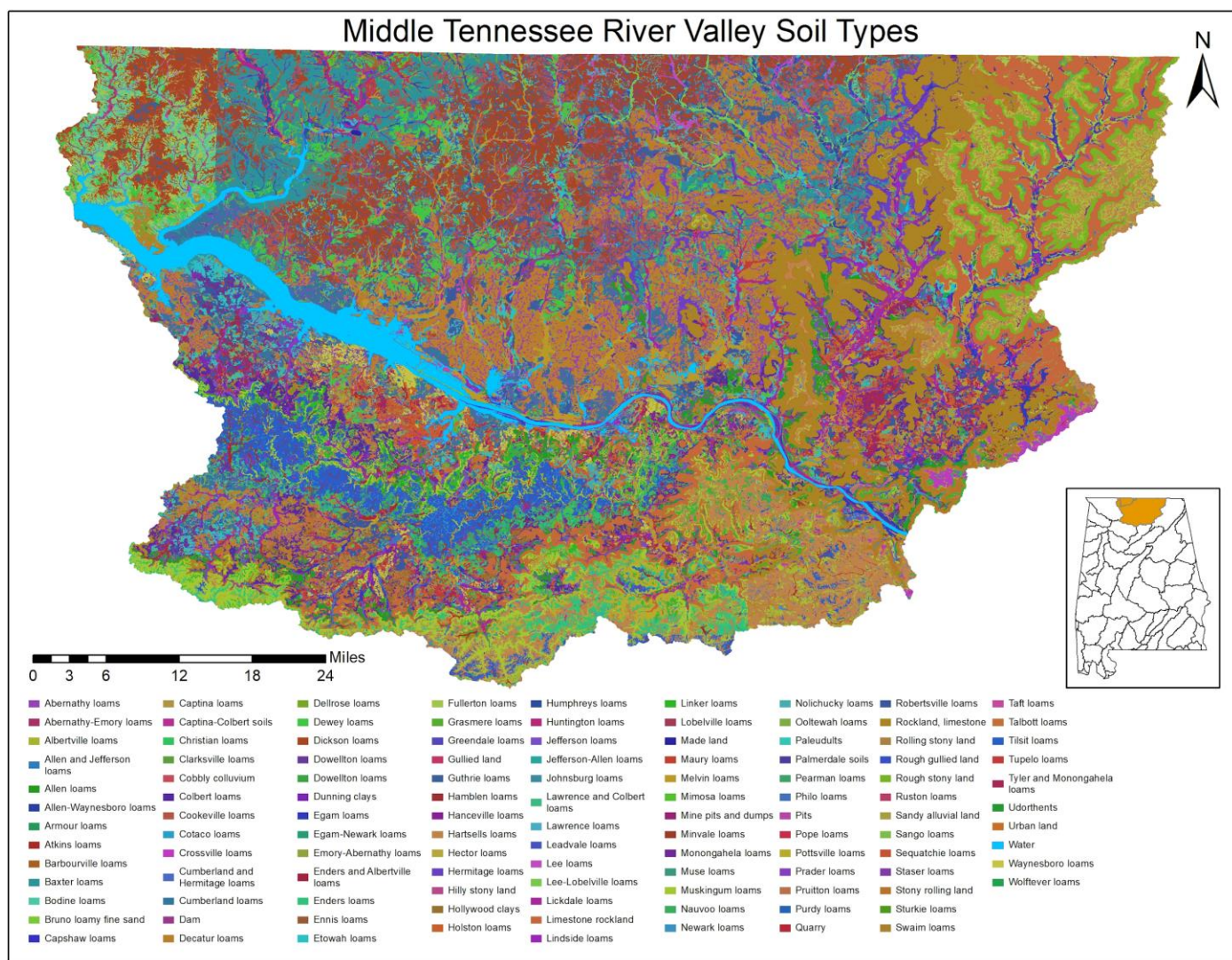


Figure 15: Map of All Soil Types in the Project Area

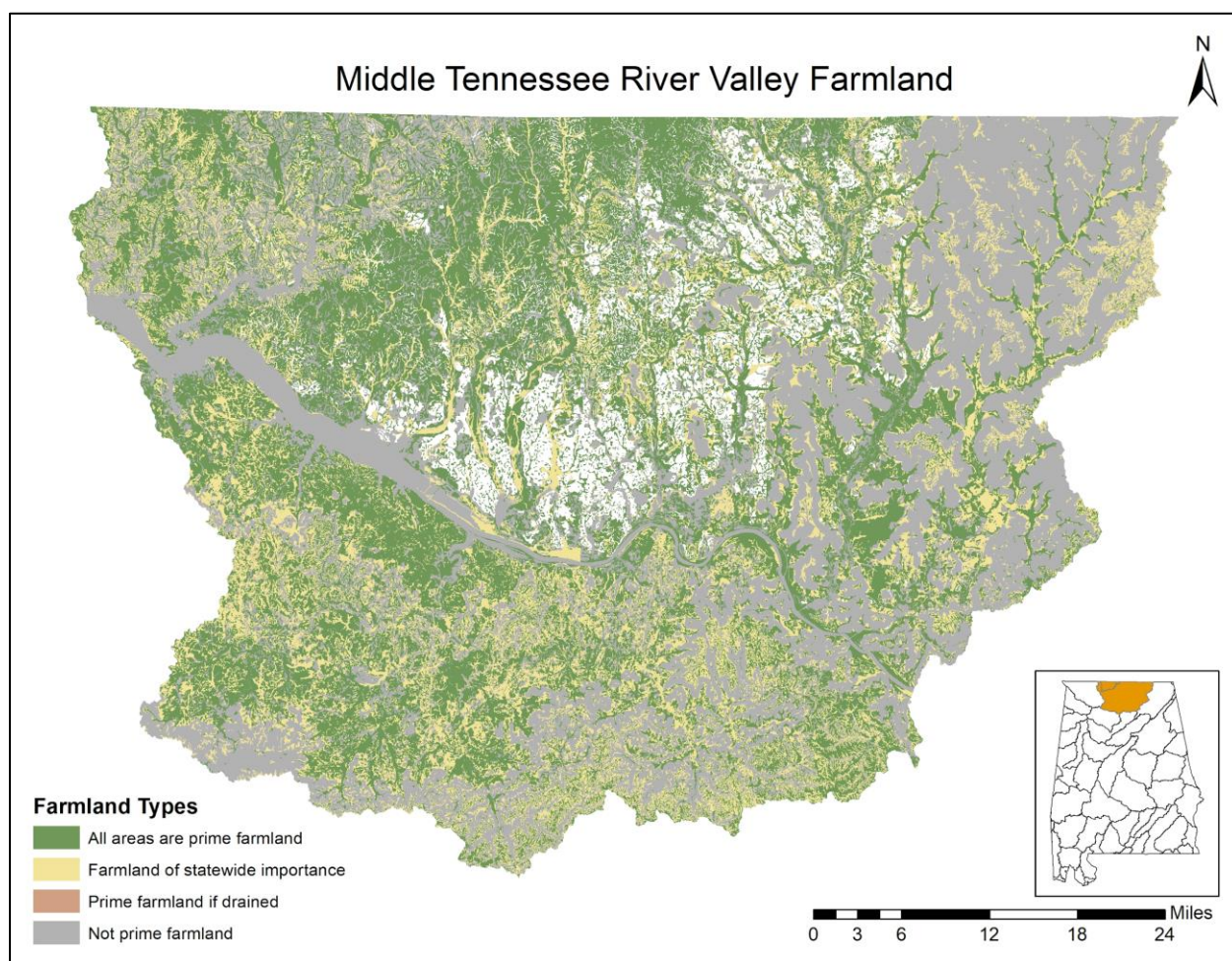


Figure 16: Map of Prime/Important Farmland in the Project Area



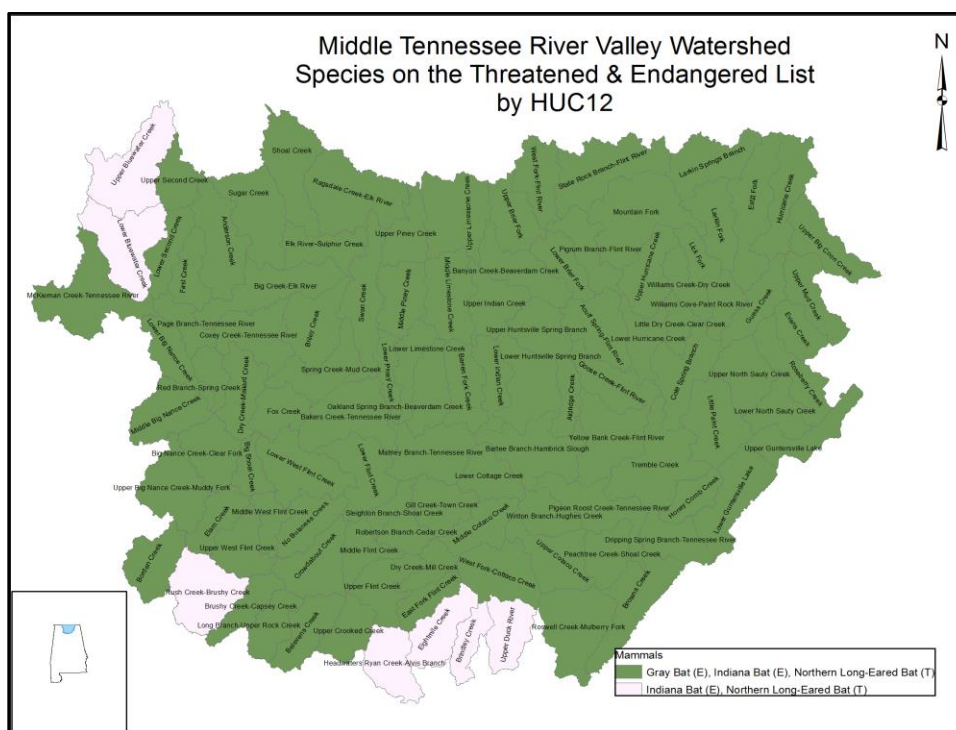


Figure 19: Map of T&E Mammal Species in the Project Area

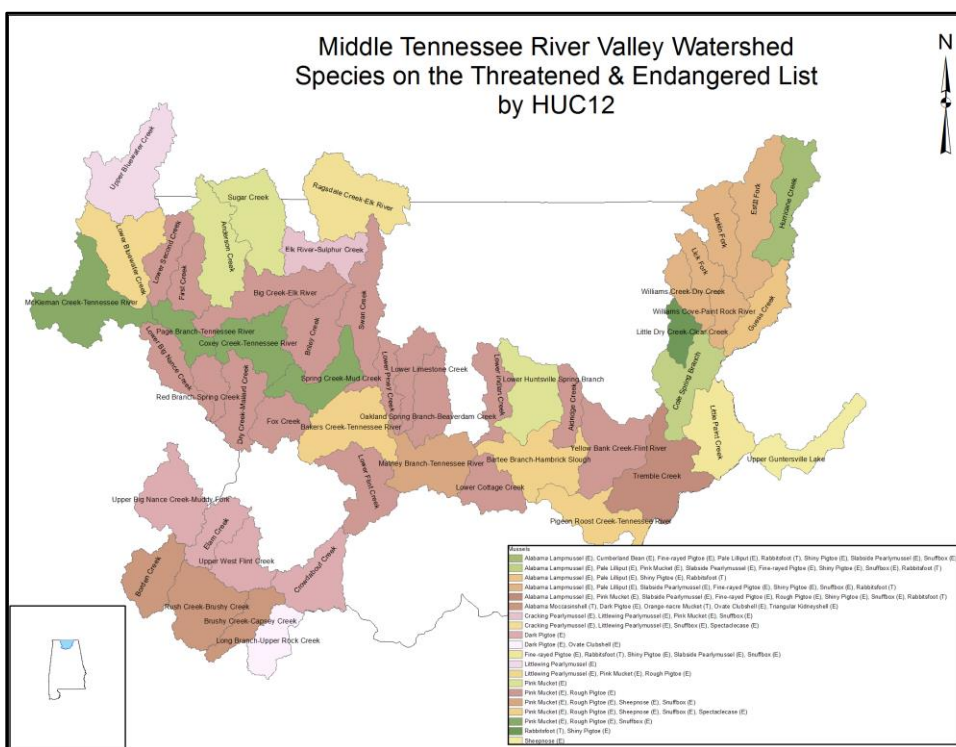
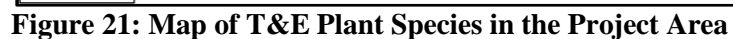


Figure 20: Map of T&E Mussel Species in the Project Area



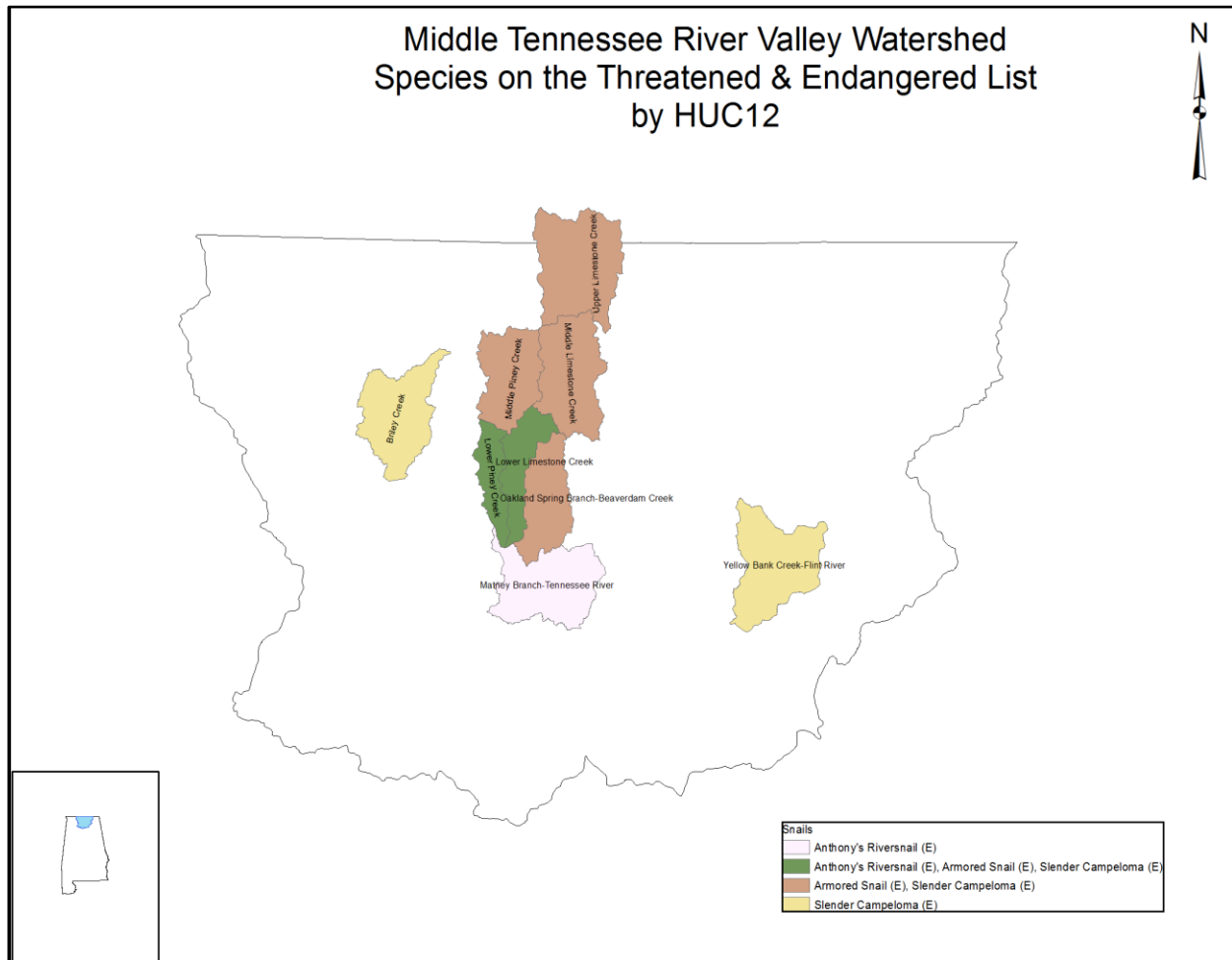


Figure 23: Map of T&E Snail Species in the Project Area

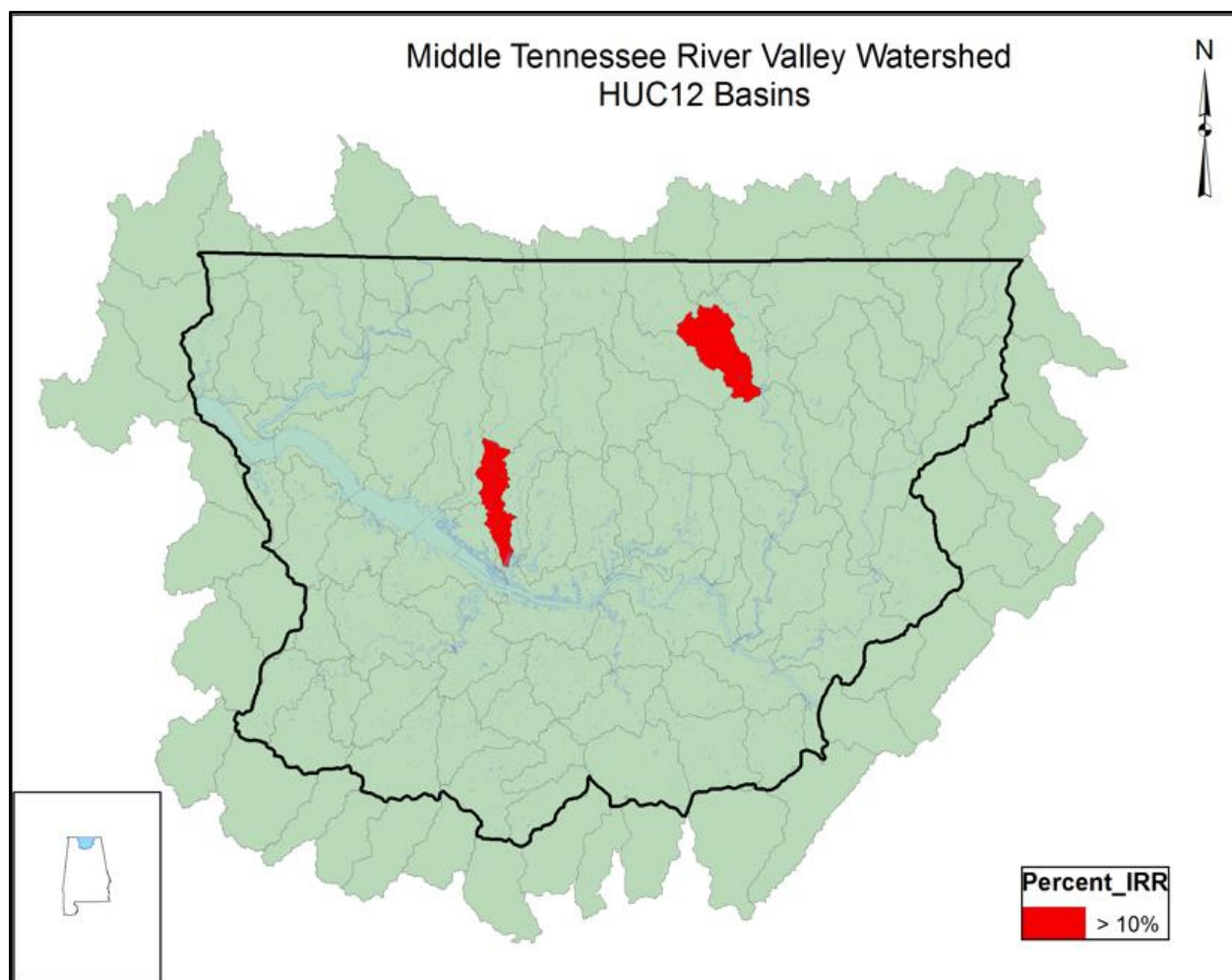


Figure 24: Map of HUC-12 Watersheds Exceeding 10 % Irrigated Acreage Density (acres of irrigation/HUC-12 acreage) of Surface Water in the Project Area

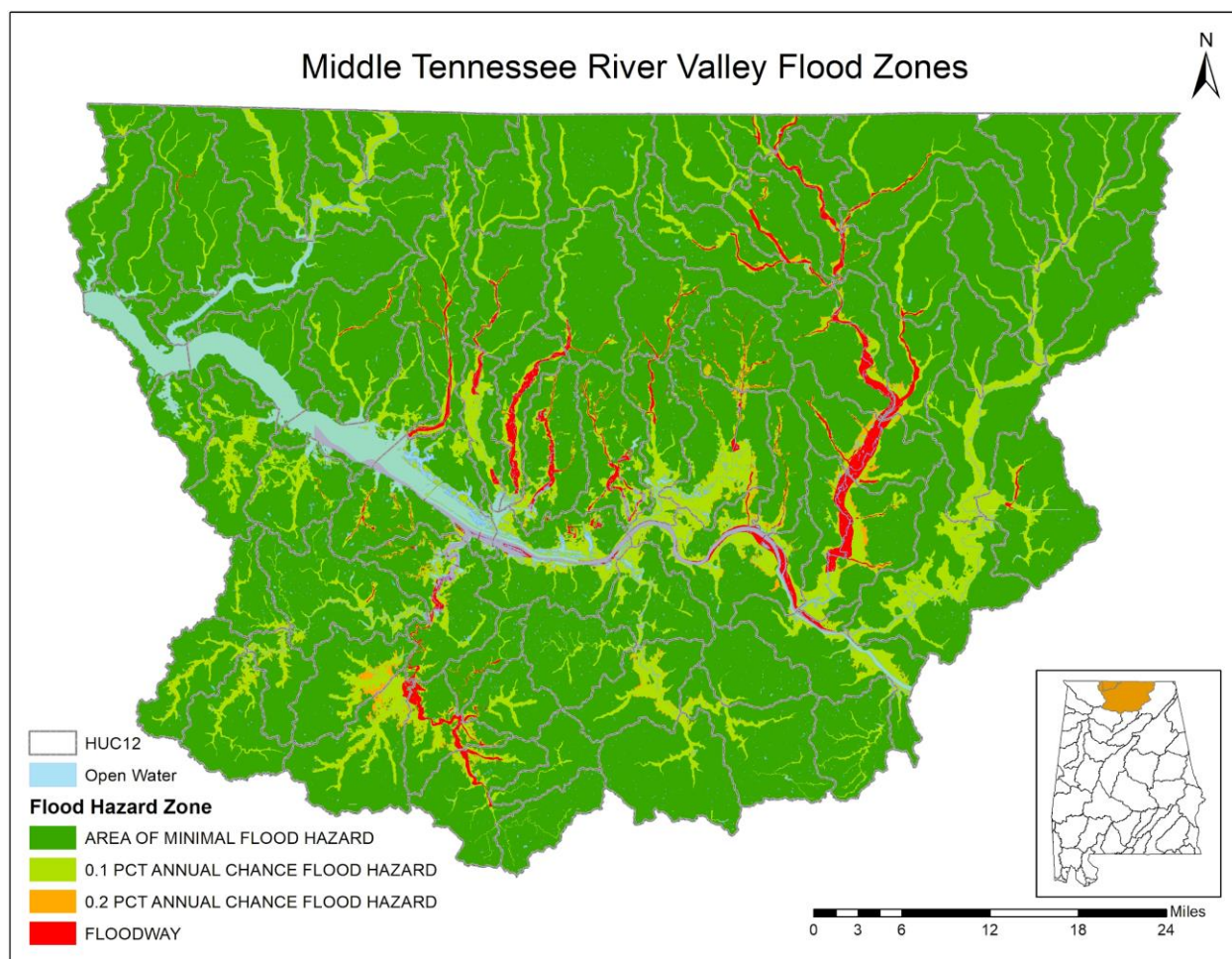


Figure 25: Flood Hazard Zones within the Project Area

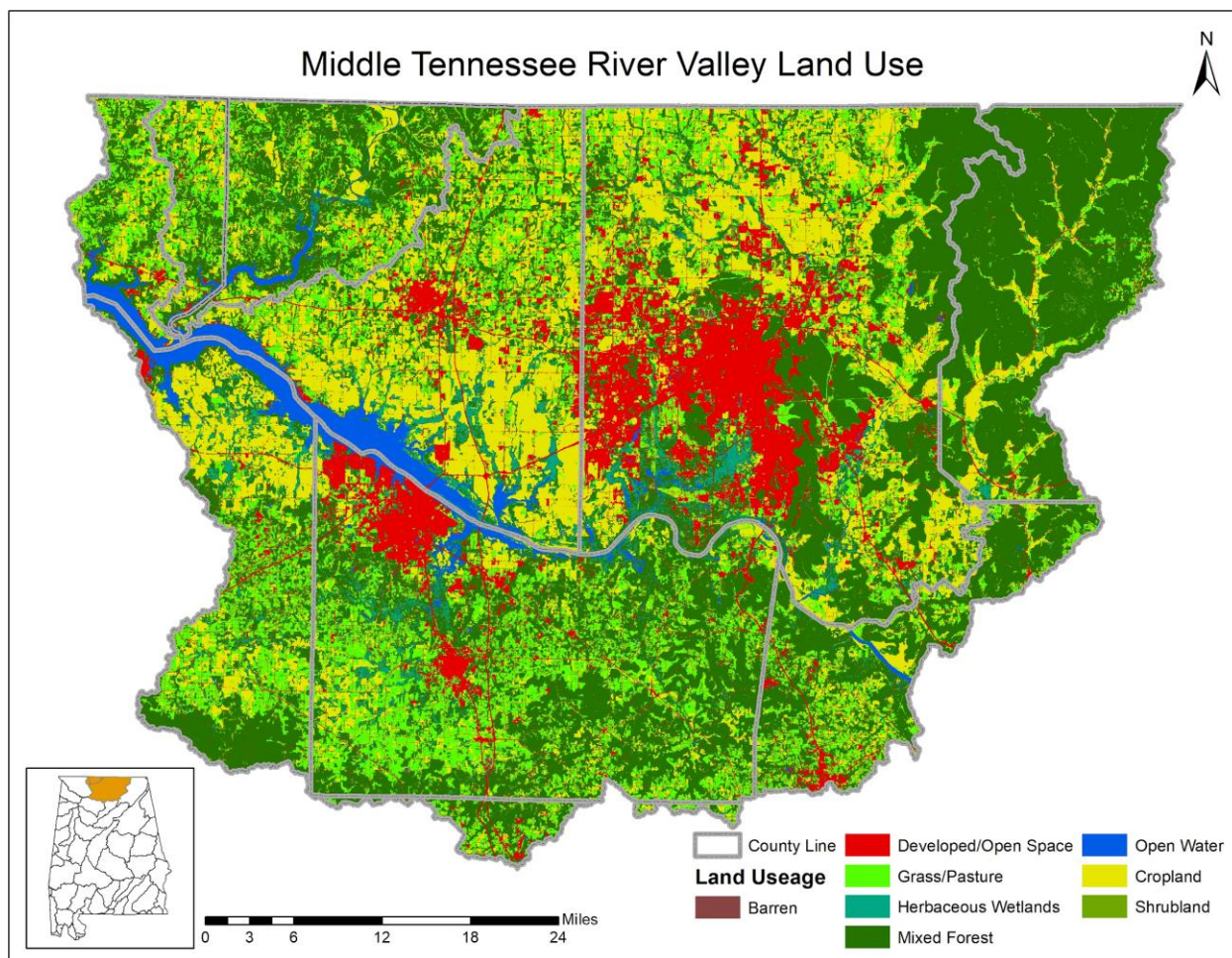


Figure 26: Land Use in the Project Area

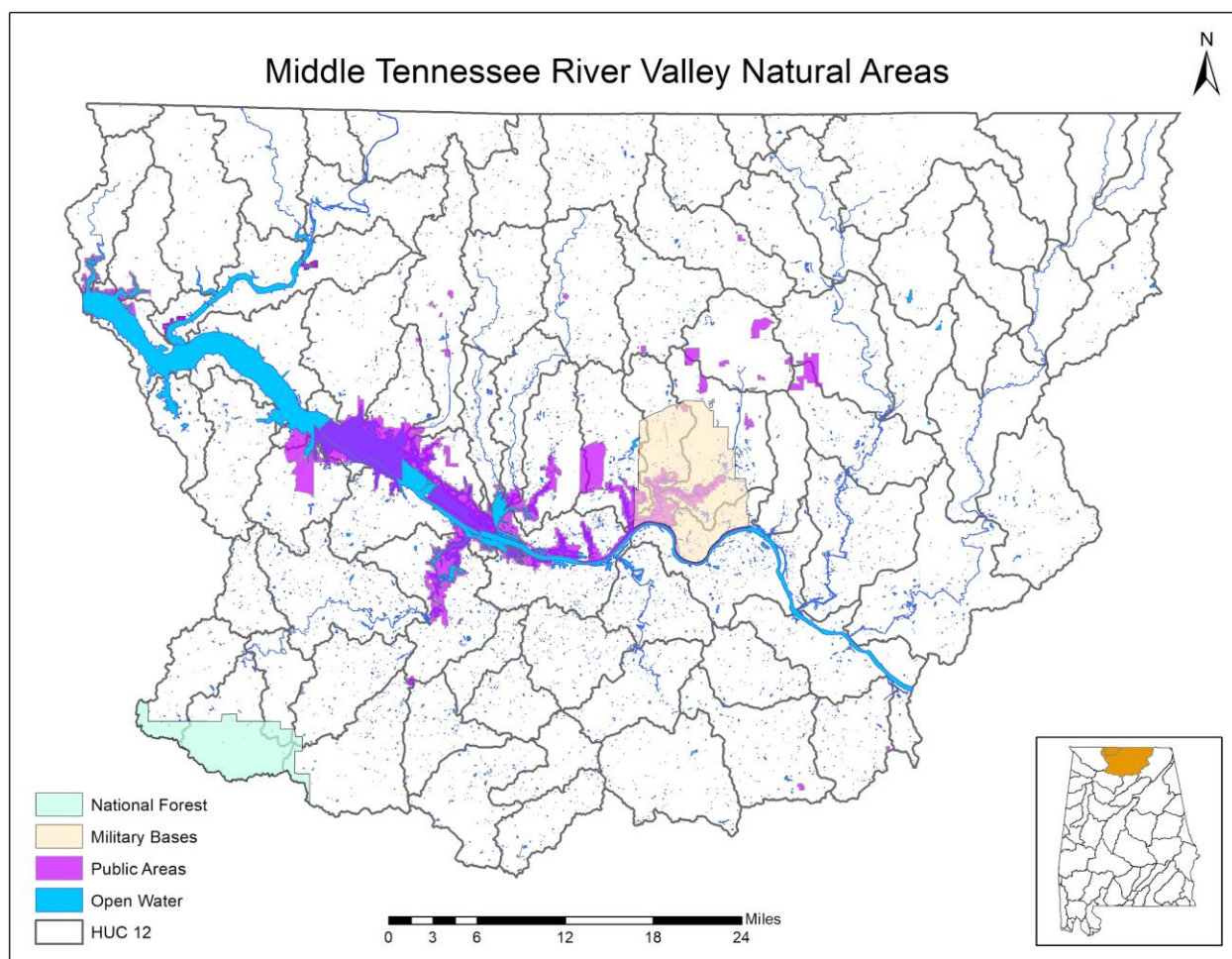


Figure 27: Map of the Natural Areas within the Project Area

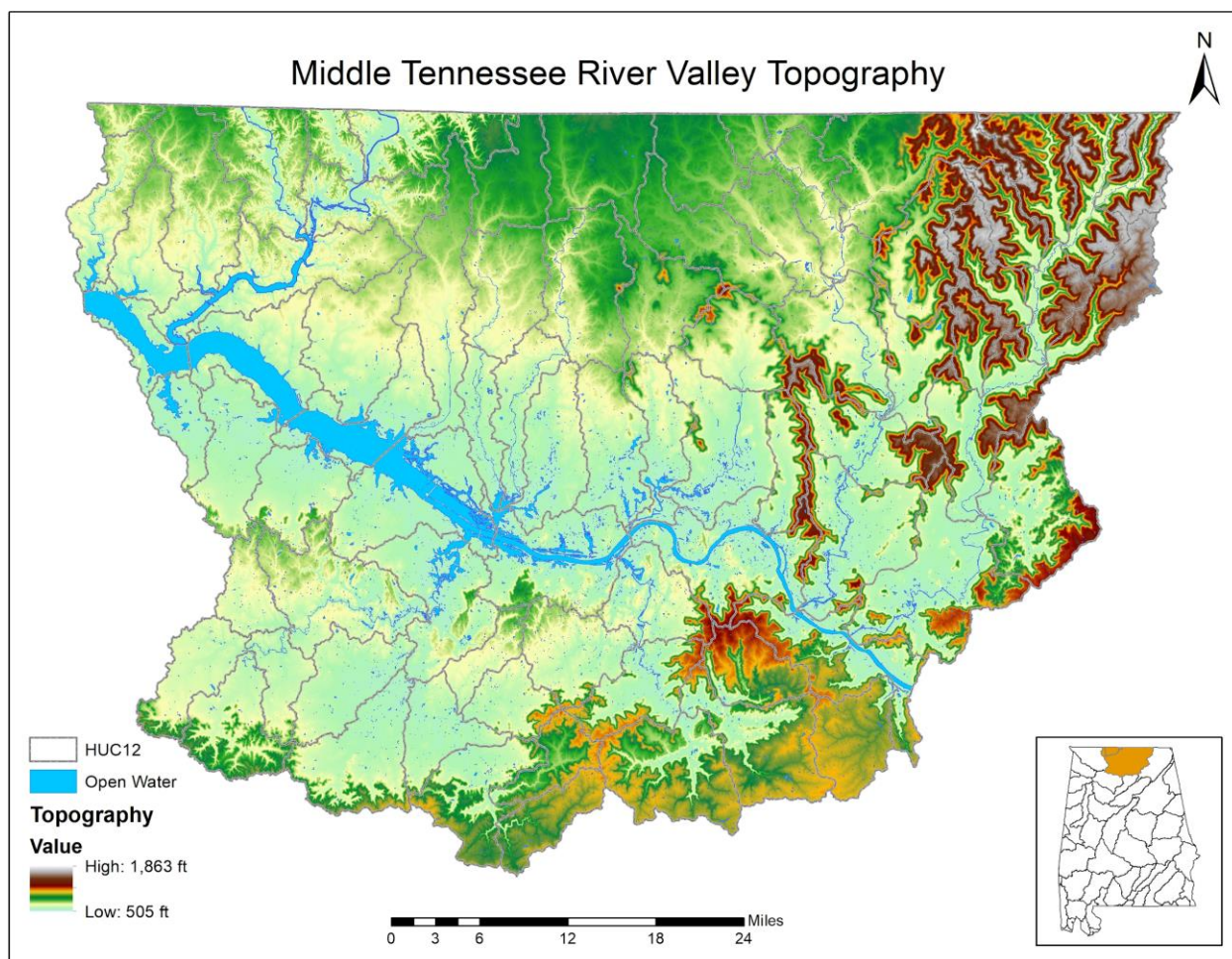


Figure 28: Topography in the Middle TN River Valley Watershed Project Area

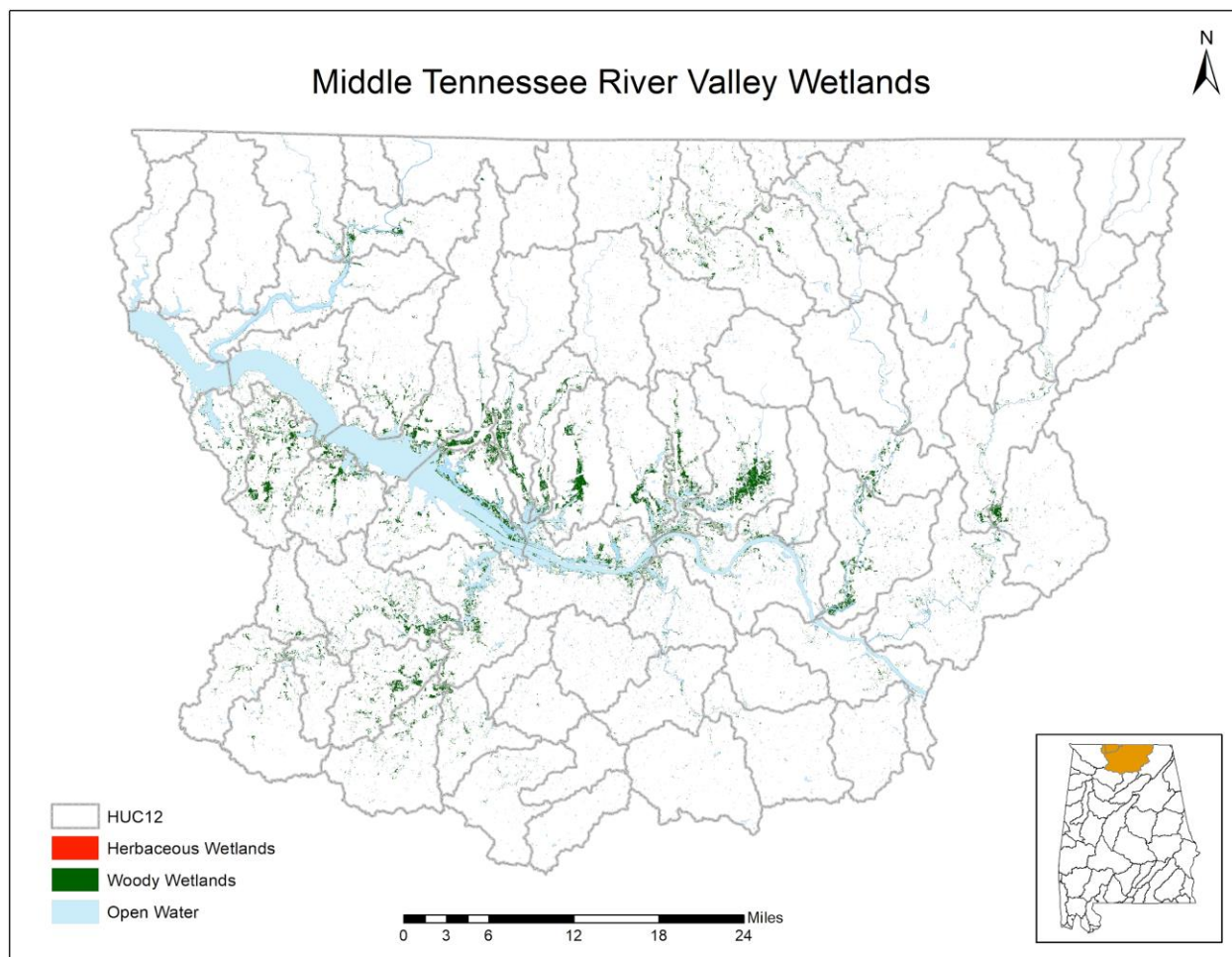


Figure 29: Mapped Wetlands in the Project Area

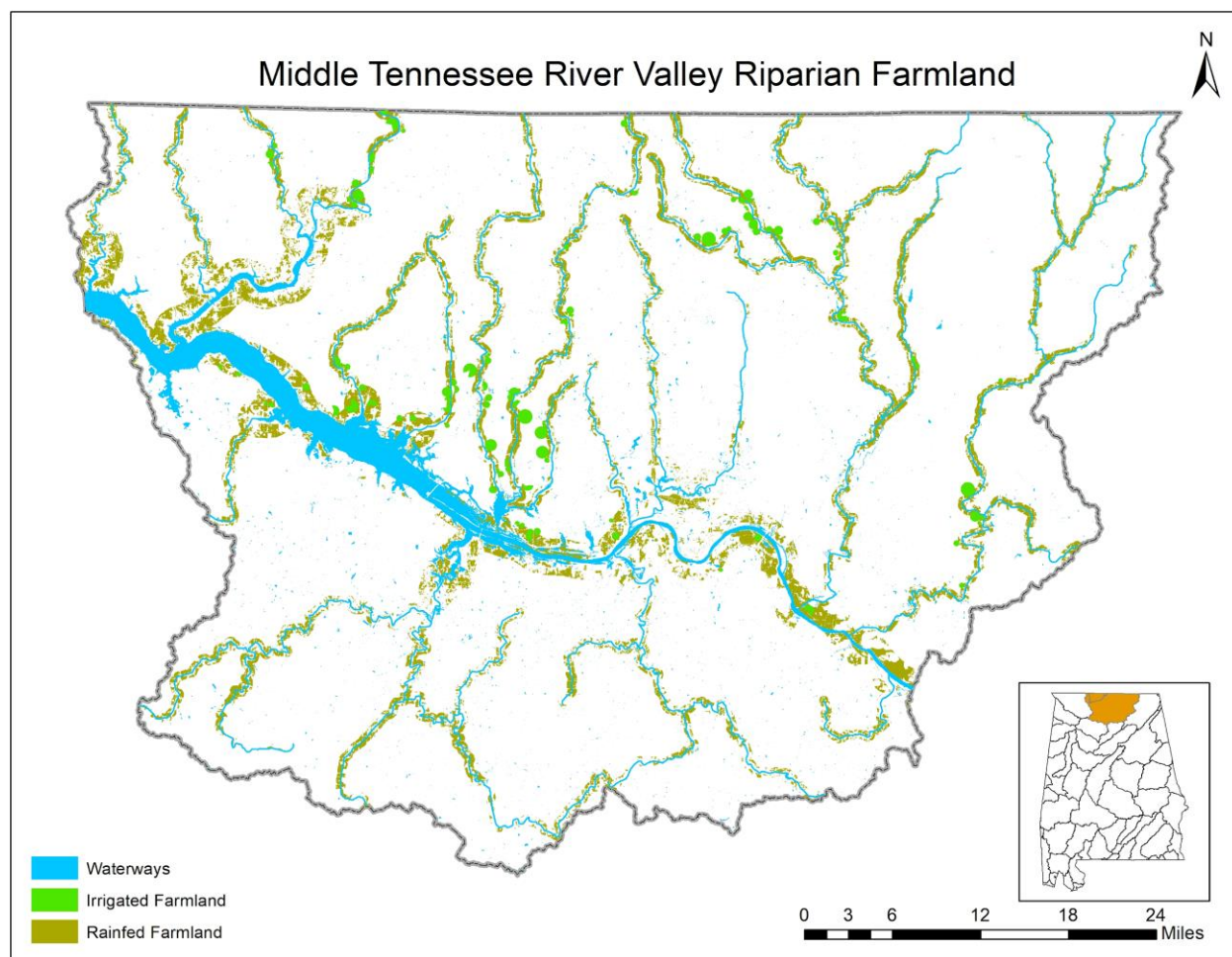


Figure 30: Mapped Riparian Farmland in the Project Area

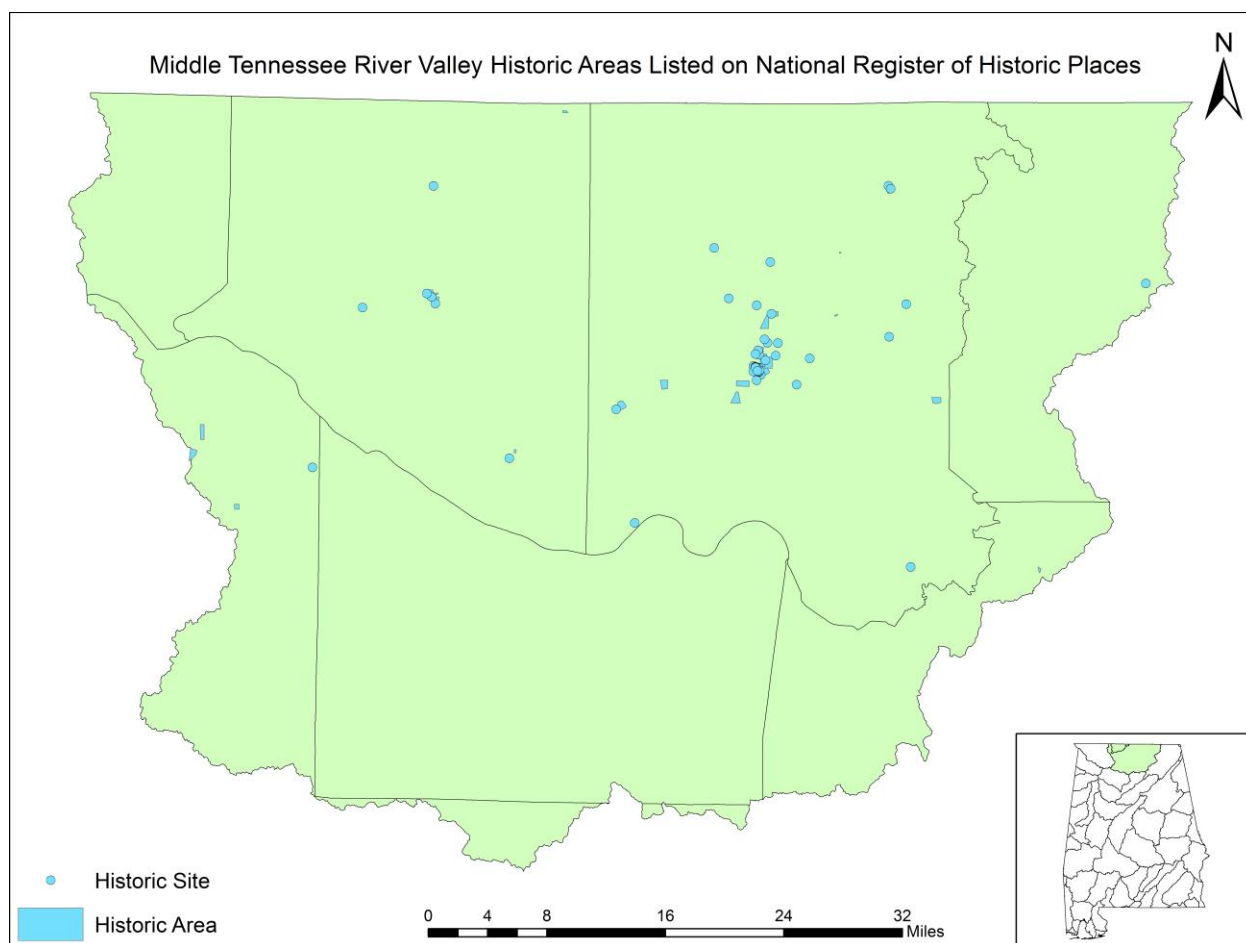


Figure 31: Map of Historic Areas Listed on NRHP Within Middle TN River Valley Watershed Area

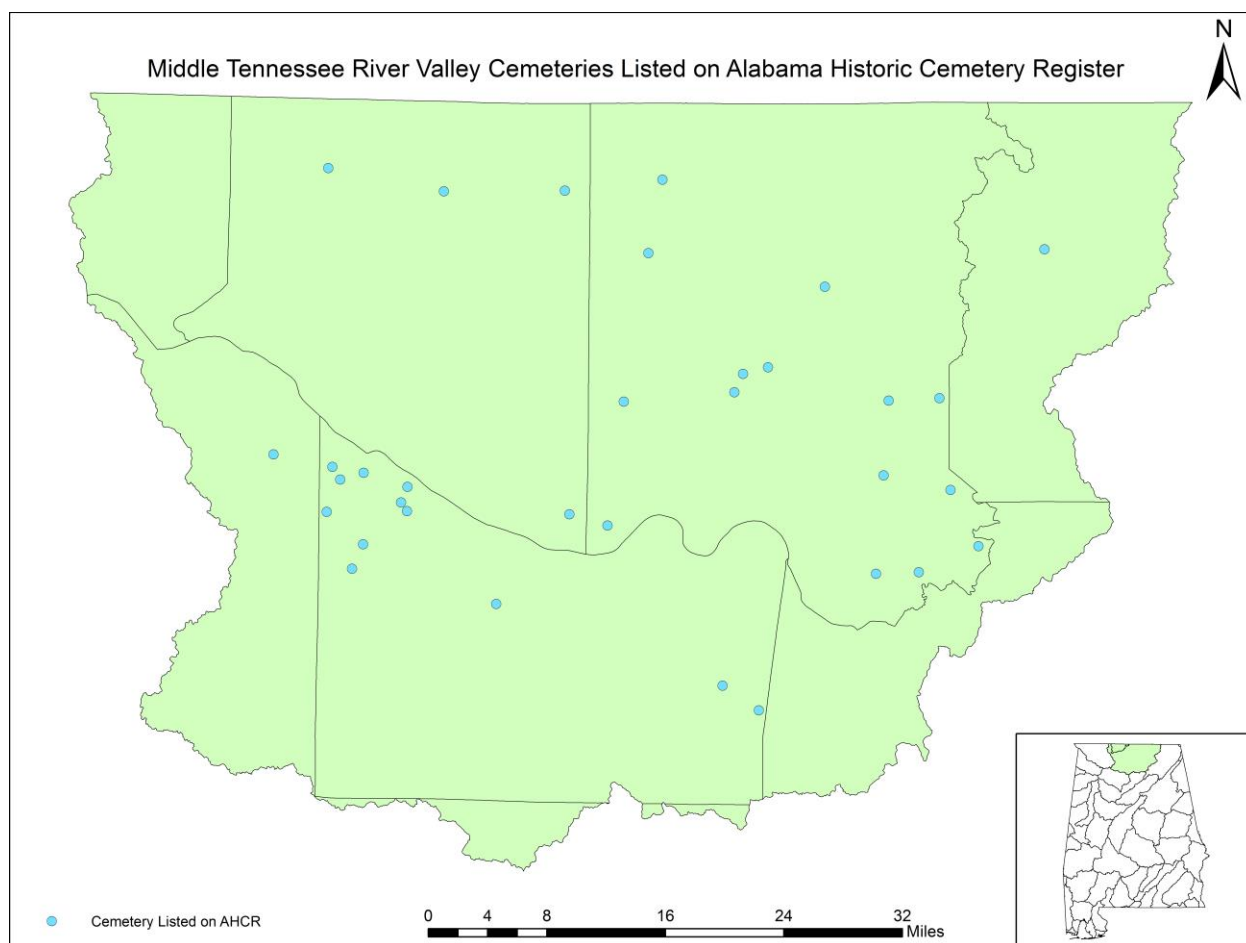


Figure 32: Map of Cemeteries Listed on AHCR Within Middle TN River Valley Watershed Area

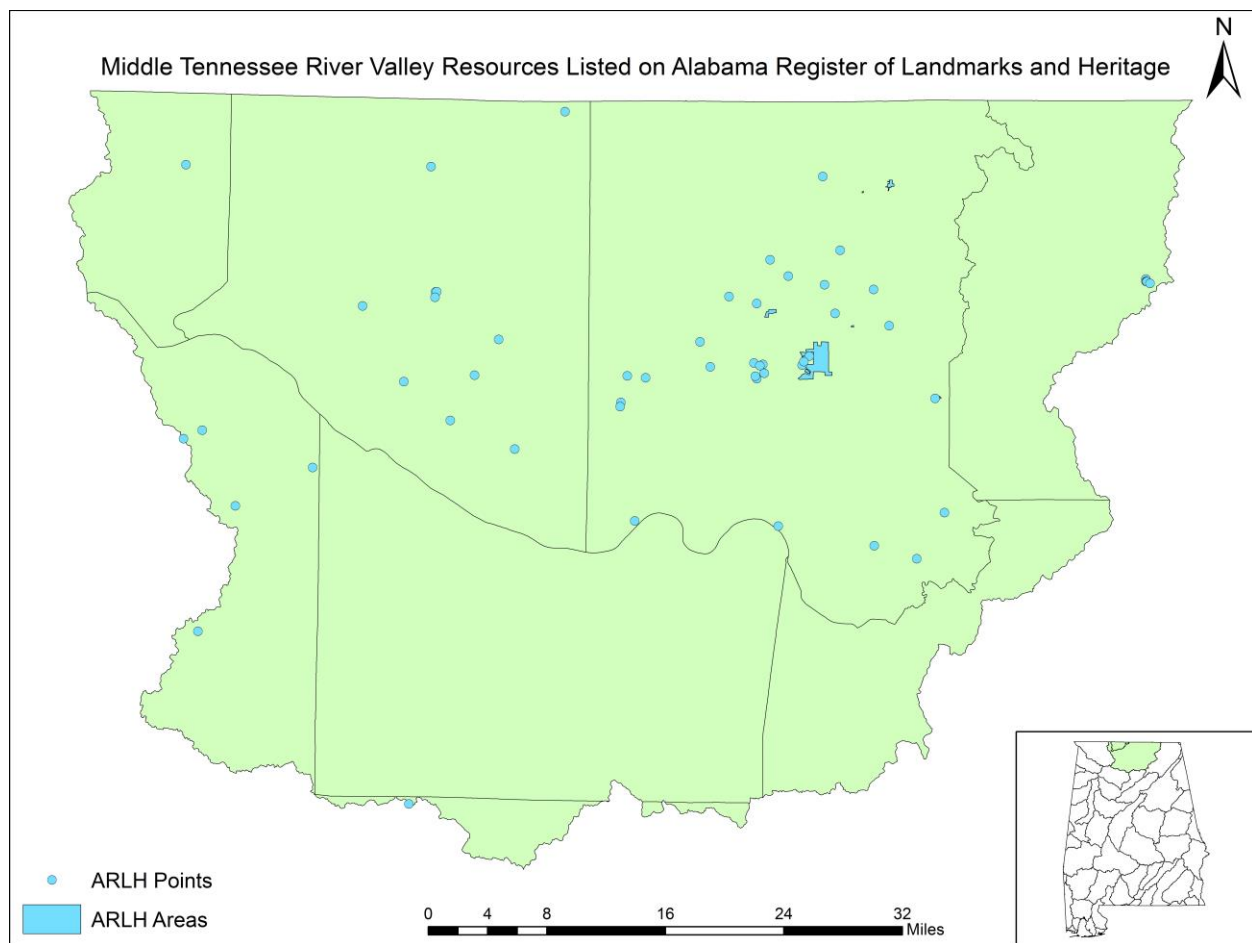


Figure 33: Map of Landmarks and Heritage Listed on ARLH Within the Middle TN River Valley Watershed Area

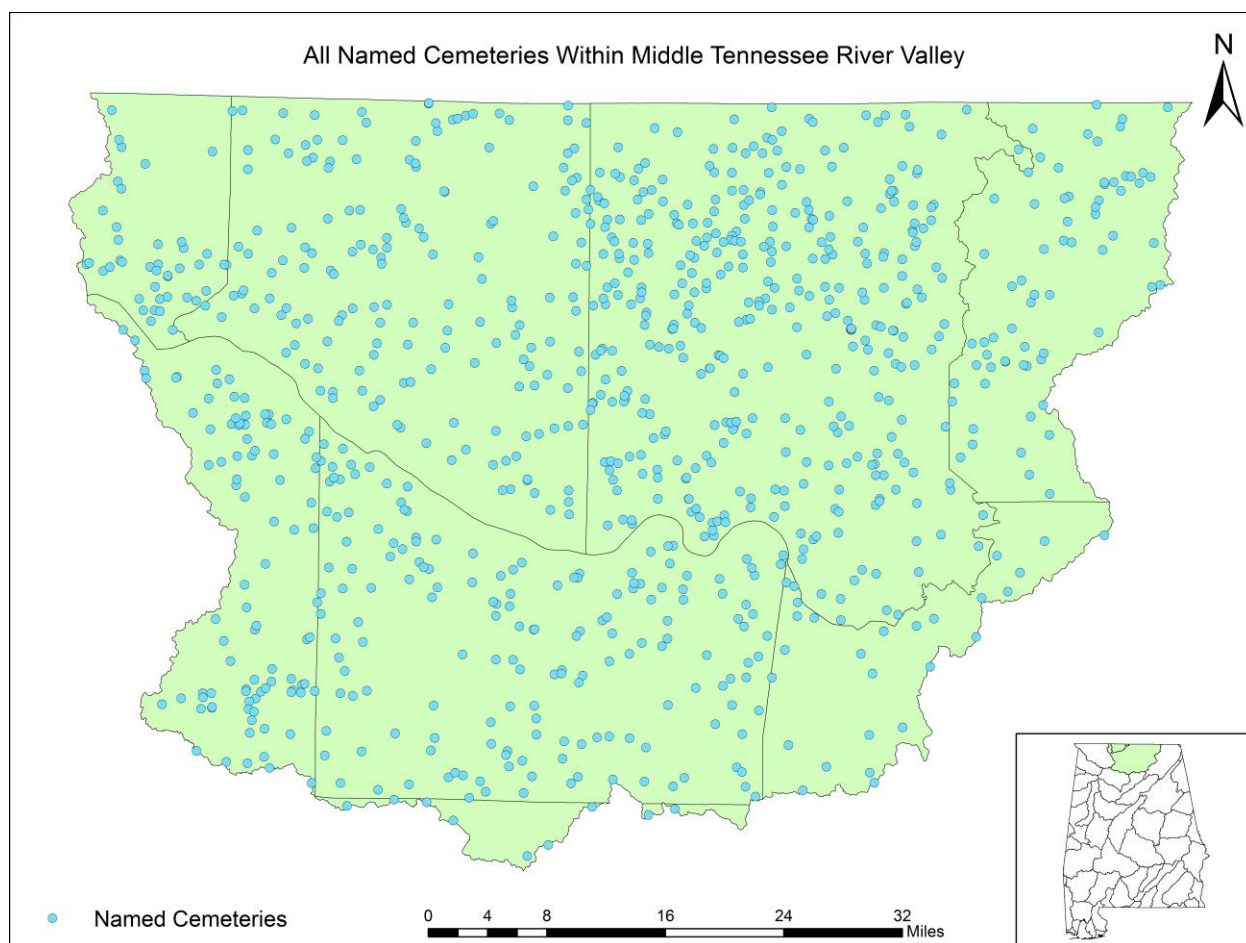


Figure 34: Map of All Named Cemeteries Within the Middle TN River Valley Watershed Area

APPENDIX D

Investigation and Analysis Report

D.1 National Economic Development Analysis

National Economic Development Analysis

1. Benefits and Costs

This section provides a National Economic Development (NED) analysis that evaluates the costs and benefits of the Preferred Alternative of increasing on-farm irrigation systems compared to the No Action Alternative (referred to as No Action). The analysis uses Natural Resources Conservation Service guidelines for the evaluation of NED benefits as outlined in the NRCS Natural Resources Economics Handbook and the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies.

All economic benefits and costs are provided in 2019 dollars and have been discounted and amortized to average annualized values using the 2019 federal water resources planning rate of 2.875 percent.

1.1. Analysis Parameters

This section describes the general parameters of the analysis, including the project purpose, funding sources, the evaluation unit, the project implementation timeline, the period of analysis, and on-farm irrigation adoption rates.

1.1.1. Project Purpose

The purpose of this project is to develop diffuse or decentralized on-farm irrigation systems suitable for the farming practices in the Middle TN River Valley that adhere to State and Federal law and sustainably use water systems.

1.1.2. Funding

Funding is expected to be provided through Public Law 83-566 funds with a cost-share from farmers. The farmer portion would be from non-federal funds.

1.1.3. Evaluation Unit

We compare the Preferred Alternative and the No Action Alternative on the basis of additional irrigated acres due to PL 83-566 funding.

1.1.4. Project Timeline

With current funding, we estimate irrigation investment associated with the project will take place over nine years. Irrigation investment will begin in Year 1. From initial discussions with farmers in the Middle Tennessee River Valley Watershed, most interested participants already have access to ground or surface water, so the only investment would be in irrigation equipment, e.g., center pivots, etc., which can be installed and running within the first year of the project.

1.1.5. Period of Analysis

The period of analysis used is 60 years. At the current rate of irrigation adoption (the No Federal Action plan), it would take approximately 120 years to reach the hypothetical 180,000 irrigated acres within the watershed dependent upon only surface water sources based on the Irrigation

Density Analysis (see Appendix D.2). The Preferred Action target adoption rate of double the current rate would shorten that time period to approximately 60 years to reach the hypothetical 180,000 irrigated acres. This is the first “Environmental Sensitivity Threshold” reached. We assume the useful life of any irrigation system is 20 years.

1.1.6. Irrigation Adoption Rates

With no plan, funds dedicated towards irrigation investment in the future are uncertain. Therefore, there are no NED costs and benefits in a future without plan. Handyside (2017) found that irrigated acreage increased at an average of 1425 acres per year from 2006-2015 within the Middle TN River Valley watershed. With the plan, we project that irrigation acreage adoption will double that rate (2850 additional irrigated acres per year) until available program funds are expended (approximately nine years).

After 20 years a farmer would have to reinvest in a new irrigation system (or make substantial upgrades to the old). Funds are uncertain for reinvestment, so we assume no irrigation investment associated with the project after the 20-year useful life of the irrigation system purchased with project funds. Thus, after Year 20, the total amount of irrigated acreage associated with the project begins to decrease

2. Proposed Project Costs

2.1. Costs Considered and Quantified

Tables 19, 20 and 21 (NWPM 506.11, 506.12, 506.18, Economic Tables 1,2, and 4) below summarize installation costs, distribution of costs, and total annual average costs for the Alternative. The subsections below provide details on the derivation of the values in the tables. Average annual costs include those associated with installation costs. There are no OM&R costs or other direct costs associated with the plan.

Table 19. Economic Table 1-- Estimated Installation Cost, Middle Tennessee River Valley Watershed, Alabama, 2019\$

Works of Improvement	Unit	Number			Estimated cost (dollars) ^{1,2,3}						
					Public Law 83-566 Funds			Other Funds			Total
		Federal Land	Non-Federal Land	Total	Federal Land NRCS	Non-Federal Land NRCS	Total	Federal Land	Non-Federal Land	Total	
Investment in Irrigation Equipment	Acres	0	25,650	25,650	\$-	\$20,794,134.38	\$20,794,134.38	\$-	\$16,339,050.00	\$16,339,050.00	\$37,133,184.38
Total Project	Acres	0	25,650	25,650	\$-	\$20,794,134.38	\$20,794,134.38	\$-	\$16,339,050.00	\$16,339,050.00	\$37,133,184.38

¹Price Base: 2019 dollars

²Project cost includes 6.25% technical assistance costs

³Assume 70% of PL 83-566 funds go towards a 50% cost-share with farmers, while 30% of PL 83-566 funds go towards a 65% cost-share with farmer. Other funds represent farmer contributions.

Table 20. Economic Table 2-- Estimated Cost Distribution Irrigation Equipment Investment, Middle Tennessee River Valley Watershed, Alabama, 2019\$

Works of Improvement	Installation Costs-PL 83-566 Funds ^{1,2}			Installation Costs-Other Funds			Total
	Construction	Project Admin ³	Total PL 83-566	Construction	Project Admin	Total Other	
Investment in Irrigation Equipment	\$19,570,950.00	\$1,223,184.38	\$20,794,134.38	\$16,339,050.00	\$-	\$16,339,050.00	\$37,133,184.38
Total costs	\$19,570,950.00	\$1,223,184.38	\$20,794,134.38	\$16,339,050.00	\$-	\$16,339,050.00	\$37,133,184.38

¹Price Base: 2019 dollars²Assume 70% of PL 83-566 funds go towards a 50% cost-share with farmers, while 30% of PL 83-566 funds go towards a 65% cost-share with farmer. Other funds represent farmer contributions.³Project Admin includes project administration, technical assistance costs and permitting costs.

Table 21. Economic Table 4-- Estimated Average Annual NED Costs, Middle Tennessee River Valley Watershed, Alabama, 2019\$

Works of Improvement	Project Outlays (Amortization of Installation Costs)¹	Project Outlays (OM&R Cost)	Other Direct Costs	Total¹
Investment in Irrigation Equipment	\$1,136,470.35	\$-	\$-	\$1,136,470.35
Total	\$1,136,470.35	\$-	\$-	\$1,136,470.35

¹ Price base: 2019 dollars, amortized over 60 years at a discount rate of 2.875%

2.1.1. Project Installation Costs

Table 22 below shows estimated irrigation investment costs by type of irrigation. Because the ideal irrigation system would vary based on conditions at the specific site, we assume investment costs will be on average \$1,400/irrigated acre. This seems reasonable given the likelihood of use of center pivots in the watershed area. As stated earlier, we assume an increase in irrigated acres of 2,850 per year for nine years.

We assume that 70 percent of program funds will be used for irrigation investment by farmers who qualify for 50 percent cost-share (i.e., federal funds pay 50 percent irrigation investment costs), while 30 percent of program funds will be used for those who qualify for 65 percent cost-share (i.e., federal funds pay 65 percent irrigation investment costs). With these assumptions, the federal expenditures each year are roughly \$2.2 million directly on irrigation investment. We assume technical assistance costs are 6.25 percent of federal funds spent on irrigation investment, so approximately \$136,000 per year will be paid out in program funds for technical assistance to regulatory agencies. This results in average annual NED costs associated with irrigation investment of \$1.1 million.

Table 22. Irrigation Costs Per Acre for Various Systems

Irrigation Type	Estimated Investment Cost Per Acre	Source
Center Pivot	\$1,160-\$2,130	Morata, Goodrich and Ortiz (2019)
Subsurface Drip	\$1,200-\$1,800	Amosson et al. (2011), Stubbs (2015)
Surface Drip	\$860	Stubbs (2015)
Low-Flow Micro Sprinklers	\$2,800	Stubbs (2015)
Side Roll or Wheel Move	\$610	Stubbs (2015)
Big Gun or Travel	\$590	Stubbs (2015)

3. Proposed Project Benefits

Table 23 (NWPM 506.20, Economic Table 5a) summarizes annual average NED project benefits, while Table 24 (NWPM 506.21, Economic Table 6) compares them to the annual average project costs presented in Table 23. Onsite damage reduction benefits that will accrue to agriculture and the local rural community include increased agricultural production (increased net returns). There are no offsite or non-agricultural related benefits.

Table 23. Economic Table 5a-- Estimated Average Annual Watershed Protection Damage Reduction Benefits, Middle Tennessee River Valley Watershed, Alabama, 2019\$

Item	Damage Reduction Benefit, Average Annual	
	Agricultural-Related ¹	Non-Agricultural Related ¹
Onsite Damage Reduction Benefits		
Increasing crop acreage profitability with irrigation ²	\$1,397,703.44	\$-
Subtotal	\$1,397,703.44	\$-
Offsite Damage Reduction Benefits	\$-	
Subtotal	\$-	\$-
Total Quantified Benefits	\$1,397,703.44	\$-

¹Price base: 2019 dollars, amortized over 60 years at a discount rate of 2.875%

²Increased profitability includes yield increases and increased operating costs from irrigation.

Table 24. Economic Table 6-- Comparison of Average Annual NED Costs and Benefits, Middle Tennessee River Valley Watershed, Alabama, 2019\$

Works of Improvement	Agriculture Related ¹	Non-Agriculture Related ¹	Average Annual Benefits	Average Annual Costs ²	Benefit Cost Ratio
Investment in Irrigation Equipment	\$1,397,703.44	\$-	\$1,397,703.44	\$1,136,470.35	1.23
Total	\$1,397,703.44	\$-	\$1,397,703.44	\$1,136,470.35	1.23

¹Price base: 2019 dollars, amortized over 60 years at a discount rate of 2.875%

²From Economic Table 4

3.1. Benefits Considered and Quantified for Analysis

3.1.1. Damage Reduction Benefits

Fruit, vegetable, and/or tree nut production makes up less than one percent of the agricultural acreage in the Middle TN River Valley watershed area. Thus, only damage reduction benefits associated with basic crops of corn, soybeans, cotton and wheat were considered in our analysis. From conversations with farmers and extension professionals, we do not anticipate substantial cropping pattern changes due to increased irrigation. Since the sites are not yet identified, we calculate a weighted average damage reduction benefit per acre based on the differences in net profits between irrigated and non-irrigated acreage for each crop, and weight those differences by the approximate acreage proportion for each basic crop within the watershed project area in 2017.

The differences in net profit per acre between irrigated and non-irrigated crops were estimated using enterprise budgets. For corn, soybeans and cotton, we used 2019 Enterprise Budgets provided by the Alabama Cooperative Extension System (ACES). ACES does not develop wheat budgets, so we utilized the 2018-2019 Enterprise Budgets for wheat from the Georgia Cooperative Extension. We used this proxy because Georgia and Alabama are comparable in their production practices. The net profits per acre and yield goals are displayed in Table 25 below. (Full budgets used for this analysis can be found in the supplemental materials in the NED Appendix, Section 5.1.) Irrigation investment costs were removed from each budget because these are accounted for in the cost section of our analysis. The 5-year average Alabama commodity prices in Table 26 are used to calculate revenues.

Table 25. Irrigated vs Non-irrigated comparison of net profits per acre (excluding irrigation investment costs)

	Corn (bushels)		Soybeans (bushels)		Cotton (pounds)		Wheat (bushels)	
	Irrigated	Non-Irr	Irrigated	Non-Irr	Irrigated	Non-Irr	Irrigated	Non-Irr
Yield Goal/Acre	275 bu	150 bu	65 bu	45 bu	1350 lbs	800 lbs	80 bu	55 bu
Net profits/Acre	\$211.56	\$96.58	\$179.74	\$74.90	\$145.84	\$110.66	\$50.33	\$11.35

Table 26. Average Commodity Prices in Alabama by Year

Year	Corn (\$)	Soybean (\$)	Cotton (\$)	Wheat (\$)
2013	4.71	12.90	0.82	6.85
2014	3.75	10.00	0.60	5.95
2015	3.74	8.95	0.68	5.15
2016	3.63	9.83	0.71	4.45
2017	4.00	9.43	0.68	4.60
5-Year Average	3.97	10.22	0.70	5.40
Source: USDA NASS				

The differences between irrigated and non-irrigated profits per acre were used to calculate an average damage reduction benefit per acre and weighting those differences by the approximate proportion of total acreage for each basic crop within the watershed from the 2017 USDA CropScape Data Layer. As seen in the Table 27 below, we use an average damage reduction benefit from irrigation of \$114.99 per irrigated acre.

As stated earlier, we assume an increase in irrigated acres of 2,850 per year for nine years. This results in an average annual damage reduction benefits associated with irrigation investment of \$1.4 million.

Table 27. Proportional Average Damage Reduction Benefits Per Acre

Crop	Approximate Proportion of Acreage in Watershed	Difference Irrigated and Non-irrigated Profits/Acre	Weighted Profits/Acre
Corn	24%	\$114.98	\$27.18
Soybeans	48%	\$104.84	\$49.84
Cotton	12%	\$256.50	\$31.52
Wheat	17%	\$38.98	\$6.44
Total Average Damage Reduction Benefit/Acre			\$114.99

4. Regional Economic Development

We calculate Regional Economic Development (RED) benefits following the NRCS Water Resources Handbook for Economics section 611.0504. Agricultural multipliers express the amount of impact increases in agricultural income have on the regional economy. We use an agricultural multiplier from Haggblade, Hammer and Hazell (1991). We use the multiplier 2.23 which is estimated for the state of Oklahoma and should be similar to Alabama given both are fairly rural. This multiplier is estimated from a Semi-Input-Output model and accounts for effects from interindustry linkages and increases in local income that increases demand for goods and services. We multiply average annual net NED benefits by the multiplier to get an average annual RED net benefit of \$582,550.

5. References

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- Budgets. (n.d.). Retrieved May 31, 2019, from <http://agecon.uga.edu/extension/budgets.html>
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- Runge, M., Kelton, J., Birdsong, W., Dillard, B., & Balkcom, K. (2019, February 21). Enterprise Budgets for Row Crops. Retrieved May 28, 2019, from <https://www.aces.edu/blog/topics/farming/enterprise-budgets-for-row-crops/>
- Stubbs, M. (2015). Irrigation in U.S. Agriculture: On-Farm Technologies and ... Retrieved from <https://fas.org/sgp/crs/misc/R44158.pdf>

5. NED Appendix

5.1. Supplementary Tables

Table 28. Irrigated Corn Enterprise Budget, 2019\$

CORN IRRIGATED ALABAMA Reduced Tillage- Enterprise Planning Budget Summary					
Estimated Costs Per Acre		Note: To customize this budget, you may change any numbers in blue.			
Following Recommended Management Practices		Yield Goal		275 bushels/acre	
ALABAMA, 2019					
NOTE: The following costs are estimates. Actual costs and quantities will vary from farm to farm.					
The most important information will be contained in the "Your Farm " column that you provide.					
	UNIT	QUANTITY	PRICE OR COST/UNIT	TOTAL PER ACRE	YOUR FARM
1. VARIABLE COSTS					
Seed	THOUS.	35.00	3.50	122.50	
Seed Treatment**	ACRE	1.00	0.00	0.00	
Tech Fee	ACRE	1.00	0.00	0.00	
Fertilizer					
Nitrogen*	UNITS	330.00	0.45	148.50	
Phosphate	UNITS	60.00	0.45	27.00	
Potash	UNITS	60.00	0.32	19.20	
Chicken Litter	TONS	0.00	0.00	0.00	
Micronutrients	ACRE	1.00	5.00	5.00	
Lime (Prorated)	TONS	0.33	35.00	11.55	
Herbicides	ACRE	1.00	41.50	41.50	
Insecticides	ACRE	1.00	8.00	8.00	
Fungicides	ACRE	1.00	20.00	20.00	
Nematicide	ACRE	0.50	14.00	7.00	
Consultant/Scouting Fee	ACRE	0.00	5.00	0.00	
Irrigation	AC/IN	6.00	12.00	72.00	
Drying	BU.	275.00	0.25	68.75	
Hauling	BU.	275.00	0.35	96.25	
Crop Insurance	ACRE	1.00	20.00	20.00	
Aerial Application	ACRE	2.00	9.00	18.00	
Cover Crop Establishment.	ACRE	1.00	20.00	20.00	
Land Rent	ACRE	1.00	0.00	0.00	
Labor (Wages & Fringe)	HOUR	1.10	14.23	15.65	
Tractor/Machinery	ACRE	1.00	29.00	29.00	
Interest on Operating Capital	DOL.	374.95	0.060	22.50	
TOTAL VARIABLE COST				\$772.40	
(Approximate Range per Acre : \$400 to \$900)					
2. FIXED COSTS					
Tractor/Machinery	ACRE	1.00	46.00	46.00	
Irrigation	ACRE	0.00	125.00	0.00	
Land Ownership Cost	ACRE	1.00	0.00	0.00	
General Overhead	DOL.	772.40	0.08	61.79	
TOTAL FIXED COSTS				\$107.79	
(Approximate Range per Acre : \$150 to \$280)					
3. TOTAL COST OF ALL SPECIFIED EXPENSES				\$880.19	
(Approximate Range per Acre : \$350 to \$850)					
* N rate 1.2 lb. N/Yield Goal Bushel					
** Reduced Tillage recommendation of extra insecticide treatment					
1 Production costs held constant except for drying and hauling					
Issued in furtherance of Cooperative Extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, and other related acts, in cooperation U.S. Department of Agriculture. The Alabama Cooperative Extension System (Alabama A&M University and Auburn University) offers educational programs, mat and equal opportunity employment to all people without regard to race, color, national origin, religion, sex, age, veteran status, or disability.					

Table 29. Non-Irrigated Corn Enterprise Budget, 2019\$

CORN ALABAMA Reduced Tillage- Enterprise Planning Budget Summary					
Estimated Costs Per Acre		Note: To customize this budget, you may change any numbers in blue.			
Following Recommended Management Practices		Yield Goal		150 bushels/acre	
ALABAMA, 2019					
NOTE: The following costs are estimates. Actual costs and quantities will vary from farm to farm.					
The most important information will be contained in the "Your Farm " column that you provide.					
	UNIT	QUANTITY	PRICE OR COST/UNIT	TOTAL PER ACRE	YOUR FARM
1. VARIABLE COSTS					
Soil Test	ACRE	1.00	1.00	1.00	
Seed	THOUS.	25.00	3.50	87.50	
Seed Treatment**	ACRE	1.00	0.00	0.00	
Tech Fee	ACRE	1.00	0.00	0.00	
Fertilizer					
Nitrogen*	UNITS	180.00	0.45	81.00	
Phosphate	UNITS	40.00	0.45	18.00	
Potash	UNITS	40.00	0.32	12.80	
Poultry Litter	TONS	0.00	0.00	0.00	
Micronutrients	ACRE	1.00	5.00	5.00	
Lime (Prorated)	TONS	0.33	40.00	13.20	
Herbicides	ACRE	1.00	41.50	41.50	
Insecticides	ACRE	0.50	8.00	4.00	
Fungicides	ACRE	1.00	0.00	0.00	
Nematicide	ACRE	0.50	14.00	7.00	
Consultant/Scouting Fee	ACRE	0.00	5.00	0.00	
Irrigation	AC/IN	0.00	12.00	0.00	
Drying	BU.	150.00	0.00	0.00	
Hauling	BU.	150.00	0.35	52.50	
Crop Insurance	ACRE	1.00	20.00	20.00	
Aerial Application	ACRE	0.00	9.00	0.00	
Cover Crop Establishment.	ACRE	1.00	20.00	20.00	
Land Rent	ACRE	1.00	0.00	0.00	
Labor (Wages & Fringe)	HOOR	1.10	14.23	15.65	
Tractor/Machinery	ACRE	1.00	29.00	29.00	
Interest on Operating Capital	DOL.	203.58	0.060	12.21	
TOTAL VARIABLE COST				\$419.37	
2. FIXED COSTS					
Tractor/Machinery	ACRE	1.00	46.00	46.00	
Irrigation	ACRE	0.00	125.00	0.00	
Land Ownership Cost	ACRE	1.00	0.00	0.00	
General Overhead	DOL.	419.37	0.08	33.55	
TOTAL FIXED COSTS				\$79.55	
3. TOTAL COST OF ALL SPECIFIED EXPENSES				\$498.92	
FERTILIZER RATES BASED ON MED. LEVEL OF SOIL FERTILITY. SOIL TEST ARE RECOMMENDED ON INDIVIDUAL FIELDS. FERT & LIME COSTS REFLECT CUSTOM SPREADING.					
* N rate 1.2 lb. N/Yield Goal Bushel					
** Reduced Tillage recommendation of extra insecticide treatment					
1 Production costs held constant except for drying and hauling					
Issued in furtherance of Cooperative Extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, and other related acts, in cooperation U.S. Department of Agriculture. The Alabama Cooperative Extension System (Alabama A&M University and Auburn University) offers educational programs, ma and equal opportunity employment to all people without regard to race, color, national origin, religion, sex, age, veteran status, or disability.					

Table 30. Irrigated Cotton Enterprise Budget, 2019\$

COTTON IRRIGATED North - Enterprise Planning Budget Summary					
Estimated Costs Per Acre		Note: To customize this budget, you may change any numbers in blue.			
Following Recommended Management Practices		Yield Goal		1350 Pounds per Acre	
ALABAMA, 2019		Cottonseed/Lint Ratio		1.1	
NOTE: The following costs are estimates. Actual costs and quantities will vary from farm to farm. The most important information will be contained in the "Your Farm " column that you provide.					
	UNIT	QUANTITY	PRICE OR COST/UNIT	TOTAL PER ACRE	YOUR FARM
1. VARIABLE COSTS					
Soil Test	ACRE	1.00	1.00	1.00	_____
Seed & Tech Fee	THOUS.	41.00	2.30	94.30	_____
Seed Treatment	BAG	1.00	8.00	8.00	_____
Fertilizer					
Nitrogen	UNITS	90.00	0.45	40.50	_____
Phosphate	UNITS	40.00	0.45	18.00	_____
Potash	UNITS	90.00	0.32	28.80	_____
Poultry litter	TONS	0.00	0.00	0.00	_____
Micronutrients/Boron	ACRE	1.00	10.00	10.00	_____
Lime (Prorated)	TONS	0.33	40.00	13.20	_____
Herbicides					
Burndown/Planting+Post/Lay-By	ACRE	1.00	60.00	60.00	_____
Insecticides					
Planting, Early, Mid, Late Season	ACRE	1.00	20.00	20.00	_____
Systemic Fungicides	ACRE	0.00	0.00	0.00	_____
Growth Regulator	ACRE	1.00	10.00	10.00	_____
Defol/Harvest Aid	ACRE	1.00	18.00	18.00	_____
Consultant/Scouting Fee	ACRE	0.00	8.00	0.00	_____
Irrigation	AC/IN	6.00	12.00	72.00	_____
Crop Insurance	ACRE	1.00	25.00	25.00	_____
Aerial Application	ACRE	0.00	9.00	0.00	_____
Boll Weevil Eradication	ACRE	1.00	3.00	3.00	_____
Cover Crop Establishment.	ACRE	1.00	20.00	20.00	_____
Land Rent	ACRE	1.00	0.00	0.00	_____
Labor (Wages & Fringe)	HOURL	3.20	14.23	45.54	_____
Tractor/Machinery	ACRE	1.00	70.00	70.00	_____
Interest on Operating Capital	DOL.	278.17	0.0600	16.69	_____
Gin/Whse.	LB	1350.00	0.10	135.00	_____
Classing/Promotion Fee	BALE	2.81	3.20	9.00	_____
Cottonseed Credit	TONS	0.74	120.00	-89.10	_____
TOTAL VARIABLE COST				\$627.93	_____
(Approximate Range per Acre : \$325 to \$750)					
2. FIXED COSTS					
Tractor/Machinery	ACRE	1.00	121.00	121.00	_____
Irrigation	ACRE	0.00	125.00	0.00	_____
Land Ownership Cost	ACRE	1.00	0.00	0.00	_____
General Overhead	DOL.	627.93	0.08	50.23	_____
TOTAL FIXED COSTS				171.23	_____
(Approximate Range per Acre : \$90 to \$300)					
3. TOTAL COST OF ALL SPECIFIED EXPENSES				\$799.16	_____
(Approximate Range per Acre : \$400 to \$1050)					
1 Production costs held constant except Gin/Whse, Classing/Promotion Fee, and Cottonseed Credit					
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Table 31. Non-irrigated Cotton Enterprise Budget, 2019\$**COTTON North Reduced Tillage - Enterprise Planning Budget Summary**

Estimated Costs Per Acre

Note: To customize this budget, you may change any numbers in blue.

Following Recommended Management Practices

Yield Goal

800 Pounds per Acre**ALABAMA, 2019**

Cottonseed/Lint Ratio

1.1**NOTE: The following costs are estimates. Actual costs and quantities will vary from farm to farm.****The most important information will be contained in the "Your Farm " column that you provide.**

	UNIT	QUANTITY	PRICE OR COST/UNIT	TOTAL PER ACRE	YOUR FARM
1. VARIABLE COSTS					
Soil Test	ACRE	1.00	1.00	1.00	
Seed & Tech Fee	THOUS.	41.00	2.10	86.10	
Seed Treatment	BAG	1.00	8.00	8.00	
Fertilizer					
Nitrogen	UNITS	90.00	0.45	40.50	
Phosphate	UNITS	40.00	0.45	18.00	
Potash	UNITS	60.00	0.32	19.20	
Poultry litter	TONS	0.00	0.00	0.00	
Micronutrients/Boron	ACRE	1.00	10.00	10.00	
Lime (Prorated)	TONS	0.33	40.00	13.20	
Herbicides					
Burndown/Planting+Post/Lay-By	ACRE	1.00	60.00	60.00	
Insecticides					
Planting, Early, Mid, Late Season	ACRE	1.00	20.00	20.00	
Systemic Fungicides	ACRE	0.00	0.00	0.00	
Growth Regulator	ACRE	1.00	8.00	8.00	
Defol/Harvest Aid	ACRE	1.00	16.00	16.00	
Consultant/Scouting Fee	ACRE	0.00	8.00	0.00	
Irrigation	AC/IN	0.00	12.00	0.00	
Crop Insurance	ACRE	1.00	25.00	25.00	
Aerial Application	ACRE	0.00	9.00	0.00	
Boll Weevil Eradication	ACRE	1.00	3.00	3.00	
Cover Crop Establishment.	ACRE	1.00	20.00	20.00	
Land Rent	ACRE	1.00	0.00	0.00	
Labor (Wages & Fringe)	HOURL	3.20	14.23	45.54	
Tractor/Machinery	ACRE	1.00	70.00	70.00	
Interest on Operating Capital	DOL.	231.27	0.0600	13.88	
Gin/Whse.	LB	800.00	0.10	80.00	
Classing/Promotion Fee	BALE	1.67	3.20	5.33	
Cottonseed Credit	TONS	0.44	120.00	-52.80	
TOTAL VARIABLE COST				\$508.95	
(Approximate Range per Acre : \$325 to \$750)					
2. FIXED COSTS					
Tractor/Machinery	ACRE	1.00	121.00	121.00	
Irrigation	ACRE	0.00	125.00	0.00	
Land Ownership Cost	ACRE	1.00	0.00	0.00	
General Overhead	DOL.	508.95	0.08	40.72	
TOTAL FIXED COSTS				161.72	
(Approximate Range per Acre : \$90 to \$300)					
3. TOTAL COST OF ALL SPECIFIED EXPENSES				\$670.66	
(Approximate Range per Acre : \$400 to \$1050)					

1 Production costs held constant except Gin/Whse, Classing/Promotion Fee, and Cottonseed Credit

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Table 32. Irrigated Soybeans Enterprise Budget, 2019\$

SOYBEANS IRRIGATED- Enterprise Planning Budget Summary					
Estimated Costs Per Acre		Note: To customize this budget, you may change any numbers in blue.			
Following Recommended Management Practices		Yield Goal		65 Bushels per acre	
ALABAMA, 2019					
NOTE: The following costs are estimates. Actual costs and quantities will vary from farm to farm.					
The most important information will be contained in the "Your Farm " column that you provide.					
	UNIT	QUANTITY	PRICE OR COST/UNIT	TOTAL PER ACRE	YOUR FARM
1. VARIABLE COSTS					
Soil Test	ACRE	1.00	1.00	1.00	_____
Seed & Inoculant	BAG	1.00	55.00	55.00	_____
Fertilizer					
Nitrogen	UNITS	30.00	0.45	13.50	_____
Phosphate	UNITS	60.00	0.45	27.00	_____
Potash	UNITS	60.00	0.32	19.20	_____
Poultry Litter	TONS	0.00	0.00	0.00	_____
Boron /Micronutrients	ACRE	1.00	10.00	10.00	_____
Lime (Prorated)	TONS	0.33	40.00	13.20	_____
Herbicides	ACRE	1.00	45.00	45.00	_____
Insecticides	ACRE	1.00	8.00	8.00	_____
Fungicides	ACRE	1.00	14.00	14.00	_____
Nematicide	ACRE	1.00	0.00	0.00	_____
Consultant/Scouting Fee	ACRE	0.00	6.00	0.00	_____
Irrigation	AC/IN	5.00	12.00	60.00	_____
Drying	BU.	65.00	0.00	0.00	_____
Hauling	BU.	65.00	0.80	52.00	_____
Crop Insurance	ACRE	1.00	20.00	20.00	_____
Aerial Application	ACRE	0.00	9.00	0.00	_____
Cover Crop Establishment.	ACRE	1.00	20.00	20.00	_____
Labor (Wages & Fringe)	HOURL	1.05	14.23	14.94	_____
Tractor/Machinery	ACRE	1.00	26.00	26.00	_____
Interest on Operating Capital	DOL.	198.92	0.0600	11.94	_____
TOTAL VARIABLE COST				\$409.78	_____
(Approximate Range per Acre : \$175 to \$475)					
2. FIXED COSTS					
TRACTOR/MACHINERY	ACRE	1.00	42.00	42.00	_____
IRRIGATION	ACRE	0.00	125.00	0.00	_____
LAND OWNERSHIP COST	ACRE	1.00	0.00	0.00	_____
GENERAL OVERHEAD	DOL.	409.78	0.08	32.78	_____
TOTAL FIXED COSTS				\$74.78	_____
(Approximate Range per Acre : \$50 to \$275)					
3. TOTAL COST OF ALL SPECIFIED EXPENSES				\$484.56	_____
(Approximate Range per Acre : \$225 to \$750)					
1 Production costs held constant except for drying and hauling					
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Table 33. Non-irrigated Soybean Enterprise Budget, 2019\$

SOYBEANS - Enterprise Planning Budget Summary					
Estimated Costs Per Acre		Note: To customize this budget, you may change any numbers in blue.			
Following Recommended Management Practices		Yield Goal		45 Bushels per ac	
ALABAMA, 2019					
NOTE: The following costs are estimates. Actual costs and quantities will vary from farm to farm. The most important information will be contained in the "Your Farm " column that you provide.					
	UNIT	QUANTITY	PRICE OR COST/UNIT	TOTAL PER ACRE	YOUR FARM
1. VARIABLE COSTS					
Soil Test	ACRE	1.00	1.00	1.00	_____
Seed & Inoculant	BAG	1.00	55.00	55.00	_____
Fertilizer					
Nitrogen	UNITS	0.00	0.45	0.00	_____
Phosphate	UNITS	60.00	0.45	27.00	_____
Potash	UNITS	60.00	0.32	19.20	_____
Poultry Litter	TONS	0.00	0.00	0.00	_____
Boron /Micronutrients	ACRE	1.00	10.00	10.00	_____
Lime (Prorated)	TONS	0.33	40.00	13.20	_____
Herbicides	ACRE	1.00	45.00	45.00	_____
Insecticides	ACRE	1.00	8.00	8.00	_____
Fungicides	ACRE	1.00	14.00	14.00	_____
Nematicide	ACRE	1.00	0.00	0.00	_____
Consultant/Scouting Fee	ACRE	0.00	6.00	0.00	_____
Irrigation	AC/IN	0.00	12.00	0.00	_____
Drying	BU.	45.00	0.00	0.00	_____
Hauling	BU.	45.00	0.80	36.00	_____
Crop Insurance	ACRE	1.00	20.00	20.00	_____
Aerial Application	ACRE	0.00	9.00	0.00	_____
Cover Crop Establishment.	ACRE	1.00	20.00	20.00	_____
Land Rent	ACRE	1.00	0.00	0.00	_____
Labor (Wages & Fringe)	HOUR	1.05	14.23	14.94	_____
Tractor/Machinery	ACRE	1.00	26.00	26.00	_____
Interest on Operating Capital	DOL.	154.17	0.0600	9.25	_____
TOTAL VARIABLE COST				\$317.59	_____
(Approximate Range per Acre : \$125 to \$400)					
2. FIXED COSTS					
Tractor/Machinery	ACRE	1.00	42.00	42.00	_____
Irrigation	ACRE	0.00	125.00	0.00	_____
Land Ownership Cost	ACRE	1.00	0.00	0.00	_____
General Overhead	DOL.	317.59	0.08	25.41	_____
TOTAL FIXED COSTS				\$67.41	_____
(Approximate Range per Acre : \$50 to \$275)					
3. TOTAL COST OF ALL SPECIFIED EXPENSES				\$385.00	_____
(Approximate Range per Acre : \$175 to \$600)					
1 Production costs held constant except for drying and hauling					
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Table 34. Irrigated Wheat Enterprise Budget, 2019\$


WHEAT FOR GRAIN, INTENSIVE MANAGEMENT GEORGIA, 2018/19						
Estimated Costs and Returns						
Expected Yield:		80 bushel		Your Yield _____		
Variable Costs	Unit	Amount	\$/Unit	Cost/Acre	\$/bushel	Your Farm
Treated Seed	pounds	125	\$ 0.30	\$ 37.72	\$ 0.47	_____
Lime	ton	0.25	\$ 46.00	\$ 11.50	\$ 0.14	_____
Fertilizer						
Nitrogen	pounds	120	\$ 0.47	\$ 56.40	\$ 0.71	_____
Phosphate	pounds	50	\$ 0.42	\$ 21.00	\$ 0.26	_____
Potash	pounds	60	\$ 0.32	\$ 19.20	\$ 0.24	_____
Weed Control	acre	1	\$ 38.41	\$ 38.41	\$ 0.48	_____
Insect Control	acre	1	\$ 3.00	\$ 3.00	\$ 0.04	_____
Disease Control**	acre	1	\$ 8.00	\$ 8.00	\$ 0.10	_____
Preharvest Machinery						
Fuel	gallon	8.0	\$ 2.65	\$ 21.23	\$ 0.27	_____
Repairs and Maintenance	acre	1	\$ 17.64	\$ 17.64	\$ 0.22	_____
Harvest Machinery						
Fuel	gallon	3.0	\$ 2.65	\$ 8.02	\$ 0.10	_____
Repairs and Maintenance	acre	1	\$ 5.43	\$ 5.43	\$ 0.07	_____
Labor	hours	1.3	\$ 13.00	\$ 16.89	\$ 0.21	_____
Irrigation*	applications	1	\$ 9.88	\$ 9.88	\$ 0.12	_____
Crop Insurance	acre	1	\$ 11.50	\$ 11.50	\$ 0.14	_____
Land Rent	acre	1	\$ -	\$ -	\$ -	_____
Interest on Operating Capital	percent	\$ 142.91	6.0%	\$ 8.57	\$ 0.11	_____
Drying - 2 Points	bushel	88	\$ 0.09	\$ 7.90	\$ 0.10	_____
Total Variable Costs:				\$ 302.29	\$ 3.78	
Fixed Costs						
Machinery Depreciation, Taxes, Insurance and Housing						
Preharvest Machinery	acre	1	\$ 24.01	\$ 24.01	\$ 0.30	_____
Harvest Machinery	acre	1	\$ 25.14	\$ 25.14	\$ 0.31	_____
Irrigation	acre	0	\$ 130.00	\$ -	\$ -	_____
General Overhead	% of VC	\$ 302.29	5%	\$ 15.11	\$ 0.19	_____
Management	% of VC	\$ 302.29	5%	\$ 15.11	\$ 0.19	_____
Owned Land Cost, Taxes, Cash Payment, etc.	acre	1	\$ -	\$ -	\$ -	_____
Other	acre	1	\$ -	\$ -	\$ -	_____
Total Fixed Costs				\$ 79.38	\$ 0.99	
Total Costs Excluding Land				\$ 381.67	\$ 4.77	
Your Profit Goal				\$ _____	/bushel	
Price Needed for Profit				\$ _____	/bushel	
*Average of diesel and electric irrigation application costs. Electric is estimated at \$7/appl and diesel is estimated at \$12.75/appl when diesel costs \$2.65/gal.						
** If disease is expected to be a problem, add an additional \$12-15/acre for chemical and application costs.						
Developed by Amanda Smith.						
Ag and Applied Economics, 9/2018						
						


Table 35. Non-irrigated Wheat Enterprise Budget, 2019\$

WHEAT FOR GRAIN, CONVENTIONAL GEORGIA, 2018/19						
Estimated Costs and Returns						
Expected Yield:		55 bushel		Your Yield _____		
Variable Costs	Unit	Amount	\$/Unit	Cost/Acre	\$/bushel	Your Farm
Seed	pounds	90	\$ 0.27	\$ 24.30	\$ 0.44	_____
Lime	ton	0.25	\$ 46.00	\$ 11.50	\$ 0.21	_____
Fertilizer						
<i>Nitrogen</i>	pounds	80	\$ 0.47	\$ 37.60	\$ 0.68	_____
<i>Phosphate</i>	pounds	40	\$ 0.42	\$ 16.80	\$ 0.31	_____
<i>Potash</i>	pounds	40	\$ 0.32	\$ 12.80	\$ 0.23	_____
Weed Control	acre	1	\$ 38.41	\$ 38.41	\$ 0.70	_____
Insect Control	acre	1	\$ 3.00	\$ 3.00	\$ 0.05	_____
Disease Control	acre	1	\$ 4.80	\$ 4.80	\$ 0.09	_____
Preharvest Machinery						
<i>Fuel</i>	gallon	3.7	\$ 2.65	\$ 9.77	\$ 0.18	_____
<i>Repairs and Maintenance</i>	acre	1	\$ 8.83	\$ 8.83	\$ 0.16	_____
Harvest Machinery						
<i>Fuel</i>	gallon	3.0	\$ 2.65	\$ 8.02	\$ 0.15	_____
<i>Repairs and Maintenance</i>	acre	1	\$ 5.43	\$ 5.43	\$ 0.10	_____
Labor	hours	0.7	\$ 13.00	\$ 9.70	\$ 0.18	_____
Irrigation*	applications		\$ 9.88	\$ -	\$ -	_____
Crop Insurance	acre	1	\$ 12.50	\$ 12.50	\$ 0.23	_____
Land Rent	acre	1	\$ -	\$ -	\$ -	_____
Interest on Operating Capital	percent	\$ 101.73	6.0%	\$ 6.10	\$ 0.11	_____
Drying - 2 Points	bushel	60	\$ 0.09	\$ 5.43	\$ 0.10	_____
Total Variable Costs:				\$ 215.00	\$ 3.91	
Fixed Costs						
Machinery Depreciation, Taxes, Insurance and Housing						
<i>Preharvest Machinery</i>	acre	1	\$ 24.01	\$ 24.01	\$ 0.44	_____
<i>Harvest Machinery</i>	acre	1	\$ 25.14	\$ 25.14	\$ 0.46	_____
<i>Irrigation</i>	acre	0	\$ 130.00	\$ -	\$ -	_____
General Overhead	% of VC	\$ 215.00	5%	\$ 10.75	\$ 0.20	_____
Management	% of VC	\$ 215.00	5%	\$ 10.75	\$ 0.20	_____
Owned Land Cost, Taxes, Cash Payment, etc.	acre	1	\$ -	\$ -	\$ -	_____
Other _____	acre	1	\$ -	\$ -	\$ -	_____
Total Fixed Costs				\$ 70.65	\$ 1.28	
Total Costs Excluding Land				\$ 285.65	\$ 5.19	
Your Profit Goal				\$ _____	/bushel	
Price Needed for Profit				\$ _____	/bushel	

* Average of diesel and electric irrigation application costs. Electric is estimated at \$7/appl and diesel is estimated at \$12.75/appl when diesel costs \$2.65/gal.

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Developed by Amanda Smith.

Ag and Applied Economics, 9/2018



D.2 Natural Resource Models and Results

Natural Resource Investigation and Analysis

1. Data Layers and GIS Model

Working with the NWMC to distinguish a watershed ideal/feasible for the development of the PL-566 project, a recommended outline of data layers was identified. Sources for these data layers were then identified and acquired during the completion of a Statewide Resource Assessment. Table 36 presents the list of these SRA data layers and identified sources. In some cases, data sources were modified and updated over the course of the project. As information was presented to the steering committee, source organizations provided updated or preferred data.

Table 36. List of SRA Data Layers and Identified Sources

Chapter	Data Layer	Sources
1	Soils	<i>Soil Survey Staff. The Gridded Soil Survey Geographic (gSSURGO) Database for Alabama. United States Department of Agriculture, Natural Resources Conservation Service. Available online at https://gdg.sc.egov.usda.gov/. FY2015 official release.</i>
2	ADEM/Water Quality	Alabama's 2018 303(d) List, provided directly by Chris Johnson, Water Quality Branch Chief. Also using SPARROW model as a base line fertilizer loading for each HUC8 (https://water.usgs.gov/nawqa/sparrow/sparrow-mod.html)
3	Cropping Information by Field	Alabama Irrigation Initiative data. USDA National Agricultural Statistics Service Cropland Data Layer. 2017 Published crop-specific data layer [Online]. Available at https://nassgeo.data.gmu.edu/CropScape/ . USDA-NASS, Washington, DC.
4	Land Use	USDA National Agricultural Statistics Service Cropland Data Layer. 2017 Published crop-specific data layer [Online]. Available at https://nassgeo.data.gmu.edu/CropScape/ . USDA-NASS, Washington, DC.
5	Survey Results	https://www.agcensus.usda.gov/Publications/2012/Online_Resource/s/County_Profiles/Alabama/
6	Climate/Weather	Alabama State Climate Office
7	Surface Water	2017 OWR Surface Water Assessment (http://adeca.alabama.gov/Divisions/owr/watermanagement/Pages/Reports-and-Information.aspx)
8	Ground Water	2017 OWR Surface Water Assessment (http://adeca.alabama.gov/Divisions/owr/watermanagement/Pages/Reports-and-Information.aspx). Also well monitoring reports from the GSA (https://www.gsa.state.al.us/gsa/groundwater)
9	Environmental Justice Layer	US Census Data (http://www.alabamaview.org/GISTIGerfiles.php)
10	Cultural Resources	Alabama Register of Landmarks & Heritage (http://www.arcgis.com/home/webmap/viewer.html?extent=-92.1118%2C29.7817%2C-81.2628%2C35.4411&webmap=f516bf2b1a94408aa14eb25b54787442)
11	T&E Species	US Fish&Wildlife: Alabama Strategic Habitat Unit mapping data and Alabama T&E Species Table. Provided directly from Jeff Powell, Deputy Field Supervisor, AL Ecological Services Field Office
	Flood Maps for Watershed Areas	Wetlands and open water classes are identified in the Land Use section
	Digital Elevation Model	Slope is captured in the land capability class in SSURGO
12	Stakeholder Engagement	Covered initially in the Survey results and more meetings to follow after the SRA is complete.
13	Ranking Tool	Kao, Chiang. "Weight determination for consistently ranking alternatives in multiple criteria decision analysis." <i>Applied Mathematical Modelling</i> 34, no. 7 (2010): 1779-1787. Chuang, Y.-C., C.-T. Chen, and C. Hwang, 2016: A simple and efficient real-coded genetic algorithm for constrained optimization. <i>Applied Soft Computing</i> , 38, 87-105.

2. Water Quality

2.1 Existing ADEM Watershed Management Plans

Water management plans previously established in the project area by ADEM funded projects have been evaluated and reviewed as part of the water quality assessment as it relates to the intended actions of this project. The Tennessee River Basin Watershed Management Plan created by ADEM and the Clean Water Partnership in 2003 provides recommendations and information regarding the Middle TN River Valley Watershed Area and was used in addressing potential concerns that may affect impaired waters, TMDLs, or non-point source pollution. The relevant sections from this Plan are 3.2.1 (Reduce nonpoint source pollution from agriculture) and 3.2.6 (Protect diminishing farmlands) (CWP & ADEM, 2003). The intentions of this program are to support existing farmland through sustainable irrigation expansion. Though some streams have pollution levels of concern that are identified in this Plan, the USDA-NRCS will adhere to ADEM's NPS guidelines outlined in this Plan. Furthermore, in addition to requiring NRCS onsite EEs (Form CPA-52), this EA promotes sustainable levels of irrigation density, water use, favors voluntary farmer stewardship and current use of BMPs, and requires updated comprehensive nutrient management plans.

2.2 SPARROW Modeling

The Spatially-Referenced Regression On Watershed attributes (SPARROW) models used in this EA were developed by the United States Geological Survey (USGS) to aid responsible authorities to model long-term water quality. The model set consists of flow, nitrogen, phosphorus, and sediment components. Models have been developed at the national, regional, and local spatial scales, and are widely employed by national, state and local authorities to model the impacts of land use activities on resultant water quality for planning and TMDL purposes.

SPARROW models are statistical regression models that are hybrid in nature as physical watershed processes are considered. Independent variables that are related to the particular dependent water quality variable under consideration are regressed using all available water quality data. For example, the nitrogen model consists of independent variables including atmospheric deposition, fertilizer, and manure applications. Variables can be either sources of nitrogen (such as those previously listed) or transport related such as decay coefficients and stream velocities. The resulting SPARROW model is a multi-variable regression equation. A watershed is discretized into stream reaches and contributing areas (average area approximately 4000 km²), and the regression equation is used to predict the requisite dependent variable for each stream reach.

In the present project, the nitrogen SPARROW model was used. This model was developed for the entire Southeastern US but focused on the area that encompasses just Alabama and Southeastern Mississippi. The nitrogen model was selected because nitrogen products are the dominant constituents that govern many biological water quality processes. Although other factors are also important (e.g., phosphorus) they cannot be effective unless sufficient nitrogen is available to the organisms. The SPARROW results for each stream segment in the Wheeler/Lower Elk HUC are shown in Table 37.

Table 37. SPARROW Model Results for Total Nitrogen Concentrations

SPARROW Model Results for Total Nitrogen Concentrations									
					Scenarios for % increased irrigation				
				Baseline	5%	10%	15%	20%	25%
Reach Name	HUC-8	Basin km ²	Mean Flow cfs	Conc mg/L	Conc mg/L	Conc mg/L	Conc mg/L	Conc mg/L	Conc mg/L
PAINT ROCK CR	6030002	398.49	21.10	262.30	269.50	273.00	276.10	278.70	280.80
PAINT ROCK CR	6030002	67.70	66.11	86.06	88.56	89.69	90.70	91.51	92.14
PAINT ROCK CR	6030002	94.49	128.01	48.75	50.26	50.92	51.50	51.97	52.32
PAINT ROCK CR	6030002	17.84	178.65	33.32	34.39	34.84	35.23	35.54	35.77
PAINT ROCK CR	6030002	39.22	459.98	17.74	18.42	18.70	18.96	19.16	19.30
PAINT ROCK CR	6030002	433.08	989.60	17.37	17.69	18.57	18.91	19.17	19.37
INDIAN CR, HUNTSVILLE SPRING	6030002	152.65	71.80	11.72	11.74	11.80	11.86	11.91	11.96
CLEAR CR	6030002	48.32	94.25	9.69	10.06	10.22	10.37	10.49	10.58
GUESS CR	6030002	87.42	199.75	9.58	10.03	10.24	10.43	10.58	10.71
HURRICANE CR	6030002	186.10	228.24	9.45	9.91	10.09	10.27	10.41	10.52
FLINT R, MOUNTAIN FK	6030002	363.49	141.85	9.19	9.65	10.05	10.44	10.81	11.14
FLINT R	6030002	256.23	1212.94	8.68	9.09	9.26	9.44	9.58	9.69

Table 37. SPARROW Model Results for Total Nitrogen Concentrations-continued

TENNESSEE R, MILLER BR	6030002	0.10	74.30	8.22	8.39	8.58	8.76	8.92	9.08
TENNESSEE R, MILLER BR	6030002	146.87	74.30	8.21	8.39	8.58	8.76	8.92	9.08
INDIAN CR, HUNTSVILLE SPRING	6030002	20.20	126.65	6.36	6.38	6.42	6.45	6.48	6.50
ELAM CR	6030002	79.55	32.90	6.21	6.42	6.56	6.71	6.84	6.96
MALLARD CR	6030002	9.15	43.79	5.35	5.51	5.64	5.77	5.89	6.00
MALLARD CR	6030002	99.49	43.79	4.90	5.05	5.17	5.29	5.40	5.50
LITTLE LIMESTONE CR	6030002	86.40	42.12	4.87	5.09	5.26	5.43	5.58	5.72
ROUND ISLAND CR	6030002	6.79	62.80	4.71	4.89	5.02	5.15	5.27	5.37
FLINT R	6030002	27.15	266.99	4.57	4.80	4.99	5.18	5.36	5.51
FLINT R, MOUNTAIN FK	6030002	216.96	101.42	4.47	4.68	4.84	5.00	5.15	5.28
ROUND ISLAND CR	6030002	129.29	62.80	4.45	4.62	4.75	4.87	4.98	5.08
W FLINT CR	6030002	252.01	159.85	4.35	4.53	4.65	4.77	4.87	4.96
LIMESTONE CR, MOORE BR	6030002	80.89	44.23	4.31	4.57	4.81	5.04	5.25	5.46
FLINT CR	6030002	98.82	63.76	4.29	4.48	4.66	4.84	4.99	5.14
INDIAN CR	6030002	24.73	245.09	4.00	4.05	4.10	4.15	4.19	4.23
LIMESTONE CR, MOORE BR	6030002	10.90	55.73	3.95	4.18	4.39	4.59	4.77	4.95

Table 37. SPARROW Model Results for Total Nitrogen Concentrations-continued

SWAN CR	6030002	30.84	81.65	3.89	4.07	4.18	4.28	4.37	4.46
BIG CR	6030004	3.24	25.90	3.75	3.89	3.99	4.10	4.19	4.28
W FLINT CR	6030002	95.90	47.01	3.71	3.88	3.97	4.05	4.11	4.17
CEDAR CR	6030002	69.45	32.29	3.71	3.95	4.19	4.41	4.62	4.81
COTACO CR	6030002	203.48	112.85	3.63	3.83	4.02	4.20	4.36	4.51
ANDERSON CR	6030004	16.90	67.17	3.54	3.74	3.91	4.08	4.23	4.37
BIG CR	6030004	40.87	25.90	3.52	3.66	3.75	3.85	3.94	4.02
BUCHANON CR	6030004	109.64	36.38	3.51	3.75	3.99	4.22	4.44	4.64
FLINT CR	6030002	79.70	470.21	3.26	3.42	3.55	3.68	3.79	3.89
ANDERSON CR	6030004	133.2	67.17	3.15	3.33	3.48	3.63	3.76	3.88
FLINT CR	6030002	231.22	233.4	3.06	3.23	3.39	3.53	3.66	3.78
FLINT CR	6030002	35.55	470.21	3.03	3.19	3.31	3.42	3.52	3.61
FLINT R, BRIER FK	6030002	131.31	91.36	3.01	3.15	3.25	3.36	3.45	3.53
SWAN CR	6030002	141.39	81.65	2.93	3.06	3.14	3.21	3.28	3.33
MUD CR	6030002	5.59	28.75	2.90	3.01	3.09	3.16	3.23	3.29
BIG CR	6030004	98.49	42.53	2.89	3.05	3.22	3.37	3.52	3.66

Table 37. SPARROW Model Results for Total Nitrogen Concentrations-continued

BEAVERDAM CR	6030002	113.1	78.72	2.88	3.00	3.09	3.18	3.27	3.34
SUGAR CR, W FK	6030004	131.35	77.09	2.82	2.97	3.11	3.24	3.36	3.47
DRY WEAKLEY CR	6030004	149.44	57.10	2.80	2.97	3.13	3.29	3.44	3.57
SIXMILE CR	6030002	42.28	19.90	2.78	2.97	3.14	3.29	3.43	3.55
FLINT CR	6030002	74.29	156.89	2.65	2.79	2.92	3.04	3.15	3.26
LIMESTONE CR	6030002	0.28	315.22	2.59	2.73	2.82	2.91	2.99	3.06
MUD CR	6030002	49.96	60.57	2.56	2.71	2.84	2.96	3.08	3.18
PINEY CR	6030002	2.61	164.49	2.56	2.66	2.74	2.81	2.87	2.93
INDIAN CR	6030002	183.43	99.87	2.54	2.64	2.72	2.81	2.88	2.95
LIMESTONE CR	6030002	11.96	495.63	2.54	2.67	2.75	2.84	2.91	2.98
PINEY CR	6030002	242.36	164.49	2.53	2.64	2.71	2.78	2.84	2.90
MUD CR	6030002	30.71	28.75	2.52	2.62	2.69	2.76	2.82	2.88
ELK R	6030004	48.18	2268.59	2.49	2.47	2.48	2.47	2.45	2.43
COTACO CR	6030002	11.71	275.01	2.47	2.62	2.75	2.87	2.98	3.08
FLINT R	6030002	54.48	732.82	2.45	2.57	2.65	2.74	2.81	2.88
FLINT R	6030002	79.61	732.82	2.43	2.55	2.64	2.73	2.81	2.88

Table 37. SPARROW Model Results for Total Nitrogen Concentrations-continued

SUGAR CR, E FK	6030004	96.69	53.07	2.43	2.56	2.68	2.80	2.91	3.01
COTACO CR	6030002	215.52	357.28	2.41	2.57	2.71	2.84	2.95	3.05
FIRST CR	6030002	5.15	55.29	2.40	2.57	2.69	2.81	2.92	3.02
FLINT CR	6030002	11.79	304.61	2.40	2.54	2.67	2.78	2.88	2.97
LIMESTONE CR	6030002	87.01	71.16	2.40	2.51	2.60	2.69	2.77	2.84
COTACO CR, W FK	6030002	70.33	58.08	2.39	2.54	2.68	2.80	2.92	3.02
LIMESTONE CR	6030002	1.18	254.63	2.34	2.46	2.53	2.60	2.66	2.71
LIMESTONE CR	6030002	217.94	254.63	2.33	2.45	2.52	2.58	2.64	2.69
SECOND CR	6030002	4.88	93.23	2.30	2.43	2.55	2.66	2.76	2.85
FIRST CR	6030002	79.21	55.29	2.28	2.44	2.56	2.68	2.78	2.88
LYNN CR	6030004	46.13	26.92	2.23	2.39	2.56	2.71	2.86	2.99
SECOND CR	6030002	152.10	93.23	2.23	2.36	2.47	2.58	2.68	2.77
MILL CR	6030004	24.60	20.89	2.21	2.27	2.32	2.37	2.42	2.46
ELK R	6030004	145.83	3163.69	2.12	2.15	2.16	2.17	2.17	2.18
ELK R	6030004	29.91	3785.22	2.12	2.13	2.18	2.20	2.22	2.24
ELK R	6030004	8.86	3088.50	2.12	2.12	2.15	2.16	2.16	2.16

Table 37. SPARROW Model Results for Total Nitrogen Concentrations-continued

RICHLAND CR	6030004	244.26	142.94	2.11	2.27	2.44	2.59	2.73	2.86
ELK R	6030004	66.26	3682.64	2.10	2.12	2.16	2.17	2.19	2.20
ELK R	6030004	6.77	3322.02	2.10	2.11	2.14	2.15	2.16	2.16
ELK R	6030004	92.51	3322.02	2.09	2.10	2.13	2.14	2.15	2.16
ELK R	6030004	18.41	3615.38	2.08	2.10	2.13	2.15	2.16	2.17
COTACO CR, W FK	6030002	19.46	144.38	2.08	2.20	2.32	2.42	2.52	2.60
ALDRIDGE CR	6030002	60.58	34.29	2.07	2.09	2.13	2.17	2.20	2.23
FLINT R, BRIER FK	6030002	41.81	282.67	1.98	2.07	2.14	2.20	2.26	2.31
RICHLAND CR	6030004	35.54	285.08	1.96	2.08	2.20	2.32	2.42	2.52
DRY WEAKLEY CR	6030004	3.51	100.17	1.94	2.06	2.18	2.29	2.39	2.49
SUGAR CR	6030004	5.00	274.98	1.88	1.97	2.06	2.13	2.21	2.27
SUGAR CR	6030004	156.66	274.98	1.85	1.95	2.03	2.11	2.18	2.24
TENNESSEE R	6030002	5.46	49728.45	1.81	1.84	1.87	1.88	1.89	1.90
TENNESSEE R	6030002	94.03	49659.90	1.81	1.84	1.86	1.88	1.89	1.90
TENNESSEE R	6030002	119.06	45833.11	1.78	1.81	1.83	1.85	1.86	1.87
TENNESSEE R	6030002	122.48	45719.89	1.77	1.80	1.83	1.84	1.85	1.86

Table 37. SPARROW Model Results for Total Nitrogen Concentrations-continued

TENNESSEE R	6030002	7.24	45620.82	1.77	1.79	1.82	1.83	1.84	1.85
TENNESSEE R	6030002	8.57	45571.29	1.77	1.79	1.82	1.83	1.84	1.85
TENNESSEE R	6030002	142.81	45464.43	1.76	1.78	1.81	1.82	1.83	1.84
TENNESSEE R	6030002	4.81	44932.75	1.71	1.74	1.76	1.77	1.78	1.79
TENNESSEE R	6030002	78.39	44430.93	1.70	1.73	1.75	1.76	1.77	1.77
TENNESSEE R	6030002	20.16	44305.32	1.69	1.72	1.74	1.75	1.75	1.76
TENNESSEE R	6030002	0.88	44305.32	1.69	1.71	1.74	1.75	1.75	1.76
TENNESSEE R	6030002	24.99	43944.96	1.69	1.71	1.73	1.74	1.74	1.75
TENNESSEE R	6030002	52.03	43592.16	1.68	1.70	1.72	1.73	1.74	1.74
TENNESSEE R	6030002	78.53	43669.35	1.68	1.70	1.72	1.73	1.74	1.74
RICHLAND CR	6030004	51.02	449.83	1.67	1.78	1.89	1.99	2.08	2.16
RICHLAND CR	6030004	1.01	512.29	1.58	1.68	1.78	1.88	1.96	2.04
BIG CR	6030004	74.44	135.14	1.57	1.67	1.77	1.87	1.96	2.04
NO BUSINESS CR	6030002	94.82	50.42	1.53	1.64	1.73	1.82	1.89	1.96
SUGAR CR, E FK	6030004	23.22	120.10	1.53	1.61	1.70	1.78	1.86	1.92
MILL CR	6030002	51.63	54.49	1.51	1.61	1.70	1.78	1.85	1.92
LYNN CR	6030004	17.08	109.30	1.50	1.61	1.72	1.82	1.92	2.01
ROBERTSON FK CR	6030004	74.97	63.53	1.48	1.59	1.70	1.80	1.90	1.99

Table 37. SPARROW Model Results for Total Nitrogen Concentrations-continued

TENNESSEE R	6030002	49.28	42314.31	1.48	1.49	1.51	1.51	1.51	1.52
SHOAL CR, E FK	6030004	66.31	40.94	1.47	1.55	1.65	1.73	1.82	1.89
YOKLEY CR	6030004	52.30	37.15	1.46	1.56	1.66	1.75	1.84	1.92
*A	6030002	41.50	38.92	1.26	1.26	1.27	1.29	1.31	1.32
RICHLAND CR	6030004	158.97	721.66	1.18	1.26	1.33	1.40	1.46	1.52
PIGEON ROOST CR	6030004	60.72	58.15	1.17	1.25	1.33	1.41	1.48	1.54
SHOAL CR	6030004	37.55	119.06	1.14	1.20	1.26	1.31	1.36	1.41
RICHLAND CR	6030004	50.27	805.12	1.12	1.20	1.27	1.34	1.40	1.45
TENNESSEE R	6030002	161.47	41264.50	1.09	1.09	1.08	1.08	1.07	1.07
SHOAL CR, W FK	6030004	52.32	47.21	1.08	1.15	1.22	1.29	1.36	1.42
AGNEW CR	6030004	35.63	37.69	0.94	1.00	1.06	1.12	1.18	1.23
SHANNON CR	6030004	47.80	49.72	0.89	0.94	1.00	1.05	1.10	1.15

Excessive nitrogen can lead to an over-abundance of biological productivity which can result in eutrophication and harmful algal blooms in receiving waters. For this reason, nitrogen products were the primary focus of the SPARROW regression model. Total nitrogen concentration data were generated for 122 reaches in the study area. Model results of 10% increased irrigated land are mapped to the HUC-12 watershed in Figure 35.

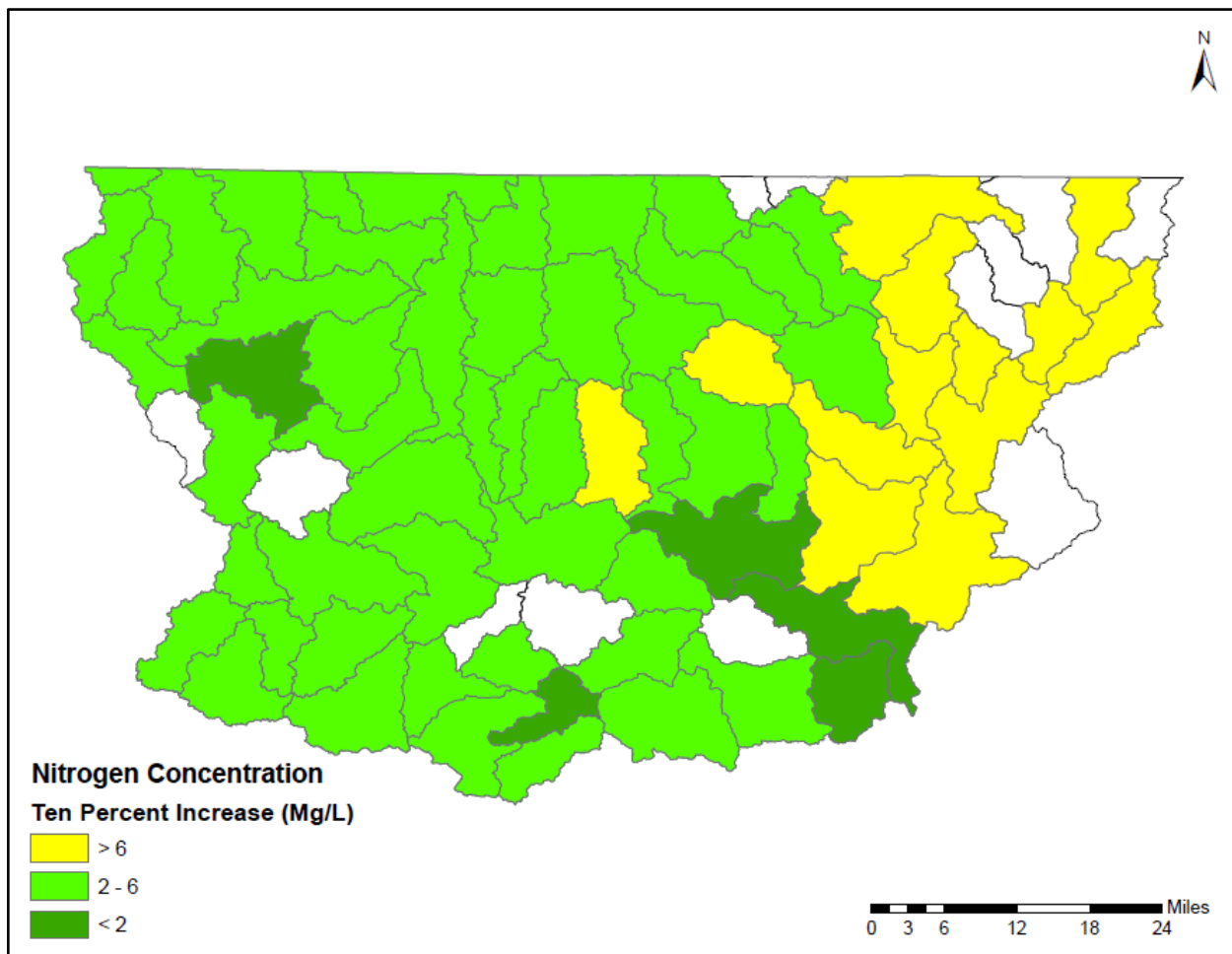


Figure 35: SPARROW Model Scenario with Ten Percent Rainfed Agricultural Lands converted to Irrigated Agricultural Land - Total Nitrogen Concentrations by HUC-12

3. Water Quantity

According to the USGS and OWR assessment, 65 percent of irrigation withdrawals in the basin are surface water sources, while 35 percent of irrigation withdrawals are from groundwater. Water quantity was analyzed for the entire basin using multiple methods. Extensive modeling at the HUC-8 watershed level was conducted using the Water Supply Stress Index (WaSSI) in conjunction with the DSSAT/GriDSSAT crop model. In addition to the WaSSI model, the tributaries within the basin were analyzed for runoff. This was done to further analyze irrigation use that may not have direct access to the Tennessee River. Finally, “irrigation density” analysis is used as a proxy to protect the smaller watersheds (HUC-12). Promoting expanded irrigation in HUC-12s that have less than 10 percent of the overall drainage areas as irrigated acres is recommended to protect local water supplies and existing irrigation investments. This is to further ensure impacts to local water resources are negligible to minor in intensity. Using these criteria, there is approximately 180,000 irrigated acre potential in the watershed. Using the USGS data, this would equate to 117,000 surface water supplied acres and 40,068 groundwater supplied acres.

Groundwater and aquifers were analyzed using available information from both the Alabama Office of Water Resources and Geological Survey of Alabama. In this case, current and projected irrigation demand was compared to documented aquifer recharge.

3.1 HUC-12 Irrigation Density Analysis (i.e. Sensitivity Analysis)

Due to the area of the watershed and volume of water involved, the major concern is not about overall water supply but rather agricultural withdrawals on smaller tributaries where the withdrawals would represent a much larger fraction of the total flow. There are 108 HUC-12 watersheds in and bordering the watershed and streamflow data is not available for all the potential project sites. To address this issue, irrigated acreage density (acres of irrigation as a ratio of total /HUC-12 acreage) has been mapped to the HUC-12 maps of the area. Any watershed where the irrigated acreage density exceeds 10 percent may be considered less than desirable for expanding irrigation using surface water supplies (see Appendix C, Figure 24). This guideline is based on statewide modeling and research efforts (Srivastava et al., 2010). Using this guideline, assuming only dry agricultural land be converted to irrigated land and the irrigation expands uniformly across the HUC-12 watersheds, it is feasible to sustainably irrigate approximately 180,000 acres in the basin (see table 38 below). At this level, the impact to total surface water resources would be minor. This is a very conservative threshold on irrigation expansion and does not incorporate the additional acreage expansion that could sustainably occur with groundwater or direct access to the Tennessee River.

Table 38. HUC-12 Acreage Water Quantity Analysis Results

Basin Area (ac)	Ag land (ac)	Current Irrigated Ag Land (ac)	Percent Basin Area Irrigated	Percent Ag Land Irrigated	10% of Basin Area	Recommended Total Irrigated Ag Land from Surface Water Sources (ac)
1,864,881	687,221	24,066	1.29%	3.50%	186,488	179,020

Table 39. HUC-12 Irrigation Density Acreage Analysis

HUC-8	HUC-12	HU-12 NAME	Area (acres)	Ag Land (acres)	Irrigated Ag Land (acres)	Percent Currently Irrigated	10% of area (acres)	Ag Land Available to Irrigate (acres)
6030002	60300020701	Upper Limestone Creek	29,933	18,889	769	2.60%	2,993	2,993
6030002	60300020304	Upper Brier Fork	19,722	13,246	391	2.00%	1,972	1,972
6030004	60300040303	Sugar Creek	28,385	10,164	325	1.10%	2,839	2,839
6030002	60300020303	Mountain Fork	41,125	18,274	134	0.30%	4,112	4,112
6030004	60300040404	Anderson Creek	35,406	18,984	120	0.30%	3,541	3,541
6030002	60300020902	Pigeon Roost Creek-Tennessee River	33,047	8,175	4	0.00%	3,305	3,305
6030002	60300021107	Coxey Creek-Tennessee River	30,541	13,096	300	1.00%	3,054	3,054
6030002	60300020405	Yellow Bank Creek-Flint River	37,894	13,939	312	0.80%	3,789	3,789
6030002	60300020803	Lower Piney Creek	13,373	7,881	2,006	15.00%	1,337	0
6030002	60300020906	Matney Branch-Tennessee River	36,161	13,885	1,297	3.60%	3,616	3,616
6030002	60300020203	Cole Spring Branch	32,921	9,737	724	2.20%	3,292	3,292
6030002	60300020905	Oakland Spring Branch-Beaverdam Creek	24,624	16,310	2,273	9.20%	2,462	2,462
6030002	60300020204	Tremble Creek	47,988	17,015	547	1.10%	4,799	4,799
6030002	60300020703	Lower Limestone Creek	17,443	11,137	1,563	9.00%	1,744	1,744
6030002	60300020504	Barren Fork Creek	25,773	5,599	79	0.30%	2,577	2,577
6030002	60300021102	Bakers Creek-Tennessee River	41,019	10,041	519	1.30%	4,102	4,102
6030002	60300020402	Lower Hurricane Creek	19,395	7,591	117	0.60%	1,940	1,940

Table 39. HUC-12 Irrigation Density Acreage Analysis

HUC-8	HUC-12	HU-12 NAME	Area (acres)	Ag Land (acres)	Irrigated Ag Land (acres)	Percent Currently Irrigated	10% of area (acres)	Ag Land Available to Irrigate (acres)
6030002	60300021201	Red Branch-Spring Creek	11,734	7,465	1,121	9.50%	1,173	1,173
6030002	60300021106	Dry Creek-Mallard Creek	26,143	13,058	281	1.10%	2,614	2,614
6030002	60300021105	Spring Creek-Mud Creek	26,239	10,135	1,163	4.40%	2,624	2,624
6030002	60300020904	Bartee Branch-Hambrick Slough	39,945	8,211	184	0.50%	3,994	3,994
6030002	60300020305	Banyon Creek-Beaverdam Creek	28,470	16,828	1,890	6.60%	2,847	2,847
6030002	60300020302	West Fork-Flint River	5,565	3,152	299	5.40%	556	556
6030002	60300020306	Lower Brier Fork	19,017	12,363	2,156	11.30%	1,902	0
6030004	60300040401	Shoal Creek	8,882	2,208	50	0.60%	888	888
6030004	60300040403	Elk River-Sulphur Creek	23,962	8,334	765	3.20%	2,396	2,396
6030002	60300020801	Upper Piney Creek	19,827	11,261	86	0.40%	1,983	1,983
6030002	60300020802	Middle Piney Creek	26,887	15,808	39	0.10%	2,689	2,689
6030002	60300020702	Middle Limestone Creek	34,134	16,785	983	2.90%	3,413	3,413
6030002	60300021203	Upper Second Creek	5,122	2,725	17	0.30%	512	512
6030002	60300020307	Pigrum Branch-Flint River	22,648	13,486	1,022	4.50%	2,265	2,265
6030002	60300020403	Acuff Spring-Flint River	31,960	11,587	279	0.90%	3,196	3,196
6030002	60300021101	Swan Creek	35,900	16,943	714	2.00%	3,590	3,590
6030004	60300040402	Ragsdale Creek-Elk River	24,453	8,354	600	2.50%	2,445	2,445
6030002	60300021103	Briley Creek	33,197	21,022	937	2.80%	3,320	3,320
6030002	60300021007	Middle Flint Creek	17,347	8,748	0	0.00%	1,735	1,735
6030002	60300021004	Robertson Branch-Cedar Creek	14,238	6,073	0	0.00%	1,424	1,424
6030002	60300021010	Upper West Flint Creek	23,539	6,533	0	0.00%	2,354	2,354
6030002	60300021006	Crowdabout Creek	30,892	14,687	0	0.00%	3,089	3,089
6030002	60300021002	Dry Creek-Mill Creek	13,284	3,442	0	0.00%	1,328	1,328
6030002	60300020602	West Fork-Cottaco Creek	34,305	12,362	0	0.00%	3,431	3,431

Table 39. HUC-12 Irrigation Density Acreage Analysis

HUC-8	HUC-12	HU-12 NAME	Area (acres)	Ag Land (acres)	Irrigated Ag Land (acres)	Percent Currently Irrigated	10% of area (acres)	Ag Land Available to Irrigate (acres)
6030002	60300020603	Upper Cotaco Creek	31,259	10,100	0	0.00%	3,126	3,126
6030002	60300020901	Peachtree Creek-Shoal Creek	20,625	9,462	0	0.00%	2,062	2,062
6030002	60300021001	East Fork Flint Creek	15,317	5,166	0	0.00%	1,532	1,532
6030002	60300021003	Upper Flint Creek	25,780	9,479	0	0.00%	2,578	2,578
6030002	60300020404	Goose Creek-Flint River	27,119	5,970	0	0.00%	2,712	2,712
6030002	60300021013	Lower West Flint Creek	38,216	12,779	0	0.00%	3,822	3,822
6030002	60300020606	Lower Cottage Creek	21,507	5,870	0	0.00%	2,151	2,151
6030002	60300021009	Elam Creek	19,363	10,422	0	0.00%	1,936	1,936
6030002	60300020502	Upper Huntsville Spring Branch	23,327	1,480	0	0.00%	2,333	1,480
6030002	60300020604	Gill Creek-Town Creek	23,424	9,178	0	0.00%	2,342	2,342
6030002	60300021205	Page Branch-Tennessee River	14,060	1,938	0	0.00%	1,406	1,406
6030002	60300021005	Sleighton Branch-Shoal Creek	10,133	3,004	0	0.00%	1,013	1,013
6030002	60300020202	Little Paint Creek	35,819	7,617	0	0.00%	3,582	3,582
6030001	60300010905	Honey Comb Creek	189	0	0	0.00%	19	0
6030002	60300020601	Winton Branch-Hughes Creek	18,262	4,629	0	0.00%	1,826	1,826
6030002	60300020201	Little Dry Creek-Clear Creek	11,619	1,157	0	0.00%	1,162	1,157
6030002	60300020605	Middle Cotaco Creek	22,662	7,013	0	0.00%	2,266	2,266
6030002	60300021008	No Buisness Creek	23,354	13,785	0	0.00%	2,335	2,335
6030002	60300020503	Lower Huntsville Spring Branch	34,068	3,786	0	0.00%	3,407	3,407
6030002	60300020505	Lower Indian Creek	19,764	3,710	0	0.00%	1,976	1,976
6030002	60300021014	Lower Flint Creek	33,431	7,494	0	0.00%	3,343	3,343
6030002	60300021011	Big Shoal Creek	12,956	5,789	0	0.00%	1,296	1,296
6030002	60300021012	Middle West Flint Creek	12,813	6,674	0	0.00%	1,281	1,281
6030002	60300020903	Aldridge Creek	14,572	1,438	0	0.00%	1,457	1,438

Table 39. HUC-12 Irrigation Density Acreage Analysis

HUC-8	HUC-12	HU-12 NAME	Area (acres)	Ag Land (acres)	Irrigated Ag Land (acres)	Percent Currently Irrigated	10% of area (acres)	Ag Land Available to Irrigate (acres)
6030002	60300021104	Fox Creek	20,084	10,018	0	0.00%	2,008	2,008
6030004	60300040405	Big Creek-Elk River	38,662	15,437	0	0.00%	3,866	3,866
6030002	60300020105	Williams Creek-Dry Creek	15,437	1,230	0	0.00%	1,544	1,230
6030002	60300020107	Williams Cove-Paint Rock River	14,611	1,761	0	0.00%	1,461	1,461
6030002	60300020106	Guess Creek	21,629	3,051	0	0.00%	2,163	2,163
6030002	60300020301	State Rock Branch-Flint River	4,346	2,706	0	0.00%	435	435
6030002	60300020101	Hurricane Creek	13,721	832	0	0.00%	1,372	832
6030002	60300021204	Lower Second Creek	19,614	8,872	0	0.00%	1,961	1,961
6030002	60300020103	Estill Fork	23,545	2,135	0	0.00%	2,355	2,135
6030002	60300020401	Upper Hurricane Creek	27,444	5,777	0	0.00%	2,744	2,744
6030002	60300021202	First Creek	18,752	10,686	0	0.00%	1,875	1,875
6030002	60300020102	Larkin Fork	20,888	986	0	0.00%	2,089	986
6030002	60300020501	Upper Indian Creek	24,608	9,467	0	0.00%	2,461	2,461
6030002	60300020104	Lick Fork	13,843	789	0	0.00%	1,384	789
6030003	60300030601	Larkin Springs Branch	244	0	0	0.00%	24	0
3160110	31601100402	Long Branch-Upper Rock Creek	50	0	0	0.00%	5	0
3160110	31601100202	Brushy Creek-Capsey Creek	115	0	0	0.00%	11	0
3160109	31601090101	Roswell Creek-Mulberry Fork	278	0	0	0.00%	28	0
3160109	31601090104	Eightmile Creek	134	0	0	0.00%	13	0
6030001	60300010906	Dripping Spring Branch-Tennessee River	141	0	0	0.00%	14	0
3160110	31601100101	Borden Creek	19	0	0	0.00%	2	0
3160110	31601100401	Belevens Creek	148	0	0	0.00%	15	0
6030001	60300010904	Browns Creek	272	0	0	0.00%	27	0
3160109	31601090105	Brindley Creek	21	0	0	0.00%	2	0

Table 39. HUC-12 Irrigation Density Acreage Analysis

HUC-8	HUC-12	HU-12 NAME	Area (acres)	Ag Land (acres)	Irrigated Ag Land (acres)	Percent Currently Irrigated	10% of area (acres)	Ag Land Available to Irrigate (acres)
3160110	31601100501	Headwaters Ryan Creek-Alvis Branch	24	0	0	0.00%	2	0
3160110	31601100405	Upper Crooked Creek	133	0	0	0.00%	13	0
3160109	31601090102	Upper Duck River	184	0	0	0.00%	18	0
3160110	31601100201	Rush Creek-Brushy Creek	100	0	0	0.00%	10	0
6030005	60300050103	Big Nance Creek-Clear Fork	1,542	0	0	0.00%	154	0
6030001	60300010603	Roseberry Creek	26	0	0	0.00%	3	0
6030005	60300050104	Middle Big Nance Creek	21	0	0	0.00%	2	0
6030001	60300010604	Upper North Sauty Creek	211	0	0	0.00%	21	0
6030001	60300010606	Upper Guntersville Lake	1	0	0	0.00%	0	0
6030001	60300010601	Evans Creek	7	0	0	0.00%	1	0
6030005	60300050102	Upper Big Nance Creek-Muddy Fork	247	0	0	0.00%	25	0
6030001	60300010605	Lower North Sauty Creek	4	0	0	0.00%	0	0
6030001	60300010901	Lower Guntersville Lake	92	0	0	0.00%	9	0
6030005	60300050105	Lower Big Nance Creek	608	0	0	0.00%	61	0
6030005	60300050801	McKieman Creek-Tennessee River	6	0	0	0.00%	1	0
6030005	60300050201	Upper Bluewater Creek	4	0	0	0.00%	0	0
6030005	60300050202	Lower Bluewater Creek	792	0	0	0.00%	79	0
6030001	60300010404	Upper Mud Creek	131	0	0	0.00%	13	0
6030001	60300010305	Upper Big Coon Creek	61	0	0	0.00%	6	0
Total			1,864,881	687,221	24,066		186,488	179,020
Years to 10% at 1,500 ac/yr								119
Years to 10% at 3000 ac/yr								60

3.2 Integrated Crop-Hydrology Model for the Wheeler Lake Watershed

In order to evaluate the impacts that increased irrigation would have on the water resources of the basin, an integrated model of the hydrology and agricultural water demand is necessary. The Water Supply Stress Index (WaSSI) model developed by the Eastern Forest Environmental Threat Assessment Center of the USDA Forest Service (Sun et al., 2008; Caldwell et al., 2012) forms the hydrologic component of the coupled model. The Water Supply Stress Index is defined simply as the ratio of the total water demand for a period of time in a basin to the total water supply for that time (including return flows from all withdrawals).

The WaSSI model is composed of a hydrologic model to compute the water supply term together with a module to estimate water demand for the HUC. The hydrologic model computes the water balance for each of ten land cover classes independently in each HUC watershed.

Evapotranspiration (ET), infiltration, soil storage, snow accumulation and melt, surface runoff, and baseflow processes are calculated in each basin based on spatially explicit 2001 MODIS land cover, and discharge (Q) is instantaneously routed through the stream network from upstream to downstream watersheds. ET is estimated with an empirical equation based on multisite eddy covariance ET measurements using MODIS derived monthly leaf area index (LAI), potential ET (PET_{Hamon}), and precipitation (PPT) as independent variables (Sun et al., 2011). PET by Hamon's method is computed using only the daylight hours in the month (related to the mean latitude of the HUC) and the saturated vapor density computed from the mean monthly temperature (Hamon, 1963). Estimation of infiltration, soil storage, base flow and runoff are accomplished through algorithms from the Sacramento Soil Moisture Accounting Model.

As originally constituted by the National Forest Service the model did not include streamflow regulation by reservoirs. However, reservoirs, due to their ability to provide water yields to downstream HUCs, are important to reflecting stress especially during the growing season. Consequently, we have added all of the reservoirs in the Alabama to the model. The regulation effects are simulated through the incorporation of the area-capacity and operating (rule) curve relationships for the reservoirs of significant size to impact streamflow at the 8-digit HUC level. Inflow to the reservoir is computed by the WaSSI hydrologic model and the resulting reservoir elevation is computed from the area-capacity relationship. The operating curve is then consulted to determine the desired elevation for the time of year and the required reservoir release is computed to bring the reservoir back to its desired elevation.

The water demand component of the WaSSI model uses county-level 2010 annual U.S. Geological Survey (USGS) water demand and groundwater withdrawal estimates for eight water use sectors (Kenny et al., 2009). The sectors include domestic use, industrial demand, public needs, irrigation, mining, livestock, thermoelectric power, and aquaculture.

In order to model the dynamic irrigation demand sector for WaSSI, a coupled model is necessary. The Decision Support System for Agrotechnology Transfer (DSSAT v4.5) model (Jones et al., 2003; Hoogenboom et al., 2010) is a framework for biophysical modeling that includes a suite of

more than 20 different cropping and fallow system models. DSSAT simulates crop growth and yield in response to management, climate, and soil conditions and requires a minimum set of inputs such as a variety of weather, soil type and profile variables, cultivar specific parameters and field management strategies including planting dates, irrigation and fertilization. In use for over 25 years, this widely used crop model has been applied to predict crop yield and water use, to develop management strategies and to study nitrogen cycling dynamics under many different soil and climate scenarios (Liu et al., 2011; Soler et al., 2011; Thornton et al., 2009; Soler et al., 2007; Yang et al., 2006; Jones et al., 2003; among others).

The DSSAT crop model was designed to analyze a wide variety of agricultural impacts but was originally conceived for a point or field scale. A spatial model becomes necessary when analyzing water resources at the watershed, state and regional level. Thus, the DSSAT system was configured to run in a gridded mode at a grid spacing of approximately 4.75 km. This gridded crop model is referred to as “GriDSSAT” (McNider et al 2011). An input data file that defines the location, weather, cultivar soil type and other input parameters for each grid cell was developed. A batch process then runs DSSAT for every point in the grid. GriDSSAT is configured to run in a real-time daily mode or in a historic weather data mode. Both modes require the model to process over 36,000 points for every day in a growing season to cover most of the Southeastern region.

In the broad geographic context of GriDSSAT the selection of the cultivar is different than in a specific field mode. We must have cultivar characteristics which broadly mimic the type of cultivars that are employed across the region perhaps at the expense of the specific cultivar response at the field level. As such, an initial cultivar was developed in a field mode but one that had generic attributes of a broad range of cultivars. Next, a regional test of the cultivar was made at locations across a broad range of soils and weather. Finally, the model was evaluated against southeast regional NASS county level crop data.

The cultivar-specific coefficients were modified by generalized likelihood uncertainty estimation (Beven and Binley, 1992) to determine a set of coefficients that reduced the difference between simulated and observed grain yield and anthesis date resulting in a best fit (lowest RMSE) for the experimental corn cultivar used.

The base cultivar used in GriDSSAT was calibrated against field trial yield data conducted at the Tennessee Valley Research and Extension Center (TVREC) located in Belle Mina, Alabama - an agricultural experiment station operated by the Auburn University Agricultural Extension Service. Dynagro 58K02 was selected as the TVREC target cultivar with six irrigating years (2004-2009) of data available (observed standard deviation = 159 kg/ha (20 bu/ac)). The Dynagro 58K02 hybrid fit the overall corn average of the TVREC Variety Trials for both irrigated and rainfed trials well with a coefficient of determination of 0.9609 and an RMSE of 647 kg/ha (10 bu/ac, which represents eight percent of the mean). Crop management profiles were created for each of the six years of data from the Variety Trial report and the soil used a silty clay loam representative of the TVREC fields. A medium to full season default corn hybrid cultivar (McCurdy 84aa) was selected as the base cultivar for calibration as it was well suited to the area and has been used in previous studies in the Southeastern United States (Ma et al., 2009; Cabrera et al., 2007; Ma et al., 2006).

The goal of the calibration process was to derive a set of parameters for the McCurdy 84aa cultivar that would best mimic the target (Dynagrow 58K02) cultivar.

The results of the DSSAT model calibration on yield are shown in Figure 36. The yield calibration resulted in a coefficient of determination of 0.7235 and an RMSE of 817 kg/ha (13 bu/ac, eight percent). The means for the observed and simulated grain weights were 10184 kg/ha (161 bu/ac) and 10586 kg/ha (168 bu/ac) respectively. The higher variance in the observed data suggests water and nitrogen stressors were present in the irrigated trials. Cultivar coefficients are best calibrated under optimal growing conditions with no stress. However, taking into account the assumption of unequal variances, a t-test of the observed and simulated yields suggests that the difference of the means is not significant with a P-value of 0.532.

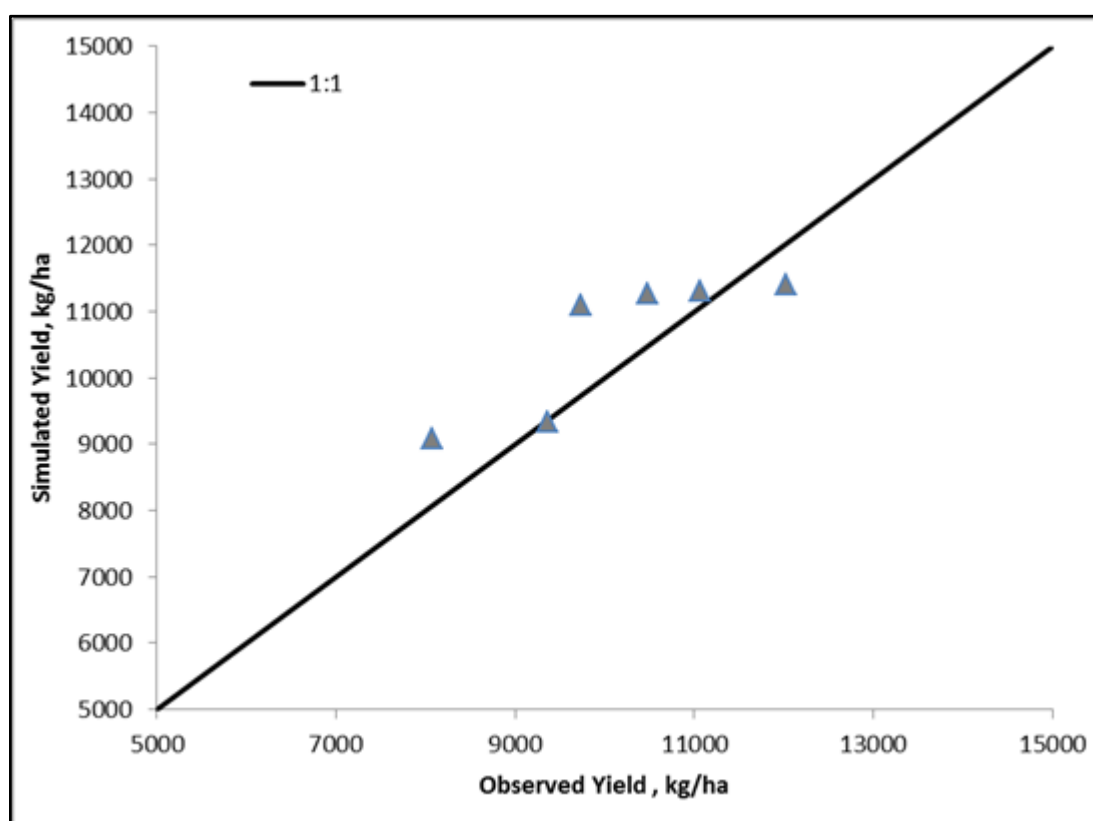


Figure 36: Cultivar calibration results for 2004-2009: DSSAT simulated yields compared to observed TVRC Variety Trial yields of DnyaGro 58K02

3.3 Average Yields Simulation

The next step was to evaluate the performance of the calibrated cultivar in simulating the overall yield averages in the region. To achieve this, 11 years (2000-2011) of Alabama Corn Hybrid Variety Trials from Auburn University Agricultural Extension Service's TVREC, and the Sand Mountain Research and Extension Center (SMREC) at Crossville, AL were employed. Irrigated and rainfed trial averages were used from TVREC while only rainfed trials were available at SMREC. The results of the evaluations can be seen in Figure 37. The model performed well in simulating the measured regional variety trial averages. The coefficient of determination for the evaluation was 0.7887 and a RMSE of 1603 kg/ha (25 bu/ac, 19 percent). The regression slope was 0.9968 with an intercept of 848 kg/ha.

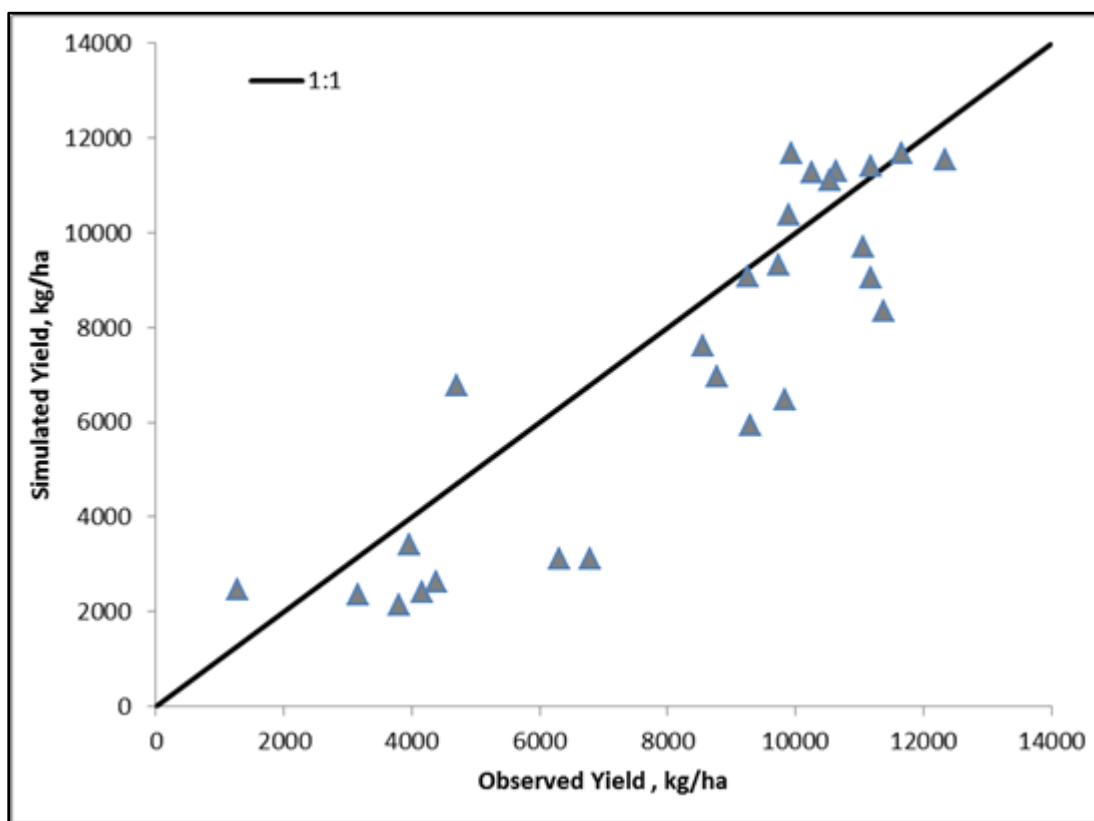


Figure 37: Cultivar evaluation results for 2000-2011: DSSAT simulated yields compared to observed TVRC and SMREC Variety Trial average yields.

We execute the model using irrigation demands supplied by GridDSSAT. Note that in the present version we are using corn as the surrogate crop for irrigation demand. That is, we assume all land defined by CropScape as currently in production is in Corn. Corn is used as a proxy for all irrigated crops because it usually requires the most water of all row crops grown in the Southeast. The model acreage input is then increased to represent expanding irrigation up 25 percent increased acreage from the 2015 irrigated acreage baseline. The model results show the highest irrigation demands occur in the middle of the growing season (May, June and July), with little to no demand the other months. It also shows an incremental increase in demand as the acreage is increased (see Table 40 below).

Table 40. Average Monthly Irrigation Demand under current and increased irrigated acreage scenarios

Month #	Month	Average IRR Demand (MGD)	Average (MGD) +5%	Average (MGD) +10%	Average (MGD) +15%	Average (MGD) +25%
1	January	1.11	1.11	1.11	1.11	1.11
2	February	1.75	1.75	1.75	1.75	1.75
3	March	2.25	2.25	2.25	2.25	2.26
4	April	3.23	3.27	3.31	3.35	3.43
5	May	22.59	23.59	24.59	25.59	27.59
6	June	44.38	46.47	48.56	50.65	54.83
7	July	32.81	34.33	35.84	37.36	40.39
8	August	5.33	5.48	5.63	5.78	6.08
9	September	2.11	2.11	2.11	2.11	2.11
10	October	1.85	1.85	1.85	1.85	1.85
11	November	1.59	1.59	1.59	1.59	1.59
12	December	1.35	1.35	1.35	1.35	1.35

The WASSI model has been evaluated for all of the HUC-8 watersheds in Alabama, either using observed long-term gage data where available or the data contained in the AL Office of Water Resources resource evaluation. A suitable gage for the Wheeler HUC exists in Florence, AL downstream of the Wheeler Dam. This gage was established in 1894 and has consistent records from 1937 to 2005. The WASSI comparison to the monthly data at the gage is shown in Figure 38.

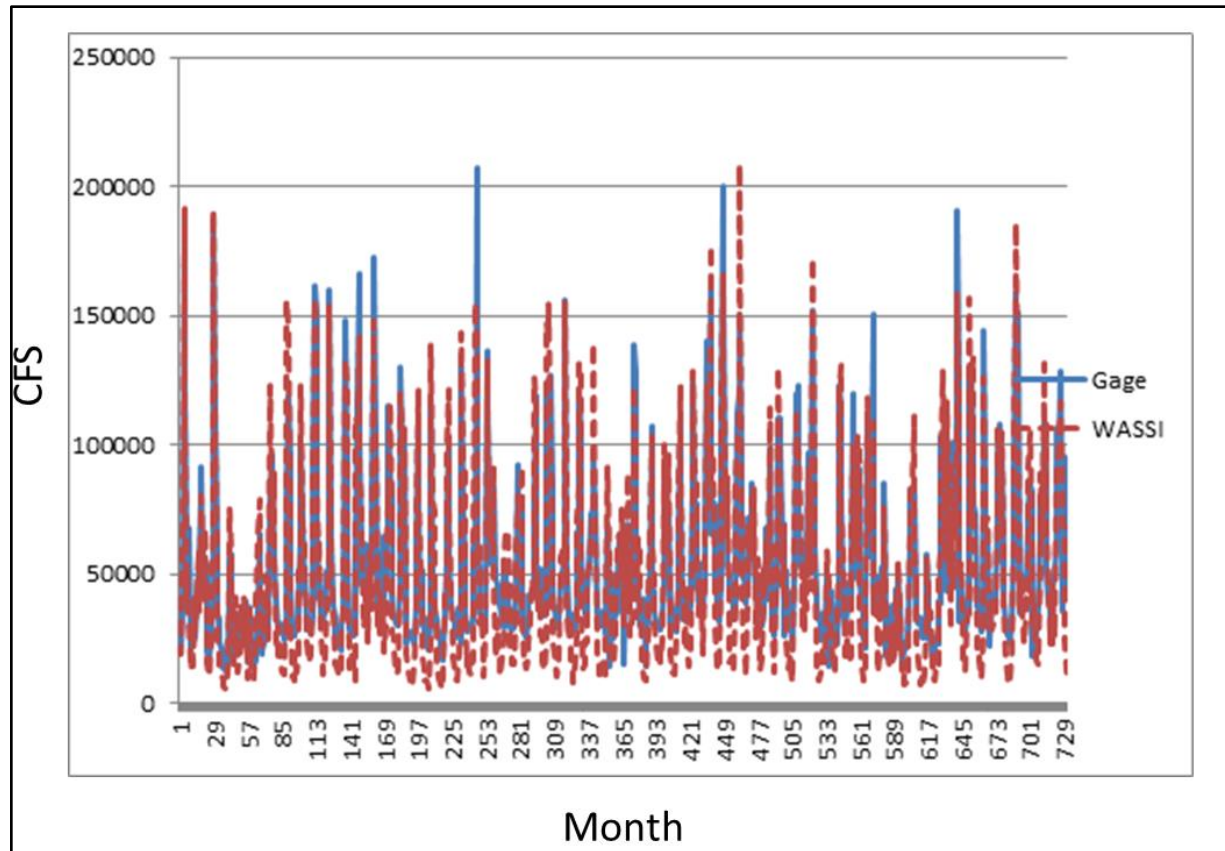


Figure 38: The WASSI comparison to the monthly data at the gage

3.4 Hydrologic Modeling Methodology

The effectiveness of hydrologic models is usually quantified through the model bias and a measure of model error known as the Nash-Sutcliffe Efficiency Statistic (R2NSE). The R2NSE is essentially a ratio of the model error to the variance of the observed data and thus serves to represent a measure of model variability compared to the variability of the observations. Some authors suggest that The R2NSE values as low as 0.50 are acceptable while a more common metric is The R2NSE > 0.70. In our case, the R2NSE value is 0.71 and the model bias is -0.07. Thus, a bias of less than 10 percent and a Nash-Sutcliffe value of greater than 0.70 would indicate a generally good fit to the streamflow observations.

3.5 Results of Wheeler-Elk WaSSI Modeling

The coupled crop-hydrology model results are reported below. The results are based on data covering the “weather years” 1915 to 2011. This time period covers a wide variety of conditions that are representative of conditions that could be experienced in the future.

3.5.1 Irrigation Demand

The model provides irrigation demand over the region. Figure 39 depicts long-term average monthly irrigation demand.

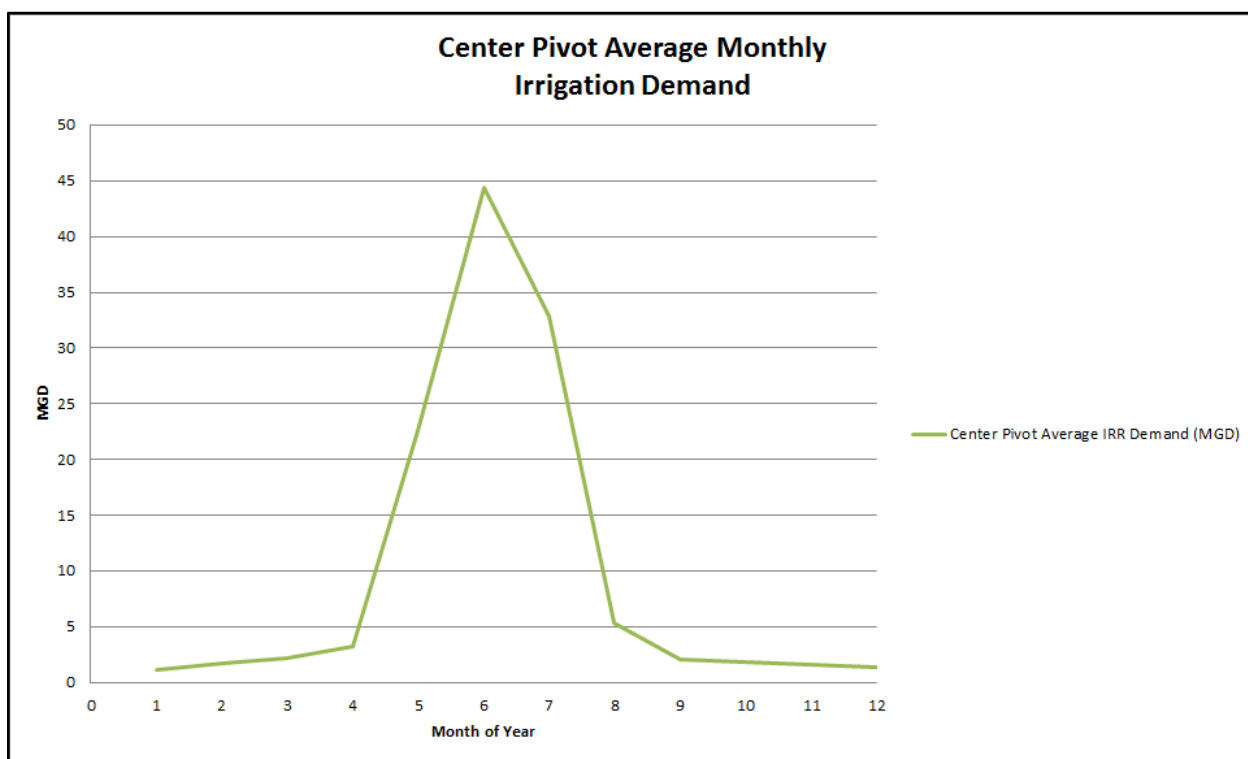


Figure 39: Long-Term Average Monthly Irrigation Demand

3.5.2 Model Irrigation Demand compared to OWR Assessment Data

The “2017 Alabama Surface Water Assessment Report” provides a snapshot of monthly agricultural demand for 2010 and estimates the future demand in 2040. The data is reported at the HUC-8 basin scale within the state. Aggregating the data for Wheeler and Lower Elk HUC-8 watersheds and comparing it with the model data provides confidence that the model is capturing most of the irrigation demand. Discrepancies are attributed to the fact that the assessment is only a snapshot of one year and a projection; it includes other water demands not modelled (like golf courses and livestock). Also, the model is based on a standard growing season. Figure 40 includes the assessment and model data.

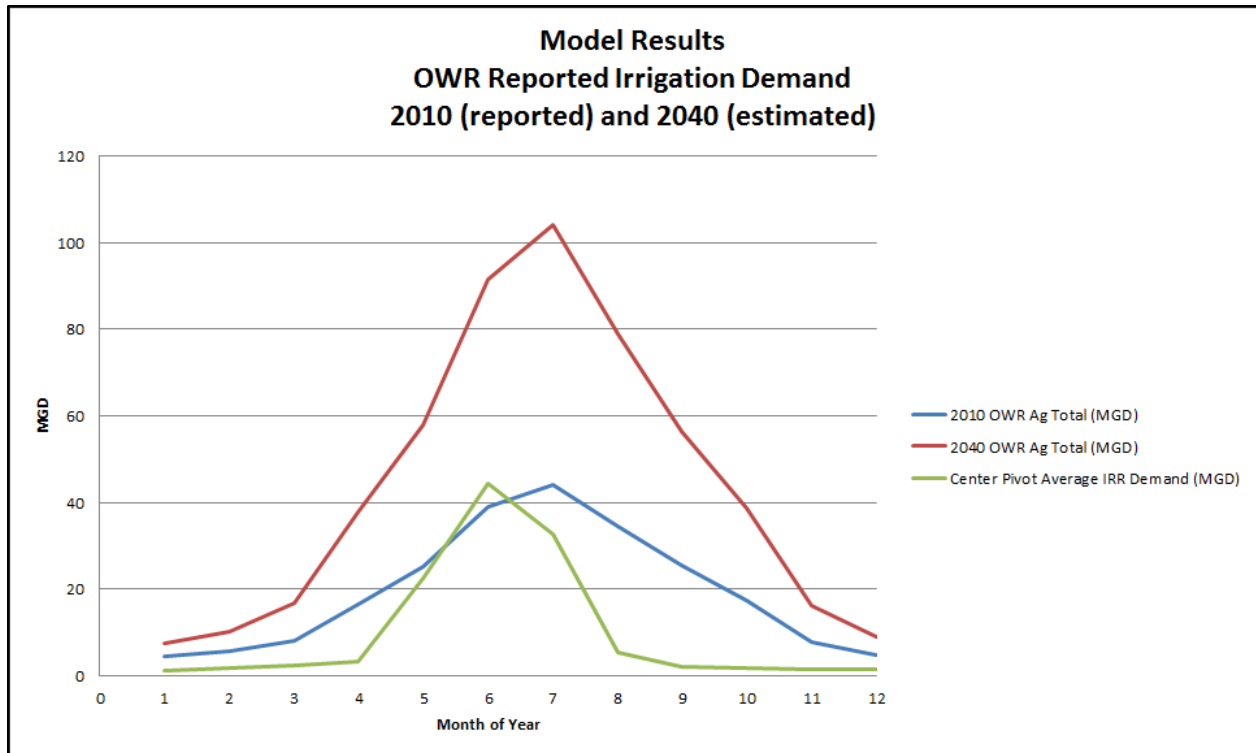


Figure 40: OWR Assessment and Model for Reported Irrigation Demand

3.5.3 Model Scenario Results

The model is useful not only in understanding the current impact irrigation may have but in looking forward to understanding how irrigation growth may impact water resources. By expanding the acres irrigated in the model, water demand goes up. Increasing acreage by some defined percentage and reporting the results shows the relative impact increasing irrigation may have on water resources.

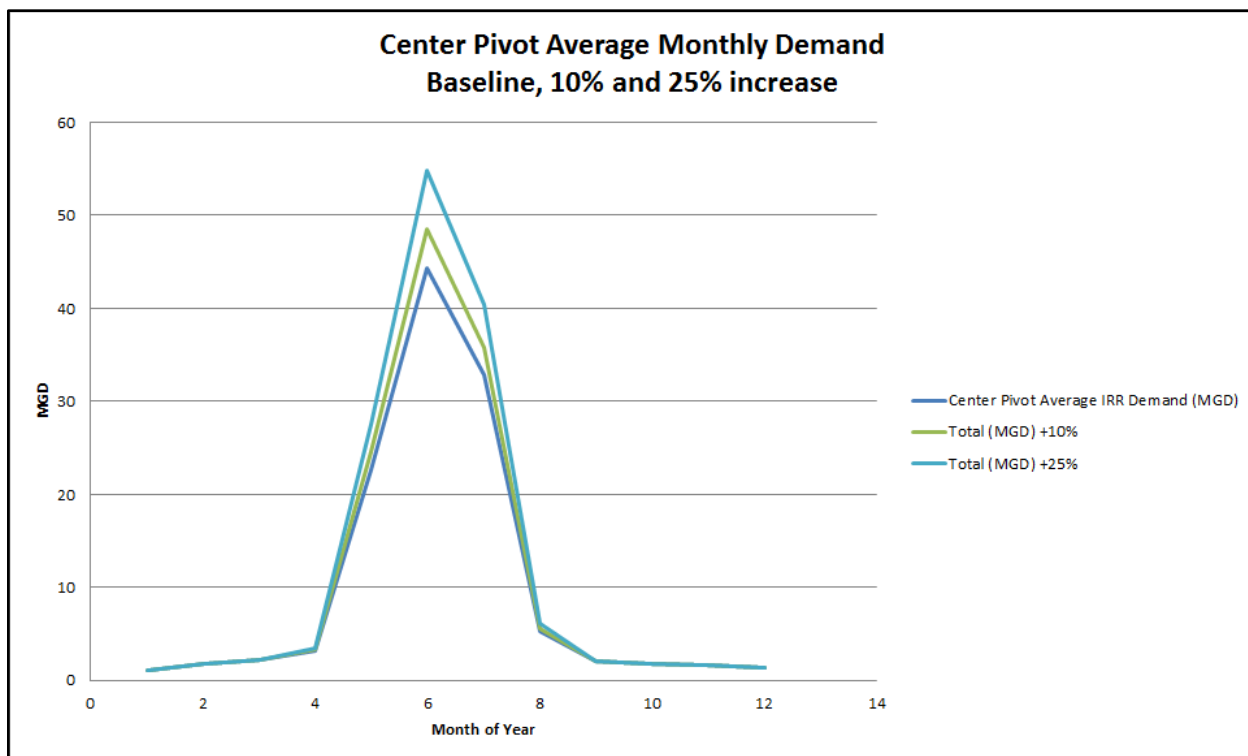


Figure 41: Center Pivot Average Monthly Demand

The model estimates increasing irrigated acreage by 10 percent in the watershed would increase the irrigation demand by about four MGD during the peak month. Increasing irrigated acreage by 25 percent would increase irrigation demand by about 10 MGD.

This change in irrigation demand reduces overall flow out of the watershed, which should be reflected in the WaSSI. The index is best understood as the percent (or fraction) of available water that is consumed. The closer the index is to “1”, the closer consumption is to available water in the watershed. Thus, an index of “0.10” means only 10 percent of the water in the shed is consumed. The USFS set a maximum index at 0.40 (or 40 percent consumption). Analyzing long term results, we count the number of months the WaSSI exceeds a threshold. The following chart shows the percent time the WaSSI is above/below the threshold of 40 percent.

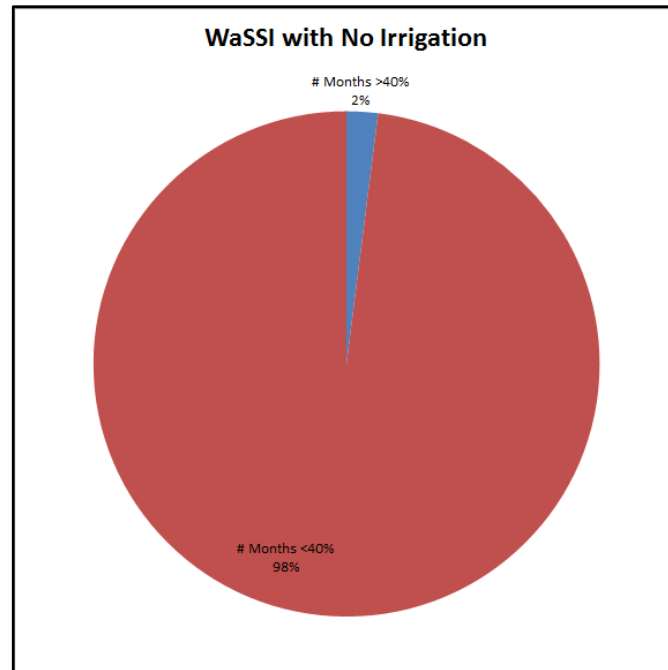


Figure 42: WaSSI Model Index with No Irrigation

Based on the model, the index only exceeds 0.40, two percent of the time with no irrigation. Adding irrigation results in the following.

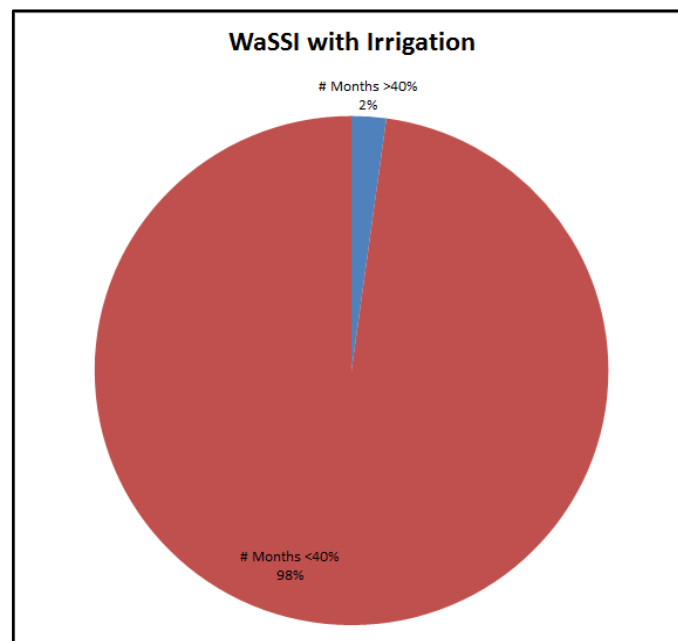


Figure 43: WaSSI Model Index with Irrigation

Relative to streamflow, the quantity of irrigation water withdrawn is so small that it is statistically negligible. Irrigation generates two additional months that exceed 0.40 for the entire time period.

Even increasing irrigated acreage by 25 percent would not result in an increase in the overall index.

Figure 44 (below) is the long-term maximum record, it shows the rare times when the watershed would be stressed by ALL other withdrawals (blue) and all withdrawals, including irrigation in red.

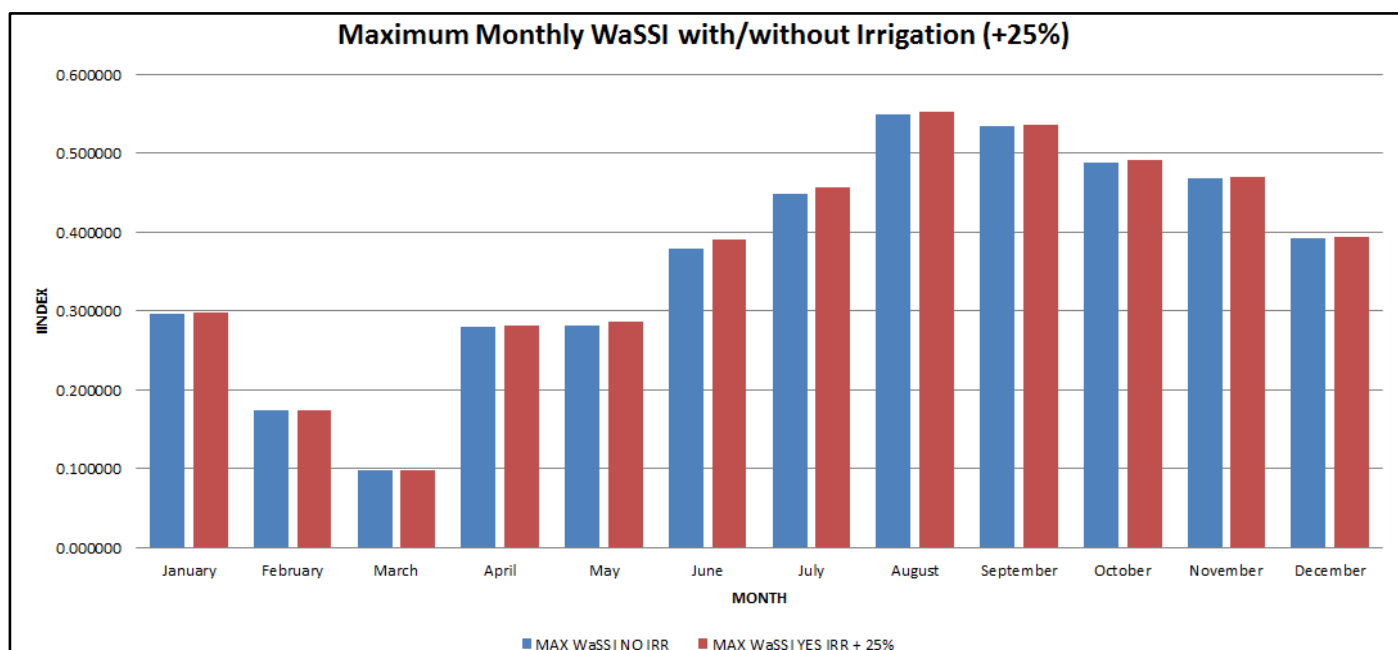


Figure 44: Maximum Monthly WaSSI with/without Irrigation (+25%)

3.6 Surface Water Extreme Scenarios

The following table depicts the drainage area and annual runoff for each of the tributaries originating only within the Middle TN River Valley Watershed.

Table 41. Surface Water Budget

Gauged Tributary in Basin	Drainage Area (sq mi)	Annual Runoff inches
Paint Rock	320	28.32
Indian Creek	49	19.49
Limestone Creek	119	22.56
Big Nance Creek	166	22.34
Flint	375	22.56
Average		23.05

An analysis of the gauged, major tributaries to the Tennessee River in the basin, returns an average annual runoff of 23 inches. This includes only runoff originating within the basin and excludes Tennessee River flows entering the basin.

3.6.1 Current Irrigated Land Scenarios

Assuming an average case scenario where 65 percent of the irrigation demand came from surface water originating only within the basin. If all the current irrigated land in the basin used runoff originating in the basin and at the average demand estimate, it would be 0.18 percent of total annual runoff. Current irrigation demand, while not negligible, is very minor in intensity.

3.6.2 Threshold Irrigated Land Scenarios

Assuming an average case scenario where 65 percent of the irrigation demand came from surface water originating within the basin. If the sensitivity threshold of approximately 117,000 acres (surface water fraction of 180,000) were irrigated using runoff originating in the basin and at the average demand estimate, it would total nine percent of annual runoff. This upper limit of irrigated land in the Basin would be classified as minor intensity.

Over the long-term, if all the agricultural land in the basin were irrigated, 65 percent of that demand came from runoff originating in the basin and at the average demand estimate, it would be about 60 percent of total annual runoff.

Table 42. Current Irrigation Demand

Runoff (in)	Current Max Irrigation Demand (in)	Current Max Demand/Runoff	Current Min Irrigation Demand (in)	Current Min Demand/Runoff	Current Avg Irrigation Demand (in)	Current Avg Demand/Runoff	Current Avg Irrigation Demand (in) 65%/Runoff	Current Avg Demand 65%/Runoff
23.05	0.15	0.64%	0.01	0.02%	0.06	0.27%	0.04	0.18%

Table 43. All Agricultural Land Irrigation Demand

Runoff (in)	ALL Ag Land Max Irrigation Demand at 65% (in)	ALL Ag Land Max Demand at 65%/Runoff	ALL Ag Land Min Irrigation Demand at 65% (in)	ALL Ag Land Min Demand at 65%/Runoff	ALL Ag Land Avg Irrigation Demand (in) at 65%	ALL Ag Land Avg Demand 65%/Runoff
23.05	31.76	137.77%	1.17	5.06%	13.73	59.56%

3.7 Groundwater and Aquifer Results

Using withdrawal data provided in the OWR assessment (Harper et al. 2015), irrigation withdrawals are put into context relative to other sectors use. Using the aquifer area and recharge data provide by the GSA and irrigation location and demand data, a sensitivity model was built to analyze the impact current and future irrigation has on groundwater resources. Current acreage is already defined, threshold acreage is based on the irrigation density analysis and assumes 35 percent of the irrigation water supply comes from groundwater. Finally, all agricultural land is the upper limit of possible irrigation.

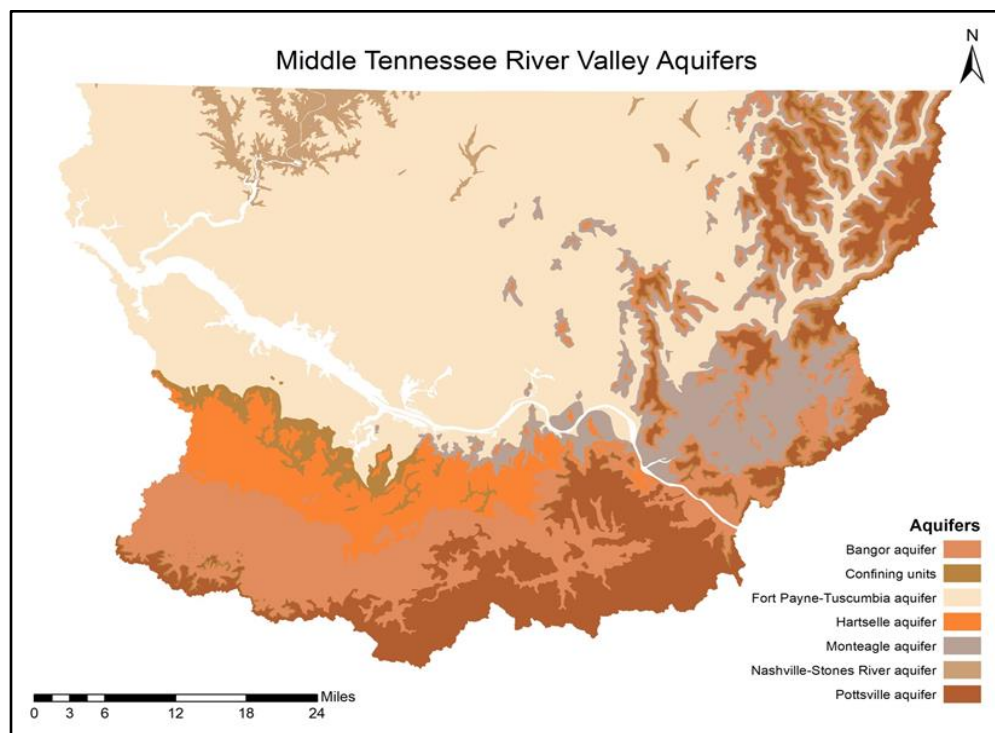


Figure 45: Major Aquifers in the Middle TN River Valley Watershed

3.7.1 Watershed Withdrawal Budgets

Groundwater accounts for ~1.4 percent of total withdrawal budget for the Basin. During the growing season, groundwater can account for ~1.8 percent of total monthly withdrawals. Budget includes all sector withdrawals, including power generation, which accounts for the large withdrawals. Huntsville and Decatur Municipal Water supplies are predominately surface water (Tennessee River).

Table 44. Watershed Withdrawal Budget

Month	Basin All Withdrawals (MGD)	Basin All Withdrawals (in)	Basin GW Withdrawals (MGD)	Basin GW Withdrawals (in)	GW Percentage of ALL Withdrawals
Jan	3,152	1.99	33	0.02	1.06%
Feb	3,016	1.72	34	0.02	1.12%
Mar	2,110	1.33	35	0.02	1.66%
Apr	3,185	1.95	41	0.02	1.28%
May	3,227	2.04	44	0.03	1.36%
Jun	3,253	1.99	49	0.03	1.52%
Jul	3,179	2.01	56	0.04	1.75%
Aug	2,898	1.83	51	0.03	1.75%
Sep	3,235	1.98	43	0.03	1.34%
Oct	2,991	1.89	40	0.03	1.35%
Nov	2,759	1.69	34	0.02	1.24%
Dec	3,154	1.99	34	0.02	1.09%
Average	3013	1.87	41	0.03	1.38%

Groundwater accounts for ~6.5 percent of withdrawal budget for the Basin, excluding thermal power/cooling generation. During the growing season, groundwater can account for about eight percent of total monthly withdrawals. Budget includes all sector withdrawals, excluding power generation, which accounts for the large withdrawals. Huntsville and Decatur Municipal Water supplies are predominately surface water (Tennessee River).

Table 45. Watershed Withdrawal Budget, excluding thermal power/cooling generation.

Month	Basin All Withdrawals minus Power (MGD)	Basin All Withdrawals minus Power (in)	Basin GW Withdrawals (MGD)	Basin GW Withdrawals (in)	GW Percentage of ALL Withdrawals
Jan	664	0.42	33	0.02	5.02%
Feb	637	0.36	34	0.02	5.31%
Mar	457	0.29	35	0.02	7.68%
Apr	677	0.41	41	0.02	6.01%
May	689	0.44	44	0.03	6.35%
Jun	701	0.43	49	0.03	7.06%
Jul	692	0.44	56	0.04	8.05%
Aug	631	0.40	51	0.03	8.02%
Sep	691	0.42	43	0.03	6.26%
Oct	638	0.40	40	0.03	6.33%
Nov	586	0.36	34	0.02	5.85%
Dec	664	0.42	34	0.02	5.18%
Average	644	0.40	41	0.03	6.43%

3.7.2 Aquifer Recharge Analysis Results

The impact of irrigation demand on the aquifer is analyzed by determining the percentage of recharge that is consumed within the aquifer. Three scenarios were analyzed, all assuming 35 percent of the water consumed would come from groundwater resources. The first scenario is current acreage demand. The second is the fraction of the threshold limit of 179,000 acres within the aquifer. Third is the fraction of all agricultural land in the watershed.

Table 46. Current Average Irrigation Demand as A Percentage of Total Recharge

Aquifer	Current Irrigated area (ac)	Average Annual Recharge (in)	Current Average Irrigation Demand (in)	Current AVG Demand /Recharge	Current Average Irrigation Demand (.in) 35%	Current AVG Demand 35% / Recharge
Fort Payne-Tuscumbia aquifer	20,812	9.27	0.108	1.17%	0.004078623	0.04%
Bangor aquifer	18	8.85	0.000	0.00%	1.30528E-05	0.00%
Pottsville aquifer	0	8.9	0.000	0.00%	0	0.00%

Table 47. Threshold Irrigation Demand as A Percentage of Total Recharge

Aquifer	Percent of threshold Agland (ac)	Average Annual Recharge (.in)	Agland AVG Irrigation Demand at 35%(.in)	Agland AVG Demand (35%)/Recharge
Fort Payne-Tuscumbia aquifer	90,714	9.27	0.16	1.7%
Bangor aquifer	27,037	8.85	0.16	1.8%
Pottsville aquifer	23,173	8.90	0.17	1.9%

Table 48. All Agricultural Land Irrigation Demand as A Percentage of Total Recharge

Aquifer	Total Agland (ac)	Average Annual Recharge (.in)	ALL Agland AVG Irrigation Demand at 35%(.in)	ALL Agland AVG Demand (35%)/Recharge
Fort Payne-Tuscumbia aquifer	421,848	9.27	0.74	7.9%
Bangor aquifer	90,174	8.85	0.53	6.0%
Pottsville aquifer	54,731	8.90	0.43	4.9%

The results show that demand in the largest aquifer is currently only 0.4 percent of recharge; at threshold acreage it would be approximately 1.7 percent of recharge; and if all the agricultural land was irrigated and 35 percent of the water came from groundwater sources, it would be approximately 7.9 percent of recharge. Note this impact on recharge does not take water storage into account. Overall, even at the upper all agricultural land limits of 7.9 percent of total recharge, withdrawals would not begin to use or deplete storage.

4. Soil Conservation Measures Crop Model results

Figure 46 depicts the results from crop models increasing the organic carbon content of both rainfed and irrigated crop model experiments. Additional had a marginal impact on the rainfed results over the period (90 weather years 1921-2011). Even with a five percent increase in organic carbon, yields still do not compare with irrigated yields. However, the combination of increased organic carbon and irrigation show a noticeable increase over irrigation alone.

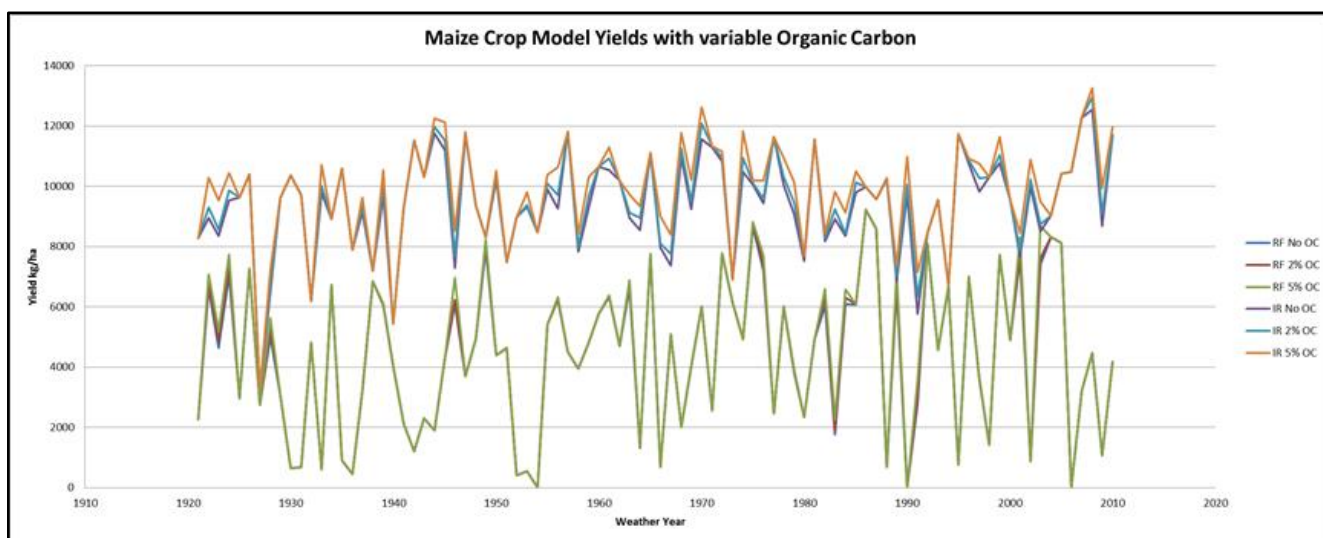


Figure 46: Crop Model Yields with Variable Organic Carbon

Yield statistics (in kg/ha) show similar increases when combining conservation measures and irrigation, as shown in Table 49.

Table 49. Crop Yield Statistics Combining Conservation Measures with Irrigation

	RF No OC ¹	RF 2% OC ¹	RF 5% OC ¹	IR No OC ¹	IR 2% OC ¹	IR 5% OC ¹
Average	4,343	4,382	4,454	9,386	9,529	9,809
Max	9,213	9,215	9,218	12,537	12,944	13,265

¹ OC stands for Organic Carbon as it relates to soil health

5. Climate

5.1 Monthly Normals

The Livneh et al. (2014) climate dataset has an original horizontal resolution of 1/16 degrees which contains daily values of minimum temperature, maximum temperature, and precipitation for the period 1915-2011. This daily data was area weighted to the HUC-8 regions of the United States. With the focus on the Wheeler Lake HUC-8, this data was further averaged to monthly values for the 30-year period 1981-2010, which is the current period for climate normals in the United States. These average monthly values are displayed in Figures 47-48. The lowest minimum temperatures occur in December and January, with values just above and below 30 °F, respectively. The highest maximum temperatures occur in July and August with values approaching 90 °F. The average annual precipitation is about 56 inches, with the maximum monthly value being in December with about 5.8 inches, and the minimum monthly value being in August with about 3.5 inches. Figure 49 shows the Köppen-Geiger climate classifications for the United States (Brugger, 2017; Kottet et al., 2006). This classification uses a 3-character sequence which for all of Alabama including the Wheeler Lake HUC is “Cfa”, where “C” is the main climate regime of “warm temperate”, “f” is the precipitation category of “fully humid”, and “a” is the temperature category of “hot summer”.

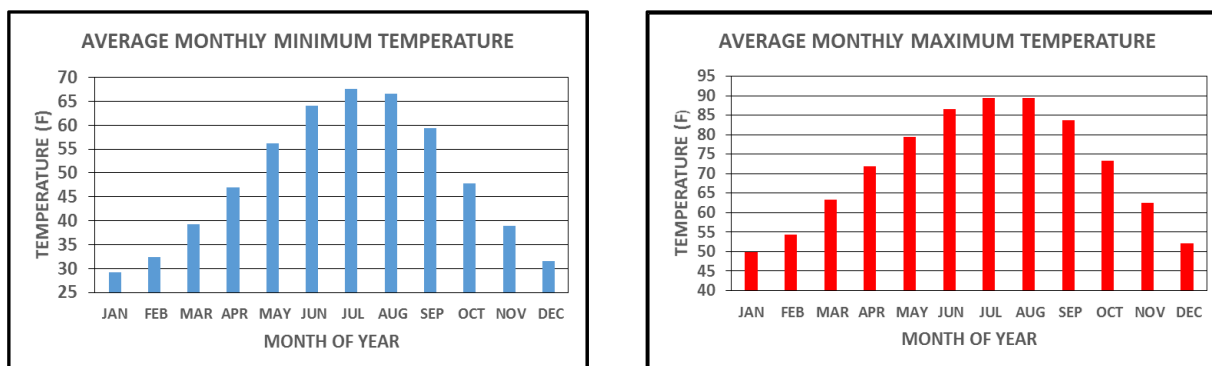


Figure 47: Average monthly minimum temperature (left) and maximum temperature (right) in units of °F for the Wheeler Lake HUC-8 basin for the period 1981-2010.

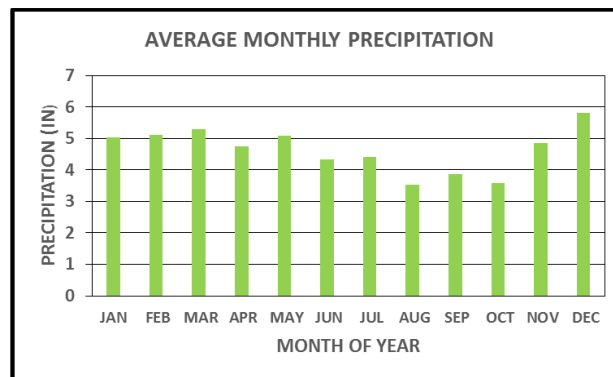


Figure 48: Average monthly precipitation in units of inches for the Wheeler Lake HUC-8 basin for the period 1981-2010

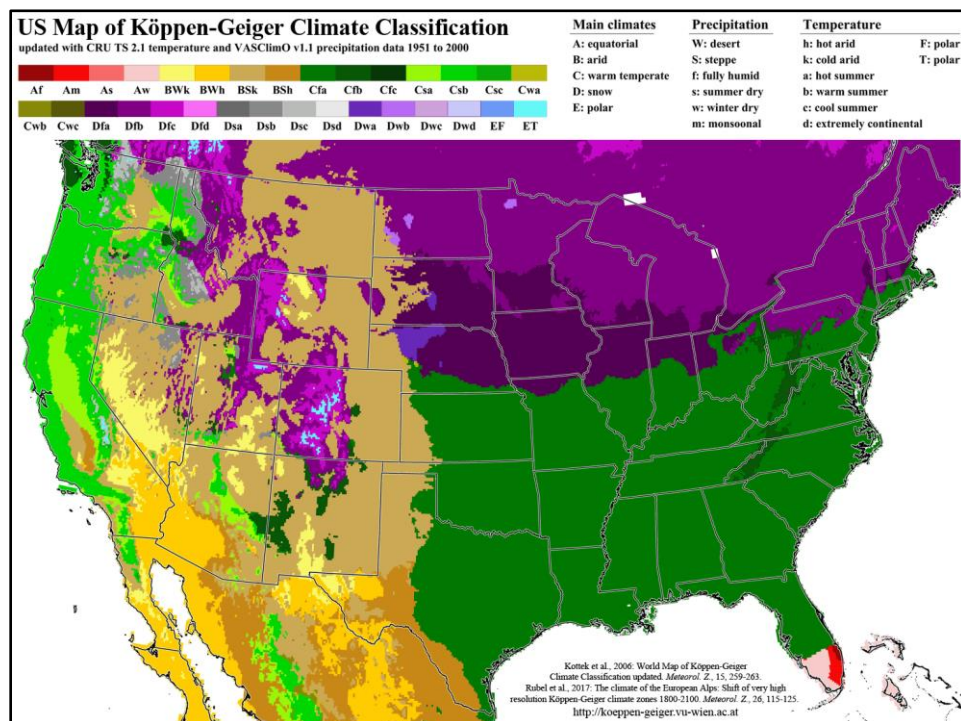


Figure 49: Köppen-Geiger Climate Classification Map (Brugger, 2017; Kottek et al., 2006)

5.2 Daily Precipitation

The daily precipitation data from 1981-2010 for the Wheeler Lake HUC-8 was sorted from smallest to largest and the cumulative distribution function was calculated and shown in Figure 50. The period comprises 10,957 days which when divided by 30 years gives an average year length of 365.23 days, which is equivalent to 100 percent of the data. The vertical axis in Figure 50 is labeled with respect to the “average day” rather than percentages. The 1-inch threshold is at about day 356 which leads to the conclusion that about 98 percent of the time daily precipitation amounts are 1 inch or less. The National Weather Service threshold for measurable precipitation at a given location is 0.01 inches. This threshold is at about day 158, so about 207 days of the year have values at or above this amount.

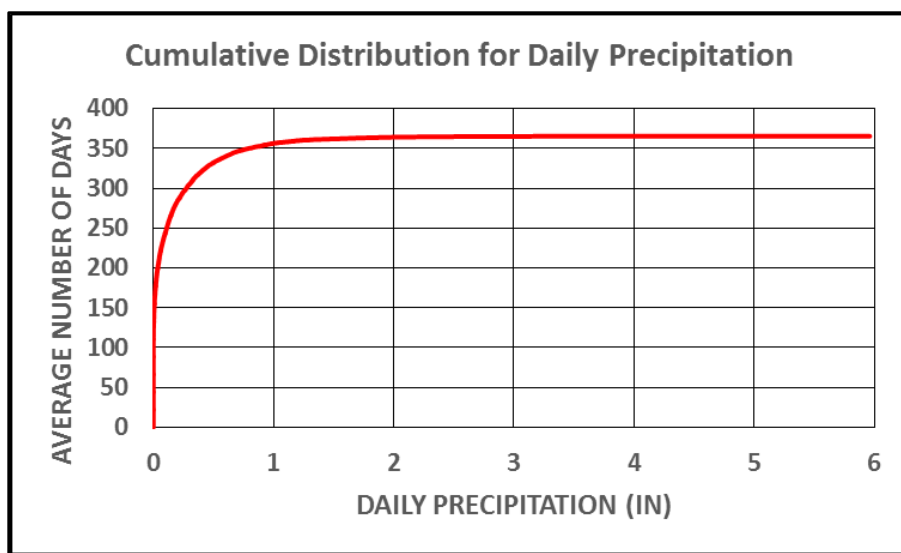


Figure 50: Cumulative distribution function for daily precipitation values for the Wheeler Lake HUC-8 basin for the period 1981-2010. The horizontal axis is precipitation amount in units of inches. The vertical axis is the average number of days.

5.3 Precipitation Versus Evaporation

5.3.1 Monthly Averages

Monthly evapotranspiration on the HUC-8 scale is one of the outputs of the Water Supply Stress Index (WaSSI) hydrology model (Caldwell et al. 2012). The evapotranspiration calculations are detailed in Sun et al. (2011a, 2011b) and involve three steps. In the first step a monthly potential evapotranspiration is calculated by Hamon's method. The second step uses a set of multiple linear regression relationships which uses the Hamon values, precipitation, and leaf-area index to obtain evapotranspiration estimates for each land-use class. The final step limits the actual evapotranspiration to the available soil moisture. Figure 51 shows the monthly averages for precipitation for the Wheeler HUC for the period 1916-2011, and the WaSSI-derived evapotranspiration for the same period. Figure 52 shows the monthly averaged precipitation minus the WaSSI-derived evapotranspiration for the same period (hereafter referred to as PME). The one negative month is August with a value of about -0.20 inches. However, the entire period of June-September has PME values close the ± 0.50 -inch range.

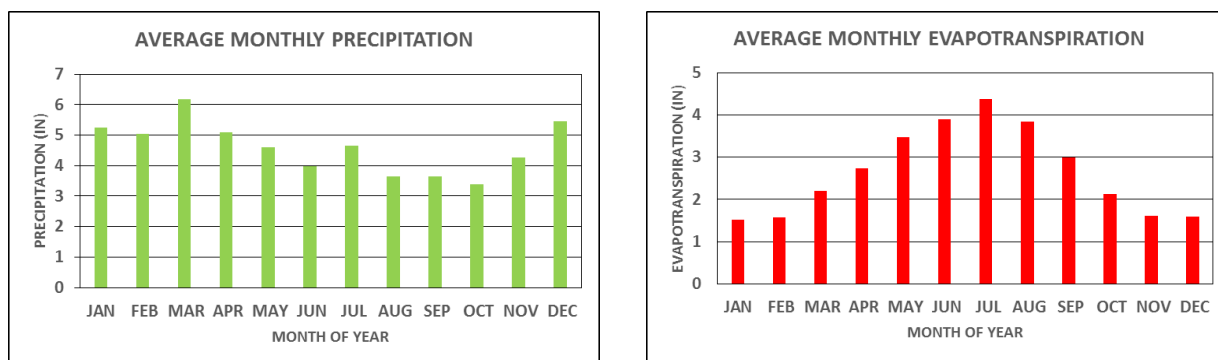


Figure 51: Average monthly precipitation (left) and WaSSI-derived evapotranspiration (right) in units of inches for the Wheeler Lake HUC-8 basin for the period 1916-2011.

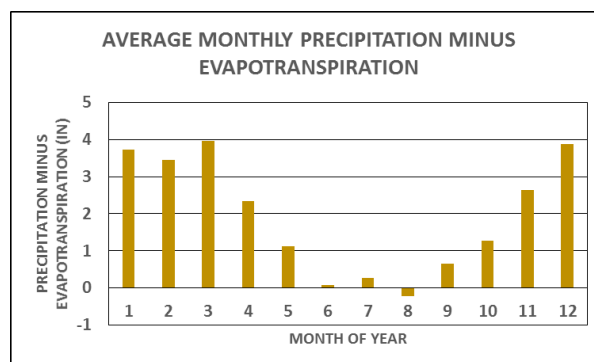


Figure 52: Average monthly precipitation minus WaSSI-derived evapotranspiration in units of inches for the Wheeler Lake HUC-8 basin for the period 1916-2011.

5.3.2 Return Periods

From standard hydrology practices "...the return period of an event of a given magnitude may be defined as the average recurrence interval between events equaling or exceeding a specified magnitude" (Chow et al. 1988). In hydrology this is typically related to flood events. Here it will be applied to the monthly PME values for the Wheeler Lake HUC-8 basin for the period 1916-2011. Three thresholds were chosen: 1) -12.5 mm (nominally 0.50 inches), 2) -25.0 mm (nominally 1.0 inch), and 3) -50.0 mm (nominally 2.0 inches). Six different time periods were also chosen from 1-6 months. For the monthly periods time is with respect to consecutive months. Table 50 gives the corresponding return periods and Table 51 provides the number of events. In Table 50 for the -12.5 mm threshold and 1-month category a return period of 0.60 years is displayed. That means that the return period for a PME of -12.5 mm **or less** and for a period of one month **or more** is 0.6 years. The shortest return periods are for the -12.5- and -25.0-mm thresholds for one month (0.6 and 1.0 years, respectively), and the -12.5 threshold for two months of 2.5 years. Larger departures in magnitude or length are less common having return periods of six years or more. No events were found for five or six consecutive months. Only one event was found for three consecutive months at the -25.0 mm threshold and it was assigned a return period equal to the entire data record of 1916-2011. Tables 52 and 53 show the same information but restricted to periods which overlap all or part of the growing season defined as April-September. There are fewer events because some dry periods occur earlier in the spring and later in the fall. Otherwise the return period values are very similar.

Table 50. Return periods (years) for PME for the Wheeler Lake HUC-8 basin for the period 1916-2011 for the thresholds of -12.50, -25.00 and -50.00 mm and for time periods of 1-6 months for the entire calendar year.

	1	2	3	4	5	6
-12.50	0.60	2.50	8.90	34.10	NA	NA
-25.00	1.00	6.40	96.00	NA	NA	NA
-50.00	6.80	NA	NA	NA	NA	NA

Table 51. Return periods (years) for PME for entire calendar year (with number of events). Same as Table 50, except the number of events is displayed.

	1	2	3	4	5	6
-12.50	167	38	10	3	0	0
-25.00	97	14	1	0	0	0
-50.00	13	0	0	0	0	0

Table 52. Return periods (years) for PME for the Wheeler Lake HUC-8 basin for the period 1916-2011 for the thresholds of -12.50, -25.00 and -50.00 mm and for time periods of 1-6 months for only the growing season of April – September.

	1	2	3	4	5	6
-12.50	0.50	2.40	8.10	34.10	NA	NA
-25.00	0.80	5.10	96.00	NA	NA	NA
-50.00	6.80	NA	NA	NA	NA	NA

Table 53. Return periods (years) for PME for 1-6 months (with number of events). Same as Table 52, except the number of events is displayed.

	1	2	3	4	5	6
-12.50	145	36	8	3	0	0
-25.00	84	12	1	0	0	0
-50.00	13	0	0	0	0	0

5.3.3 Probability of a Return Period

Another concept from hydrology is the probability of a return period (Chow et al. 1988). As used in hydrology with annual data equation (1) gives the probability P of meeting or exceeding a specified event with a return period of T in N years. In the derivation of (1) it is assumed that the hydrological events from year to year are statistically independent. For our monthly PME values this is probably not true, but no effort has been applied to adjust for temporal correlation. When applied to the PME return values in Table 50, P will be the probability of an event less than or equal to given threshold and for the specified monthly duration. Since the source data is in months the return period T is in months and the exponent N is in months. With these changes when (1) is applied to the data in Table 50 the result are the curves in Figure 53. For convenience, the N values are plotted as years in Figure 53.

$$(1) \quad P = 1 - \left(1 - \frac{1}{T}\right)^N$$

Figure 53 illustrates that PME values of either -12.5 or -25.0 mm for periods of one or two months are fairly common, with probabilities approaching 0.70 or more after three years. More extreme events require much more time to be likely, if at all.

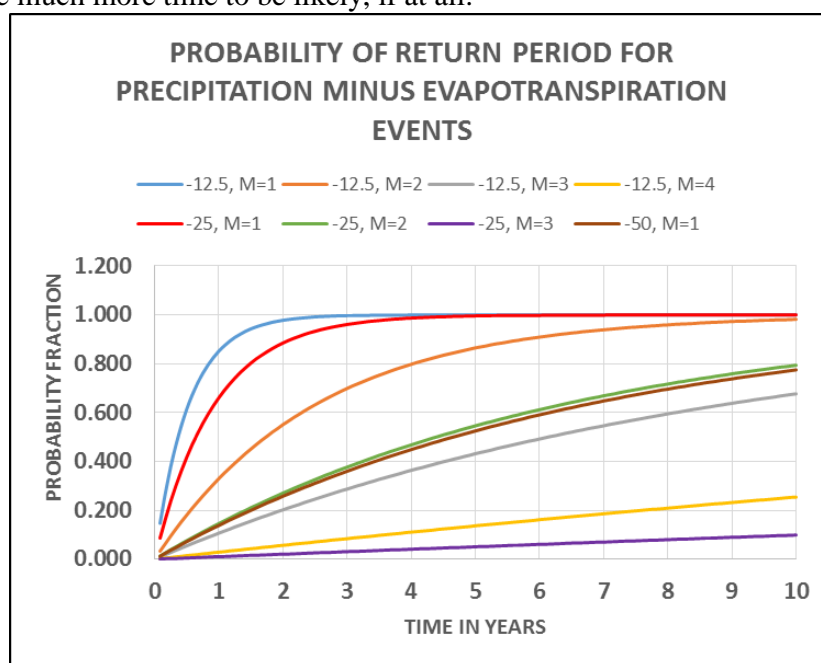


Figure 53: Probability of a return period for PME events for the Wheeler Lake HUC-8 basin for the period 1916-2011 (based on the data of Table 51). Horizontal axis is time in years. Vertical axis is probability. Each curve is color-coded by the legend at the top. For example, the blue curve labeled as -12.5, M=1 is the probability curve for a PME value of -12.5 mm or less for a period of one month or more.

6. Air Quality

6.1 Construction

In this discussion the generation of particulate dust by construction activities related to installing the irrigation equipment will be assumed to be a good proxy for potential air quality impacts. Given the relatively small areas and time involved one would be led to believe that the impacts would be small. The philosophy below is to use the simplest tool possible but making assumptions to maximize concentrations where reasonable. The parameters used in this discussion are listed below in Table 54.

Table 54. Input parameters for dust production calculations

Description	Symbol	Value (units)
Weight of concrete mixer truck (empty)	W_T	30,000 (lbs)
Weight of concrete	W_C	40,000 (lbs)
Average farm size in Wheeler HUC	A	0.692 (km ²) (equal to 171 acres)
Radius of average farm size	R	0.469 (km)
Soil silt percentage	P	25.0 (%)
Concrete truck speed	G	0.011 (km s ⁻¹) (equal to 25 mph)
Wind Speed	U	1.0 (meters per second)
2.5-micron fraction	k	0.15
10.0-micron fraction	k	1.0
emission equation silt exponent	a	0.90
emission equation weight exponent	b	0.45
Gaussian equation σ_Y dispersion parameter	c	24.167
Gaussian equation σ_Y dispersion parameter	d	2.5334
Gaussian equation σ_Z dispersion parameter	α	453.85
Gaussian equation σ_Z dispersion parameter	β	2.1166
Assumed concentration time	H	4 (hours)

To model dust production, this discussion assumes a concrete truck is the dust generator. This is reasonable given that such a vehicle is able to generate dust and it is possible that some farmers may need to have concrete pads poured for installation of the irrigation equipment. The EPA document AP-42 (EPA 2019) gives equation (1) as the formula for the emission rate on unpaved roads in units of g vehicle⁻¹ km⁻¹, where k has a different value for different particle sizes, P is the soil silt percentage, and W is the weight of the vehicle. W is the total weight of the vehicle which is the sum of the W_T and W_C values in Table 54. EPA has standards for two classes of particles: one is for particles having diameters less than or equal to 2.5 microns (μm), and the other is for particles having diameters less than or equal to 10.0 μm.

$$(1) \quad E = 281.9 k \left(\frac{P}{12} \right)^a \left(\frac{W}{3} \right)^b$$

Equation (2) gives the radius of the average farm area (A) in the Wheeler HUC. Accounting for the round trip (D) is given by equation (3).

$$(2) \quad R = \sqrt{\frac{A}{\pi}}$$

$$(3) \quad D = 2 * R$$

Dividing the round-trip distance D by an assumed vehicle speed G gives an emission time T as in equation (4).

$$(4) \quad T = \frac{D}{G}$$

Taking the emission value from equation (1) and multiplying by the distance D and dividing by the time scale T gives the emission rate (E_R) in units of g vehicle⁻¹ s⁻¹, as given by equation (5).

$$(5) \quad E_R = \frac{E * D}{T}$$

Equation (6) is a simple Gaussian plume model (EPA 1995), where E_R is the emission rate from equation (5), K is a units conversion (10^6 gives a concentration of $\mu\text{g m}^{-3}$ when E_R has the units of equation 5), V is a vertical distribution term, d is a decay term, π is the usual mathematical meaning, U is the wind speed, σ_Y is the lateral dispersion, σ_Z is the vertical dispersion, and Y is the distance from the plume center. Equation (6) gives an instantaneous, steady-state estimate of a concentration. Simplifying equation (6) to get an estimate of the maximum concentration (C_{MAX}), gives equation (7), where Y has been set to zero and the V and d terms are set to one.

$$(6) \quad C = \frac{(E_R K V d)}{(2 \pi U \sigma_Y \sigma_Z)} \exp \left[\frac{-1}{2} \left(\frac{Y}{\sigma_Y} \right)^2 \right]$$

$$(7) \quad C_{MAX} = \frac{(E_R K)}{(2 \pi U \sigma_Y \sigma_Z)}$$

A simple version of (6) and (7) uses the Pasquill-Gifford categories (Turner 1970) to give estimates of the dispersion parameters as a function of stability, wind speed, and distance from the source. The Pasquill-Gifford categories are labeled as “A” through “F” as given in Table 55, where “A” is the most unstable and “F” is the most stable. Given that the wind speed U has been set to a small value of 1 m s⁻¹, and that construction will likely occur in spring or summer daylight conditions, stability class “A” has been chosen from Table 55. In equations (8) – (10), the parameters c, d, α , and β , in general, have different values for each stability class and for various distance ranges from the source (EPA 1995). The values used in these calculations are listed in Table 54.

$$(8) \quad \theta = 0.017 [c - d \ln \ln (R)]$$

$$(9) \quad \sigma_Y = 465.12 R \tan \theta$$

$$(10) \quad \sigma_Z = \alpha R^\beta$$

Table 55. Pasquill-Gifford Stability Classes (after Turner 1970).

Wind Speed Category	Daytime Insolation Category			Nighttime Category	
10-m wind speed (m s ⁻¹)	strong	moderate	slight	cloud \geq 4/8	cloud \leq 3/8
< 2	A	A-B	B	E	F
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
> 6	C	D	D	D	D

With dispersion parameters specified by equations (8)-(10) and used in equation (7), the final 24-h maximum concentration estimate is given by equation (11). The time in hours for H is set at 4 h since concrete trucks would not be running continuously for this type of construction – it likely would be less than an hour given the amount of concrete to be delivered.

$$(11) \quad C_{MAX,24} = \frac{H}{24} C_{MAX}$$

The concentrations from the above approach are given in Table 56 where they are compared against the current EPA standards for 2.5 μm and 10.0 μm particle size classes. It is observed that the modeled concentrations are well below the standards and as indicated several times above would likely be much smaller.

Table 56. Comparison of calculated and EPA standard concentrations.

Particle Size Category	Estimates from Equation (11)	EPA 24-h standard
2.5 microns	7.5 $\mu\text{g m}^{-3}$	35 $\mu\text{g m}^{-3}$
10.0 microns	75.0 $\mu\text{g m}^{-3}$	150 $\mu\text{g m}^{-3}$

6.2 Fertilizer Application

Bouwman et al. (2002) summarize the complex processes which control the NO_x (NO + N₂O) emissions from soils, which, among many other factors, include soil temperature, moisture, texture, pH, fertilizer amount, and tillage practices. According to Bouwman et al. (2002), N₂O emissions tend to dominate the NO_x total for most soils. Accordingly, this section will focus on the increase of N₂O emissions resulting from the enhanced fertilizer applications which are usually done in conjunction with crop irrigation. Calculations will be done for the average farm size in both the Wheeler and Lower Elk HUCs, and for rainfed and irrigated scenarios. Table 57 lists the primary input parameters used in the N₂O emission calculations. The fertilizer application rates are obtained from simulations performed at UAH with the DSSAT crop model. The fertilizer is assumed to be ammonium nitrate (NH₄NO₃).

Table 57. Input parameters for N₂O calculations

Description	Symbol	Value (units)
Average farm size in Wheeler HUC	A	0.692 (km ²) (equal to 171 acres)
Average farm size in Lower Elk HUC	A	0.737 (km ²) (equal to 182 acres)
Wind Speed	U	1.0 (m s ⁻¹)
Rainfed Fertilizer Rate	F	202 kg ha ⁻¹ yr ⁻¹
Irrigation Fertilizer Rate	F	280 kg ha ⁻¹ yr ⁻¹

For these calculations, an area-source, two-dimensional, steady-state Gaussian model will be employed as in equation (12), where the concentration C is in units of $\mu\text{g m}^{-3}$. The symbols have the same meaning as in the particulate dust calculations (equation 6), except that E_R is now an area source with units of $\text{g m}^{-2} \text{s}^{-1}$.

$$C = \frac{E_R K}{2 \pi U} \int \frac{V d}{\sigma_Y \sigma_Z} \left\langle \int \exp \left[\frac{-1}{2} \left(\frac{Y}{\sigma_Y} \right)^2 \right] dy \right\rangle dx \quad (12)$$

The fertilizer rates in Table 57 are for the total weight of fertilizer. To convert to a pure N rate F_{NR} , they are multiplied by a fraction as in (13), where 0.35 is the atomic weight of N divided by the molecular weight of NH₄NO₃.

$$(13) \quad F_{NR} = 0.35 F$$

Millar et al. (2012) provide a relationship between nitrogen fertilizer application rate F_{NR} (kg N ha⁻¹ yr⁻¹) and N₂O-N emissions (g N₂O-N ha⁻¹ yr⁻¹), as in equation (14). To calculate the needed emission rate E_R used in (12), one must do the appropriate unit conversions and scaling, as in equation (15). Factor number one (from the left) in (15) converts from ha⁻¹ to km⁻². Factor number two converts from km⁻² to m⁻². Factor number three converts from yr⁻¹ to s⁻¹. For the last factor (number four), the emissions rate is scaled to an assumed growing season of four months out of twelve.

$$(14) \quad E = 670 \exp (0.0067 F_{NR})$$

$$(15) \quad E_R = \frac{10^2}{1} \frac{10^{-6}}{1} \frac{1}{(365 \text{ days} * 24 \text{ hours} * 3600 \text{ seconds})} \frac{12}{4} E$$

Using the values from (15) in (12) for both rainfed and irrigated scenarios gives the results in Table 58 for the average farm sizes in the Wheeler and Lower Elk HUCs, where the concentrations have

been converted to Parts Per Billion (PPB) of N₂O. The increase in N₂O emissions is close to 5 PPB. Both the rainfed and irrigated concentrations are well below the EPA 1-h N₂O standard of 100 PPB.

Table 58. Impact of increased fertilizer application with irrigation. All concentrations are in units of parts per billion.

HUC Name	N ₂ O Rainfed (PPB)	N ₂ O Irrigated (PPB)	Difference (PPB)	EPA 1-h Standard (PPB)
Wheeler	25.00	30.00	5.00	100.00
Lower Elk	23.40	28.20	4.80	100.00

6.3 Greenhouse Gas Emission Analysis

The COMET-Farm (<https://cometfarm.nrel.colostate.edu>) analysis system is designed to assess on-farm greenhouse gas emissions. COMET-Farm requires field definition, historic farm practices and future practices to evaluate both baseline and predicted greenhouse gas emissions. COMET-Farm is designed for field-scale evaluations and not regional emissions modeling. For this project, a representative field in Belle Mina, Limestone County was identified and defined. Conventional crop rotation, planting dates, fertilizer rates and irrigation applications were defined. For the baseline, no irrigation was applied. The results are included below in Table 59.

Table 59. COMET-Farm Results. Rain-fed baseline and Irrigated Projection

Report finished: 00:03:27 100% Complete

NAME: Cameron Handyside

PROJECT: Mid TN River WS Project 1

Daycent Status: Running at 100%

JOBID: 15978_27144_NONE

Time: Tue Jun 11 2019 11:05:07 GMT-0500 (Central Daylight Time)

Version: Ver. 2.2.2, build 3.2.7087.27559 (28-May-2019)

USDA

United States Department of Agriculture

Natural Resources Conservation Service

Source	Baseline Emissions		Irrigated				
	Emissions	+/-	Emissions	+/-	Change	+/-	
Belle Mina 1 (175 acres - Corn, Soybean, Cotton)							
C (tonnes CO ₂ equiv./yr.)	-129.2	NR [†]	-132.3	NR [†]	-3.0	NR [†]	
CO ₂ (tonnes/yr.)	0.0	+0/-0	0.0	+0/-0	0.0	+0/-0	
CO (tonnes CO ₂ equiv./yr.)	0.0	+0/-0	0.0	+0/-0	0.0	+0/-0	
N ₂ O (tonnes CO ₂ equiv./yr.)	956.9	+1102.1/-727.2	1000.8	+1147.9/-759.8	+43.9	+48.9/-33.4	
CH ₄ (tonnes CO ₂ equiv./yr.)	0.0	+0/-0	0.0	+0/-0	0.0	+0/-0	
Total	827.7	NR [†]	868.5	NR [†]	+40.8	NR [†]	

The COMET-Farm system also outputs the margin of error for different greenhouse gas components as shown in Figure 54, below.

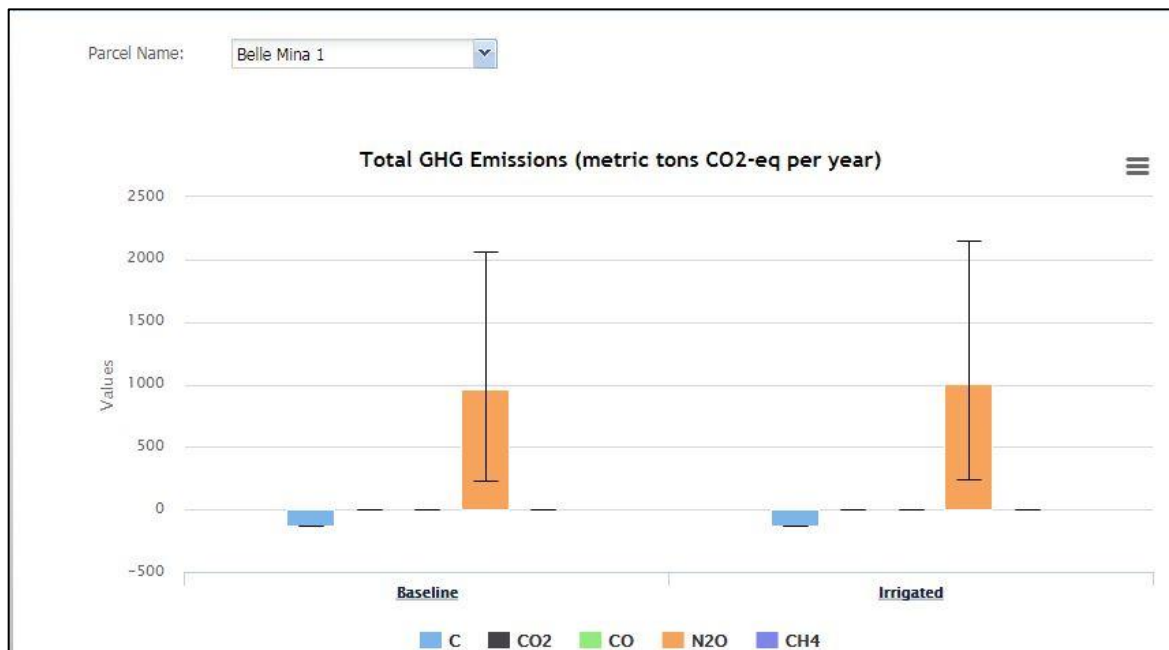


Figure 54: Graph of emission components

The COMET-Farm system is designed to assess emissions due to farm management changes. However, the results can be compared to the air quality model used to determine NO_x emissions. Converting the COMET mass rate numbers to a concentration involves two steps and several assumptions as shown below.

$$(1) \quad R_{N_2O} = \frac{R_{CO_2}}{1} \frac{10^3}{1} \frac{1}{298} \frac{12}{4} \frac{1}{\Delta t}$$

The terms in equation (1) on the right-hand side will be discussed, from left to right. The first term, R_{N_2O} , is the annual increase in metric tons of N₂O in CO₂ equivalent mass obtained from the COMET model (43.9). The second term, 10^3 , converts metric tons to kg. The third term, 298^{-1} , converts CO₂ equivalent mass to actual N₂O mass in kg. The fourth term, $12/4$, takes the annual number and scales it to the four months of the growing season. The last term, Δt , is the number of seconds in a year. The result on the left-hand side, R_{N_2O} , is then an emission rate of N₂O in kg s⁻¹.

$$(2) \quad C_{N_2O} = \frac{R_{N_2O} \Delta t_E}{A Z} \frac{10^3}{1} \frac{10^6}{1} \frac{f}{1}$$

To convert the emissions rate from equation (1) to a concentration, several assumptions must be used. Equation (2) shows the variables needed to convert an emission rate to a concentration. The terms in equation (2) on the right-hand side will be discussed, again, from left to right. The numerator in the first term multiplies an emission rate R_{N_2O} times an emission time scale, Δt_E , which

will be discussed further later. This gives a mass value in units of kg. The denominator in the first term calculates a volume by multiplying a farm area (175 acres converted to m^2) times a planetary boundary layer (PBL) height Z . Typical spring and summer maximum values of Z are on the order of 1-2 km. A value of 1,000 m has been used here. The second term, 10^3 , converts kg to g. The third term, 10^6 , converts g to micro-grams (μg). With these three terms a concentration of $\mu\text{g m}^{-3}$ is defined. The final factor “ f ” (a constant for standard pressure and temperature), converts $\mu\text{g m}^{-3}$ to parts per billion (PPB), which is the units of the left-hand side term CN_2O . The emission time scale, Δt_E , could be defined by one of many different ways. Using the same wind speed as the Gaussian plume calculations (1 m s^{-1}) and the distance defined by a square of the farm size A , gives a time scale of about 15 minutes for air to travel across the example farm. Another equally important time scale is the time required for an air parcel to climb to the top of the PBL and back to the surface. Assuming a circular eddy and same velocity gives a time scale of about 50 minutes. Since the latter is close to an hour, Δt_E has been set to 1 h (3,600 s). With these assumptions the R_{CO_2} value of 43.9 metric tons per year gives an increase of 0.120 PPB of N_2O . This number is considerably smaller than the number of about 5 PPB obtained from the Gaussian plume calculations. This difference can be explained, in part, by the fact the Gaussian plume calculations were done in a way to give the maximum possible, worst-case scenario value of concentration increase at the center of a down-wind plume. The Gaussian values do not give an area average estimate of the concentration across the field. Nonetheless, the conclusion is the same: the increase in N_2O concentration is below the EPA 1-h standard of 100 PPB. A summary of the key numbers in this calculation are given in Table 60.

Table 60. Summary of key variables in N_2O concentration calculation.

R_{CO_2} (metric tons/year)	A (m^2)	Z (m)	Δt_E (s)	$C_{\text{N}_2\text{O}}$ (PPB)
43.9	7.08×10^5	1,000	3,600	0.12

APPENDIX E

Supporting Information

MEMORANDUM OF UNDERSTANDING
Between the
TENNESSEE VALLEY AUTHORITY
and the
UNITED STATES DEPARTMENT OF AGRICULTURE

RELATIVE TO: Coordinating activities of the Tennessee Valley Authority under the Tennessee Valley Authority Act of 1933, as amended (48 Stat. 58, 49 Stat. 1079), with those of the Soil Conservation Service under the Watershed Protection and Flood Prevention Act, as amended (68 Stat. 666, 70 Stat. 1088).

Termination of a

WITNESSETH

WHEREAS, the SCS is assigned responsibility for the administration of the Watershed Protection and Flood Prevention Act, as amended (68 Stat. 666, 70 Stat. 1088); and

WHEREAS, under the Tennessee Valley Authority Act of 1933, as amended (48 Stat. 58, 49 Stat. 1079), the TVA is concerned with and has statutory responsibilities relating to navigation and the control of flood waters in the Tennessee River and its tributaries; and

WHEREAS, it is the desire of the SCS and TVA to coordinate their mutual interests and activities in carrying out their assigned responsibilities in the Tennessee River Basin,

NOW THEREFORE, the SCS and the TVA agree on procedures to accomplish their desires as follows:

A. Preapplication Phase:

1. SCS and TVA will inform each other of local interest in watershed programs within the Tennessee River Basin as such interest comes to their attention.
2. At the time local interest in a specific watershed is first recognized, TVA also will advise SCS regarding any of TVA's active projects or plans which might significantly influence the feasibility of a small watershed project under the Watershed Protection and Flood Prevention Act.

B. Application Phase:

1. Upon receiving an application for planning assistance, SCS will forward a copy to TVA for review and comment.
2. In response, TVA will indicate the nature of its interest in the Watershed, including reference to any identifiable TVA requirements for approval of structures under Section 26a of the Tennessee Valley Authority Act of 1933, as amended, in the affected area. This statement of interest will become a part of the application file for the watershed in question.
3. SCS will inform TVA of plans for a field examination or similar preliminary survey, will invite TVA to participate, and will furnish TVA a copy of the preliminary field report.
4. SCS will inform TVA of the action taken on the application by the Service.
5. SCS will inform TVA when planning assistance is authorized.
6. SCS will inform TVA of interest and needs expressed by local sponsoring organizations and will arrange to inform local sponsoring organizations of the nature of the interest of TVA in the watershed.

C. Work Plan Development Phase:

1. On apprising TVA of an approval and authorization for assistance in Watershed Work Plan development, SCS will send TVA a list of the types of data needed from TVA for planning.
2. TVA will furnish SCS such data and planning materials as are available and applicable under the generalized list supplied by SCS.
3. SCS will furnish TVA a copy of the Plan of Operations (work outline) for developing the Watershed Work Plan.
4. a. SCS will consult with TVA on the development of Watershed Work Plans, specifically with respect to proposed structural works of improvement, that TVA decides or has previously indicated would significantly affect TVA's interests. As appropriate, SCS will also discuss with TVA the interpretation and application of data submitted by TVA.
b. SCS will furnish TVA (a) a map showing the tentative location of contemplated structural works and (b) preliminary structure estimates of items usually listed in the standard "Structure Data Table" of Watershed Work Plans after preliminary agreement has been reached with the responsible local sponsoring organization.
c. TVA will examine this preliminary information, request of SCS any additional information, if needed, and advise SCS of any significant conflict between the proposed works and TVA's responsibilities for navigation, flood control, public lands, or other properties.
d. After any necessary consultation with SCS, TVA will advise SCS as to any structures requiring approval under Section 26a of the Tennessee Valley Authority Act of 1933, as amended. SCS will formulate and develop with the local sponsoring organization further plans and recommendations with respect to such structures on a basis which will enable them to meet the requirements of the TVA Act.
5. SCS will inform TVA of the time and place of the informal review of the Work Plan draft with other agencies. In advance of this meeting, SCS will transmit to TVA copies of the Work Plan draft for information and office review. Following the informal review of the Work Plan draft, TVA will advise SCS of its views.
6. SCS will furnish TVA copies of the final Watershed Work Plan for review and comment. TVA will reply, identifying the structures, if any, requiring further review or approval under Section 26a of the Tennessee Valley Authority Act of 1933, as amended.

D. Installation Phase:

1. SCS will direct attention of the Sponsors of each watershed project to the requirements of Section 26a of the Tennessee Valley Authority Act of 1933, as amended. When the watershed goes into installation phase and when SCS has been advised that review and approval of the design of structures is required, the Sponsors will be informed by SCS of the requirement for Section 26a approval prior to construction.

E. General:

1. This agreement will be effective as of the date appearing in the first paragraph hereof. The agreement may be amended by mutual agreement. Either party may terminate the agreement upon 90 days' notice given in writing to the other party.
2. This agreement does not constitute a financial obligation to serve as a basis for expenditures.

IN WITNESS WHEREOF, the parties have executed this agreement on the day, month and year first above written

TENNESSEE VALLEY AUTHORITY

By /s/ A.J. Wagner
Title General Manager

APPROVED BY TVA

BOARD OF DIRECTORS

Nov. 6, 1958

/s/

Leona L. Malkemus
Assistant Secretary

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

By /s/ Gladwin Young
Title Acting Administrator

Figure 55: MOU between the TVA and USDA

The following figure represents the ALFA distributed Survey used as part of the Project Scoping Process:

Agricultural irrigation is poised for expansion in Alabama. In order to better understand farmers' interest in expanding irrigation in the state, your input is needed. If you currently irrigate, or if you would like to add irrigation on your farm, please complete the information below. All information provided will remain confidential.

In order to help us collect the best possible information, please note:

- The first section of the survey should only be completed by those currently irrigating crops.
- The second section should only be completed by those who do not currently irrigate.
- The third section should be completed by all respondents.

The survey can also be completed online at www.alabamairrigation.org.

Thank you for taking time to assist with this survey!

Only Answer Questions 1 – 10 if you are currently using irrigation

1. Do you currently irrigate crops in Alabama? If your answer is no, please skip to the next section of the survey.

___ Yes ___ No

2. In what county, or counties, in Alabama do you currently irrigate agricultural crops?

3. How many acres do you currently irrigate?

___ Less than 1 acre to 24 acres	___ 500 – 749 acres
___ 24 – 49 acres	___ 750 – 999 acres
___ 50 – 99 acres	___ 1,000 – 1,499 acres
___ 100 – 249 acres	___ 1,500 – 1,999 acres
___ 250 – 499 acres	___ 2,000 or more acres

4. If a federally-funded cost share program was available, would you be more likely to invest in expanding your irrigated acres?

___ Yes ___ No

5. How many additional acres would you like to be able to irrigate if you qualified for cost-share funding?

___ Not interested in expansion at this time	
___ Less than 1 acre to 24 acres	___ 500 – 749 acres
___ 24 – 49 acres	___ 750 – 999 acres
___ 50 – 99 acres	___ 1,000 – 1,499 acres

☐ 100 – 249 acres☐ 1,500 – 1,999 acres☐ 250 – 499 acres☐ 2,000 or more acres

6. Do you currently have plans to irrigate any newly rented or leased acres?

☐ Yes ☐ No

7. If so, do you currently have rental/lease agreement for at least a minimum of five years?

☐ Yes ☐ No

8. What percentage of your cropland do you currently irrigate?

☐ Less than 20%

☐ 21 – 49%

☐ 50 – 74%

☐ 75 – 100%

9. What is your water source (check all that apply)?

☐ Surface Water

☐ On-farm pond or reservoir

☐ Groundwater (well)

10. If you answered "surface water" above, please list the name of the river or stream.

Only Answer Questions 11 – 18 if you are currently NOT using irrigation

11. Do you currently irrigate crops in Alabama? If your answer is yes, please go back and complete the previous section of the survey. If your answer is no, please continue with the questions below.

☐ Yes ☐ No

12. In what county, or counties, in Alabama do you currently farm?

13. If a federally-funded cost share program was available, would you be more likely to invest in irrigation?

☐ Yes ☐ No

14. How many additional acres would you like to be able to irrigate if you qualified for cost-share funding?

☐ Not interested in expansion at this time

☐ Less than 1 acre to 24 acres

☐ 500 – 749 acres

☐ 24 – 49 acres

☐ 750 – 999 acres

☐ 50 – 99 acres

☐ 1,000 – 1,499 acres

☐ 100 – 249 acres

☐ 1,500 – 1,999 acres

☐ 250 – 499 acres

☐ 2,000 or more acres

15. Do you currently have plans to irrigate any newly rented or leased acres?
 ___ Yes ___ No
16. If so, do you currently have rental/lease agreement for at least a minimum of five years?
 ___ Yes ___ No
17. What would be your water source (check all that apply)?
 ___ Surface Water
 ___ On-farm pond or reservoir
 ___ Groundwater (well)

18. If you answered "surface water" above, please list the name of the river or stream.
- _____

All respondents should complete the section below (questions 19 - 24)

19. Name: _____
20. Recent economic analysis concludes that installing a system irrigating 140 acres costs between \$200,000 and \$224,000, with a full return on investment within three to five years. This program will include a farmer cost share component. What cost-share percentage would you be willing to pay for irrigation?
 ___ None, I would not be willing to invest in irrigation even if cost-share funding was available
 ___ 25%, I would be willing to invest up to 25% of the total cost
 ___ 50%, I would be willing to invest up to 50% of the total cost
 ___ 75%, I would be willing to invest up to 75% of the total cost
 ___ 100%, I plan to expand irrigation on my farm with or without possible cost share funding
21. What types of conservation practices would you be interested in adding (check all that apply)?
 ___ Irrigation Pivot ___ Well
 ___ Irrigation Pipeline ___ Pump (electric)
 ___ Subsurface Irrigation ___ Pump (diesel)
 ___ Irrigation reservoir ___ Convert combustion pump to electric
 ___ Micro-irrigation
 ___ Convert current irrigation to low-pressure drop nozzles
22. Are there other irrigation practices not listed above you would be interested in?
- _____
23. Please enter the Latitude and Longitude of each location (field, hoop house, etc.) where irrigation would occur. To get the Latitude and Longitude for each location use the Compass App on your smartphone. Stand at the location to be irrigated and turn on your compass. The Latitude and Longitude will appear on your phone screen.
- | | |
|------------|-------------|
| Lat: _____ | Long: _____ |
| Lat: _____ | Long: _____ |
| Lat: _____ | Long: _____ |
| Lat: _____ | Long: _____ |
| Lat: _____ | Long: _____ |

<p>Lat: _____ Long: _____</p> <p>24. What has prevented you from irrigating or expanding irrigation on your farm?</p> <p>____ Economics</p> <p>____ Age</p> <p>____ Access to Water</p> <p>____ Land is rented</p> <p>Other: _____</p> <p>Please mail completed surveys to the following address: Alabama Association of Conservation Districts Attn. Katy Parker, Executive Director P.O. Box 304800 Montgomery, AL 36130-4800</p> <p>If you prefer to scan and e-mail, please send to katy@ALConservationDistricts.org THANK YOU!</p>

Figure 56: ALFA Farmer Survey

ALABAMA IRRIGATION INITIATIVE WHEELER WATERSHED		
Tennessee Valley Research and Extension Center October 23, 2018		
Name	Phone	E-Mail
SID CAMERON	229/938-0980	sid.cameron@vaq.mant.com
Vernon Abney	334-687-4536	vernon.abney@al.usda.gov
Ashley Henderson	334 300-3392	
Sabra Sutton	334-721-4389	sabra@al.conservationalwatersheds.org
Courtney Curren	334-549-0820	
Gabe Holdeman	334 581 5299	additent@gmail.com
Rachel Kuntz	205-370-8043	rmtk@alabamian.edu
Lucia Bentesan	334 332 8672	L280056@alabamian.edu
Brenda Wigginton	256-777-5600	bwigginton@al.net
Kathy Gotcher	256-974-1174 ext 3	Kathy.gotcher@al.usda.gov
Nikita Morgan	256-764-5833 ext 3	nikita.morgan@al.usda.gov
NOLAN BROWN	256-990-6057	LORIEB@AROMORE.net
GABRIEL LLOYD	256-1612-8185	GABRIEL.LLOYD@ALABAMA.COOP
PAUL CLARK	256-565-6238	PC/CLK21@CHANTA.NET
Monte Davis	256 990-2978	
ARLEN MARS	256-656-4307	MARS/FARMS3@AOL.COM
DENNIS BRAGG		



ALABAMA IRRIGATION INITIATIVE WHEELER WATERSHED		
Tennessee Valley Research and Extension Center October 23, 2018		
Name	Phone	E-Mail
Stuart Sanderson	256-980-4789	stuart.sanderson@gmail.com
M. Daniel Mills	704-787-2825	mike.mills@rethink.com
Brian LeCroy	256-990-1437	blecroy@att.net
Dusty Hall	256-679-2521	DustHall2@gsa.net
Clayton DeVaney	256-898-4679	ClaytonDeVaney@gmail.com
Keith DeVaney	256-759-8988	KeithDeVaney54@gmail.com
Don Douvan	256-777-5037	Douvan@alabamian.edu
Michael Bean	256-508-4492	mbean4560@AOL.COM
DOUG PARRISH	256-579-1474	DOUGPARRISH@TRIGREEN.COM
STEVE GRIFFITH	256-574-9851	stgiffith@faemestel.com
Philip Stewart	256 574- 9118	philip.stewart3190@yahoo.com
Brent Stuenkel	256-214-2608	stuenkel@alabamian.edu
Al Stanley	256-837-6850	astanley@stanley-hav.com
Robert Hensford	256-569-1342	robhensford@alabamian.edu
James Hensford	256-597-7308	JHensford@alabamian.edu
Don Ware	256-637-2261	ware@alabamian.edu
Jared Darnell	256 303 6816	jd.farm1@gmail.com



Figure 57: Sign-in Sheets for the October 23, 2018 Farmer Interest Meeting in Belle Mina, AL

Irrigation Meeting November 27, 2018
Moulton Field Office-Lawrence

23.	Mark Strohman	markstrohman@statewater.com	NRES
24.	Bill Kallendul	billkallendul@statewater.com	SWED
25.	Kathy Gatcher	KathyGatcher@statewater.com	NRES-Lawrence
26.	Karin Foster	karin.foster@statewater.com	Lawrence Co. SWC D
27.			
28.			
29.			
30.			
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32.			
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40.			
41.			
42.			
43.			
44.			
45.			

11/27/18
William Lee - LeeFarm@comcast.net
Heath Durnell - CliftonFarms7@gmail.com
Larkin Martin - MartinFarm@bellsouth.net
Shannon Norwood - ShannonNorwood@trigreen.com
Will Gatcher - WillGatcher@trigreen.com
Austin Thorn - AustinThorn@trigreen.com
Paul Clark - pclark2188@charter.net

June 2019


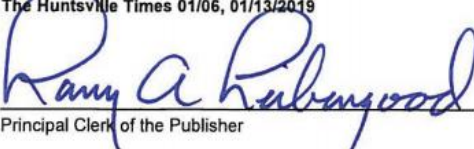


 <p>State of Alabama,) ss County of Madison)</p> <p>Larry Leibengood being duly sworn, deposes that he/she is principal clerk of Alabama Media Group; that The Huntsville Times is a public newspaper published in the city of Huntsville, with general circulation in Madison County, and this notice is an accurate and true copy of this notice as printed in said newspaper, was printed and published in the regular edition and issue of said newspaper on the following date(s): The Huntsville Times 01/06, 01/13/2019</p> <p> Principal Clerk of the Publisher</p> <p>Sworn to and subscribed before me this 14th day of January 2019</p> <p> Notary Public</p> <p>PUBLIC NOTICE Notice that a public meeting for comments will be held to review the United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), with assistance from Auburn University and in cooperation with the Alabama Soil and Water Conservation Committee, Draft Watershed Plan-Environmental Assessment for the Middle Tennessee River Valley Watershed (Draft Plan - EA) to expand agricultural irrigation. This program may be partially funded through the Watershed Protection and Flood Prevention Act of 1954 (PL 83-566) and will address increasing irrigated acreage on agricultural land, while avoiding significant negative impact on the surrounding natural environment and cultural resources. The public meeting will be held 5-6 pm on January 22, 2019 at the Aerospace Training Center, 6250 US-31 Decatur, AL. Huntsville Times: January 6, 13, 2019</p>	<p>The Huntsville Times LEGAL AFFIDAVIT</p> <p>AD#: 0008967918 Total \$155.40</p> <div style="text-align: center;">  </div>
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Figure 59: Affidavit for Announcement of Public Meeting

January 22, 2019

Middle Tennessee River Valley Draft Watershed Plan

Agency
Public Input Meeting

Name	Affiliation	Email / phone	Address
Eve Brantley	AU / ACES	brantley@auburn.edu	Auburn, AL
Kevin Doty	VAH	kevin.doty@nrcs.vah.edu	VAH
James Cruise	VAH	James.Cruise@nrcs.vah.edu	
Kathy Gotcha	NRCS	kathy.gotcha@al.usda.gov	
William Puckett	SWCC	william.puckett@swcc.alabama.gov	
MAURY ESTES	UAH	MAURY.ESTES@nrcs.vah.edu	UAH
Steve Musser	NRCS	Steve.Musser@al.usda.gov	3351 Skyway Dr Auburn AL
Cameron Handy	UAH	cameron.handy@ua.edu	
Rachel Kuntz	AU/ACES	rmk001@auburn.edu	
Brittney Gordin	AU/ACES	bk9007@auburn.edu	
Jenny Wood	UAH	jmw0057@ua.edu	
Kael Haynes	VAH	keha018@vaah.edu	
Vernon Abney	NRCS	vernon.abney@al.usda.gov	3351 Skyway Dr. Auburn, AL
EDDIE MCGRIFF	AU/ACES	dem029@auburn.edu	

Figure 60: Agency Meeting Sign-In Sheet, January 22, 2019

January 22, 2019

Middle Tennessee River Valley Draft Watershed Plan

Public Input Meeting

Name	Affiliation	Email / phone	Address
MAURY ESTES	UAH	MAURY. ESTES@NSTC.UAH.EDU	UAH
Kevin Doty	UAH	kevin.doty@nstc.uah.edu	UAH
James Cruise	UAH	James.cruise@nstc.uah.edu	
Jenny Wood	UAH	jmw0057@uah.edu	
Kel Hynes	UAH	keh0018@uah.edu	
Brittney Godwin	Auburn University	bg0007@auburn.edu	
Rachel Kuntz	AU/ACES	rmkoolb@auburn.edu	
Courtney Curenton	AACD	Courtney@alconservationdistricts.org	
William Puckett	SWCC	William.Puckett@swcc.alabama.gov	
EDDIE MCGRIFF	AU/ACES	olem0029@auburn.edu	
Eve Brantley	AU/ACES	brantley@auburn.edu	
Cameron Hardy	UAH	cameron.hardy@nstc.uah.edu	

Figure 61: Public Meeting Sign-In Sheet, January 22, 2019

January 22, 2019

Middle Tennessee River Valley Draft Watershed Plan

Public Input Meeting

Name	Affiliation	Email / phone	Address
Vernon Abney	NRCS	vernon.abney@al.usda.gov	3351 Skyway Dr. Auburn, AL
Kathy Gotchen	NRCS	Kathy.gotchen@al.usda.gov	13075 AL Hwy 157 Moulton, AL 35850
Kyle Bridger Fort	Bridger + Fort	Kyle.bridger@gmail.com	PO Box 282, Tennes, AL 35621
Bill Bailey	Limestone	bill.bailey502@gmail.com	PO box 117 Elk Mtn AL 35605
Stacy Mosser	NRCS	stacy.mosser@al.usda.gov	3351 Skyway Dr. Auburn AL 36802

Figure 62: Public Meeting Sign-In Sheet (#2), January 22, 2019

**Public Input Meeting
Draft Watershed Plan
Middle Tennessee River Valley Watershed
January 22, 2019 5-6 pm**

- 1) Introductions – Dr. Eve Brantley, Auburn University
- 2) Project overview presentation – Dr. Eve Brantley, AU, and Mr. Cameron Handyside, University of Alabama-Huntsville
- 3) Time line – 14 days public input and comment
- 4) Document availability
 - a. Paper copies at NRCS offices in Cullman, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall, and Morgan Counties, Alabama
 - b. Online draft available for download
<https://cses.auburn.edu/eve-brantley/draft-middle-tn-river>
 - c. Direct comments to Mr. Vernon Abney, USDA NRCS,
Vernon.Abney@al.usda.gov
- 5) Open discussion
- 6 pm Adjourn

Figure 63: Agenda for Public Meeting, January 22, 2019

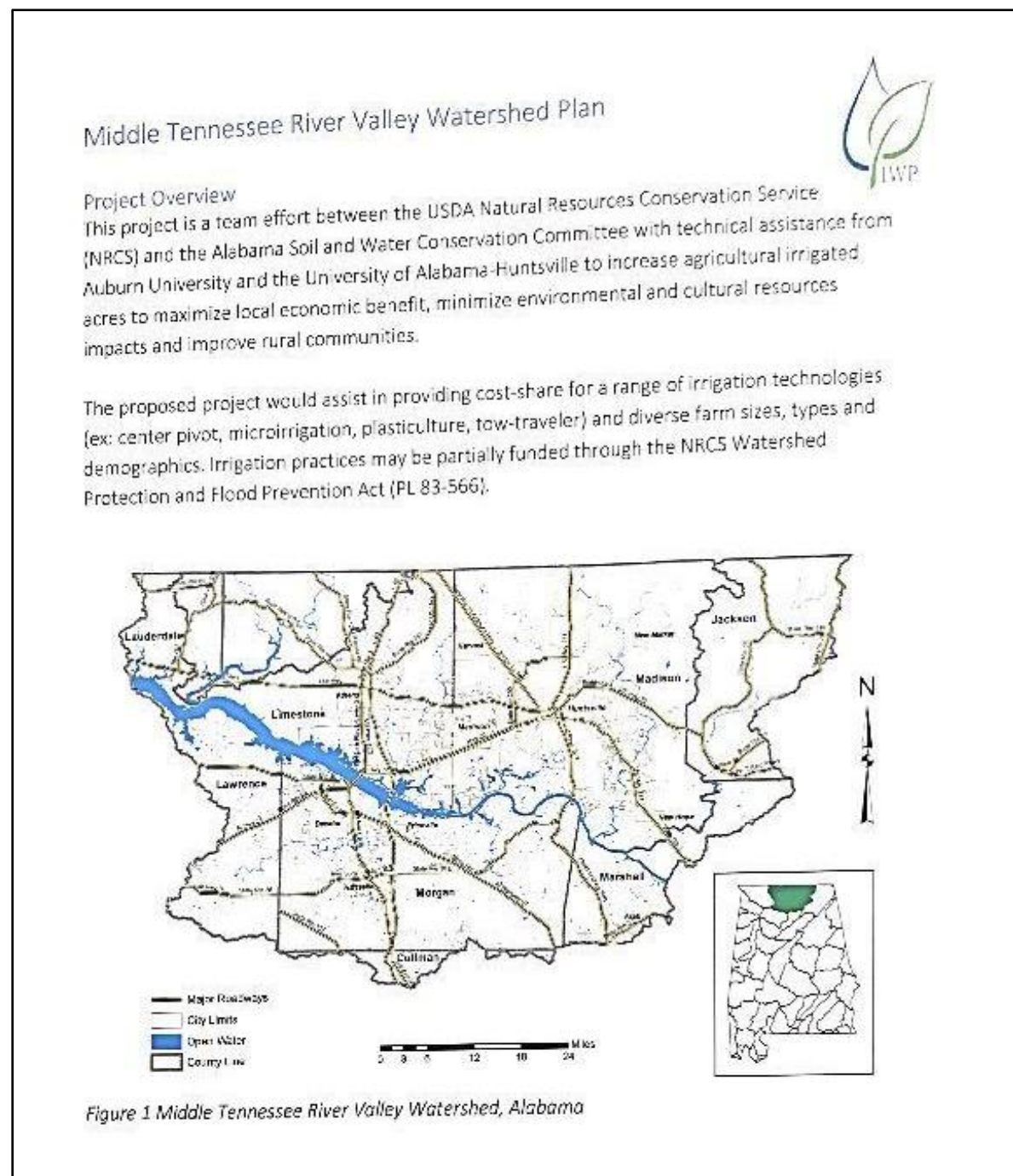


Figure 64: Fact Sheet Offered at Public Meeting (Page 1)

Purpose and Need

Through the Watershed Program authorized by Public Law 83-566, NRCS provides technical and financial assistance to local organizations for planning and carrying out watershed projects that help solve natural resource and related economic problems in a specific watershed. These issues can include watershed protection, flood prevention, erosion and sediment control, water supply, water quality, fish and wildlife habitat enhancement, and wetlands creation.

In accordance with the provisions of the NRCS's Watershed Program, the Alabama Soil and Water Conservation Committee is eligible for funding to address agricultural water needs. The purpose of this project is to provide cost-share funding to expand irrigation.

WE WANT YOUR INPUT!

NRCS invites all interested parties to review the Draft Watershed Plan-EA and attend the public meeting to learn more about the project. We are asking for your comments and suggestions to develop a Final Watershed Plan-EA. Written comments are highly encouraged and will be accepted in person at the public meeting or via U.S. Mail or email.

Comments may be sent:

US Mail

Mr. Vernon Abney, State Conservation Engineer

Natural Resources Conservation Service

P.O. Box 311

Auburn, Alabama 36831-0311

Email Vernon.Abney@al.usda.gov

Paper copies of the draft watershed plan are available at NRCS offices in Cullman, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall, and Morgan Counties, Alabama

Electronic copy available for download at <http://csees.auburn.edu/eve-brantley/draft-middle-tn-river/>

A public meeting will be held January 22, 5-6 pm at the Aerospace Training Center – Calhoun Community College, 6250 US-31 Decatur, AL

Figure 65: Fact Sheet Offered at Public Meeting (Page 2)



Figure 66: Invitation Letter to Cooperating Agencies – USCOE used as Example

E-mail to Cooperating Agencies:

Dear All,

Please join us for a Cooperating Agency interactive webinar on Friday, January 25 9-11 am to accept comments on the Draft Watershed Plan for the Middle Tennessee River Valley. Cooperating Agency comments will be accepted until February 20, 2019.

If you're a new Zoom participant, we have a quick start guide here:

<https://aub.ie/zoomquickstart>

Join from PC, Mac, Linux, iOS or Android: <https://auburn.zoom.us/j/957904492>

Connect using Computer/Device audio if possible. Or Telephone: Meeting ID: 957 904 492 Dial: +1 646 876 9923 (US Toll) or +1 669 900 6833 (US Toll)

A copy of the draft plan will be available at this web page:

<https://cses.auburn.edu/eve-brantley/draft-middle-tn-river/>

PROJECT OVERVIEW

This project is a team effort between the USDA Natural Resources Conservation Service (NRCS) and the Alabama Soil and Water Conservation Committee with technical assistance from Auburn University and the University of Alabama-Huntsville to increase agricultural irrigated acres to maximize local economic benefit, minimize environmental and cultural resources impacts and improve rural communities.

The proposed project would assist in providing cost-share for a range of irrigation technologies (ex: center pivot, microirrigation, plasticulture, tow-traveler) and diverse farm sizes, types and demographics. Irrigation practices may be partially funded through the NRCS Watershed Protection and Flood Prevention Act (PL 83-566).

PURPOSE AND NEED

Through the Watershed Program authorized by Public Law 83-566, NRCS provides technical and financial assistance to local organizations for planning and carrying out watershed projects that help solve natural resource and related economic problems in a specific watershed. These issues can include watershed protection, flood prevention, erosion and sediment control, water supply, water quality, fish and wildlife habitat enhancement, and wetlands creation.

In accordance with the provisions of the NRCS's Watershed Program, the Alabama Soil and Water Conservation Committee is eligible for funding to address agricultural water needs. The purpose of this project is to provide cost-share funding to expand irrigation.

We are asking for your comments and suggestions to develop a Final Watershed Plan-EA. Paper copies of the draft watershed plan are available at NRCS offices in Cullman, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall, and Morgan Counties, Alabama.

Written comments are highly encouraged and will be accepted in person or via U.S. Mail or email at:

Please email comments to Vernon Abney, USDA NRCS, Vernon.Abney@al.usda.gov

Comments may be sent by US Mail:

Mr. Vernon Abney, State Conservation Engineer

Natural Resources Conservation Service

P.O. Box 311

Auburn, Alabama 36831-0311

Thank you,

Eve

Eve Brantley, PhD, Water Resources Specialist and Associate Professor
Alabama Cooperative Extension System Dept of Crop, Soil and Environmental Sciences
Auburn University
brantley@auburn.edu

Figure 67: E-mail Sent to Cooperating Agencies

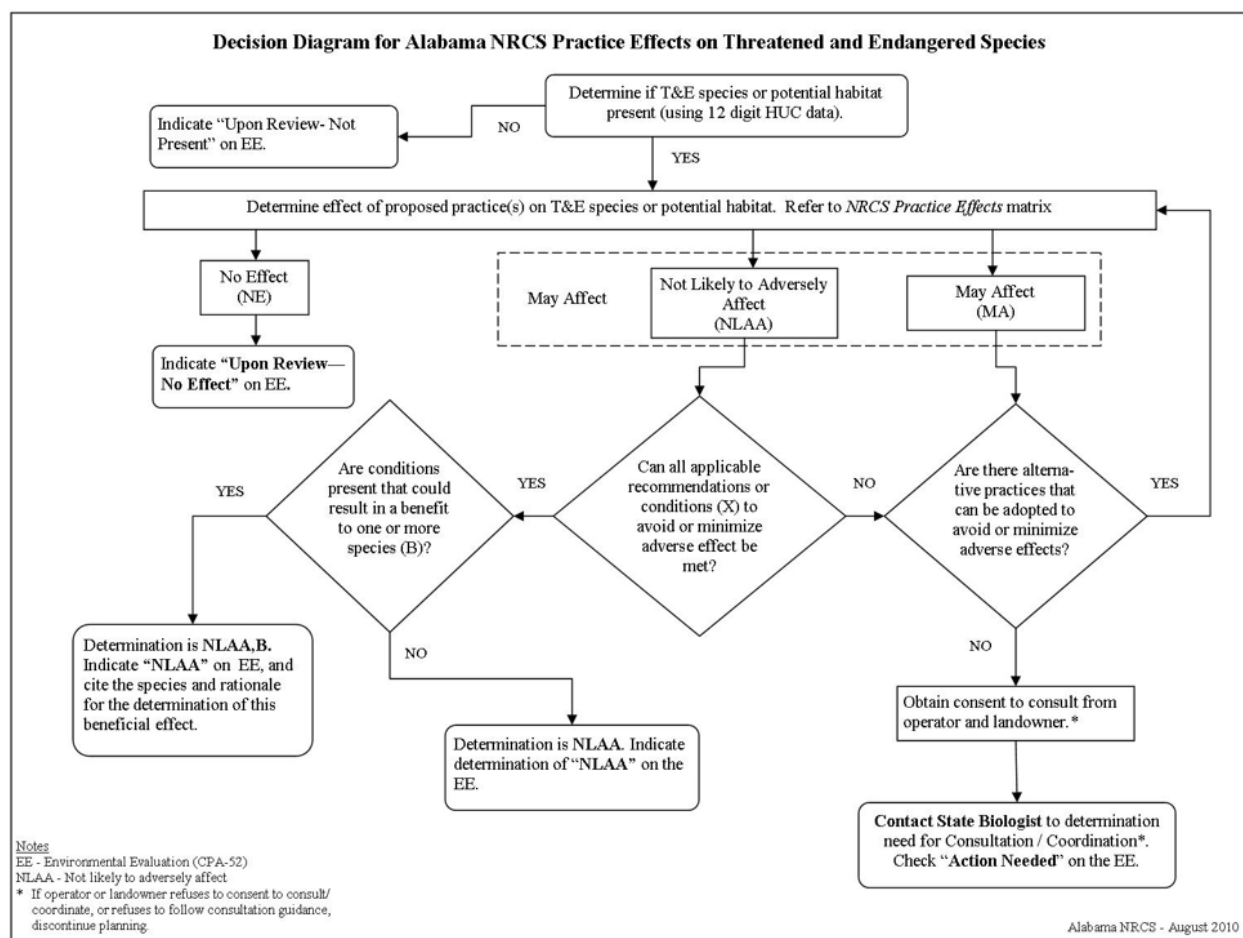


Figure 68: Decision Diagram for Alabama NRCS Practice Effects on T&E Species

Table 61. Irrigation Practice Effects on T&E Species

Code	Practice	Unit	Practice Effects				Comments
			No Effect	Not likely to adversely Affect T&E Species	MA	NLAA, B	
441	Irrigation System, Microirrigation	ac	N				
442	Irrigation System, Sprinkler	ac	N				
443	Irrigation System, Surface and Subsurface	ac	N				
430	Irrigation Water Conveyance	ft		Avoid Crossing streams with this practice.			If pipeline crosses a stream, contact NRCS Biologist to determine if consultation is necessary.
449	Irrigation Water Management	ac	N				
533	Pumping Plant	no		If the practice will be placed within 50 feet of a stream within a 12-digit HUC containing T&E aquatic species, further investigation is required. Increase buffer distance as needed to maintain the ecological and structural integrity of the riparian buffer and stream bank. If the practice will be placed in a habitat type where a threatened or endangered species may reside AND if disturbance of native vegetation (changing land use, herbicide application, earthmoving, soil disturbance, etc.) is involved in the installation of this practice, further investigation is required. Review the Sensitive Habitat Fact Sheet and plant fact sheets. Make a visual observation of the area to determine if the species or habitat for the species exists.		If this practice improves water quality and/or quantity, then this practice is beneficial for aquatic species.	Contact State Biologist to determine if consultation is necessary. Can be beneficial to aquatics if replacing surface water withdrawals at critical times.
642	Water Well	no		If the practice will be placed in a habitat where a threatened or endangered species may reside, further investigation is required. Review the Sensitive Habitat Fact Sheet, then make a visual observation of the area to determine if the species or habitat for species exists. Examples include: Avoid ground disturbing activities within Red Hills Salamander habitat. Avoid altering hydrology of ephemeral drains (avoid logging during wet weather) within the FWS habitat. If the practice will be placed in a habitat type where a threatened or endangered species may reside AND if disturbance of native vegetation (changing land use, herbicide application, earthmoving, soil disturbance, etc.) is involved in the installation of this practice, further investigation is required. Review the Sensitive Habitat Fact Sheet and plant fact sheets. Make a visual observation of the area to determine if the species or habitat for the species exists.		If this practice improves water quality and/or quantity, then this practice is beneficial for aquatic species.	Benefits to aquatics apply if this practice results in stream exclusion.

Table 62. Consulting Entities Corresponding with Resource Concerns and Regulations

Resource Concern / Regulation	Consulting Entity
Air Quality	EPA Office of Air and Radiation
Water Quality	ADEM / EPA Office of Water
Cultural Resources (Historic Properties)	SHPO / THPO / Federally recognized Tribe
Coastal Zones	State Coastal Zone Program Office
Endangered and Threatened Species	USFWS / NMFS
Essential Fish Habitat	NMFS
Tribal Interests	Poarch Creek Indian / Affected Tribal Government
Waters of the United States, Including Wetlands	USACE
Wild and Scenic Rivers	NPS

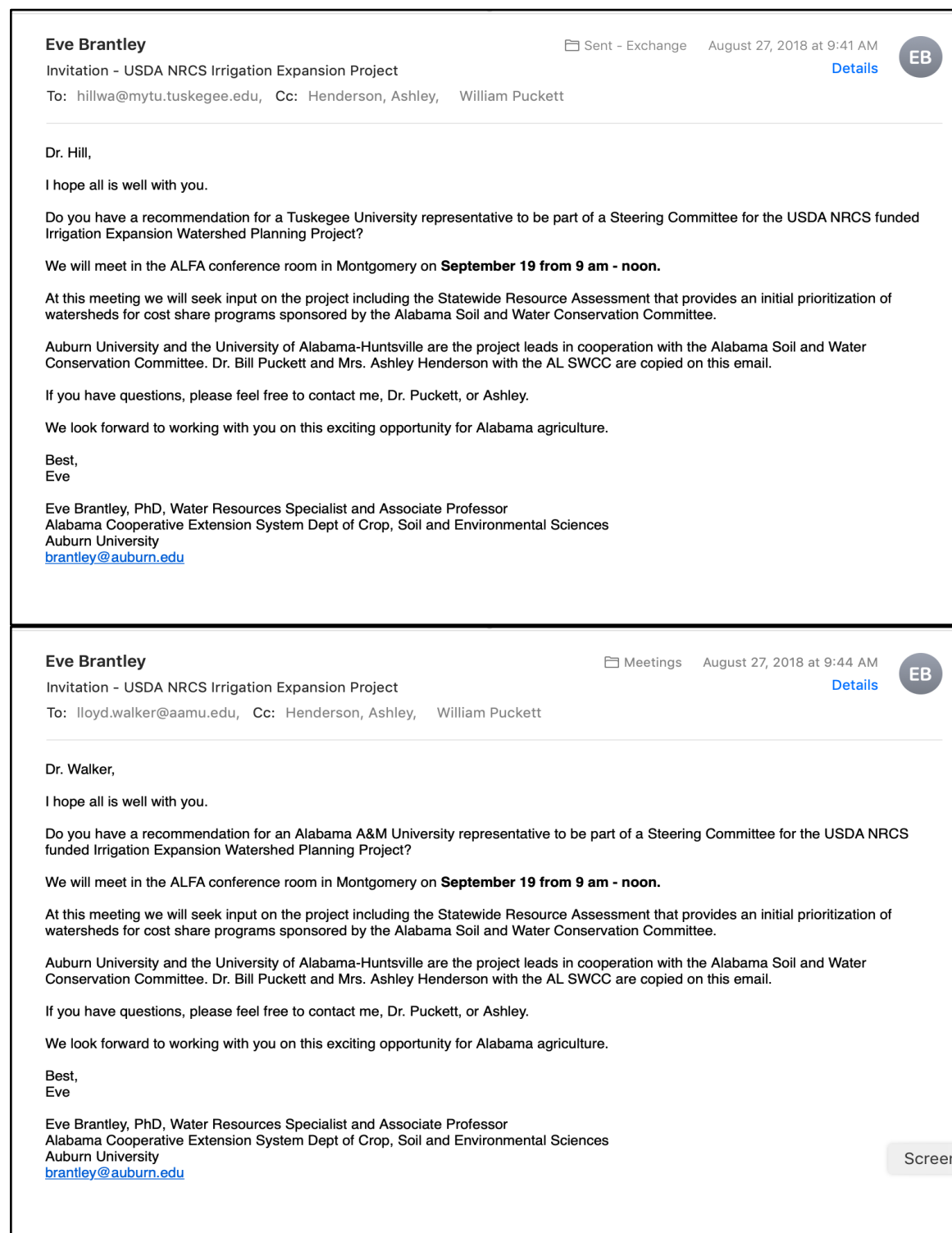


Figure 69: Invitations to the Deans of Agriculture at Land Grant Universities, Tuskegee University and Alabama A&M University, to participate in the steering committee for the watershed plan.

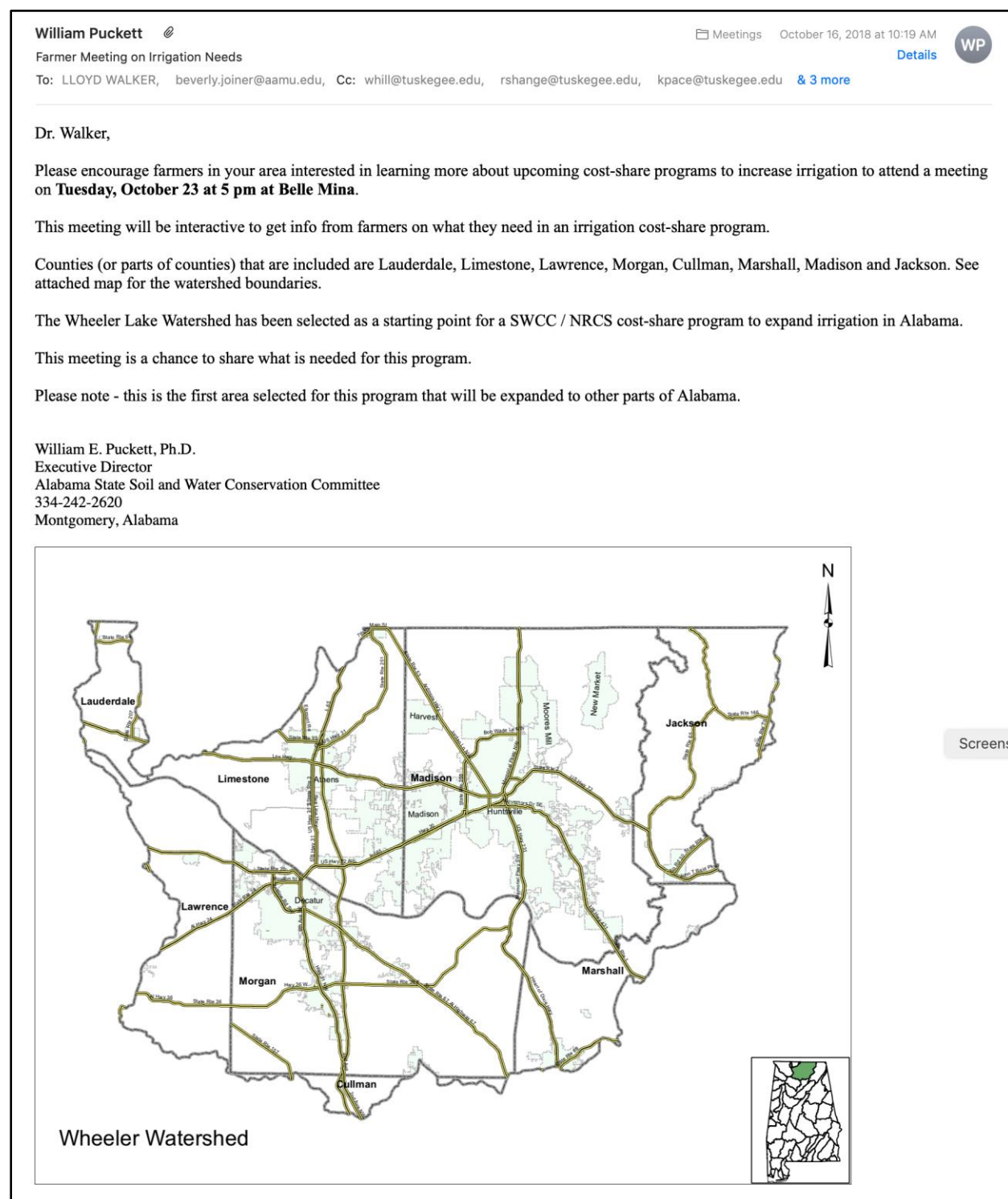


Figure 70: Email Request to Alabama A&M University Dean of Agriculture to encourage farmer participation in a local meeting in the Middle Tennessee River Watershed.

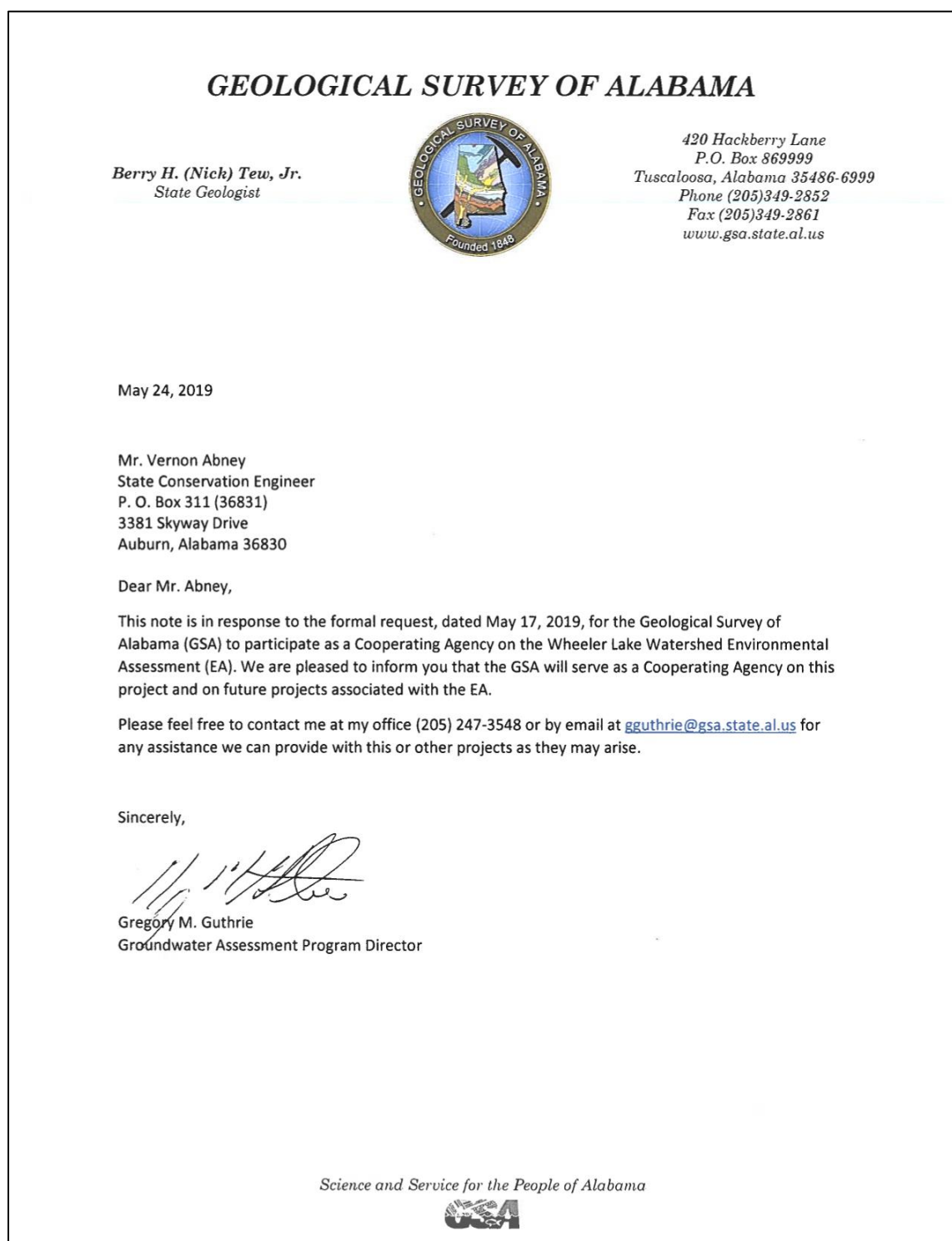


Figure 71: GSA Cooperating Agency Letter

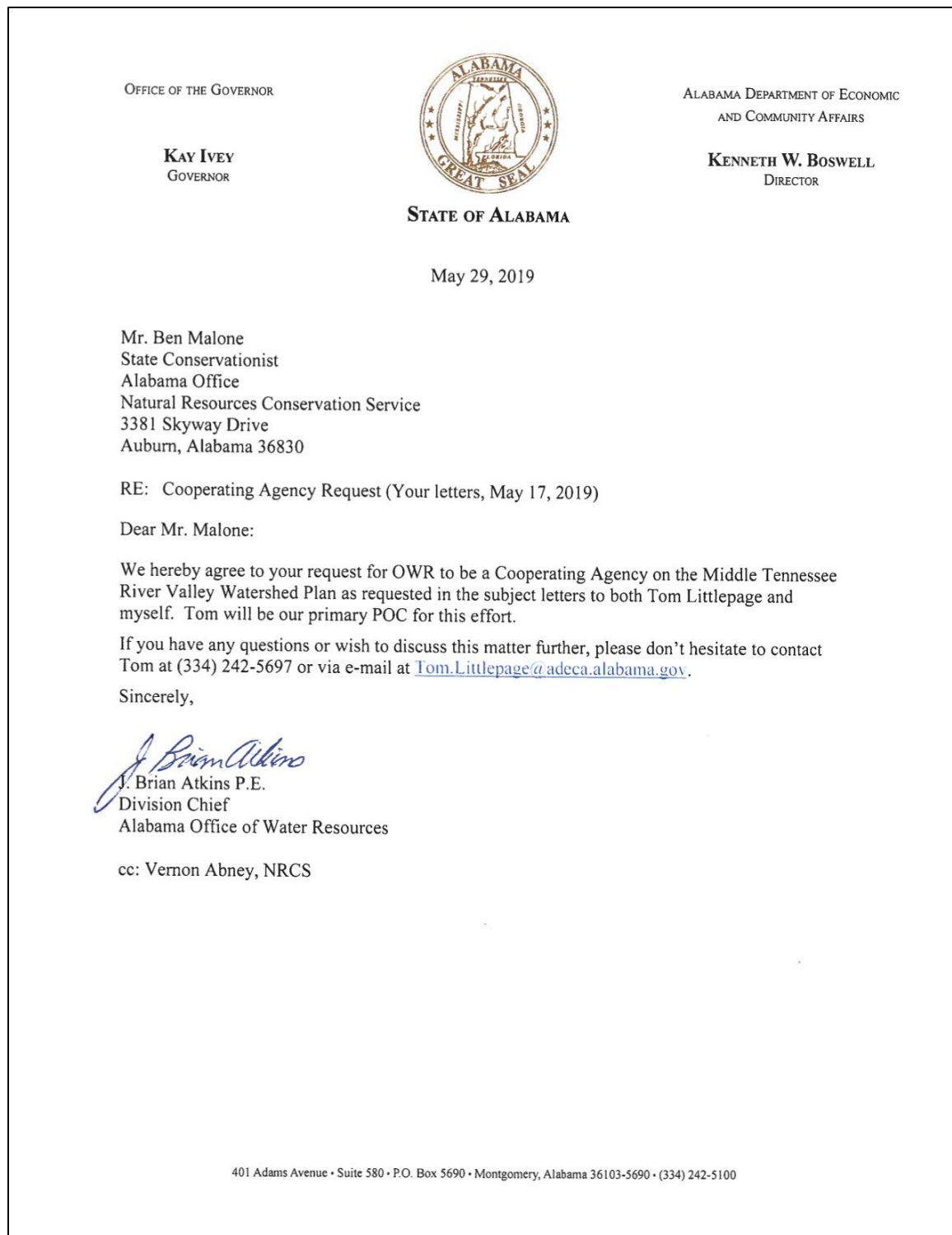

**Figure 72: OWR Cooperating Agency Letter**

Table 63. Ranking Criteria List for Project Site / Farmer Application Prioritization. This table does not include the specific scores pertaining to each issue but does show the subject matter the SLO will use for the ranking process to more accurately ensure unbiased, accurate farm information submitted in applications.

Farmer Application Ranking Criteria
Is this the primary application for this program?
Field to be irrigated has current conservation plan with installed conservation practices.
Current tillage method resulted in $\geq 50\%$ residue on the field to be irrigated
Single species cover crop currently used on the field to be irrigated
Multi-species cover crop currently used on the field to be irrigated
Field has water source developed and ready for hookup to planned irrigation system
Field has water source identified but not developed or ready for hookup to planned irrigation system
Power is available and ready for hookup to planned irrigation system
Distance to water source, $< 1/2$ mile
Distance to water source, $> 1/2$ and < 1 mile
Distance to water source, ≥ 1 mile
If water source for irrigation is a stream, less than 10% of HUC-12 watershed land area is irrigated
No permits (i.e., USCOE, USFWS, ADEM) are required for planned irrigation system, except for Office of Water Resources' Certificate of Use.
Field not limited on irrigation general table in Soil Survey
Field is somewhat limited on irrigation general table in Soil Survey
Field is very limited on irrigation general table in Soil Survey
TOTAL POINTS (0-180)



United States Department of Agriculture
Natural Resources Conservation Service

3381 Skyway Drive
Auburn, AL 36830
(334) 887-4561

EXCERPT – Refer to NRCS Field Office Technical Guide for entire document

Conservation Practice Classification of Effects for Cultural Resources (NG, PG or G Ratings)

If a practice is classified or rated PG (Potentially Ground disturbing) and will be disturbing new ground or is rated G (Ground disturbing), the Cultural Resources Review (CRR) form must be sent to the Cultural Resources Specialist (CRS) for further review. Exceptions to this required review by the CRS for some PG practices are footnoted with explanations below.

All management – related practices that are rated NG (Not Ground disturbing) however include facilitating G or PG practices within the standard will require a review by the CRS.

ALL Cultural Resources Reviews for AWEP, EWP and Easement Programs (e.g. FRPP, GRP, WRP), will be forwarded to the CRS for further review *regardless of the practice rating or classification of effect* (NG, PG or G).

Always contact the CR specialist if a cultural resource will be affected in any way (positively or negatively) as a result of federal assistance.

If any artifacts or archaeological features are encountered during (or after) practice installation, work shall cease, and the CRS shall be notified immediately. If the CRS is not available, contact the Cultural Resources Coordinator.

Practice Name	Practice Number	Rating
Critical Area Planting	342	PG
Dam	402	G
Irrigation Canal or Lateral	320	G
Irrigation Ditch Lining	428	NG
Irrigation Field Ditch	388	G
Irrigation Land Leveling	464	G
Irrigation Pipeline	430	G
Irrigation Storage Reservoir	436	G
Irrigation System – Micro-irrigation	441	PG
Irrigation System, Sprinkler	442	PG
Irrigation System, Surface and Subsurface	443	G
Irrigation System, Tailwater Recovery	447	PG
Irrigation Water Management	449	NG
Land Clearing	460	G
Land Smoothing	466	G
Lined Waterway or Outlet	468	PG
Monitoring Well	353	G
Pond	378	G
Pumping Plant	533	G
Water Harvesting Catchment	636	G
Water Well	642	G

eFOTG Section II

Figure 73. NRCS Conservation Practice Classification of Effects for Cultural Resources

CULTURAL RESOURCES REVIEW: _____ COUNTY	
1. Owner /Farm Tract No. _____	Start Date _____
2. Program/CTA: _____ Practice Codes _____	
3. PRESENT Land Use: Crops/Plowed <input type="checkbox"/> Grass <input type="checkbox"/> Trees <input type="checkbox"/> Fallow <input type="checkbox"/> Clear-Cut <input type="checkbox"/>	
Exposed/Eroded <input type="checkbox"/> Wetland <input type="checkbox"/> Other _____	
4. APE: _____ Acres/Ft 5. _____ Acres of APE inspected 6. APE Surface Visibility _____ %	
<p>The APE (<i>Area of Potential Effect</i>) is the specific area affected by program/practice, including all new or existing borrow/disposal areas, new or temporary access roads & any other off-site or indirect ground-disturbing activities.----- NOTE: If artifacts are discovered during practice construction, stop work in the immediate area and contact CRS for guidance. If artifacts discovered after completion, contact CRS ASAP.</p>	
7. Information Sources: FO Inspection of APE <input type="checkbox"/> Landowner/User <input type="checkbox"/> AFC <input type="checkbox"/>	
Other _____ 8. ACROD site file search date _____	
9. Are any Cultural Resources in/within 100ft of the APE? NO <input type="checkbox"/> YES <input type="checkbox"/>	
If YES -- Artifacts Reported by FO/owner/others? <input type="checkbox"/> Site deliberately avoided during planning? <input type="checkbox"/>	
10. Will the practice(s) exceed the depth & extent of previous cultivation? YES <input type="checkbox"/> NO <input type="checkbox"/>	
<div style="display: flex; justify-content: space-between;"> <div>11. IF a site is in or near the APE OR any practice is PG or G SEND to the CRS for further review</div> <div style="border: 1px solid black; padding: 2px; text-align: center;">OR</div> <div>IF there are NO sites AND NO PG or G Practice, NO review by the CRS is required. Sign & File at the FO.</div> </div>	
12. CR Review Completed by: _____ Date _____	
13. FO Comments: _____	
_____ 14. Date PRS data added _____	
15. Township: _____ Range: _____ Section(s) _____	
----- To be Completed by the CRS ----- To be Completed by the CRS ----- To be Completed by the CRS -----	
CRS Contacted / Form Rec'd _____ Site File Check date _____ Site(s): NO	
YES: _____ <input type="checkbox"/> Avoided <input type="checkbox"/> Ineligible NO EFFECT <input type="checkbox"/>	
CRS Comments _____	
_____ Site Probability: High Medium Low	
CRS will survey ASAP <input type="checkbox"/> at a later date <input type="checkbox"/> Recommends FO inspect after practice installation <input type="checkbox"/>	
and report to CRS if artifacts observed.	
Date(s) Surveyed by CRS _____ Date APE inspected by FO _____	
CRS _____ Date _____	
Entered into PRS by CRS _____ Scanned/Copied to FO _____	
Revised 1/16/2019	

Figure 74: Cultural Resources NRCS Review Form

U.S. Department of Agriculture Natural Resources Conservation Service		NRCS-CPA-52 4/2013		A. Client Name:		
ENVIRONMENTAL EVALUATION WORKSHEET		B. Conservation Plan ID # (as applicable): Program Authority (optional):				
D. Client's Objective(s) (purpose):		C. Identification # (farm, tract, field #, etc as required):				
E. Need for Action:	H. Alternatives					
	No Action	✓ if RMS	Alternative 1	✓ if RMS	Alternative 2	✓ if RMS
Resource Concerns						
In Section "F" below, analyze, record, and address concerns identified through the Resources Inventory process. (See FOTG Section III - Resource Planning Criteria for guidance).						
F. Resource Concerns and Existing/ Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	I. Effects of Alternatives					
	No Action		Alternative 1		Alternative 2	
	Amount, Status, Description (Document both short and long term impacts)	✓ if does NOT meet PC	Amount, Status, Description (Document both short and long term impacts)	✓ if does NOT meet PC	Amount, Status, Description (Document both short and long term impacts)	✓ if does NOT meet PC
SOIL: EROSION						
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
SOIL: SOIL QUALITY DEGRADATION						
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
WATER: EXCESS / INSUFFICIENT WATER						
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
WATER: WATER QUALITY DEGRADATION						
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC

NRCS-CPA-52, April 2013

Figure 75: NRCS CPA-52 Environmental Evaluation Worksheet (Page 1)

F. Resource Concerns and Existing/ Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	I. (continued)					
	No Action		Alternative 1		Alternative 2	
	Amount, Status, Description (Document both short and long term impacts)	✓ if does NOT meet PC	Amount, Status, Description (Document both short and long term impacts)	✓ if does NOT meet PC	Amount, Status, Description (Document both short and long term impacts)	✓ if does NOT meet PC
AIR: AIR QUALITY IMPACTS		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
PLANTS: DEGRADED PLANT CONDITION		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
ANIMALS: INADEQUATE HABITAT FOR FISH AND WILDLIFE		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
ANIMALS: LIVESTOCK PRODUCTION LIMITATION		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
ENERGY: INEFFICIENT ENERGY USE		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC		<input type="checkbox"/> NOT meet PC
HUMAN: ECONOMIC AND SOCIAL CONSIDERATIONS						

NRCS-CPA-52, April 2013

Figure 76: NRCS CPA-52 Environmental Evaluation Worksheet (Page 2)

Special Environmental Concerns: Environmental Laws, Executive Orders, policies, etc.						
In Section "G" complete and attach Environmental Procedures Guide Sheets for documentation as applicable. Items with a "•" may require a federal permit or consultation/coordination between the lead agency and another government agency. In these cases, effects may need to be determined in consultation with another agency. Planning and practice implementation may proceed for practices not involved in consultation.						
G. Special Environmental Concerns (Document existing/ benchmark conditions)	J. Impacts to Special Environmental Concerns					
	No Action		Alternative 1		Alternative 2	
	Document all impacts (Attach Guide Sheets as applicable)	✓ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	✓ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	✓ if needs further action
•Clean Air Act <i>Guide Sheet</i> <i>FS1</i> <i>FS-2</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
•Clean Water Act / Waters of the U.S. <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
•Coastal Zone Management <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
Coral Reefs <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
•Cultural Resources / Historic Properties <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
•Endangered and Threatened Species <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
Environmental Justice <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
•Essential Fish Habitat <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
Floodplain Management <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
Invasive Species <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
•Migratory Birds/Bald and Golden Eagle Protection Act <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
Natural Areas <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
Prime and Unique Farmlands <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
Riparian Area <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
Scenic Beauty <i>Guide Sheet</i> <i>Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>

NRCS-CPA-52, April 2013

Figure 77: NRCS CPA-52 Environmental Evaluation Worksheet (Page 3)

Wetlands <i>Guide Sheet Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
Wild and Scenic Rivers <i>Guide Sheet Fact Sheet</i>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>
K. Other Agencies and Broad Public Concerns	<i>No Action</i>	<i>Alternative 1</i>		<i>Alternative 2</i>		
Easements, Permissions, Public Review, or Permits Required and Agencies Consulted.						
Cumulative Effects Narrative (Describe the cumulative impacts considered, including past, present and known future actions regardless of who performed the actions)						
L. Mitigation (Record actions to avoid, minimize, and compensate)						
M. Preferred Alternative	Preferred alternative	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	Supporting reason					
N. Context (Record context of alternatives analysis)						
The significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality.						
O. Determination of Significance or Extraordinary Circumstances						
Intensity: Refers to the severity of impact. Impacts may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.						
If you answer ANY of the below questions "yes" then contact the State Environmental Liaison as there may be extraordinary circumstances and significance issues to consider and a site specific NEPA analysis may be required.						
Yes	No					
<input type="checkbox"/>	<input type="checkbox"/>	• Is the preferred alternative expected to cause significant effects on public health or safety?				
<input type="checkbox"/>	<input type="checkbox"/>	• Is the preferred alternative expected to significantly affect unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas?				
<input type="checkbox"/>	<input type="checkbox"/>	• Are the effects of the preferred alternative on the quality of the human environment likely to be highly controversial?				
<input type="checkbox"/>	<input type="checkbox"/>	• Does the preferred alternative have highly uncertain effects or involve unique or unknown risks on the human environment?				
<input type="checkbox"/>	<input type="checkbox"/>	• Does the preferred alternative establish a precedent for future actions with significant impacts or represent a decision in principle about a future consideration?				
<input type="checkbox"/>	<input type="checkbox"/>	• Is the preferred alternative known or reasonably expected to have potentially significant environment impacts to the quality of the human environment either individually or cumulatively over time?				
<input type="checkbox"/>	<input type="checkbox"/>	• Will the preferred alternative likely have a significant adverse effect on ANY of the special environmental concerns? Use the Evaluation Procedure Guide Sheets to assist in this determination. This includes, but is not limited to, concerns such as cultural or historical resources, endangered and threatened species, environmental justice, wetlands, floodplains, coastal zones, coral reefs, essential fish habitat, wild and scenic rivers, clean air, riparian areas, natural areas, and invasive species.				
<input type="checkbox"/>	<input type="checkbox"/>	• Will the preferred alternative threaten a violation of Federal, State, or local law or requirements for the protection of the environment?				
P. To the best of my knowledge, the data shown on this form is accurate and complete:						
In the case where a non-NRCS person (e.g. a TSP) assists with planning they are to sign the first signature block and then NRCS is to sign the second block to verify the information's accuracy.						
Signature (TSP if applicable)		Title		Date		
Signature (NRCS)		Title		Date		
If preferred alternative is not a federal action where NRCS has control or responsibility and this NRCS-CPA-52 is shared with someone other than the client then indicate to whom this is being provided.						

NRCS-CPA-52, April 2013

Figure 78: NRCS CPA-52 Environmental Evaluation Worksheet (Page 4)

The following sections are to be completed by the Responsible Federal Official (RFO)		
<p>NRCS is the RFO if the action is subject to NRCS control and responsibility (e.g., actions financed, funded, assisted, conducted, regulated, or approved by NRCS). These actions do not include situations in which NRCS is only providing technical assistance because NRCS cannot control what the client ultimately does with that assistance and situations where NRCS is making a technical determination (such as Farm Bill HEL or wetland determinations) not associated with the planning process.</p>		
Q. NEPA Compliance Finding (check one)		
The preferred alternative:		Action required
<input type="checkbox"/>	1) is not a federal action where the agency has control or responsibility.	Document in "R.1" below. No additional analysis is required
<input type="checkbox"/>	2) is a federal action ALL of which is categorically excluded from further environmental analysis AND there are no extraordinary circumstances as identified in Section "O" .	Document in "R.2" below. No additional analysis is required
<input type="checkbox"/>	3) is a federal action that has been sufficiently analyzed in an existing Agency state, regional, or national NEPA document and there are no predicted <u>significant adverse environmental effects or extraordinary circumstances</u> .	Document in "R.1" below. No additional analysis is required.
<input type="checkbox"/>	4) is a federal action that has been sufficiently analyzed in another Federal agency's NEPA document (EA or EIS) that addresses the proposed NRCS action and its' effects and has been formally adopted by NRCS . NRCS is required to prepare and publish its own Finding of No Significant Impact for an EA or Record of Decision for an EIS when adopting another agency's EA or EIS document. (Note: This box is not applicable to FSA)	Contact the State Environmental Liaison for list of NEPA documents formally adopted and available for tiering. Document in "R.1" below. No additional analysis is required
<input type="checkbox"/>	5) is a federal action that has NOT been sufficiently analyzed or may involve predicted significant adverse environmental effects or extraordinary circumstances and may require an EA or EIS.	Contact the State Environmental Liaison. Further NEPA analysis required.
R. Rationale Supporting the Finding		
R.1 Findings Documentation		
R.2 Applicable Categorical Exclusion(s) (more than one may apply)		
<p>7 CFR Part 650 Compliance With NEPA, subpart 650.6 Categorical Exclusions states prior to determining that a proposed action is categorically excluded under paragraph (d) of this section, the proposed action must meet six sideboard criteria. See NECH 610.116.</p>		
<p><i>I have considered the effects of the alternatives on the Resource Concerns, Economic and Social Considerations, Special Environmental Concerns, and Extraordinary Circumstances as defined by Agency regulation and policy and based on that made the finding indicated above.</i></p>		
S. Signature of Responsible Federal Official:		
<div></div>	<div></div>	<div></div>
Signature	Title	Date
Additional notes		
<div></div>		

NRCS-CPA-52, April 2013

Figure 79: NRCS CPA-52 Environmental Evaluation Worksheet (Page 5)

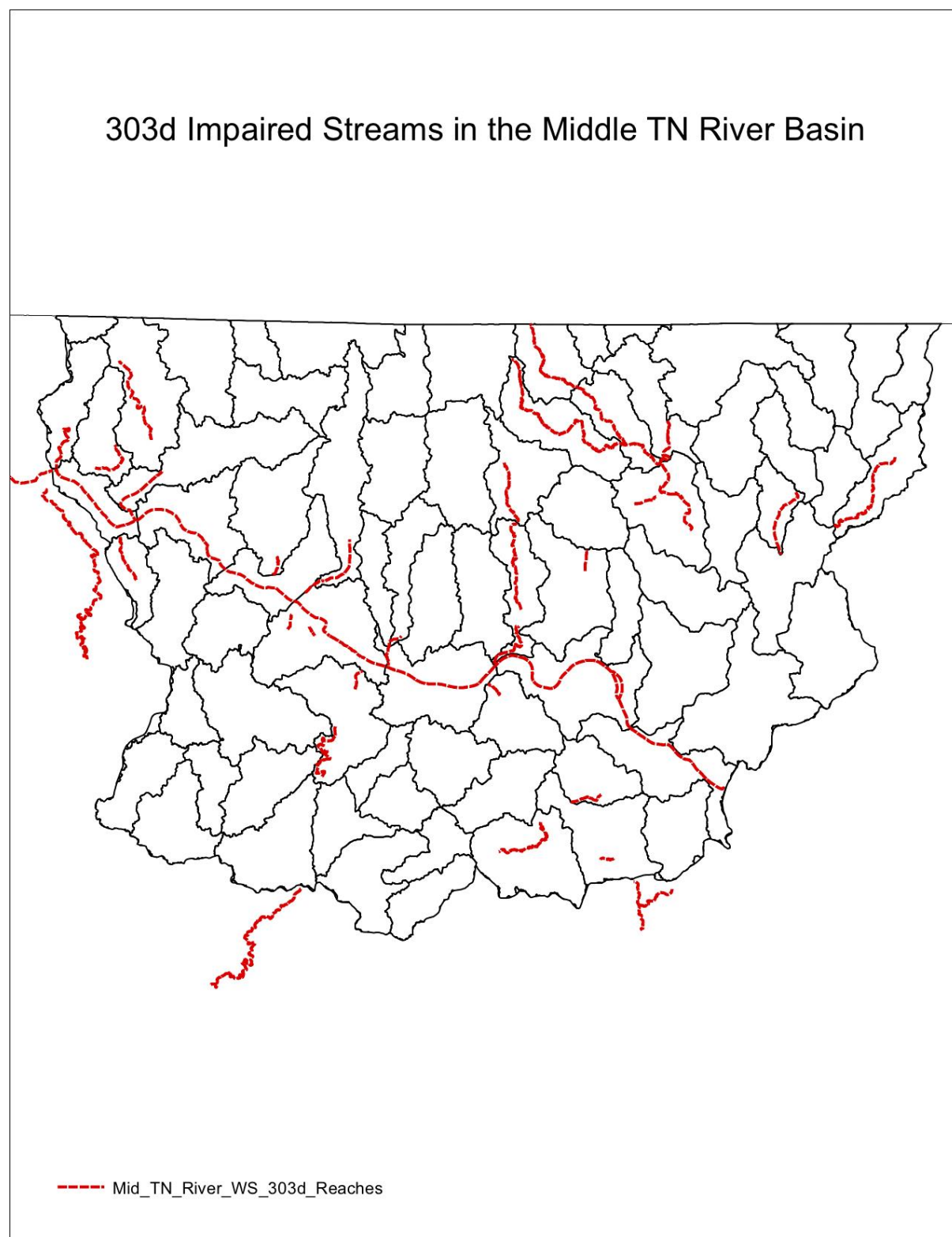


Figure 80: Alabama 303(d)-listed Streams within the Middle TN River Valley Watershed Area

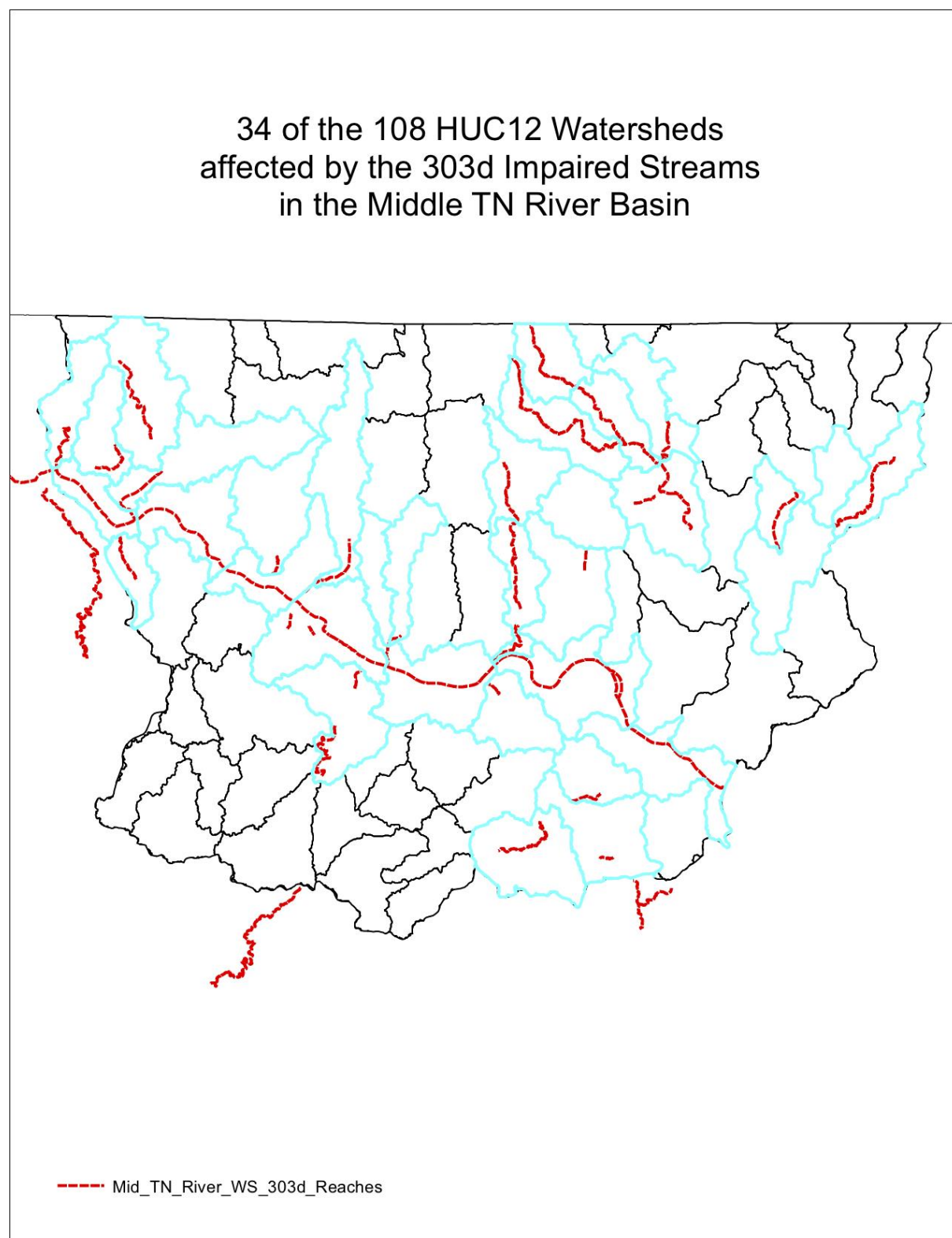


Figure 81: HUC-12s within the Middle TN River Valley Watershed Area with 303(d)-listed streams

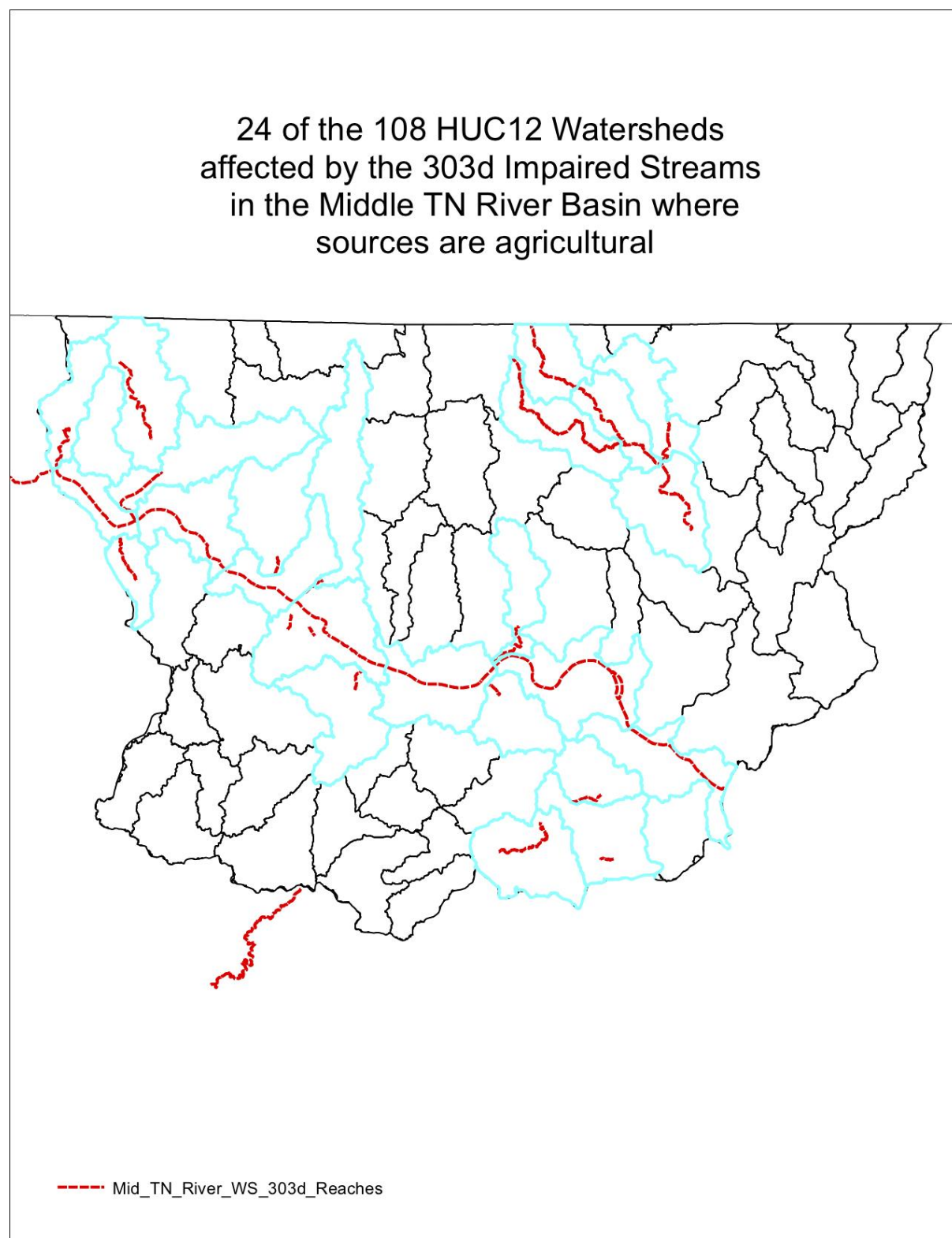


Figure 82: HUC-12s 303(d)-listed for Agricultural Non-point Source Pollution within Project Area

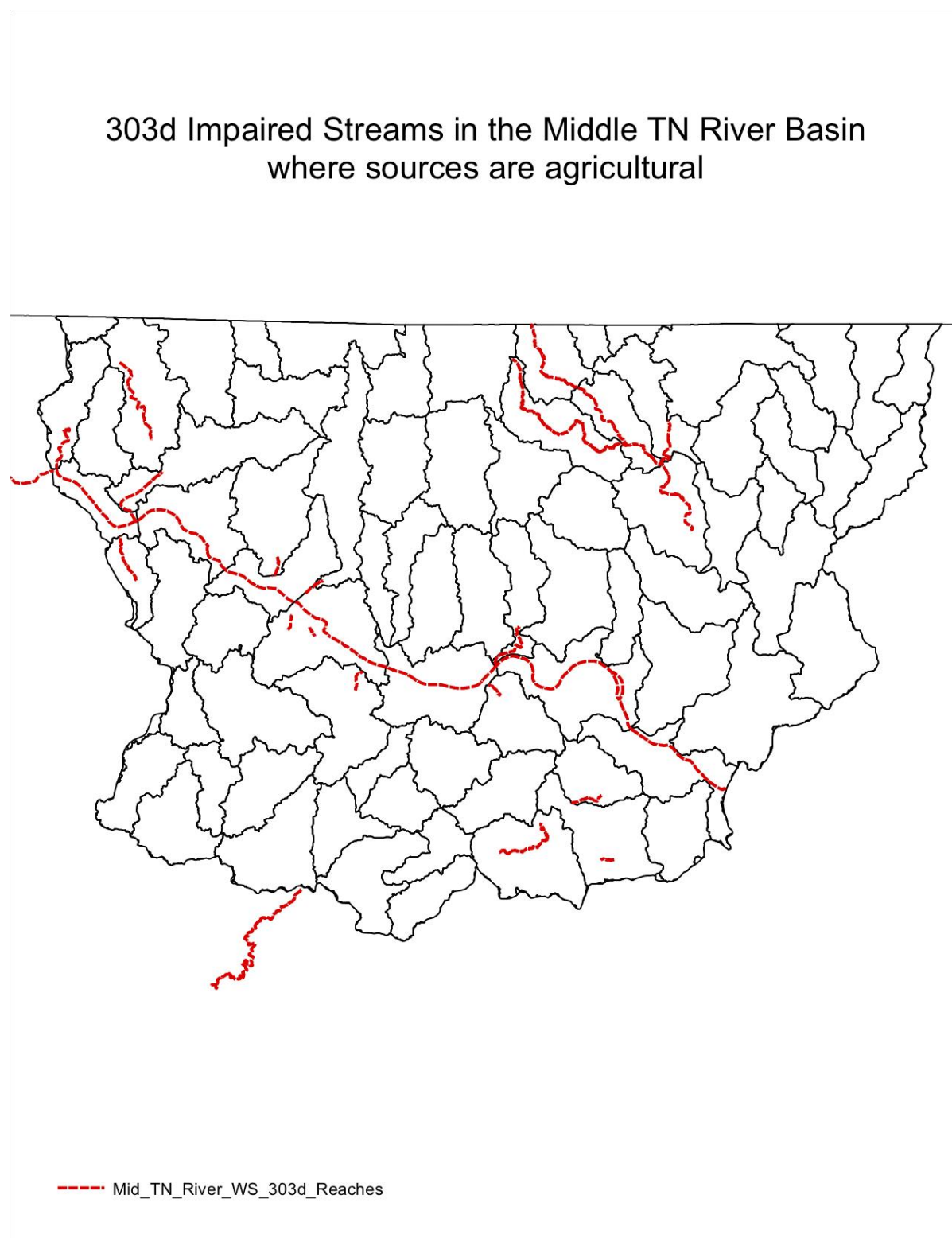


Figure 83: Alabama 303(d)-listed Streams within the Project Area: Sourced from Agriculture

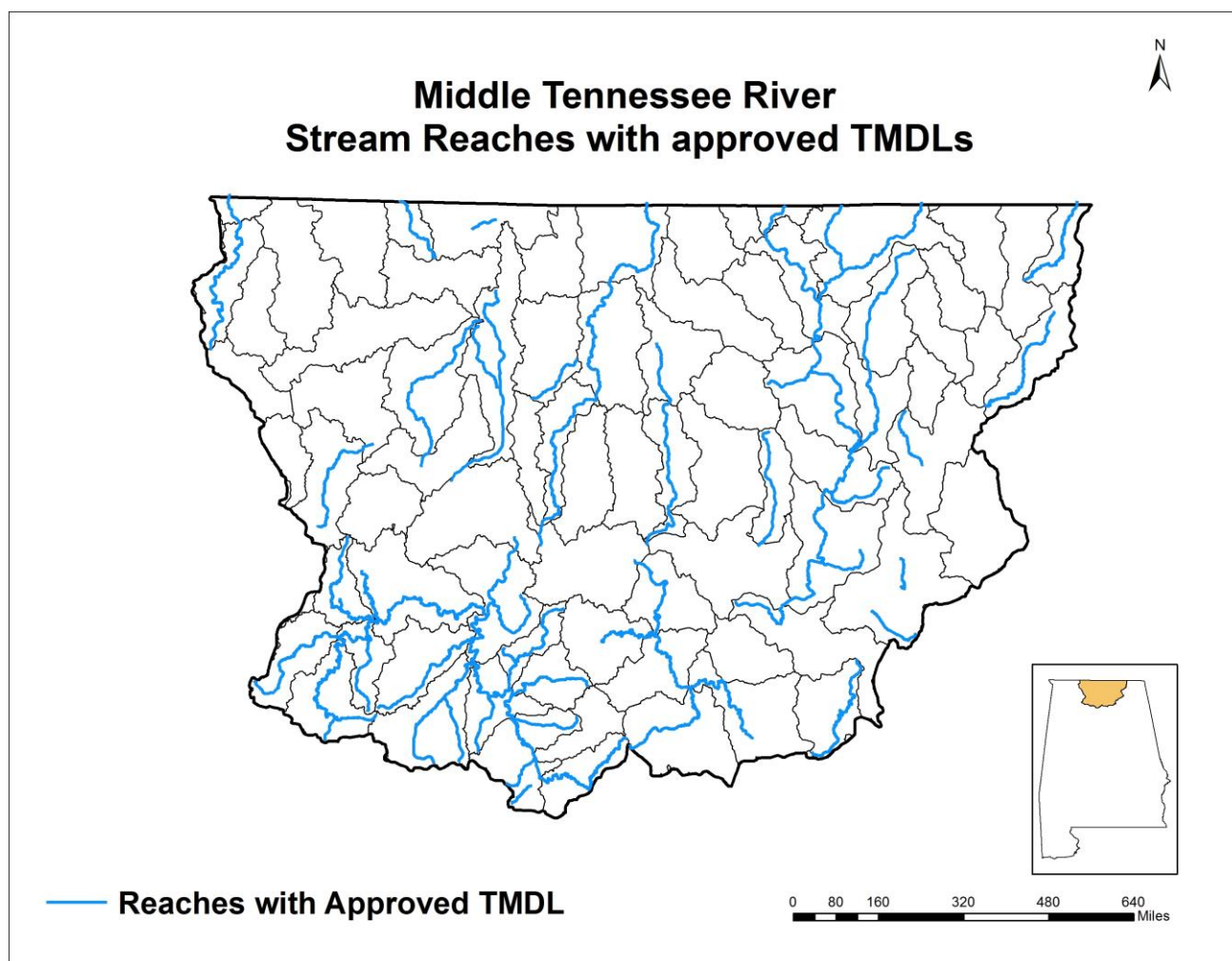


Figure 84: Stream Reached in Project Area with Approved TMDLs

